Intellislope™ Tile Plow Control System

Operator’s Manual

Firmware Version 3.5

PN 4003501-ENG_B

Table of Contents

Installation

Create Survey Configuration

Create Tile Configuration

Setup Tile Configuration

Diagnostics

Survey

AutoTile

Grade Control

Pitch Control

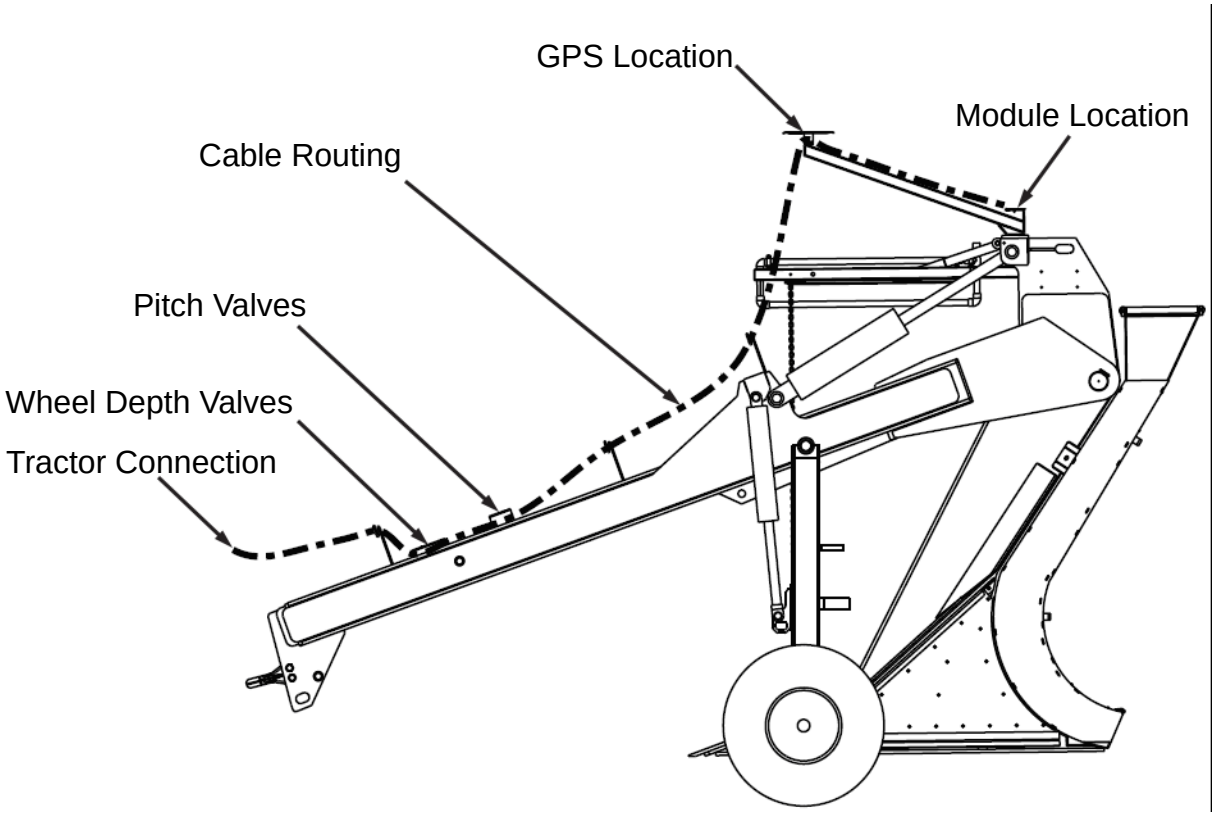
COMPONENTS AND IDENTIFICATION

DISPLAY

The Integra display will mount in the cab. Use the provided cables in the cable kit to install power direct to the battery terminals, routing them out of the way, and clear of moving parts. Use the provided zip ties, to secure the cables. If you have excess cabling, coil excess cables in an area that will not get caught on moving parts. A RAM mount is provided to mount the display in the cab, and allows for flexibility to install where windows and gauges are not obstructed.

Locate the 4001979-3 cable, and route this toward the back of the tractor. For most front wheel assist tractors this should reach to the plow harness that is installed on the tile plow. If you need additional length, extension cables are available from your dealer in 6 and 12 ft lengths for 4-Wheel drive tractors.

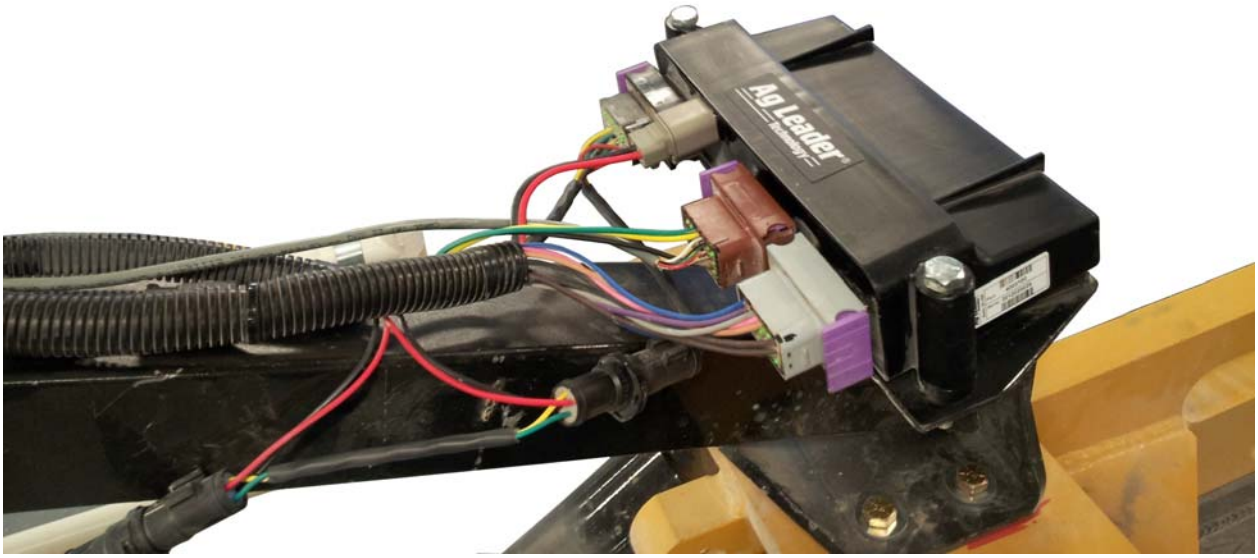
PLOW HARNESS



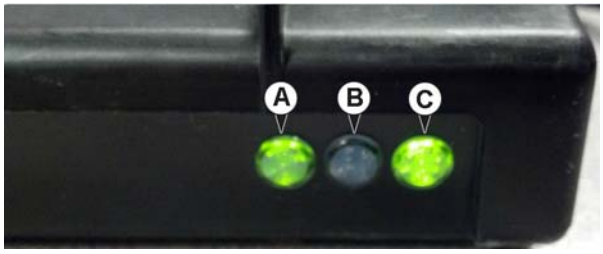
Locate cable PN 4003415. This will be mounted on the plow, with the single round cable connector at the hitch. There are 2 weather pack connectors that will connect to the Proportional valve. If you cannot route the cables to make these ends work, extensions can be ordered by your dealer to make the connections. Route the cable as shown below to ensure that moving parts do not pitch cables.

WATER MANAGEMENT MODULE

The module was designed to be oriented so the cable connections face the tractor. This is so the sensors are oriented correctly, and work as they were designed. Use the provided Module adapter plate and hardware to secure the module to the plow in the location as shown on the previous page. The label should also face Up when installing.



Make sure that you color match the connections from the Harness to the module and you don't force the connections, this can damage electrical pins. The round connections on the harness will be used to power the GPS receiver. The 2 large, and 1 small square connections will connect to the module. The Brown connector will be used for the GPS signal input.



LED (A) and (B)

- Off - CAN BUS is idle
- Flashing Green - CAN BUS communicating
- Blinking Yellow – Active BUS error when other devices are transmitting/receiving
- Solid Yellow – Passive BUS error when no other devices are acknowledging
- Solid Red – BUS Off

LED (C)

- Off – no power
- Solid Red – Low voltage
- Solid Green – Good power

GPS

Make sure the GPS receiver is mounted over the top of the cutting shear as shown. There will be 2 cables that will connect the GPS receiver to the module, one will be specific to your specific GPS receiver.

Double check to make sure that all connections are made and snug, and all cables are secured and not routed in areas that will be pinched.

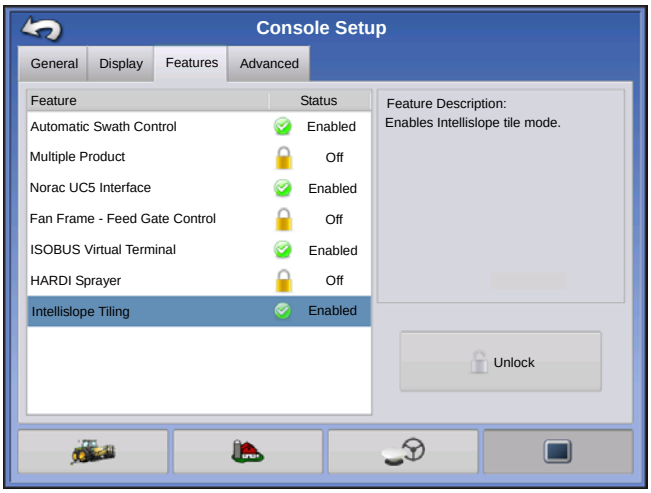
GPS RECEIVER CONFIGURATION

In order for Intellislope to receive GPS information from your GPS receiver, the GPS receiver needs to be sending out NMEA GGA, VTG, and GSA sentences. NMEA is a standardized output that virtually every GPS receiver supports. There are different BAUD rates, hertz, and types of messages that the GPS receiver can send out. Your receiver must be configured to send out the message at either 19,200 BAUD or 38,400 BAUD. The receiver must also be configured to run at 5 or 10 Hz for GGA and VTG, and 1 Hz for GSA. The only sentences Intellislope needs are GGA, VTG, and GSA. Please turn off all other messages.

If your GPS antenna has an internal roll correction applied when transmitting the Lat/Long data, you must 0 out the Antenna height while connected tot he WMC module. The WMC module has its own Roll correction sensor to compensate for the side roll of the plow. If the GPS receiver is sending this message as well, the value will be 2 times greater than it should be resulting in degraded performance.

CHECK INTELLISLOPE UNLOCK

Press: Home button > Setup (wrench) button > Display button > Features tab



The Features Tab is where you can enter unlock codes. Unlock codes are unique to the serial number of each display and the feature registration number. You must supply these numbers to your dealer when purchasing any unlock codes. Press  to enter the unlock code and Press  to enable the feature.

Operating Modes

AutoTile: driving over the tile's path to survey it and then display creates optimal tile placement according to guidelines set by user.

Grade Control: behaves like a laser control system, except that the grade can be changed without relocating or adjusting a laser tripod, and grade breaks are not limited by mast size.

Pitch Control: fall-back mode for when GPS is temporarily unavailable.

Each of these modes of operation is described in detail in its own subsection of this section.

WARNING: Hydraulic machinery can cause bodily injury or death!

The Intellislope control system is designed and tested with safety of operation in mind, however, the operators should never assume that they can anticipate the behavior of the system while it is powered. Follow these rules:

Stay away from the controlled machinery. Always ensure that no person is proximate within the range of motion of the controlled machinery while the control system is powered.

If it should be necessary to work in proximity to the machinery, first power off the control system. The system may be powered off using the display or by removing the system harness.

When controlling machinery other than a Gold Digger plow, the operator must exercise good judgment to ensure that the range of motion of controlled machinery is clear while the system is powered.

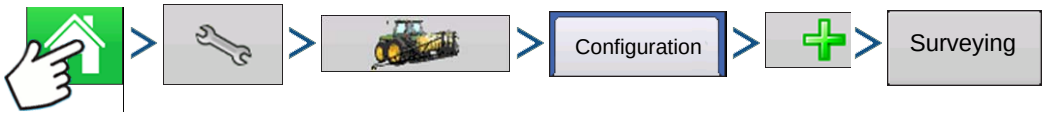
Turning off the display, or cutting the power by removing the accessory power plug, will remove power from the hydraulic valve solenoids. In Parker valves this will cause the valves to close.

Other components of the machinery, such as hydraulic system elements, have their own safety rules which are outside the scope of this manual, but which you should familiarize yourself with and follow.

ABOUT SURVEYING

- requires driving over the path where tile will be placed
- required by AutoTile but not by Grade Control or Pitch Control
- can be done right before laying tile or before tile is installed, provided your RTK base station has been surveyed in, and is placed in the same location for surveying and installation.
- can be done using tiling equipment (using the tiling configuration) or a separate vehicle (using the surveying configuration)
- can use either Versa or Integra display (tiling requires Integra display)

CONFIGURATION WIZARD



Press: Home button > Setup (wrench) button > Configuration (tractor) button > Configuration tab > Add (+) button > Surveying button

A wizard will then guide you through the process of creating a configuration using the following steps:

1. Select Vehicle

Select an existing vehicle from the drop-down menu or create a new vehicle.

Press  and create a new vehicle with the Vehicle Setup Wizard.

- Vehicle Wizard - input the following information:
  a. vehicle type
  b. make and model
  c. distance from rear axle to rear drawbar, rear lift arms, front lift arms (not necessary for surveying operation but can be useful if vehicle is used for other operations)
  d. vehicle name

Press  to edit offsets listed on screen:

- Antenna Location from Rear Axle
- Antenna Location from Centerline
- Antenna Height from Ground (Very important that this measurement is correct for accurate tile placement)
- Rear Drawbar
- Rear Lift Arms
- Front Lift Arms

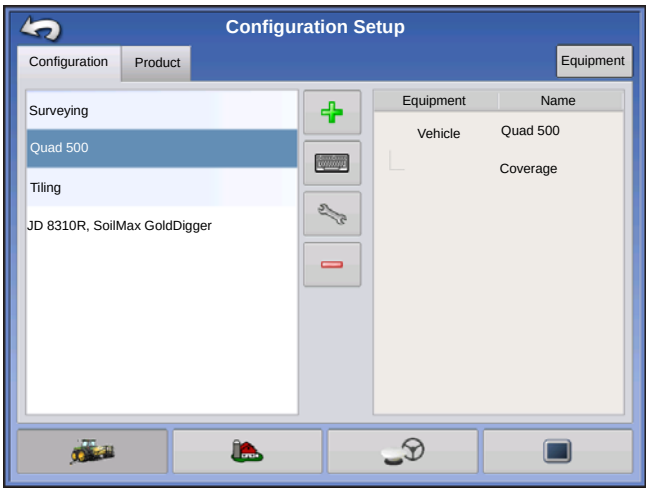
Press  to continue.

2. Select Speed Source

Select Primary and Backup Source (Display GPS, Auxiliary Device, GPS via WM Control)

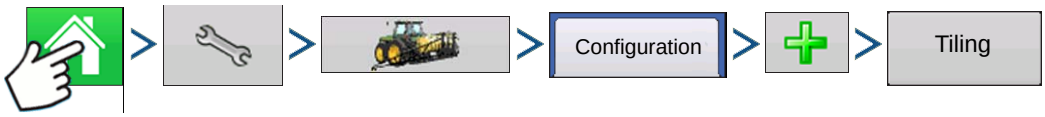
3. Enter Configuration Name

A suggested name for the configuration appears. If desired, Press  to enter a different name for your configuration. Press  when complete.



The complete configuration should now appear on the Configuration Setup screen and is now able to be selected when starting a new field operation.

CONFIGURATION WIZARD



Press: Home button > Setup (wrench) button > Configuration (tractor) button > Configuration tab > Add (+) button > Tiling button

A wizard will then guide you through the process of creating a configuration using the following steps:

1. Select Vehicle

Select an existing vehicle from the drop-down menu or create a new vehicle.

Press  and create a new vehicle with the Vehicle Setup Wizard.

- Vehicle Wizard - input the following information:
  a. vehicle type
  b. make and model
  c. distance from rear axle to rear drawbar, rear lift arms, front lift arms
  d. vehicle name

Press  to edit offsets listed on screen:

- Antenna Location from Rear Axle
- Antenna Location from Centerline
- Antenna Height from Ground
- Rear Drawbar
- Rear Lift Arms
- Front Lift Arms

Press  to continue.

2. Select Implement

Select an existing implement from the drop-down menu or create a new implement.

Press  and create a new implement with the Implement Setup Wizard.

- Implement Wizard - input the following information:
  a. make and model
  b. implement attachment type (Rear Drawbar or Rear Lift Arms)
  c. controller WM Control
  d. GPS Antenna Offset
    - Antenna Location from Hitch Point
    - Antenna Location from Ground (measurement must be taken with the implement raised all the way up in transport position.)
    - Antenna to Plow Base (when collecting surveys with this configuration, the plow must be in the same position for each survey to collect accurate soil elevation)
    - Antenna to Tip (Horizontal: an example is if the tip is 24 inches ahead of antenna, you would enter 24 in front)
    - Antenna Location from Centerline

e. implement name

Press  to continue.

3. Select Speed Source

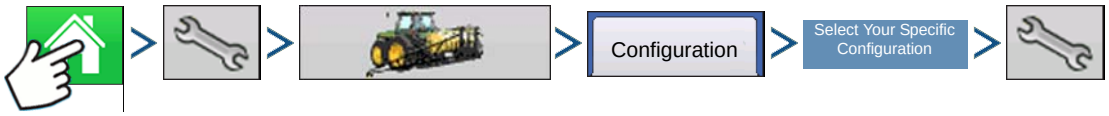
Select Primary and Backup Source (Display GPS, Auxiliary Device, GPS via WM Control)

4. Enter Configuration Name

A suggested name for the configuration appears. If desired, Press  to enter a different name for your configuration. Press  when complete.

The complete configuration should now appear on the Configuration Setup screen and is now able to be selected when starting a new Field Operation

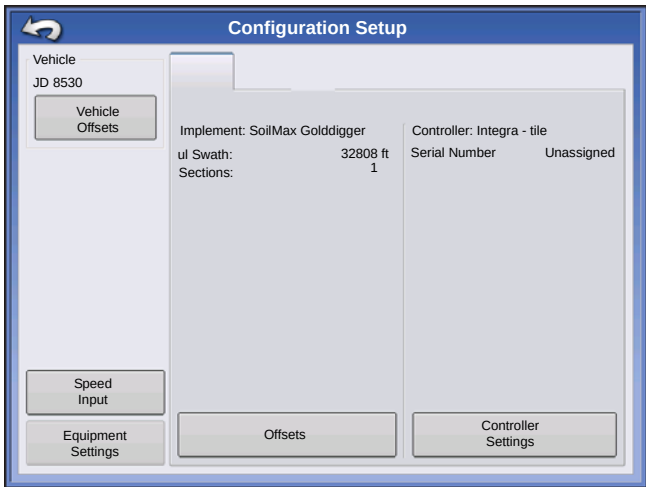
CONFIGURATION SETUP



Press: Home button > Setup (wrench) button > Configuration (tractor) button > Configuration tab > Your Specific Configuration > Setup (wrench) button

Note: *Use the **Manage Equipment** button to view a list of specific vehicles and implements.*

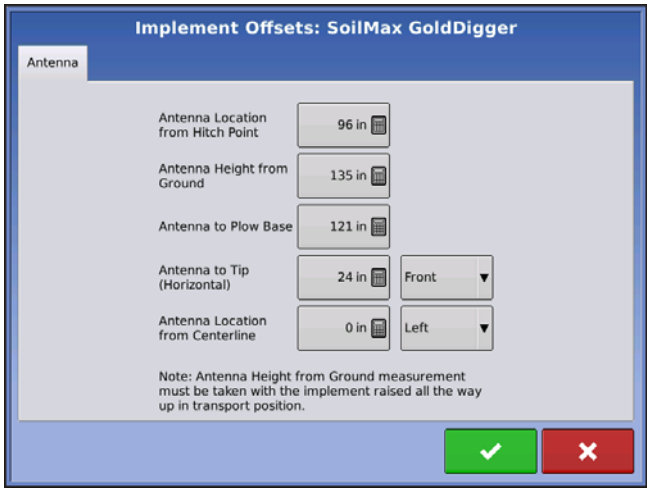
IMPLEMENT OFFSETS



Press [Vehicle Offsets] to adjust vehicle offsets.

Press: [Speed Input] to modify source of speed.

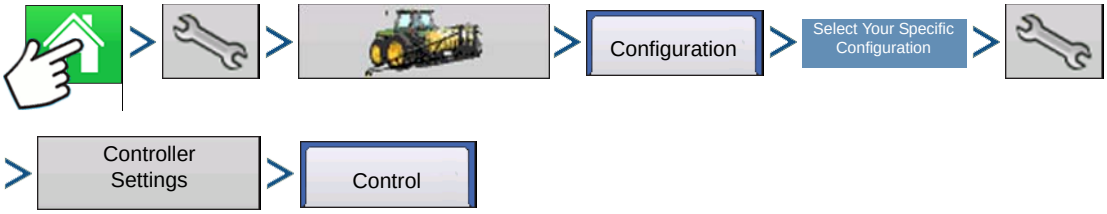
Press: [Equipment Setting] to modify setting on equipment



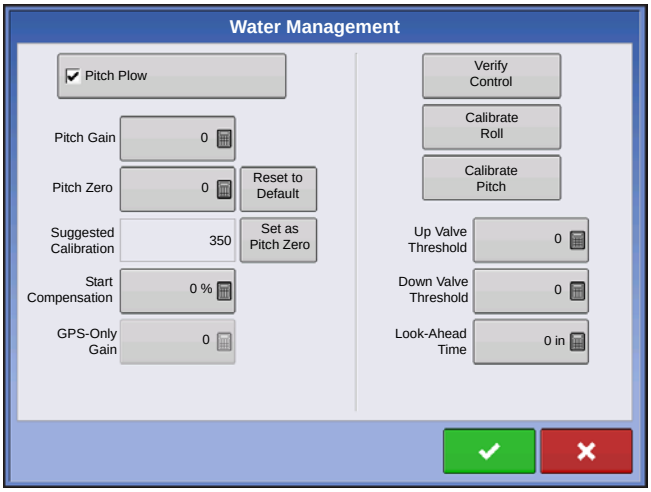
Press [Offsets] to adjust plow offsets setup when creating configuration.

Antenna to Tip is the horizontal measurement of the tip to the Antenna. An example is if the tip is 24 inches front of the Antenna, you would enter 24 in. and Front (as shown).

WATER MANAGEMENT



Press: Home button > Setup (wrench) button > Configuration (tractor) button > Configuration tab > Your Specific Configuration > Setup (wrench) button > Controller Settings button > Control tab



Pitch Plow check box: check this box only if the machine is a pitch plow (also called cantilever).

If this box is not checked, Pitch Gain, Pitch Zero, Suggested Calibration, and Start Calibration boxes will be grayed out and unavailable.

This setting effects the operation of Intellislope and it is crucial that it is set correctly. When check box is checked, it indicates that the machine being controlled is a pitch plow and the elevation of its cutting edge is determined by the pitch of the plow. This must be un-checked if the machine is not a pitch plow, such as a parallel linkage plow, trencher, scraper or pan, where the elevation of the cutting edge of the machine is directly effected by the hydraulic cylinder displacement. In this case the GPS receiver must move with the cutting edge for proper control

The following table summarizes the interaction between the pitch plow setting and adjustments on the Performance Setup screen

Adjustment	Pitch Plow Box Check	Pitch Plow Box Un-checked	Comments
Pitch Gain	Yes	No effect	Pitch Gain only has effect when the system is controlling pitch, and thus only when configured as a pitch plow.
Look Ahead Distance	Yes	No effect	Look Ahead Distance only has effect when the system is using pitch to control elevation, and thus only has effect when configured as a pitch plow.
GPS-Only Gain	No effect	Yes	GPS-Only Gain only has effect when the system is directly controlling elevation in systems where the hydraulic cylinder directly controls elevation (not a pitch plow).

Pitch Gain: determines voltages necessary to effectively adjust pitch. It defaults to a value that works well for the Parker valve and most hydraulic system flows and pressure. The gain may be increased somewhat for tractors with lower flow and pressure. Beware of making it too large, as this will cause the plow to respond in an unstable and erratic way. The higher the value the more aggressive response you will have.

Pitch Zero: sensor reading that corresponds to level installation. Value will be set automatically after running Pitch Calibration.

The Pitch Zero should be manually adjusted on this screen from time to time so that it remains close to the Suggested Calibration number.

The following may require it to be readjusted:

- change in soil characteristics in which the plow operates, since soft or wet soil can cause the plow to “slip” relative to its pitch
- substantial change in grade of the ground in which the plow operates
- remounting of the module to the plow
- change in ambient temperature.

The best strategy is to let the On Grade indicator guide any adjustment.

Reset to Default: resets Pitch Zero to value created by Pitch Calibration-See below section on Ongoing Pitch Zero Adjust.

Suggested Calibration: Every time a Grade Control or AutoTile run is completed the system updates this number to indicate the pitch zero during that run. If your plow tends to run low, this number will likely be higher than the pitch zero, so increase the Pitch Zero to match this number if your On Grade indicator signifies you are running low. Conversely if it runs high, then decrease the Pitch Zero to match this number. It is very important to watch this number to see if the Suggested Calibration number stays close (within 10) of the Pitch Zero. If it is more than 10 off either way, you should lower or raise the Pitch Zero to bring it to the Suggested Calibration number.

If for any reason the plow was operated in Grade Control or AutoTile mode with the plow out of the ground, then the Suggested Calibration number will be meaningless and should be ignored. Use the button beside the Suggested value and set the Pitch Zero to the Suggested value (the pitch number will be over written with suggested).

Set as Pitch Zero: sets the Pitch zero to the number provided by the Suggested value.

Start Compensation: At the start of an installation, the cutting edge of the plow tends to drop slightly as the shank contacts the soil. Start Compensation allows the operator to specify an initial upward pitch to offsets this drop. The extra pitch is reduced to zero over the first 2 meters after which it has no effect. Setting Start Compensation to zero is equivalent to turning it off. A typical setting is 2%.

GPS-Only Gain: This gain only applies when the Pitch Zero box is un-checked. It determines how aggressively the system reacts to elevation errors when controlling machines that are not pitch plows.

Generally these numbers will be very low like 5 or less, trial and error may be required to get the results you are desiring.

Ongoing Pitch Zero Adjustment

Rule of Adjustments

- If the plow is predominantly tracking below the target (too low), according to On Grade indicator, increase it.
- If the plow is predominantly tracking above the target (too high), according to On Grade indicator, decrease it.
- Otherwise leave it alone.

Even when the Pitch Zero is well adjusted, the on-grade indicator may reflect deviations from on grade, which is normal and expected. The plow tends to round off sharp corners in the target profile. This will cause either high or low indications as it does so.

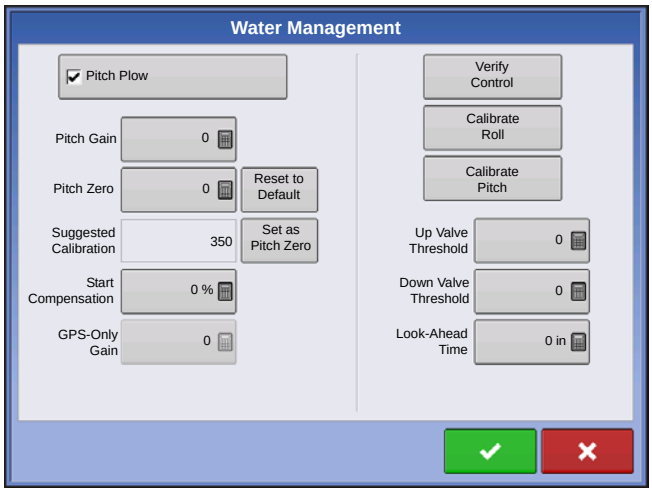
There is also a certain amount of deviation within a channel about the target profile that is typical as the control system hunts for the target and responds to external disturbances such as driving over rough terrain. The operator should remain aware of the on-grade indicator, and if grade error starts becoming abnormally large or erratic, he should look for any of number of pitfalls which can be giving rise to the problem.

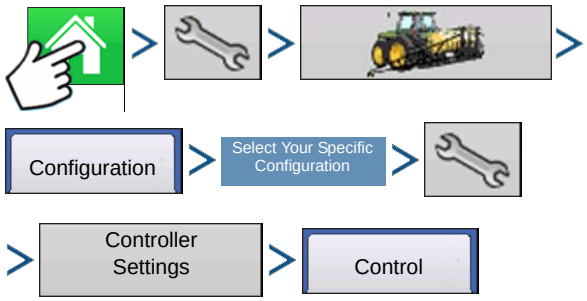
Also, noise or error in the GPS elevation, noise in the pitch signal, rocks, soft spots, some degree of control system hunting and overshoot, among other things, can cause brief deviations from on grade. Only when the plow is consistently high or low does the Pitch Zero need adjustment.

If any of the following occur, the Suggested Calibration should be ignored:

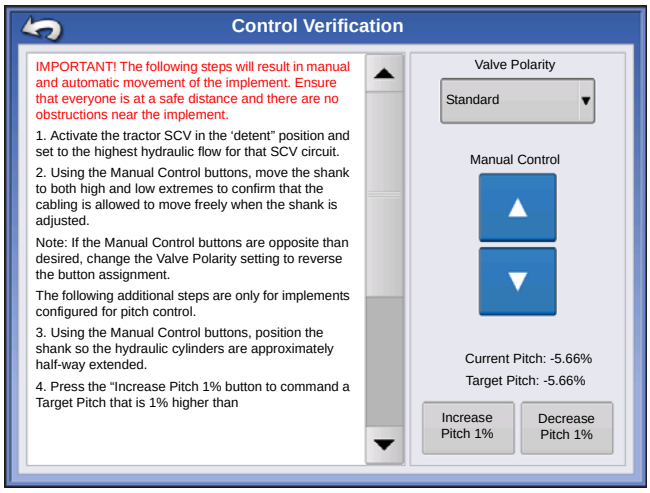
- Operating in the “Installing” state while the plow is out of the ground.
- Operating in the “Installing” state, while any external force is being applied to the shank, including any of the following: Lifting or lowering using the three-point hitch, exerting force on the shank by manually extending or retracting a hydraulic cylinder such as the diagonal lift cylinder on a Wayne's plow, or operating a Soil-Max pull-type plow too shallow such that the wheel cylinder forces have too large a component in the vertical direction.
- Operating in the “Installing” state when GPS, GPS quality or GPS RTK correction is lost.
- Installing a tile run in Pre-Ripped ground
- Operating in the “Installing” state when the three-point hitch (or raise/lower diagonal cylinder on a parallel link plow) is not fully in float.

It is easy to inadvertently cause these. If any is known to occur, the Suggested Calibration number should be ignored until after the next run.





Press: Home button > Setup (wrench) button > Configuration (tractor) button > Configuration tab > Your Specific Configuration > Setup (wrench) button > Controller Settings button > Control tab



Verify Control will check to make sure hydraulics are functioning correctly and determine the voltage necessary to move the cylinders.

Note: This may require that you move over a trench to allow the plow shank to move freely, and not overturn.

Adjust the Valve UP/Down thresholds, and then go to the Verify control screen and use the Up/Down arrows. Adjust the up/down threshold values until moving the arrows makes the implement start to respond.

To run the Control Verification, press button and follow instructions on the display.

It the implement responds opposite of the commands (for example if the UP button makes the plow go down) change the Valve Polarity setting and try again.

Up Valve Threshold, Down Valve Threshold: These two settings control how much voltage needs to be applied to the valve to cause the cylinder to begin to move. The higher the number, the higher the voltage the system will apply to begin moving the cylinder, and the quicker the response. The lower the value, the more slowly it will move. On the previous screen, use the up and down buttons to see if those values improve response.

HYDRAULIC PRESSURE AND HOSE HOOKUP

It is critical to have hydraulic pressure when operating the plow. Take care that the hydraulic flow is in the correct direction. On the front of the hydraulic valve near the hydraulic lines you will see a P and T which stand for pressure and tank. The hose that has the pressure on it is the hose that goes into P or the pressure side of the valve. You can normally tell the pressure side by the stiffness and vibration feeling in the hose.

The tractor's accessory oil pressure should be set high. Pitch plows encounter large forces which must be overcome by the cylinders. High hydraulic oil pressure is required to generate these large forces. Setting the oil pressure too low will cause pitch control errors.

When using a Soil-Max Gold Digger tile plow, the minimum recommended pressure setting is 2,600 pounds per square inch and the minimum recommended flow setting is 10 gallons per minute.

If the cylinders neither retract nor extend then one of the following may be the cause:

Problem: No hydraulic pressure is available.

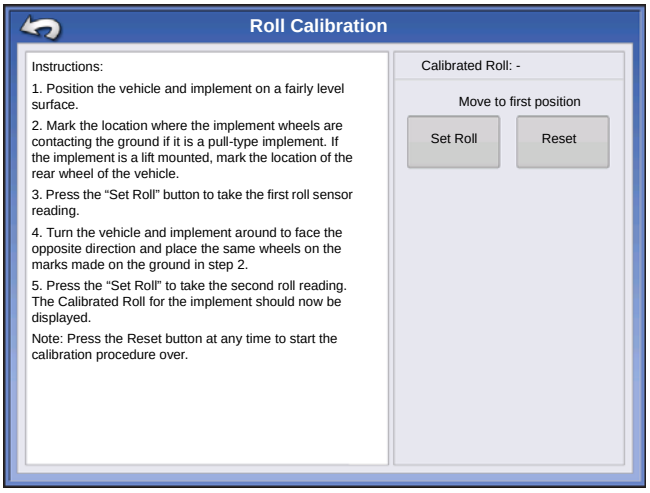
Solution: Tractor must be running, hydraulic detent engaged and hydraulics must be connected to Parker valve.

Solution: Hoses may be reversed.

Problem: Harness is not securely connected to both module and hydraulic valve.

Solution: Check that module-side plug is completely inserted and the connector is locked.

Solution: Check that the valve solenoid connectors are fully seated and screwed down.



ROLL CALIBRATION

1. Position the vehicle and implement on a fairly level surface.

2. Mark the location where the implement wheels are contacting the ground if it is a pull-type implement. If the implement is a lift mounted, mark the location of the rear wheel of the vehicle.

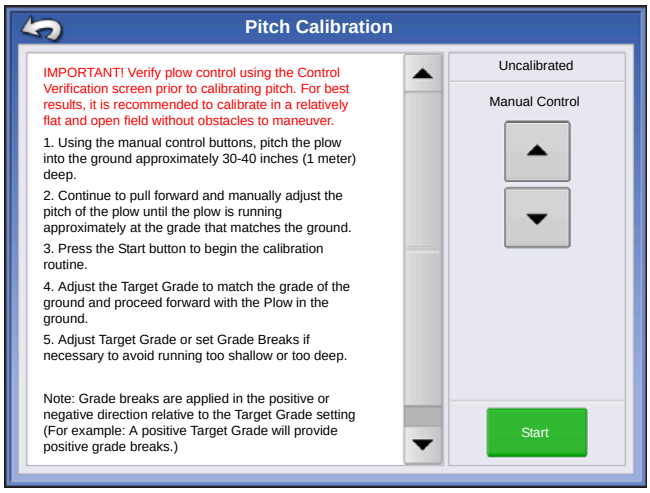
3. Press the “Set Roll” button to take the first roll sensor reading.

4. Turn the vehicle and implement around to face the opposite direction and place the same wheels on the marks made on the ground in step 2.

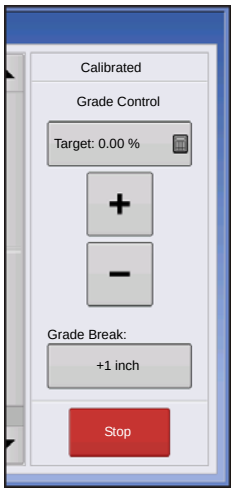
5. Press the “Set Roll” to take the second roll reading.

The Calibrated Roll for the implement should now be displayed.

Note: Press the Reset button at any time to start the calibration procedure over.



PITCH CALIBRATION



Pitch calibration number determines sensor reading for level installation. Plow status will read “Uncalibrated” until Pitch calibration is ran. Only after having followed those instructions will you need to adjust this pitch zero number.

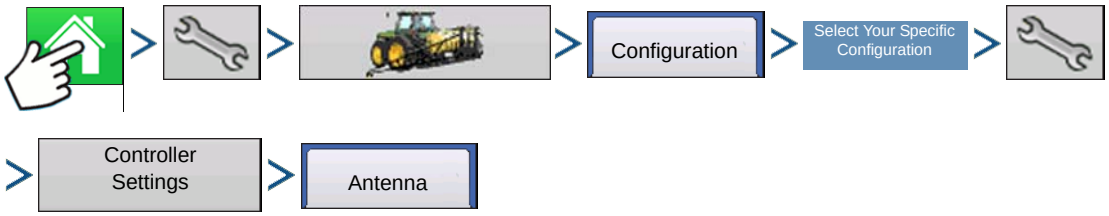
After this initial calibration run, the Pitch Zero will be set automatically. From then on, any changes to the Pitch Zero need to be made manually.

To run Pitch Calibration, Press Pitch Calibration button and follow instructions given on the display.

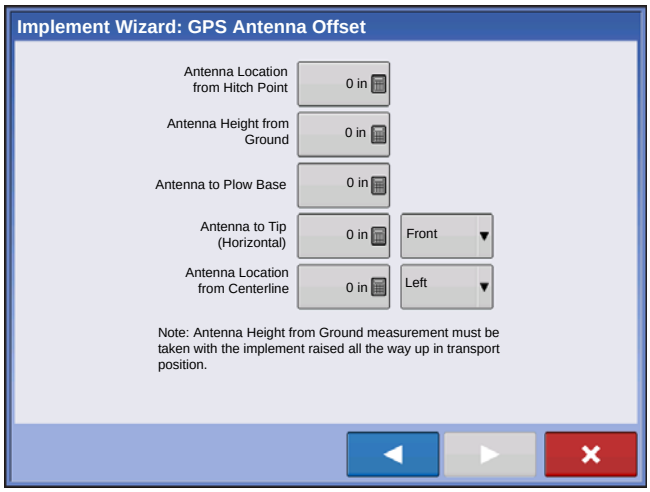
LOOK-AHEAD TIME

This normally does not need to be adjusted on Gold Digger plows. On other plows, it should be set to the horizontal distance (in inches) from the tile boot to the shear of the plow. A longer time will smooth out the plow and make it less reactive. A shorter time will make the plow react quicker but may cause oscillatory “hunting” about the target elevation.

ANTENNA OFFSETS



Press: Home button > Setup (wrench) button > Configuration (tractor) button > Configuration tab > Your Specific Configuration > Setup (wrench) button > Controller Settings button > Antenna tab



Antenna to Plow Base: Distance affects the depth because it affects how far the plow shear is below the antenna as it is lowered.

Antenna Tip (Horizontal): This is the distance from the Antenna to the tip of the plow or cutting edge. If you had a rope hanging straight down from the antenna, it would be the horizontal measurement from the tip to the rope. If the tip was 24 inches in front of the antenna, you would enter 24 in front. AutoTile uses this distance to compute the tile trench elevation from the GPS antenna's elevation. Measure the vertical distance straight down from the GPS antenna to the very bottom of the plow (bottom of the skid plate). Enter this distance in inches.

Antenna To Ground: This measurement tells AutoTile how high the GPS antenna is above the ground when surveying a path. If you are using a three-point hitch plow you must always raise the plow to the same height when surveying, otherwise AutoTile's ground profile will be wrong. This is the measurement from the GPS antenna to the ground when the plow is completely lifted and plow boot is pitched all the way up.

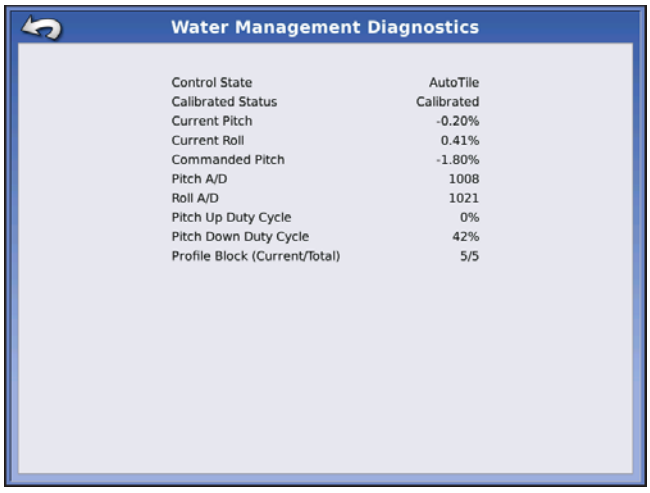
The Antenna Distance To Ground affects the depth because it affects the computed elevation of the ground.

Increasing Antenna-To-Plow-Base Distance will increase the indicated depth. Increasing Antenna Distance To Ground will decrease the indicated depth.

It is crucial to realize the indicated depth is relative to the ground's elevation at the nearest point that was surveyed. Putting a tape measure on the shear and measuring relative to the edge of the hole should only match if the AutoTile survey ended or started exactly at the hole. If it started some distance away, the elevation of the ground at that location will be used in computing the depth, not the elevation at the edge of the hole.

DEVICES

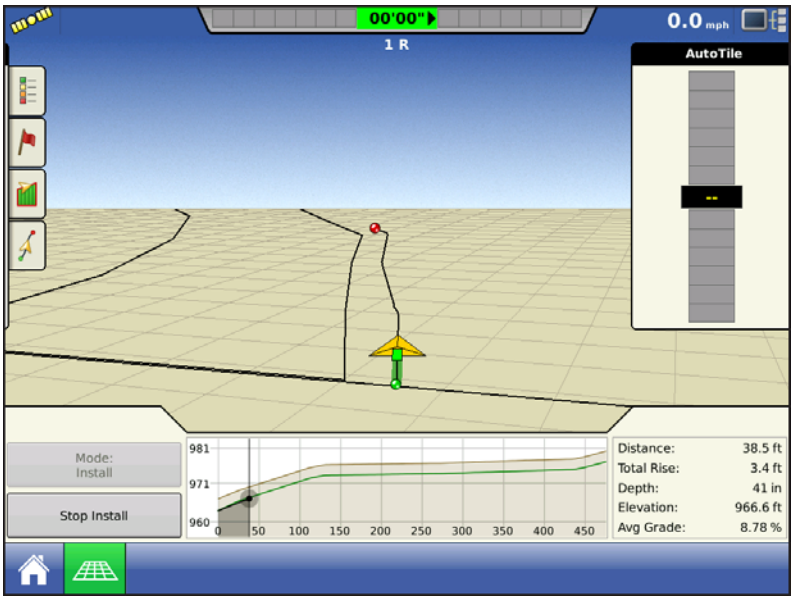
Pressing on the Device Information button, located in the upper right corner of the display, opens the Devices screens. Technical support may request that you look at these screens for help in diagnosing a problem.



GPS

During your field operation, the GPS (satellite) button in the upper left-hand side of the Status Bar should appear as green, which means you are receiving a differential GPS signal. If this icon appears yellow, you are still receiving GPS but are not receiving a differential signal; and if it appears gray then you have lost GPS. In either case, you should check your GPS settings.

The two buttons on the top left will show if they have 2 GPS signals (one from plow-CAN, one from vehicle -serial).



This screen shows insufficient GPS to operate AutoTile.

This screen shows the Error messages that an operator might receive when there is inadequate GPS.

Lessons Learned and Pitfalls to Avoid

The following is a list of pitfalls that we've observed can degrade performance. Operators should be aware of these to better avoid them, and should be alert to the on-grade indicator and installation profile to detect when these conditions arise. Some are under the control of the operator while others are not, such as hitting rocks and loss of GPS fix or quality. The list is provided on a best effort basis; it may not be exhaustive. Should an installation error occur, it is straightforward to correct by installing a bypass around the affected section of tile.

Extreme Soil Conditions

Hard clay soil, loose already-plowed soil or soft bottoms can interfere with the ability of the shank's trajectory through the ground to be controlled by the shank's pitch. Normal operation requires that the pitch of the shank guide the trajectory. Soil that has been overplowed and is loose does not generate sufficient force acting on the shank surfaces to allow pitch to control the elevation.

Tractor Effects

A tractor effects is an interaction between the tractor and plow that can push the plow off the target. One such effect occurs as the wheels of the tractor pass over a sharp hump, trash from previous plowing or

any uneven surface, the plow hitch will be similarly raised or lowered, pulling the plow frame with it. Pitch control will compensate, however the hydraulics can only fill the cylinders so fast, and so may not keep up. To allow the system to keep up, drive over any uneven surface as slowly as possible.

LOW HYDRAULIC PRESSURE

Forces acting on the buried plow shank are large. In the face of these forces, the hydraulic cylinders actuating the plow shank must create large forces and thus high hydraulic pressure is required to displace them. Insufficient hydraulic pressure can leave the system unable to adequately control pitch. Lower pressure can also make the plow slower to respond as it slows down the rate at which the hydraulic cylinders fill.

Older tractors may have open-center hydraulic systems in which hydraulic pressure is proportional to engine RPM, so at low RPM there is insufficient pressure. Modern closed-center hydraulic systems are pressure regulated and are not subject to this problem.

FAILURE TO FLOAT THE THREE-POINT HITCH

The plow needs to float and freely pivot about the hitch. Force exerted by the hitch will displace the plow from the target. Always ensure the three point hitch is freely floating before beginning installation.

OPERATING TOO SHALLOW

(less than ~20 inches), and Pull-type Plow Down Pressure

Forces bearing upon the top of the shank allow it to drive deeper when required by elevation feedback control. When too shallow, this force can be insufficient.

Related to this issue is the down pressure in the wheel cylinders of a pull-type plow. When shallow operation of a pull-type plow is required, the valve setting on the down-pressure cylinders should be lowered. Too much up pressure can also lift the plow up from the target profile.

The down pressure, depth of operation and soil conditions may interact such that some soil may require deeper operation or lower down pressure than others.

DRIVING TOO FAST

When an installation is started with the plow much deeper than the target profile, the system will schedule a target that rises rapidly towards the target profile. When this steep section meets the relatively-level target profile, driving too fast can cause the plow to overshoot the target, as the cylinders can only change the plow pitch so fast. Drive slowly when the target profile grade is changing rapidly.

OBSTRUCTIONS

If you encounter a rock or other obstruction in the field use the Stop Tiling button, and end the install. After you have freed the plow from the rock you are now able to continue tiling. If using Grade Control Mode, you can use the Grade Break to raise the target depth to prevent a flow reversal in the tile. If you were using Autotile, re-select the survey, and adjust the depth settings to create a new target depth. This may include lowering the Minimum depth value, lowering the grade, or lowering the max depth value.

DETUNED CONFIGURATION PARAMETERS

The pitch gain, look ahead distance, valve thresholds, start compensation and pitch zero settings are discussed in the Operator's Manual. Low gains and valve offsets can make the plow respond too lazily, and setting them too high can induce instability.

GPS Interruptions

The elevation control is only as good as the ability of GPS to report elevation. Loss of GPS fix or quality, or change in satellite constellation can cause the GPS to report erroneous elevations. If using a battery-powered RTK base station, the battery can run down leaving the unit without correction.

Defective Components

A rusty/dirty hydraulic valve is an example of a bad component that can degrade performance. Of course as with any electro-mechanical system. Ensure that when connecting hydraulic lines to the tractor, that the tips are clean before connecting them. Intellislope components are not immune to failure. Most component failures lead to the system being inoperative, not degraded performance.

ABOUT SURVEYING

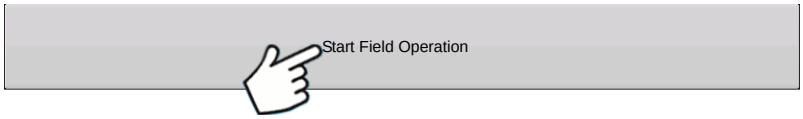
AutoTile can make tiling much easier by creating a sophisticated target profile that hugs the topography of the ground at a selected depth. AutoTile requires that a survey is taken, which records the soil profile, before installing tile. The soil profile is created by driving over the path where the tile will be installed with the Intellislope system in Surveying Mode. The soil profile is used to create the target profile for tile installation.

SURVEYING WITH A VEHICLE (NOT PLOW)

Surveys may be conducted prior to installation. This allows the flexibility of performing surveys with other vehicles such as ATVs, trucks or utility tractors. The survey log can be saved on a USB drive and transfered to a different vehicle or display for installation. Ensure that the GPS antenna is securely mounted, and that the Antenna Distance To Ground entered in the Machine Setup screen is correct. Survey logs record the elevation of the ground based on this setting. The log will reflect the setting at the time the survey was made. Any change to the Antenna Distance To Ground setting will not take effect until the next survey is performed.

It is also strongly recommended that if doing a survey days prior to installation that the GPS Base station is not moved, or is reset in exactly the same location as when the survey was collected. Failure to have the base in the same location can render the surveys inaccurate, requiring to be redone.

To begin surveying:

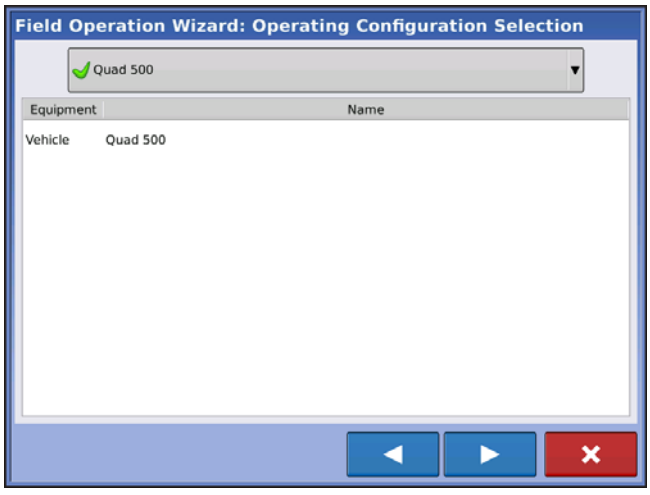


Press Start Field Operation.

On Management Selection screen, verify:

- Growing Season
- Grower
- Farm
- Field

Press  to continue.



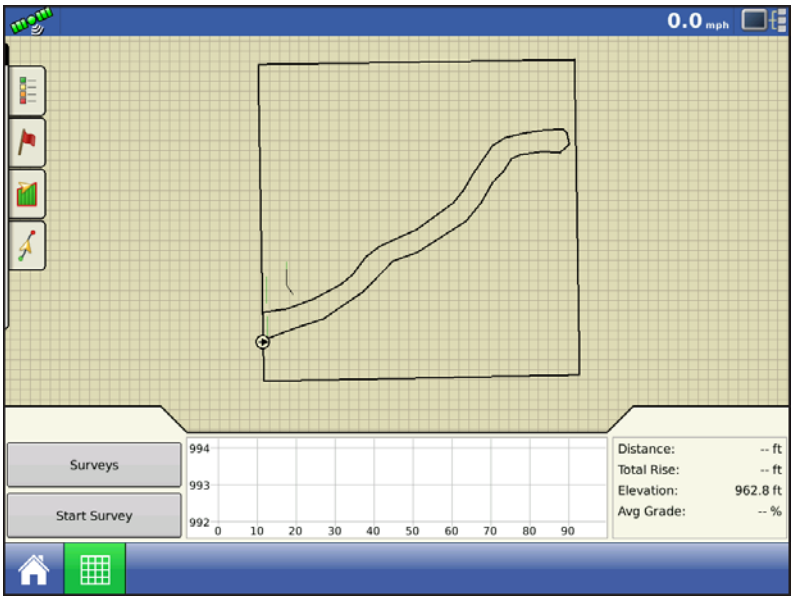
Select a survey configuration

Press  to continue.

Select a region.

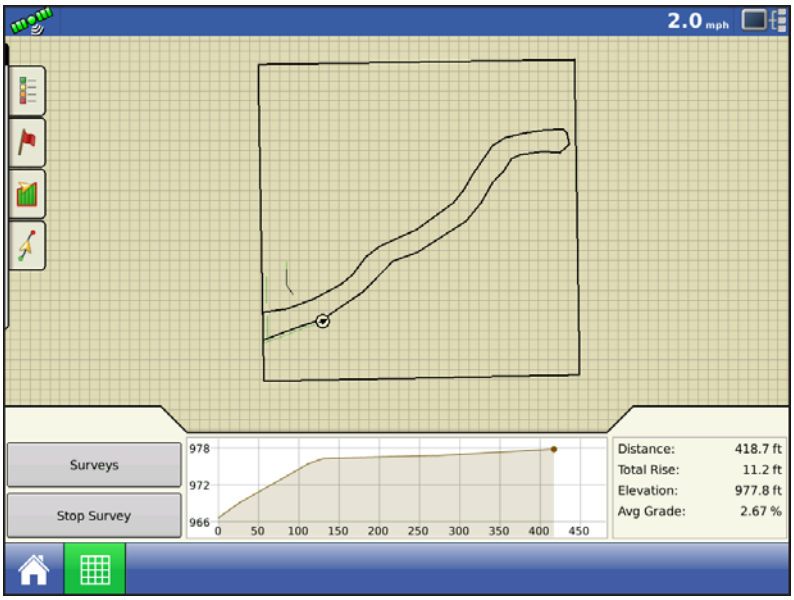
Press  to complete wizard.

Press  to go map screen.



Drive to the location where you want to start the survey and press

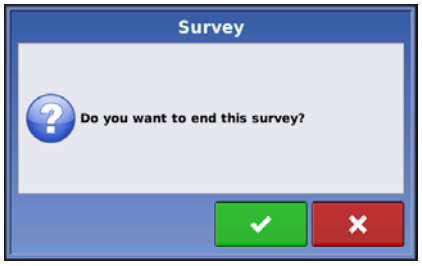
Start Survey



Drive the path where tile will be placed. At the end of the path press

Stop Survey

Confirmation Screen will appear.

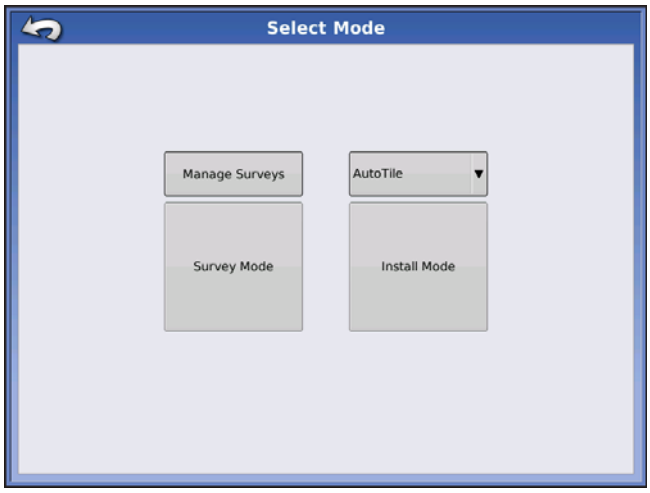


Press ✓ to end survey.

SURVEYING WITH PLOW

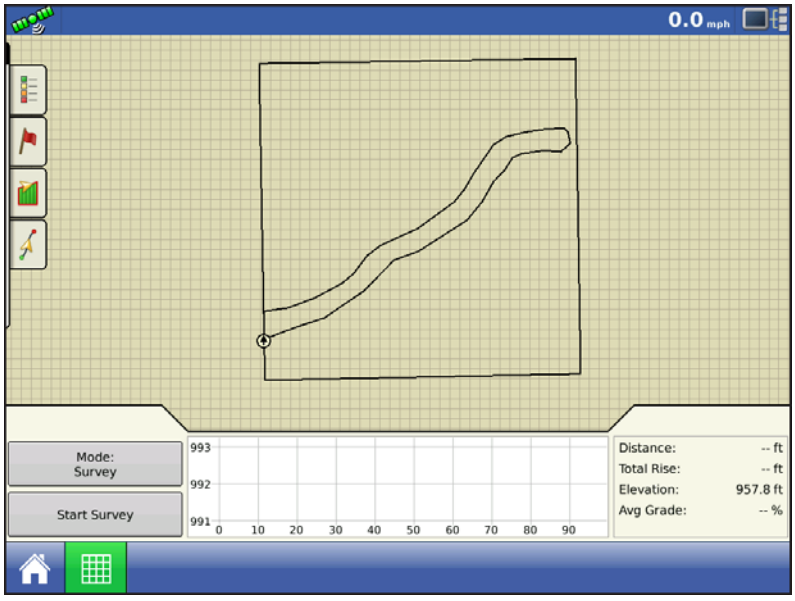
When surveying with the installation tractor, the plow must be completely raised so the GPS antenna distance to ground is consistent for every run and matches the Antenna Distance To Ground entered in the display.

For pull type plows, make sure the wheels are all the way down, and the plow shank is pitched up. For mounted, or 3pt mounted plows make sure the linkage is all the way up, and the plow shank is all the way up.



Press Mode to view Select Mode Screen.

Select Survey mode.



Drive to the location where you want to start the survey and press

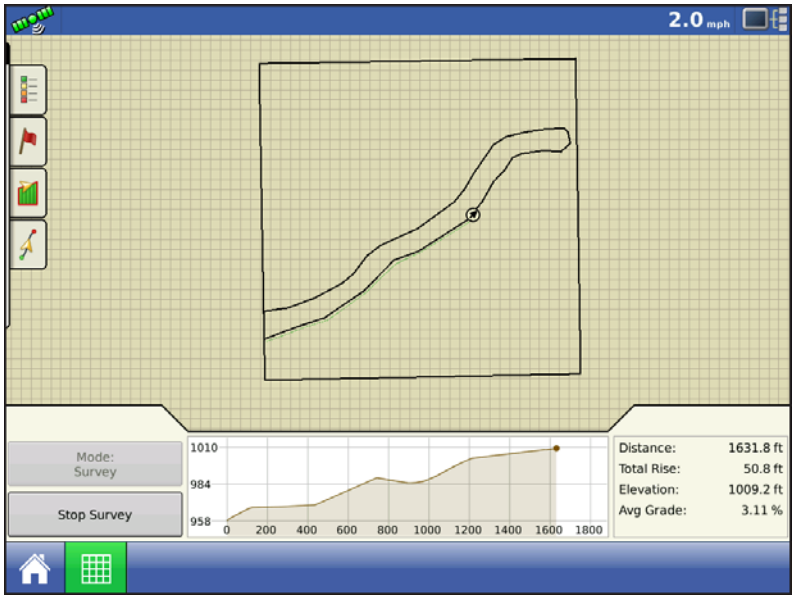
Start Survey

Then press “Start Survey”

“Start Survey” will change to “Stop”.

As you drive, your path will be indicated with a green line.

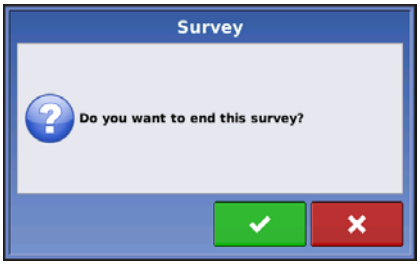
Try to get as close to the outlet or main connection as possible (whether at the start of the survey, or the end of the survey, doesn't matter), before ending the survey, but do not back up or make a loop around the starting hole while you are still surveying. Drive past the start of installation and near it if possible.



Drive the path where tile will be placed. At the end of the path press

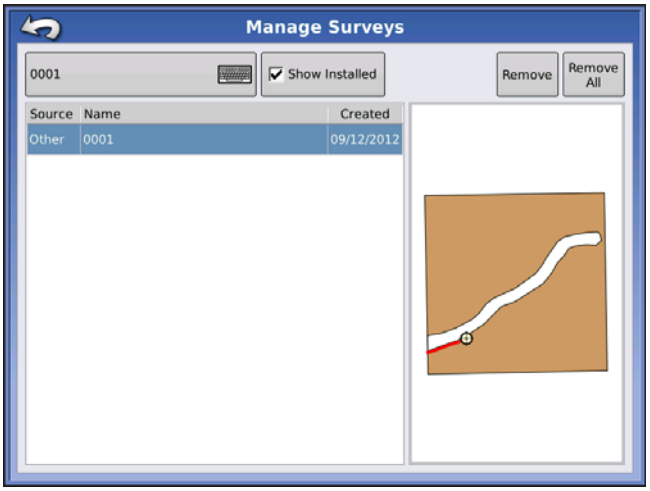
Stop Survey

Confirmation Screen will appear.



Press ✓ to end survey.

MANAGING SURVEYS



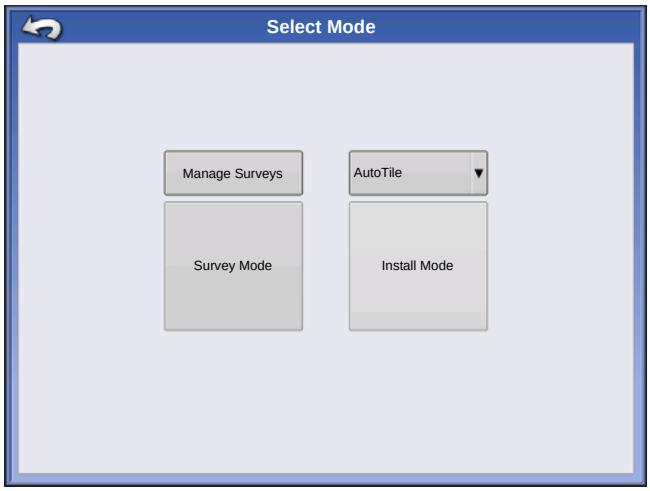
Press Surveys to view Manage Surveys Screen.

Paths are automatically named but the names can be changed by choosing a survey and pressing . Type name then press to enter it.

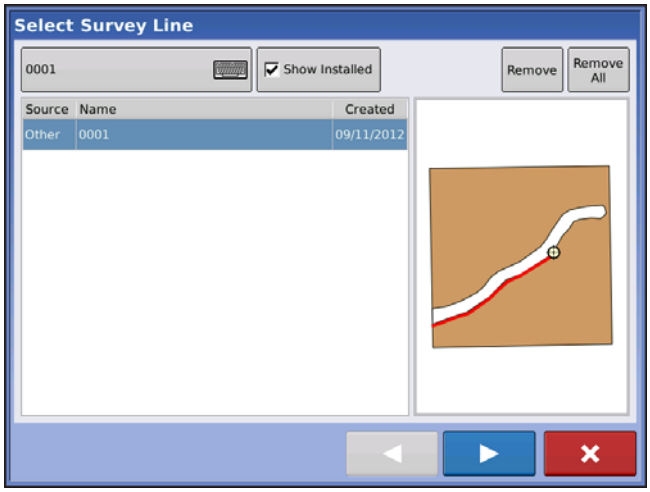
Show installed will show installed tile.

Path can be removed individually using the Remove button or all paths can be remove using the Remove All button.

INSTALLING WITH AUTOTILE

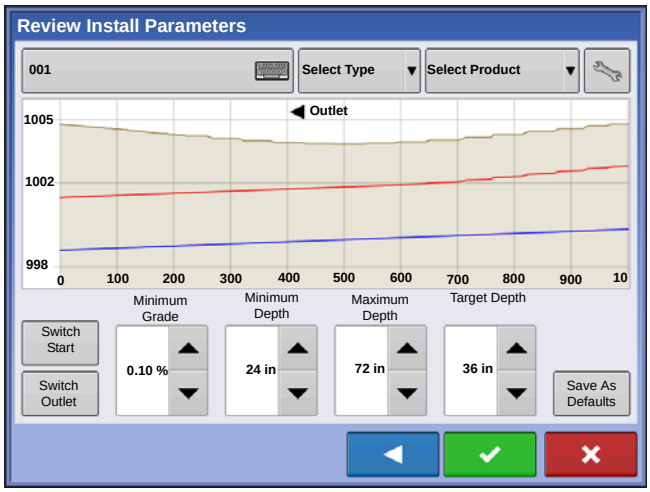


Press the Mode button on the map screen and then select AutoTile and Install on the Select Mode screen.



Selecting “Install” brings up the survey selection screen. The selected survey will be drawn as a red line on the over-head map shown on the right side of the screen. If a survey has just been completed, it will be selected by default.

Select the desired survey and press ▶ to continue.



PERFORMANCE SETUP

Minimum Grade: This is used by AutoTile to create target tile profiles. It specifies the minimum grade you wish AutoTile to maintain. 0.1% grade is a common minimum grade. Min Grade affects the target profile that the control system “aims” at. It is normal for some deviation about the target within a channel about the target profile.

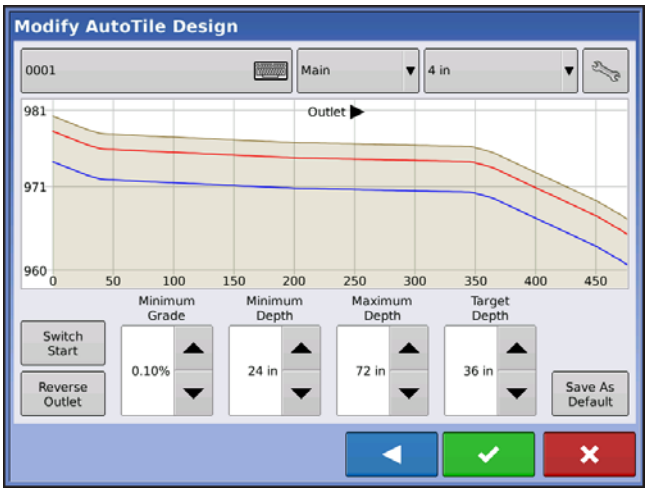
Minimum Depth: This specifies the shallowest depth at which you want AutoTile to place tile, at any point in the tile run. Keep in mind that this depth is to the bottom of the trench. You might want to change this distance if you change to a pipe with a larger or smaller diameter.

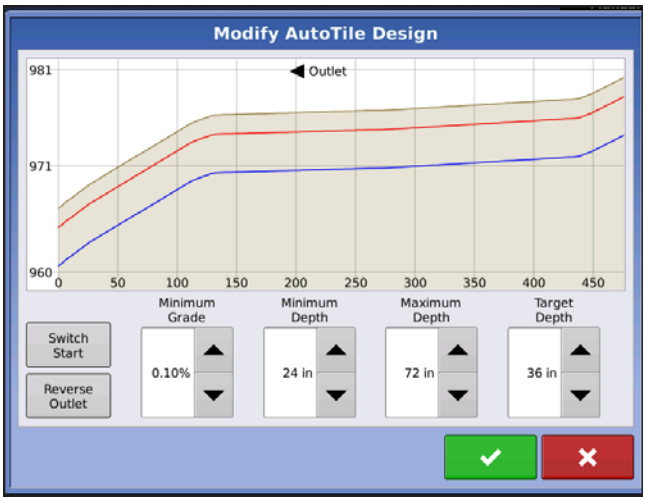
Maximum Depth: This is used by AutoTile to know how deep the plow can go. You can either use the maximum depth of the plow or use this to limit the depth you wish the plow to run to lower the pull required if ground conditions are difficult.

Target Depth: This is the depth at which AutoTile schedules tile installation (as long as other constraints permit). This is usually in the 30-42 inch range. You should adjust this if necessary to keep your tile above impermeable clays. This depth is to the bottom of the trench.

Switch Start Button

(Start at Top or Bottom of Run)

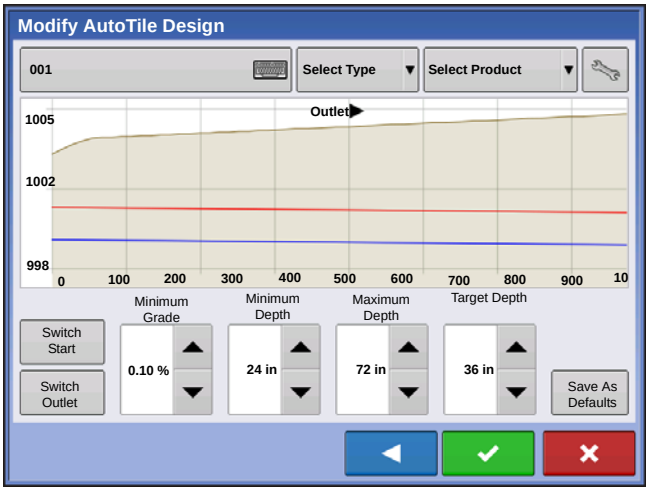


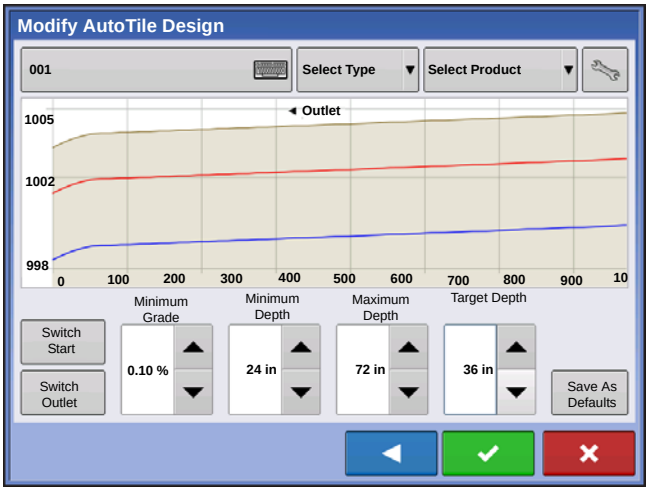


On the display screen, installation always proceeds from left to right. AutoTile assumes you will start at the lower end of the survey, and that the lower end is the outlet of the tile.

If Intellislope shows your location at the right side of the screen when you want to start installing, press “Switch Start”. The “Switch Start” button switches the starting and ending locations.The ground's profile will be flipped, and your current position will now appear on the left side of the screen.

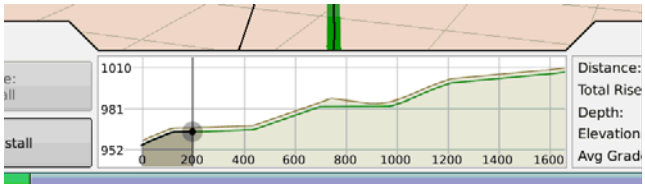
Reverse Outlet Command



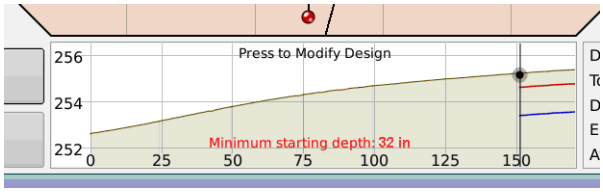


The “Reverse Outlet” button changes which end the outlet is on. The outlet end is the end of the path towards which the water drains. There is no effect on the ground profile, which remains unchanged. The

difference appears in the shallowest and deepest installation profiles, which now are designed to drain in the opposite direction.



As you start installing, you should always progress from the left side of the profile graph to the right side. If your vehicle position indicator is at the right side, tap the profile and modify your outlet location and/or your starting location.



You are allowed to start installation at any point along the surveyed path. If the profile graph is as shown as shown on the left, and you start installation, the tile will be placed at a 0.0 grade

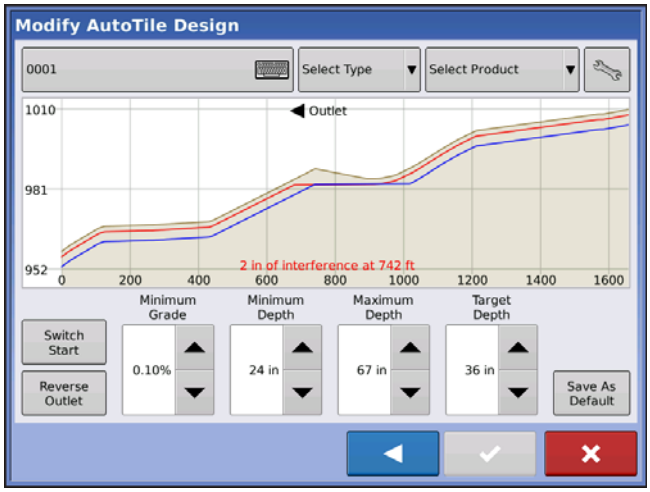
ADJUSTING PROFILE TO ALLOW TILING

When a solution exists (which depends on the topography and the constraints you have specified)

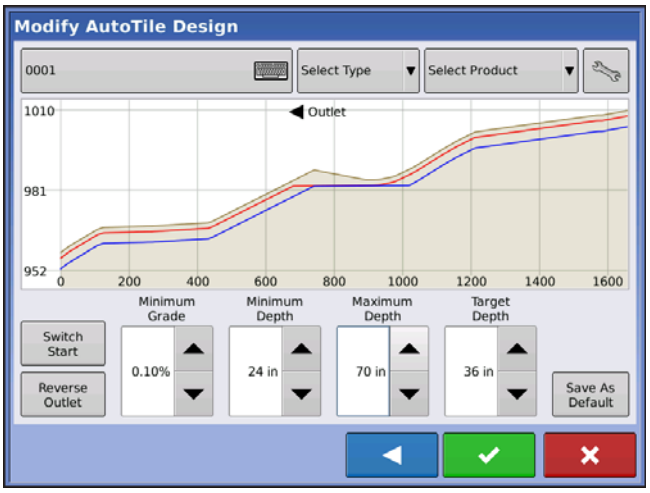
will be displayed.

The profiles displayed will enforce the “Minimum Grade”, “Minimum Depth” and “Maximum Depth” constraints that you select. The display will create a target profile that maintains Target Depth as much as possible. As you adjust these perimeters, the profile will update.

This can be useful in a number of ways. For example, to make the plow easier to pull, you might wish to decrease the “Maximum Depth” constraint as much as possible.

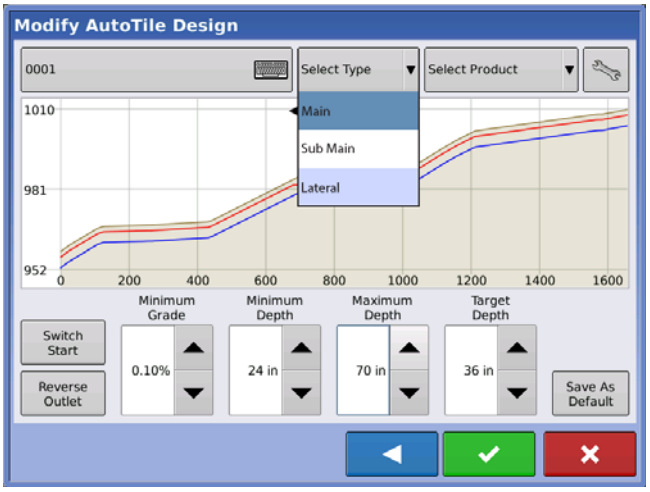


It is possible that no solution exists given the topography and constraints. Here, the system displays the message “2 in of interference at 742 ft” Given the topography and user constraints there is no profile that can be installed that meets all these constraints.



So we increase the “Maximum Depth” to 70 in. and we have a solution. The shallowest solution requires us to start at least 2.2' deep. We can start at this depth or any depth greater.

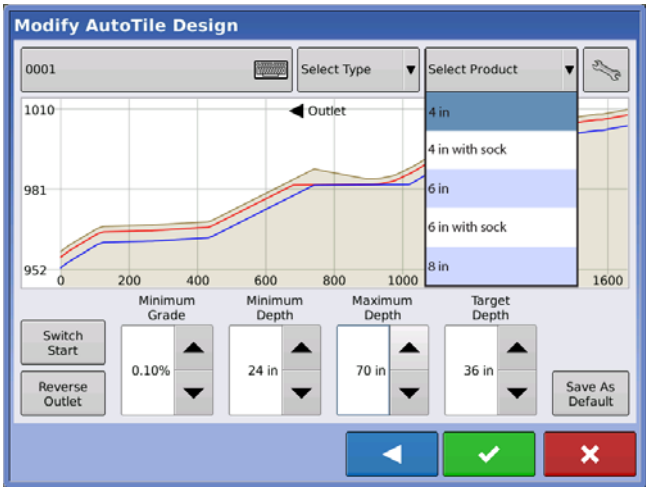
Press  to accept target profile.



TILE TYPE

Select Tile Type from drop-down menu.

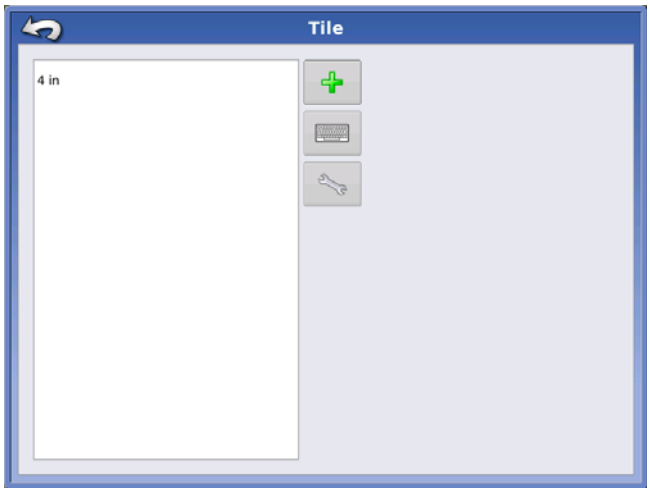
- Main
- Sub Main
- Lateral



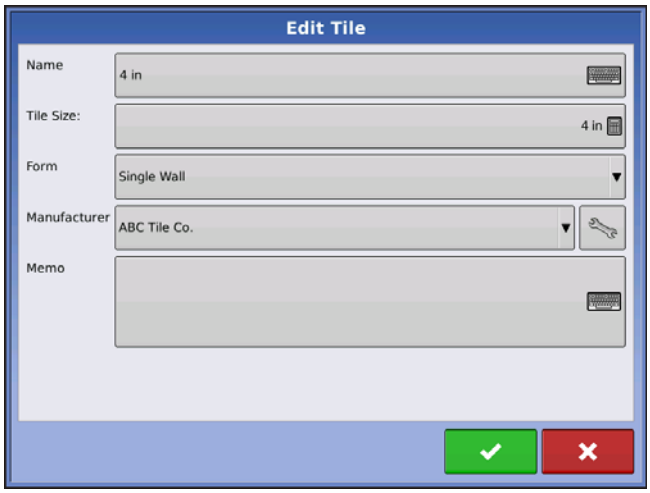
SELECT TILE PRODUCT

Select Product from drop-down menu or create a new product by pressing  and using the following steps.

CREATING TILE PRODUCTS

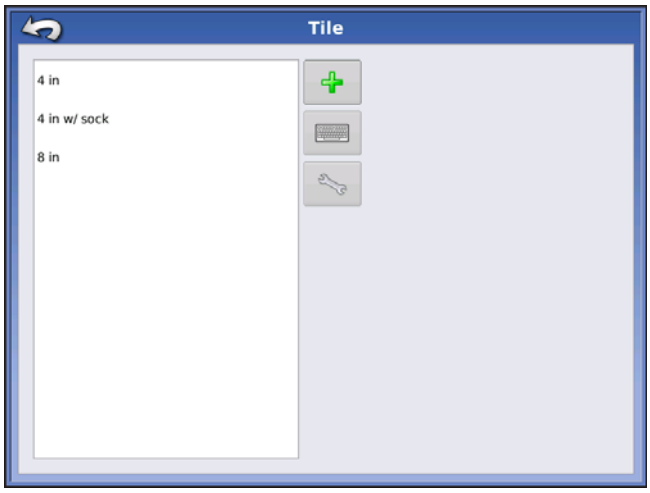


Press  on the AutoTile Design screen and then press  .



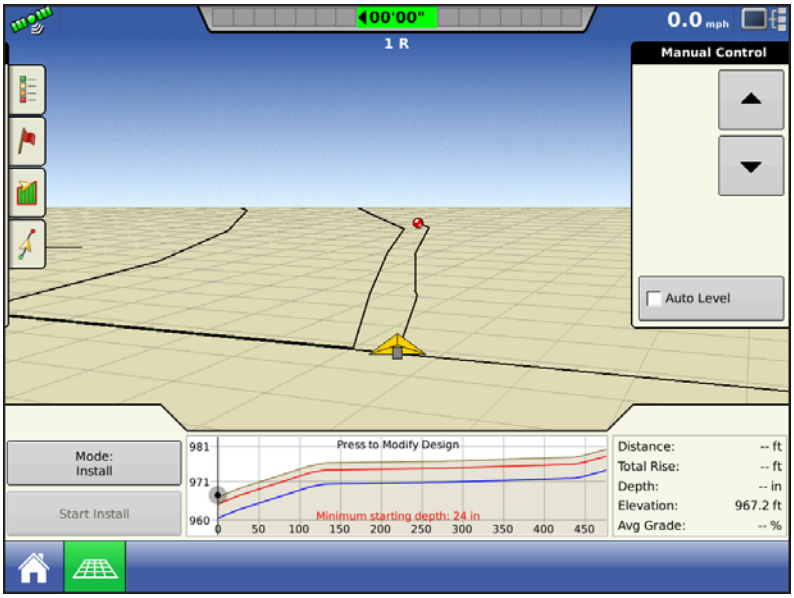
Enter a name, tile size, form, manufacturer. Any notes can be added in the memo section.

Press  when complete.



Once a tile has been created it can be selected to use in field operation.

START DEPTH MESSAGE

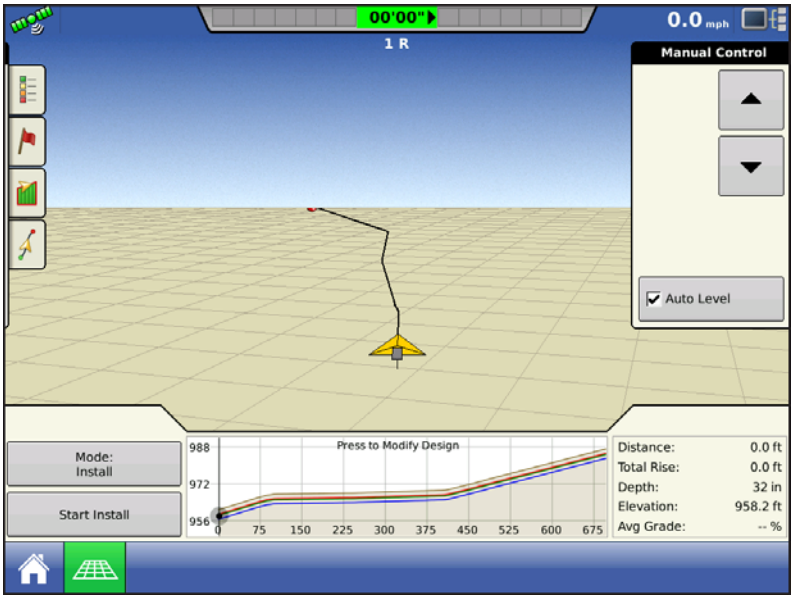


The plow may be lowered to any depth at or below the minimum starting depth, when installing from the outlet end, or uphill, as in most cases. Here the plow is still above the starting depth and a warning message, “Minimum starting depth: 24 in.” is given.

If your starting point for the install is in a location that is in front of your survey, the “Start Depth message” may be too shallow as it is reported based on the first point of the survey. For example - if the stat depth is 34" but you are 30 ft away from the beginning of the survey, you may have to lower to 35" to maintain your grade from the start of install to the start of the survey.

You must be within 65 ft (20 m) of the start of the survey to be allowed to start installation.

Start Install button will be grayed out until plow has been lower to proper depth.



Here we have lowered the plow to 32 in, which will allow us to install at our desired depth.

Auto Level: Automatically levels the cutting edge of the plow as it is lowered to its starting position (pitch plow).

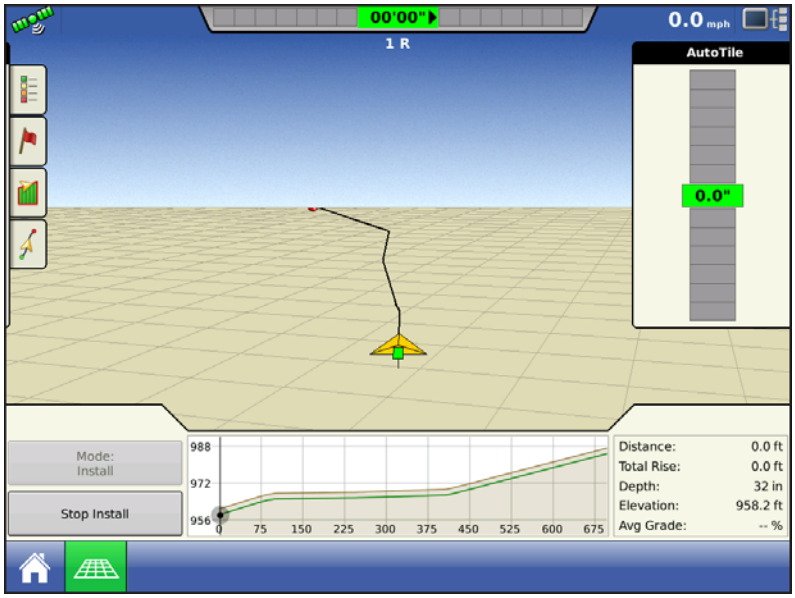
If the machine is not configured as a pitch plow, the “Up” and “Down” buttons are used to manually adjust the position of the machine's cutting edge.

Note that the plow depth indicated on the screen is relative to the elevation of the nearest surveyed point, which is not necessarily the same as the depth in the hole, since the surveyed path may have ended some distance from the starting hole.

When we have finished lowering the plow into the hole, we press the “Start Install” button and we are ready to start installing.

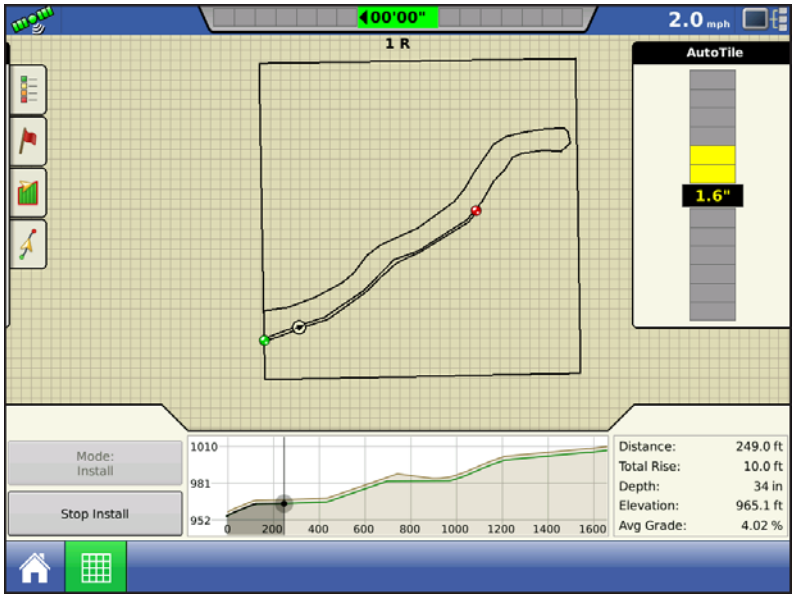
WARNING: When pushing AutoLevel make sure people are clear, as the machine will move.

AUTOTILE IN PROCESS

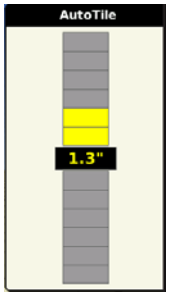


As installation progresses, the progress is marked by a shaded region under the target profile.

If the plow starts substantially below the target depth, the target profile will initially rise at an aggressive pitch to reach its target depth, and then level out.



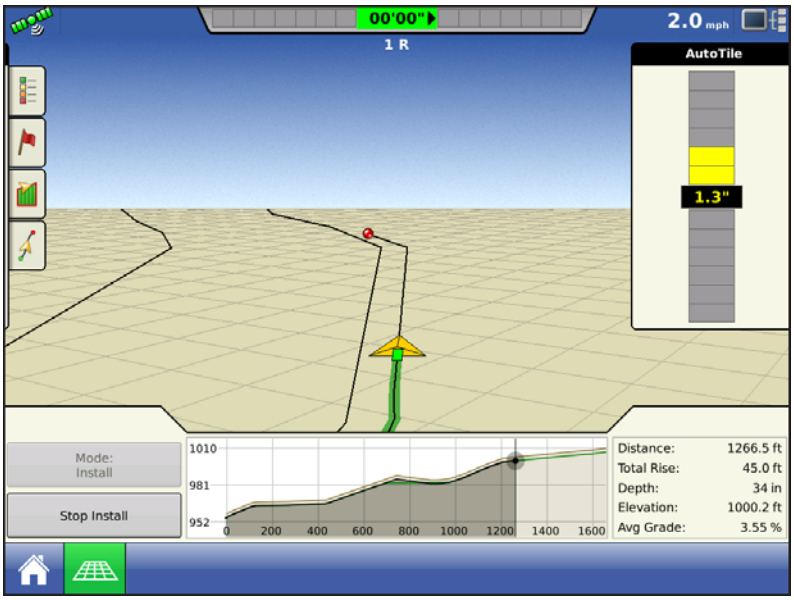
The overhead map continuously updates to show your current location in relation to the path.



On-grade Indication: Below the Target button, Intellislope displays how close the current installation point is to the target elevation.

This is similar to the arrows and on-grade signals displayed on laser masts. The distance off the target profile is indicated in inches shown as high or low. Otherwise “0.0”” is displayed on a background of green.

If this indication shows the plow running consistently too deep, or consistently too shallow, (and it is set up as a pitch plow) then the Pitch Zero needs to be adjusted on the Machine Setup screen. Please see the section “Ongoing Pitch Zero Adjustment” for detailed instructions.



We reach the end of the survey path. We press the “Stop Install” button to finish the run and save the installation log.

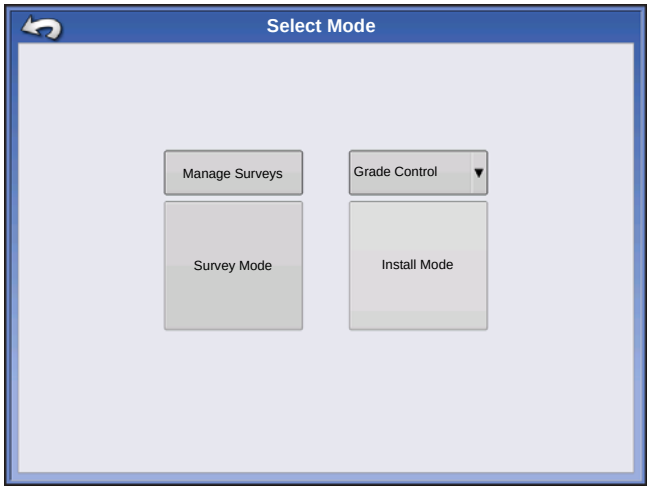
In order to extract the plow, we use the “Up” button to manually nose the plow up while pulling ahead to bring the plow out of the ground.

Never try to pick up the plow using the three-point hitch, or the wheel lift frame for a pull type, when it is in the ground. Always pitch the plow up and pull forward.

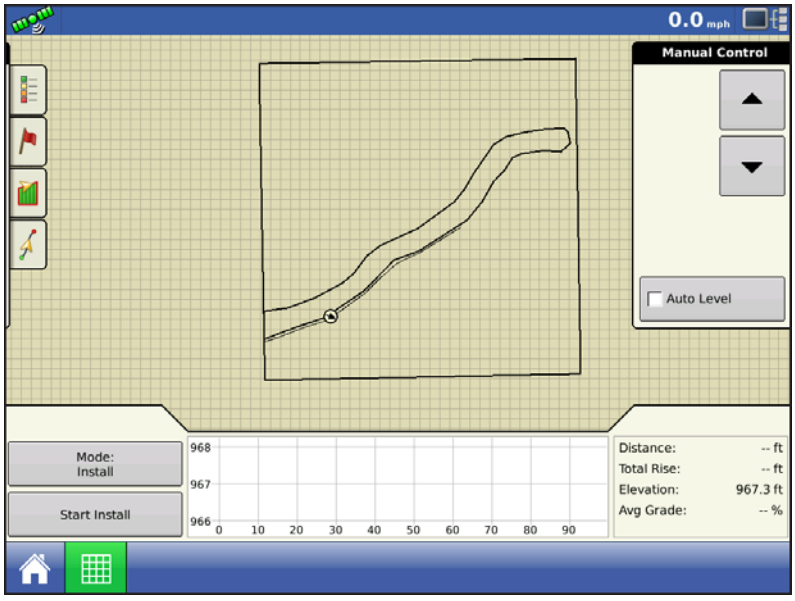
ABOUT GRADE CONTROL

If you have tiled with a laser, Grade Control should be natural. You select grade and grade break the same as with a laser. Grade Control is very similar in operation. The key advantage is that all adjustments are made in the cab instead of at the tripod.

RUNNING GRADE CONTROL



Press the Mode button on the map screen and then select Grade Control and Install on the Select Mode screen.

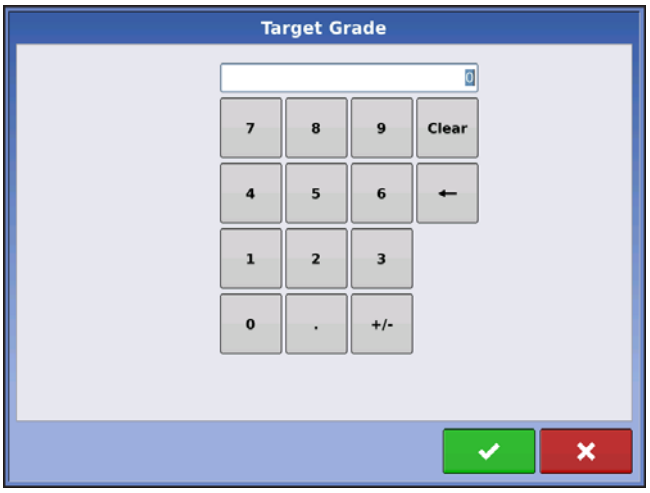


"Up" and "Down" buttons are used to raise or lower the cutting edge of the machine before engaging automatic control.

Auto Level: Automatically levels the cutting edge of the plow as it is lowered to its starting position (pitch plow).

Start Install button: Once the cutting edge of the machine has been lowered to its starting position, pressing this button will cause Intellislope to control the Target Grade and Grade Break as the vehicle progresses forward.

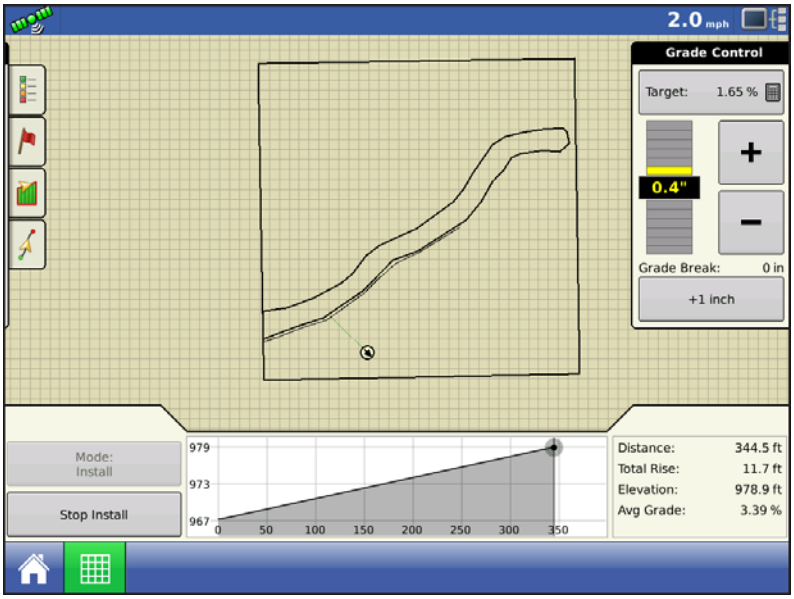
WARNING: When pushing autolevel make sure people are clear, as the machine will move.



After pushing Start Install, a dialog box will appear to set the starting Target Grade.

Press ✓ to accept Target Grade.

Once grade is accepted, the machine will automatically adjust as it is driven forward



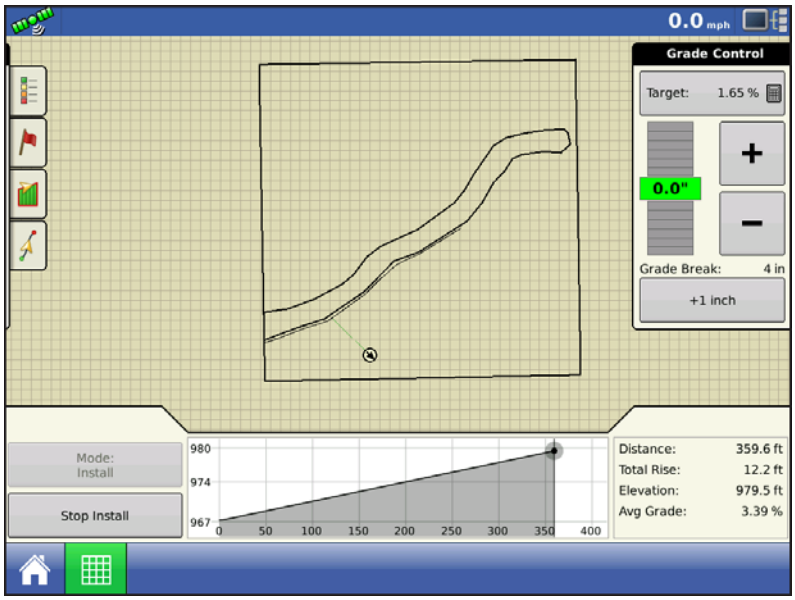
Target: Use button to select the grade you desire. You can change this setting on the fly, and Intellislope will follow the new grade starting at the point when the Target grade changed.

using the + and - button, or use the target button to use the keypad to enter the desired value

If you are installing uphill, you will need to set the target grade to a positive number, if you are driving downhill, use a negative value.

(The laser equivalent to changing this setting would be: stop the tractor, relocate the laser to the new location, adjust it to the new grade, and resume installing.)

Grade Break: This gives you the ability to add a vertical offset to the tile profile which makes the plow run shallower. Use this if you are too deep. The current Target Grade is otherwise maintained. An example of a common use for this is if you had a flat run at 0.1% grade, went up a hill, and then flattened out again. You could leave the grade at 0.1% and then grade break up the hill until you get to where it flattens out.



On-grade Indication: Below the Target button, Intellislope displays how close the current installation point is to the target elevation.

This is similar to the arrows and on-grade signals displayed on laser masts. The distance off the target profile is indicated in inches shown as high or low. Otherwise “0.0”” is displayed on a background of green.

If this indication shows the plow running consistently too deep, or consistently too shallow, (and it is set up as a pitch plow) then the Pitch Zero needs to be adjusted on the Machine Setup screen. Please see the section “Ongoing Pitch Zero Adjustment” for detailed instructions.

If you are setup as a Non pitch plow, and you are running too high, you need to adjust the GPS gain as a lower value, if you are running too low, you need to adjust to a higher value.

Note that even when the Pitch Zero is well adjusted, the on-grade indicator may reflect deviations from “on grade”, which is normal and expected. The plow tends to “round off” sharp corners in the target profile. This will cause either high or low indications as it does so. When operating in Grade Control mode, adjusting the grade break raises the target profile, and will initially cause the on-grade indicator to indicate an error equal to the grade break. As the control system responds to the new target, the plow approaches the new target profile and the indicated error decreases.

So dialing in a 4 inch grade break will initially cause the on-grade indicator to indicate a 4 inch error. As the system corrects, this will diminish towards zero and then on grade when the plow gets to the new target profile. There is also a certain amount of deviation within a channel about the target profile that is typical as the control system “hunts” for the target and responds to external disturbances such as driving over rough terrain. The operator should remain aware of the on-grade indicator, and if grade error starts becoming abnormally large or erratic, he should look for any of number of pitfalls which can be giving rise to the problem, described in *“Lessons Learned and Pitfalls to Avoid” on page 18*.

Also, noise or error in the GPS elevation, noise in the pitch signal, rocks, soft spots, some degree of control system hunting and overshoot, among other things, can cause brief deviations from on grade. Only when the plow is consistently high or low does the Pitch Zero need adjustment.

Press Stop Install button to end installation.

In order to extract the plow, we use the “Up” button to manually nose the plow up while pulling ahead to bring the plow out of the ground.

Never try to pick up the plow using the three-point hitch, or the wheel lift frame for a pull type, when it is in the ground. Always pitch the plow up and pull forward.

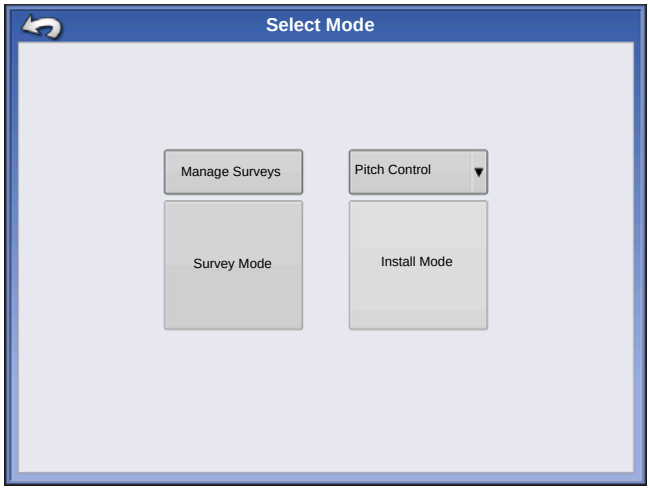
ABOUT PITCH CONTROL

Pitch Control mode is only applicable for pitch plows. Other types of machinery should not attempt to use this mode.

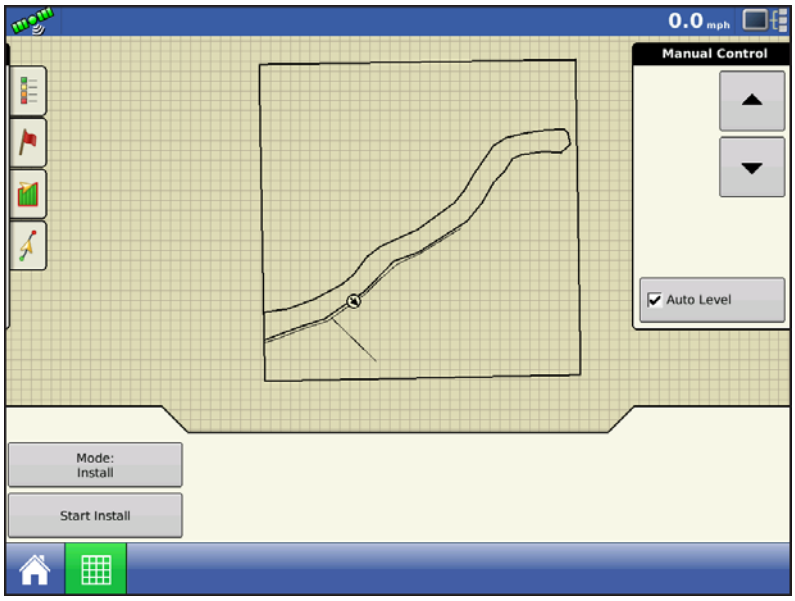
Pitch Control is a fall-back mode of operation which may be used when GPS is unavailable. Keep in mind that:

- The Pitch Zero must be calibrated and correctly adjusted.
- Always prefer Grade Control or AutoTile mode when GPS is available. Pitch Control mode does not use GPS. It merely holds the plow shank at a specified pitch.
- Do not depend on the installed grade matching the pitch with better than 0.5% accuracy.
- Entering the incorrect pitch with a pull type plow may result in the plow emerging from the ground, and be unsteady, possibly resulting in the plow tipping on its side.

RUNNING PITCH CONTROL



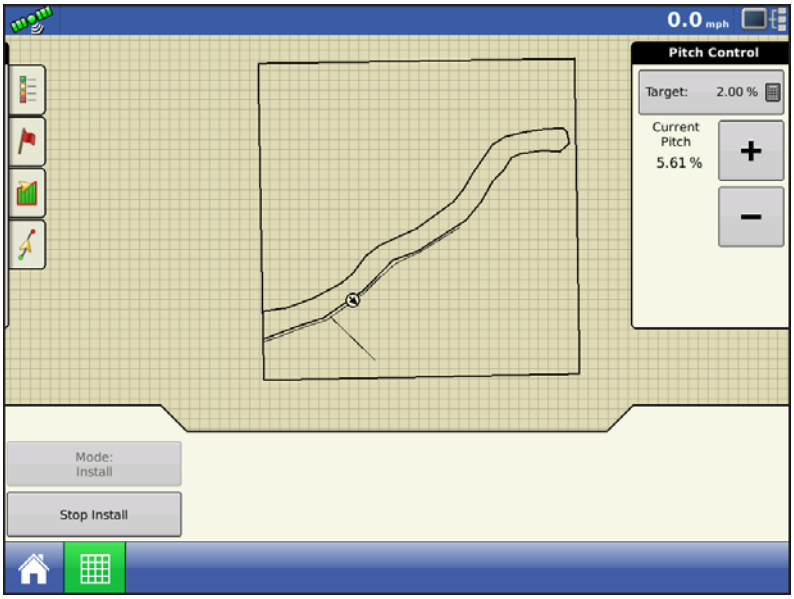
Press the Mode button on the map screen and then select Pitch Control and Install on the Select Mode screen.



Press Start Install button to begin Pitch Control.

You will be given a dialog to enter the desired starting pitch. When you accept this starting value, the machine will respond to the display, so ensure by-standards are not in the way.

The “Up” and “Down” buttons will be visible and can be used to move the cylinders prior to starting install. Use AutoLevel to level the plow at the start of the run. If the implement is in the ground, do not use the AutoLevel.



Use + and - buttons to raise and lower pitch or use Target button to enter a numeric value for pitch.

The installation grade will approximate the plow shank's pitch.

The module slope sensor will match to the provided Target Pitch.

Press Stop Install button to end Pitch Control.

In order to extract the plow, we use the “Up” button to manually nose the plow up while pulling ahead to bring the plow out of the ground.

Never try to pick up the plow using the three-point hitch, or the wheel lift frame for a pull type, when it is in the ground. Always pitch the plow up and pull forward.

Index