Operation & Maintenance Manual

Sundstrand

Automatic Grade & Slope Control

Cedarapids
A Terex Company

(P/N 499992526001) 18121 (11/00)

Cedarapids
A Terex Company

Introduction

To the Owner & Operator:

We have tried to provide information which will give you a clear understanding of equipment construction, function, capabilities and requirements. This information is based on the knowledge and experience of highly qualified people at our company and in our field organization. Proper use of this information will promote high efficiency, maximum service life and low maintenance costs.

We strongly recommend that all persons directly involved with this equipment be familiar with this manual.

The information contained in this manual should not be considered all-inclusive for every application. Questions about specific uses of this equipment should be directed to Cedarapids Inc. Anyone who uses this equipment for any purposes other than its intended use assumes the risk of any danger in doing so.

Respectfully,
Cedarapids Inc.

Important Notice!

Federal, state and local safety regulations must be complied with to prevent possible danger to person(s) or property from accidents or harmful exposure. This equipment must be used in accordance with all operation and maintenance instructions.

(1) Read all warning, caution and instruction signs. Know what guards and protective devices are included and see that each is used. Additional guards and protective devices that may be required due to proximity to related equipment must be installed by the user (owner) before operating.

(2) ***Never lubricate or adjust equipment when it is operating!***

(3) Securely lock out the involved power source before doing maintenance, cleaning, adjusting or repair. Secure the power source lockout to prevent start-up by other persons.

(4) Wear a protective mask whenever harmful air pollution exists.

(5) Use ear plugs whenever noise level is above established limits.

Cedarapids
A Terex Company

Table of Contents

Cedarapids
A Terex Company

Table of Contents

Cedarapids
A Terex Company

Sundstrand
Automatic Grade & Slope Control

Description

Automatic screed controls provide a means to enhance a paving operation by monitoring and controlling the screed position in relation to the tractor and the reference plane. This eliminates the need for a screed operator to manually introduce the changes that would be necessary for a uniformly smooth mat to be placed over irregular grades.

Automatic screed controls can enhance a good or proper paving operation by maintaining an established line of grade and/or percentage of slope. However, proper operation means controlling **all** of the factors that can adversely affect the screed. Refer to Quality Paving Guide Book.

If these factors are not controlled by recommended operational techniques they can introduce a change in the screed's position in relation to the established line of grade and/or percentage of slope quickly enough that the automation cannot correct for them. The automation cannot make up for improper operational techniques. Refer to Quality Paving Guide Book.

Evaluation of specifications and grade conditions on a job is extremely important if the paver and automation are to be configured properly to produce the desired or required results. Failure to properly configure the screed and automation for each phase of the paving operation will result in producing a mat that is unsatisfactory or will not meet specifications. One configuration of the screed and automation will not produce superior results for all conditions and jobs.

The automation system consists of two basic sensory devices, the grade control and the slope control. Both systems operate independently of each other to control the screed's angle-of-attack by moving the tow points up or down in relation to the reference plane of each. The reference plane for a grade sensory system can be one of three types, ski (mobile grade reference), joint matcher, or fixed (established) string line. The slope system uses an angular reference plane in relation to the horizon, which is perpendicular to the line of paving. All of these reference in a plane parallel to the line of paving.

Grade Control

The grade controller consists of a housing containing a grade sensing module and an amplifying module which has indicator lights and a mode operation switch. A counter-balanced sensor arm can be attached to either side of the grade sensor. Depending on the application, a wand or a skate assembly is attached to the follower. (Figure 1) A grade sensor can control either the left or right tow point cylinder, depending on which side of the paver it is mounted. Dual grade sensors can also be used to control both left and right sides of the screed.

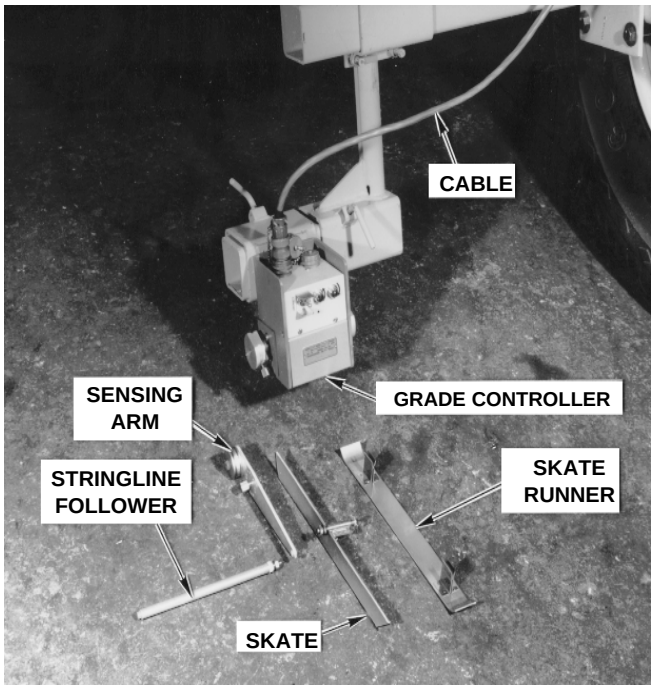


Figure 1

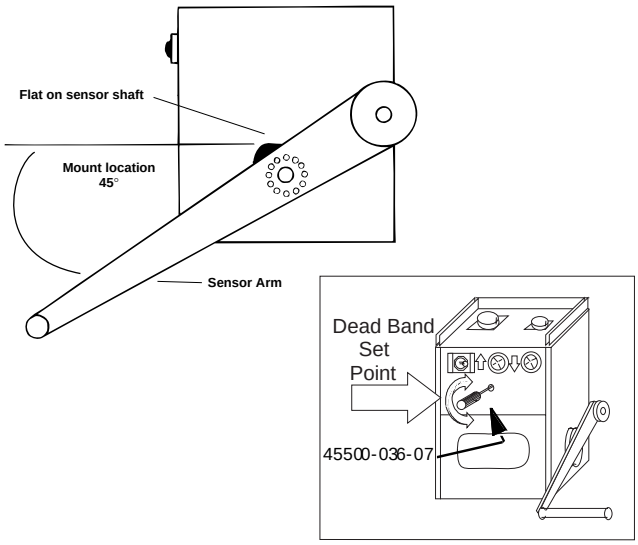
The sensor arm can be mounted on either side of the sensor, depending on which side of the paver the sensor is to be mounted. The sensor arm has to be mounted so that it is trailing the sensor at 45° angle in relation to the flat on the sensor shaft, to work properly. (Figure 2)

Cedarapids
A Terex Company

Sundstrand
Automatic Grade & Slope Control

If the sensing arm is mounted in a position other than 45°, the amount of rotation on the sensor module, in relation to the amount of deflection of the sensing arm, will not produce the correct amount of tow point cylinder movement. (Figure 3)

Mounting the sensor arm at any angle other than at 45°, changes the amount the sensor shaft is rotated for a given deviation. (Figure 4)



Complete Control
46061-550-15

Figure 2

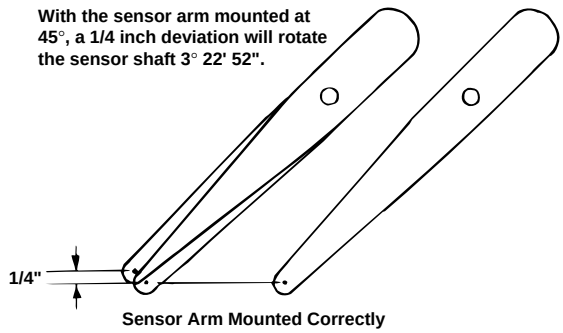


Figure 3

With the sensor arm mounted horizontally, the same 1/4 inch deviation only rotates the sentor shaft 2°27'46".

Sensor Arm Mounted Incorrectly

Figure 4

Grade Sensor Deadband

The deadband of the grade sensor refers to the amount the sensing arm can move without triggering a tow point cylinder response. A given amount is necessary to allow for normal machine vibration.

To Set Grade Sensor Deadband:

1) Assemble the grade sensor jack and mounting hardware. Place sensor on the jack and connect the electrical cable from the sensor to the tow point control connector.
2) When installing the sensor control arm, it is extremely important to install so it is trailing the sensor at 45° angle in relation the the flat on the sensor shaft.
3) Place the sensor Run/Standby switch in Standby mode.
4) Place the remote control mat thickness Manual/Setup/Auto switch in Setup mode.
5) Adjust the sensor jack height until both lights are out when the switch on the sensor is in Standby mode and the remote control material thickness switch is in the Setup mode.
6) The deadband is correct when a dime (.050 inch) can be passed under the follower without triggering a light, but a nickel (.080 inch) passed under the follower will trigger a light response.
7) If the deadband is not correct, remove the screw located on the face of the grade sensor. There is an adjustment located under the face screw.
8) Use the small screw driver provided. Clockwise rotation will increase the amount of deadband, while counterclockwise rotation will decrease the amount of deadband.

Cedarapids
A Terex Company

Sundstrand
Automatic Grade & Slope Control

Joint Matching Skate 46061-550-06

Matching the height of the mat being placed to an existing mat or curb requires the screed to be very responsive to any changes in the elevation of the existing mat or curb. This is an application where we are building "profile" or over-correcting the screed, forcing it to change depth in a very short distance. This mode is not necessarily good for rideability.

1) The grade sensor should be mounted 3/4 of the way back from the tow point, just ahead of the augers, and the sensor skate in as close to the joint as possible, taking into account the shape of the joint to be matched. If the joint being matched is distorted, it may be necessary to locate the sensor further from the joint. Keep in mind that the further the sensor is from the actual joint being matched, the less likely that an exact match will occur.
2) Place the sensor Run/Standby switch in Standby mode and the remote control mat thickness Manual/Setup/Auto switch in Setup mode.

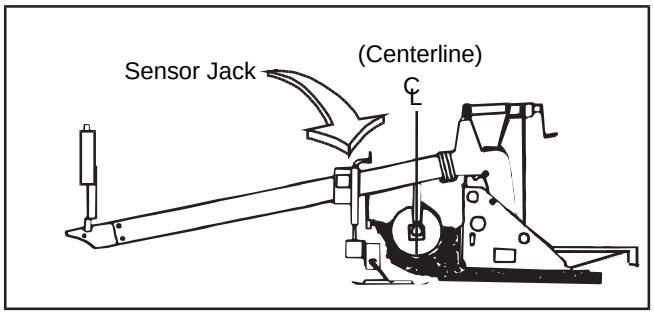


Figure 5

3) Adjust the sensor jack assembly until the lights go out.
4) Place the sensor Run/Standby switch in Run mode and the remote control mat thickness Manual/Setup/Auto switch in Auto mode.
5) If mat depth needs correction, turn the grade sensor jack slowly in the correct direction until the mat being placed is the correct thickness.

Notice - Clockwise rotation of the grade sensor jack THICKENS the mat being placed. Counterclockwise rotation of the grade sensor jack THINS the mat being placed.

Figure 6

Ski 46061-550-07

When using automation off a ski, corrections to deviations that occur at the sensor or the screed will require the paver to travel approximately 5 lengths of the tow arm before the correction is fully completed. Deviations that occur at the tow point due to the tractor traveling over irregular grades are corrected for immediately. In effect, the sensor is correcting for deviations at the tow point before they can affect the screed's angle of attack (position). In this application, we are building "rideability", or averaging all required changes in depth over a longer area.

The grade sensor should be mounted 1/4 of the way back from the tow point.

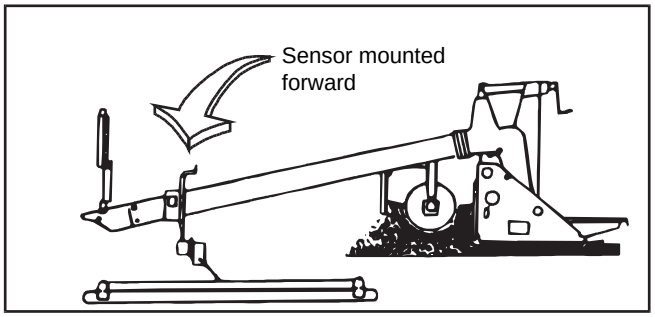


Figure 7

1) Pave manually using the depth cranks until the correct depth is achieved.
2) Place the sensor Run/Standby switch in Standby mode and the remote control mat thickness Manual/Setup/Auto switch in Setup mode.
3) Adjust the sensor jack assembly until the lights go out.
4) Place the sensor Run/Standby switch in Run mode and the remote control mat thickness Manual/Setup/Auto switch in Auto mode.
5) If mat depth needs correction, turn the grade sensor jack slowly in the correct direction until the mat being placed is the correct thickness.

   Notice - Clockwise rotation of the grade sensor jack THICKENS the mat being placed. Counterclockwise rotation of the grade sensor jack THINS the mat being placed.

Figure 8

Fixed String Line

When using automation off an established or fixed string line, it requires the screed to be responsive to any changes in elevation of the string line. This is an application where we are building profile, or over-correcting the screed and forcing it to change depth in relation to the elevation of the string line.

The grade sensor should be mounted 3/4 of the way back from the tow point, or just ahead of the augers.

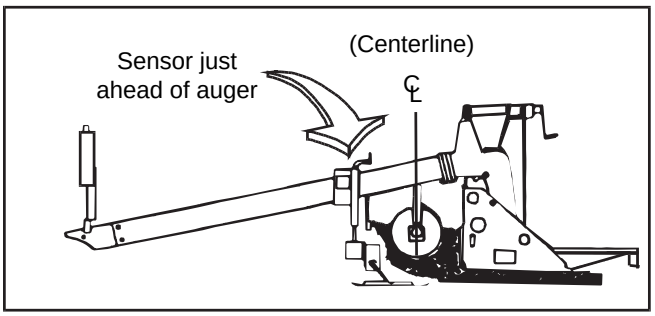


Figure 9

1) Pave manually using the depth cranks until the correct depth is achieved.
2) Place the sensor Run/Standby switch in Standby mode and the remote control mat thickness Manual/Setup/Auto switch in Setup mode.
3) Adjust the sensor jack assembly until the lights go out.
4) Place the sensor Run/Standby switch in Run mode and the remote control mat thickness Manual/Setup/Auto switch in Auto mode.
5) If mat depth needs correction, turn the grade sensor jack slowly in the correct direction until the mat being placed is the correct thickness.

   Notice - Clockwise rotation of the grade sensor jack THICKENS the mat being placed. Counterclockwise rotation of the grade sensor jack THINS the mat being placed.

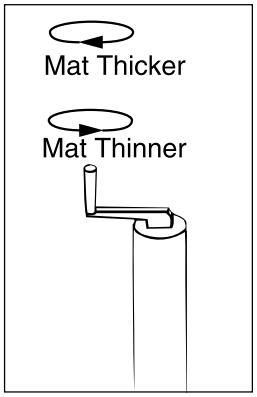


Figure 10

Cedarapids
A Terex Company

Sundstrand
Automatic Grade & Slope Control

Slope Control

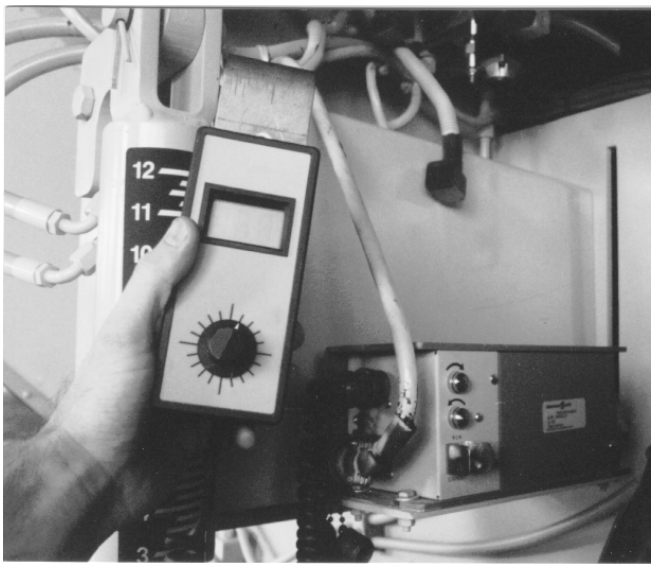
The slope control system consists of a hand-held remote set unit, a slope sensor (pendulum) and an amplifier module which has indicator lights and a mode operation switch. On the CR351 and CR361 pavers the slope sensor and amplifier modules are incorporated into the same mount housing. (Figure 11) All other models have the slope sensor and amplifier modules mounted separately. (Figures 12 & 13)

The slope control system can control the left or the right tow point cylinder and is capable of maintaining up to 10% positive or negative slope from each side of the paver. (Figure 14)

The position of the sensor, whether mounted on the forward cross beam or on the rearward cross beam, determines how fast the screed will react to a change of the null point at the sensor. By positioning the sensor, we can build profile or rideability. We need to evaluate job specifications and grade related conditions to determine the desired mounting position to produce the desired results.

Slope Sensor, 400 and 500 Series Pavers

Figure 12



Slope System Components of the 300 Series Pavers

Figure 11

Slope Controller, 400 and 500 Series Pavers

Figure 13

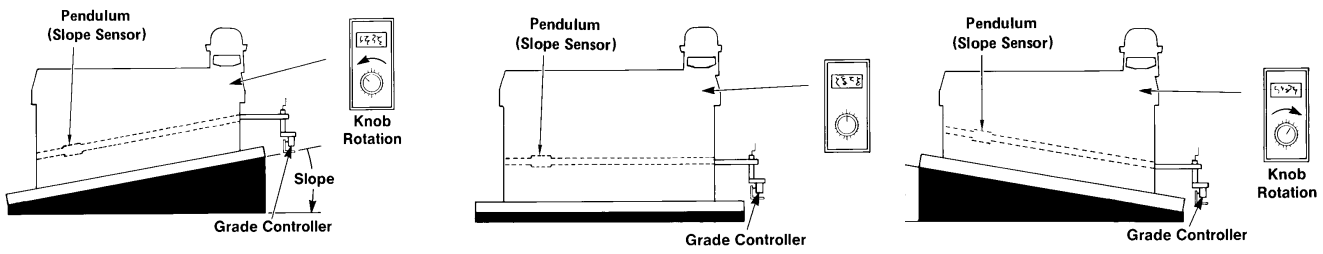


Figure 14

Slope Deadband

The deadband on the slope system refers to the amount of angular change that can occur on the slope beam without triggering a tow point cylinder response. A given amount of deadband is necessary to allow for normal machine vibration.

To Set Slope Sensor Deadband:

1) Connect the sensor harness from the slope amplifier to the slope sensor connection on the tractor bulkhead (slope sensor mounted forward). Or, from the slope amplifier to the slope sensor connection on the slope sensor (slope sensor mounted rearward). This step is not necessary on 300 series Grayhound pavers as the slope sensor and amplifier are in the same module.

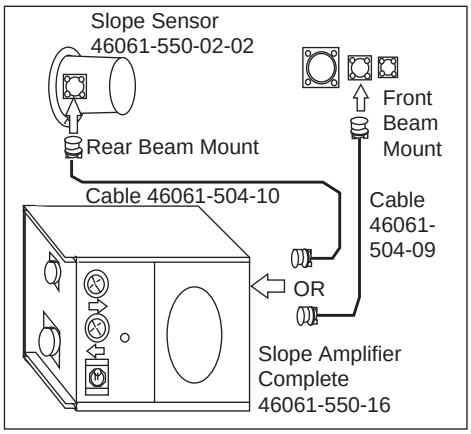


Figure 15

2) Connect the hand held remote control.

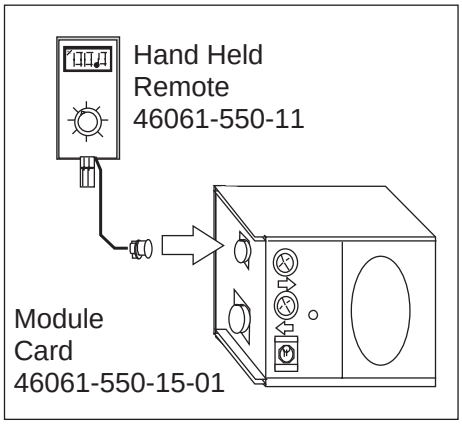


Figure 16

3) Connect the slope amplifier to tow point control cable from the slope amplifier to either the left or right tow point connector.

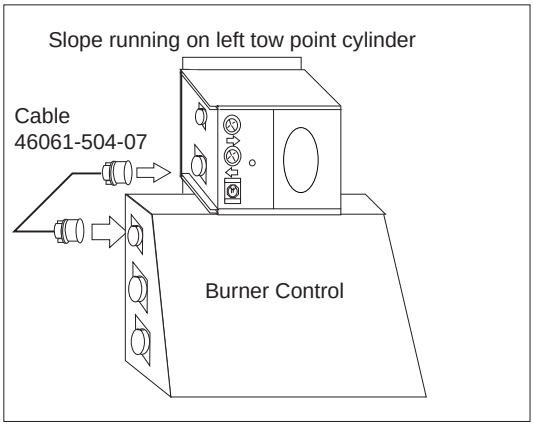


Figure 17

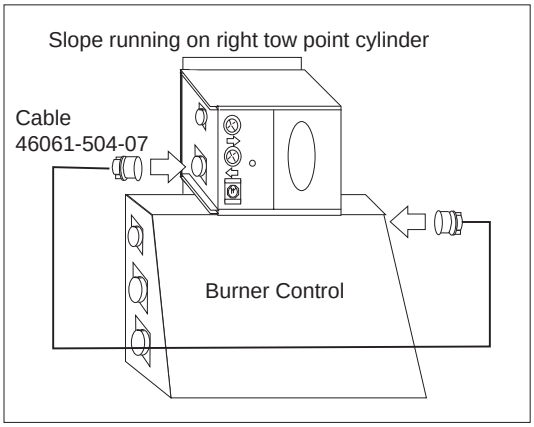


Figure 18

4) Place slope amplifier Run/Standby switch in Standby mode.
5) Place the remote control mat thickness Manual/Setup/Auto switch in Setup mode
6) Turn the slope set dial on the remote slope control until both lights on the slope amplifier go out.
7) Turn the remote slope control dial clockwise until a light just comes on, then turn counterclockwise until the light just goes out. Note the number readout on the LCD.

8) Turn the remote slope control dial counterclockwise until a light just comes on, then turn clockwise until the light just goes out. Note the number readout on the LCD.
9) Subtract the smaller noted readout number from the larger. Example: 2.1 - 1.7 = 0.4 The deadband is set correctly if the differential from light to light is 0.2% slope.
10) If the deadband is not correct, remove the screw located on the face of the slope amplifier. There is an adjustment located under the face screw.
11) Use the small screw driver provided. Clockwise rotation will increase the amount of deadband, while counterclockwise rotation will decrease the amount of deadband.

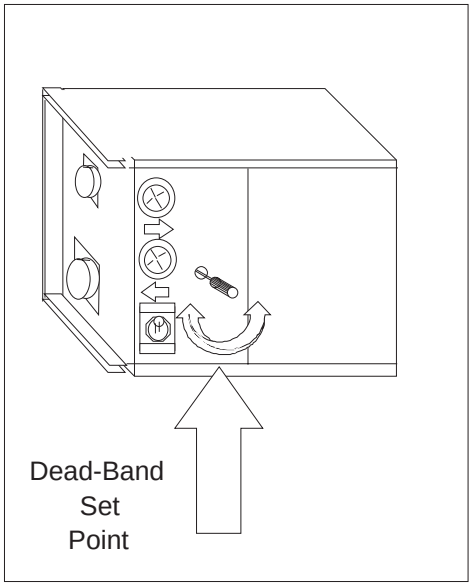


Figure 19

Building Rideability - Sensor mounted forward

When using a slope control system with the sensor mounted on the forward cross beam, corrections to deviations at the screed will require the paver to travel approximately 5 lengths of the tow arm before the correction is fully completed. Deviations that occur at the tow point, due to tractor traveling over irregular grades, are corrected for immediately. In effect, the sensor is correcting for deviations at the tow point before they can affect the screed's angle of attack (position).

In this application we are building "rideability", or averaging all required changes in depth over a longer area.

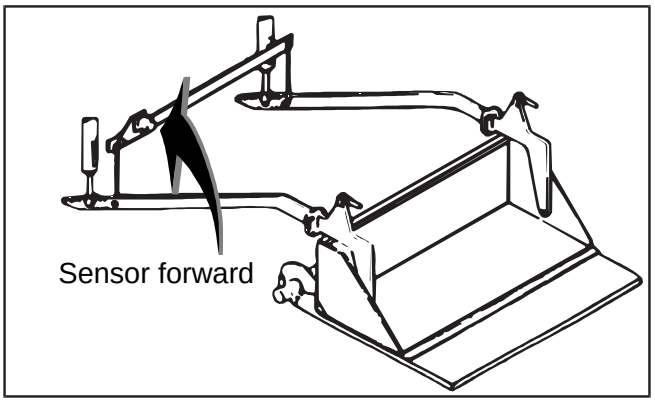


Figure 20

To use the slope system:

1) Connect system harnesses to control the desired left or right tow point cylinder as in Setting Deadband section.
2) Pave manually using the depth cranks until the desired slope is achieved on the mat being placed by checking with a carpenters level.

NOTICE - With a four foot level, 1/4" rise equals 1/2% slope and 1/2" rise equals 1% slope.

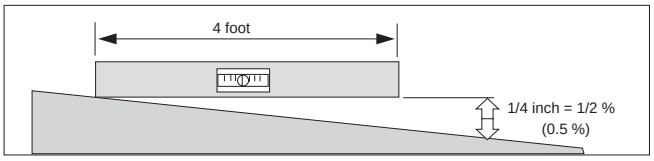


Figure 21

3) Place the Run/Standby switch on the slope amplifier to Standby and the remote mat thickness Manual/Setup/Auto switch in Setup.
4) Adjust slope hand held remote dial until the lights go out.
5) Remove the cover cap from the number set point potentiometer.
6) Adjust the number set point potentiometer until the LCD readout displays the correct percentage and fall of slope.

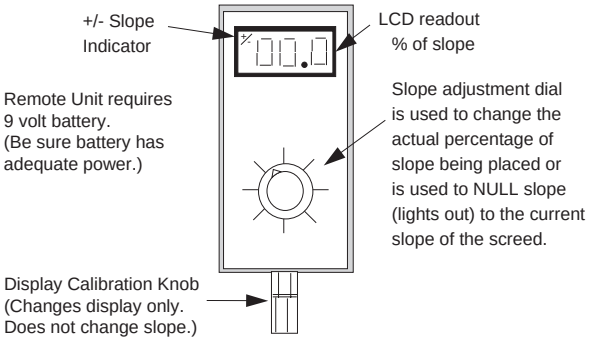


Figure 22

7) Place the Run/Standby switch on the slope amplifier to Run and the remote mat thickness Manual/Setup/Auto switch in Auto.

Building Profile - Sensor mounted rearward

When using a slope control system with the sensor mounted on the rearward cross beam, requires the screed to be very responsive to any changes in the percentage of slope of the screed. This is an application where we are building "profile", or over-correcting the screed, forcing to change depth in a very short distance.

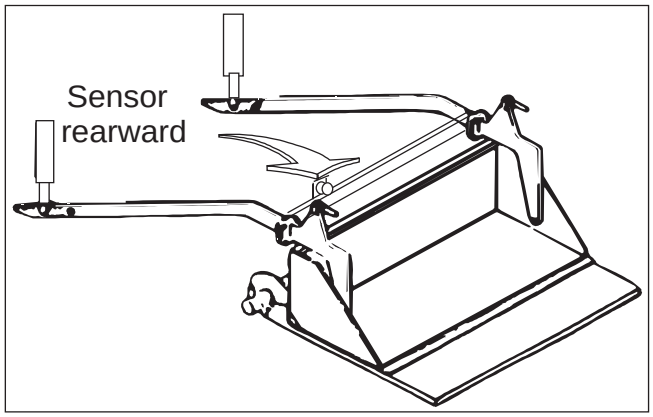


Figure 23

To use the slope system:

1) Connect system harnesses to control the desired left or right tow point cylinder as in Setting Deadband section.
2) Pave manually using the depth cranks until the desired slope is achieved on the mat being placed by checking with a carpenters level.

NOTICE - With a four foot level, 1/4" rise equals 1/2% slope and 1/2" rise equals 1% slope.

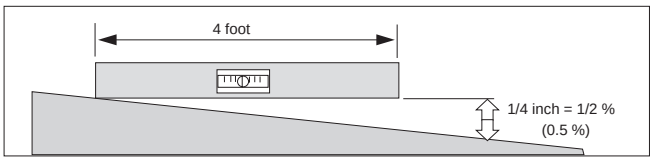


Figure 24

3) Place the Run/Standby switch on the slope amplifier to Standby and the remote mat thickness Manual/Setup/Auto switch in Setup.
4) Adjust slope hand held remote dial until the lights go out.
5) Remove the cover cap from the number set point potentiometer.
6) Adjust the number set point potentiometer until the LCD readout displays the correct percentage and fall of slope.

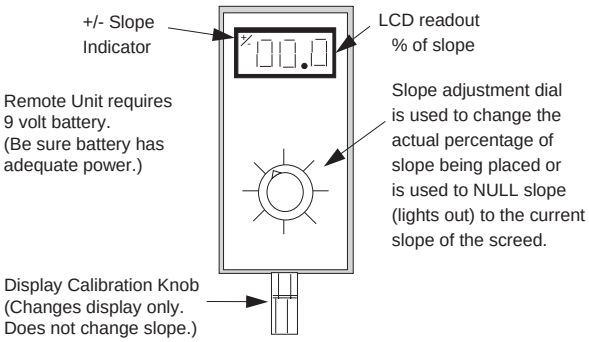


Figure 25

7) Place the Run/Standby switch on the slope amplifier to Run and the remote mat thickness Manual/Setup/Auto switch in Auto.

Troubleshooting Sundstrand Automatic Grade & Slope System

WARNING - Hydraulic cylinders may activate unexpectedly during testing which could injure someone that is not prepared for such movement. The operator and maintenance personnel must be constantly aware of who is near the paver and what mechanisms may activate during testing. Ensure that personnel are clear of mechanisms that may activate during testing.

Amplifier Module

The same amplifier module is used in both the grade and slope units. The only difference is the setting of the GRADE/SLOPE switch located on the back side of the amplifier module. If the unit is to be used as a grade control, set the Grade/Slope switch to GRADE. If unit is to be used as a slope control, set the Grade/Slope switch to SLOPE.

Grade or Slope Not Working

1) Perform checks on tractor base wiring and systems to ensure they function properly.
2) Inspect cables and connections for damage.
3) If one side works and the other does not, swap sides with those components and re-check. If problem moves with the component, replace that component.
4) Set Manual/Setup/Auto switch to Manual. Do the tow point cylinders go up and down when selected? If they do, proceed with the next step. If they do not, troubleshoot tractor wiring and/or systems.
5) Set Manual/Setup/Auto switch to Setup, set Standby/Run switch to Run.
6) Disconnect large cable from amplifier. Check pins A to B on cable for voltage. It should be 11 VDC or more. If low or no voltage, troubleshoot tractor wiring and/or systems.
7) Plug cable back into amplifier.
8) With the UP light on, check voltage on 155 to 3 (for LH tow point) or 165 to 3 (for RH tow point) for 12 VDC
9) With the DOWN light on, check voltage on 157 to 3 (for LH tow point) or 167 to 3 (for RH tow point) for 12 VDC.
10) If no voltage, take amplifier out of a unit known to be functioning properly and install it in system in question. Make sure slope/grade switch is set for unit to be used in.
11) If problem disappears, defective amplifier.

Slope Function Erratic

1) Check all connections for moisture.
2) If tow point cylinder “overshoots” during automatic operation, check for proper cylinder speed.

Automation Not Working Properly

1) Perform checks on tractor base wiring and systems to ensure they function properly.
2) Inspect all cables and connections for damage.
3) Check the deadband setting on the amplifier.
4) Check the Grade/Slope switch on the back of the amplifier. It must be in GRADE if the amplifier is used in a grade senor and in SLOPE if the unit is used in the slope system.
5) If slope system is in question, refer to Remote Slope Set.
6) Check tow point solenoid valve DIN connectors for a light. Each solenoid valve has an LED that should light when power is applied to the solenoid.
7) Take the amplifier out of a unit that is known to be functioning properly and install it in the system in question. Make sure the slope/grade switch is set properly for the unit used. If problems disappear,defective amplifier.

Light Bulb Replacement

Unscrew the lens cover from the bulb. Slide a piece of 5/16" inside diameter rubber hose over the bulb. Press down and turn bulb counterclockwise. The bulb can be purchased at most local vendors as #161 (12 VDC) bulb.

Remote Slope Set - No Display

1) Check battery in backside of remote slope hand held unit and replace if necessary. A dead battery will cause the LCD to blank out.
2) Check harnesses and connections for damage.
3) Check pins A to C on the slope amplifier (connection point that remote plugs into). Voltage should be at least 2.1 VDC. If voltage is OK, defective remote slope set unit.
4) If no or low voltage, unplug the harness coming from tow point. Check pins A to B on the socket end. Voltage should be 11 VDC or more.
5) If voltage, defective amplifier.
6) If no or low voltage, check tractor base wiring or systems.

Remote Slope Set - Display Stays On Even When Unplugged

Replace remote slope set unit.

Remote Slope Set - Slope Appears to be Unstable or Oscillates

1) Check deadband setting on amplifier.
2) If deadband is OK, unplug remote slope set unit and check pins B to D for 1500 ohms.
3) If a reading shows 500 ohms, a capacitor is shorted. Replace unit.
4) Check pins A to C for 2500 ohms, then check for continuity between pins A to B and pins B to C while rotating dial. Reading should vary as dial is turned. If not, replace unit.

Slope Sensor

Disconnect cable and check ohms between pins.

A to B: 10 ohms

C to D: 300 ohms

E to F: 300 ohms

No cross continuity.

Cedarapids
A Terex Company

Sundstrand
Automatic Grade & Slope Control