

Why and How to Calibrate Your Yield Monitor

Introduction

Increasing farm and field sizes has made keeping track of site specific production information, at a resolution sufficient to make measurable management decisions, increasingly difficult for most farmers. This situation has given rise to the development of equipment that can measure crop yields on a minute scale. These yield monitoring systems are made up of several sensors that work in concert to estimate moisture, weight or volume and area. In order for the yield monitor to be accurate these sensors must be calibrated. This document will summarize the techniques developed and implemented over the past ten years to produce high quality production data. Most of these methods are adaptations of the manufacturer's suggested procedures to accurately calibrate the sensors their systems employ.

Generally, most systems rely on four sensors that the user must calibrate. These four sensors are: header position, ground speed, moisture and grain flow.

Header Position Sensors

The header position sensor is used to start and stop logging of data as the combine head is raised or lowered. Logging is started when the operator lowers the head below the calibrated point signifying crop beginning to flow into the header. Conversely, logging is suspended when the operator raises the head above the calibrated point signifying crop flow has ended.

Proper calibration of the header sensor is important as it keeps the monitor from over or under estimating the number of acres covered within each field. Calibration of this sensor is usually completed by placing the header at a point where the start/stop should occur and recording the value using the monitor's display.

Consider changing this setting when there are significant changes in harvesting conditions that may cause changes in the speeds used to turn on headlands. Also, consider adjusting the setting when switching operators. Each person tends to operate the combine at their own pace causing the head to be raised or lower differently.

Ground Speed Sensors

Ground speed sensors are used to accurately estimate combine speed. The speed information is converted to a distance traveled per unit time. The distance value is then multiplied by the header width resulting in the area covered per unit time (usually 1 second). The area covered value is the denominator in the estimate of yield in bushels per acre; therefore its accuracy is paramount.

Most yield monitor systems give you the option to choose how your ground speed estimates are made. Generally you can chose between wheel/track (pulse counters), radar (ultrasonic) and GPS. Each has its own advantages and disadvantages (See Page 37 of The Precision-Farming Guide For Agriculturist, John Deere Publishing). GPS is probably the easiest setting to choose as no calibration is required for this system directly. However, if you are using a one hertz receiver there will be a lag in the system's



measurement of ground speed. The lag effects the accuracy of the data during the change of directions on the headlands or as speed fluctuates for in-field obstacles.

If GPS is chosen for the primary speed sensor generally the pulse system is used as a backup system in case something should interrupt the GPS signal. As a result, calibrating the ground speed sensor each year is advisable.

Speed Sensor Calibration

Proper calibration of these systems requires measuring a known distance, then driving that distance with the monitor in calibration mode. Refer to your manual for specific steps.

Things to keep in mind as you prepare for calibration are:

Are your tires properly inflated? Does the weight of the header make a significant difference in tire diameter that should be accounted for by having the header in place during calibration? Are the ground conditions similar to the field conditions to account for tire slip? There are some questions about having the hopper partially filled with grain to account for the change in diameter of the tires this may cause. To my knowledge no manual suggests completing speed calibrations with grain in the tank.

Moisture Sensors

Most moisture sensors are capacitance style sensors. They use electrically charged plates to measure the electrical properties of the grain as it flows past. These readings are related to the moisture content and temperature of the grain. Temperature is important because the ability of the grain to conduct electricity changes as it increases or decreases.

Moisture readings are used to determine the shrink factor necessary to account for the weight of water in wet grain. The shrink calculations used by yield monitors are generally **NOT** the same as the calculations used by grain elevators. As a result when you compare your yield monitor's estimates to the elevators results you should compare wet weight to wet weight. Confusion often results when users of yield monitors compare dry bushel values from these two sources.

If you have an Ag Leader[®] yield monitor you will find in the reference section of your manual the calculations used for the conversions.

Moisture Sensor Calibration

(TEMPERATURE)

In order for your moisture sensor to be accurate you must first calibrate temperature. Depending on the type of yield monitor you have you may or may not have to calibrate temperature.

If calibration is possible it is recommended that you perform the calibration after the combine has been in a consistent temperature for an extended period of time. Morning is generally best. Beware of calibrating your sensor after it has been in the sun as uneven heating can occur.



Use an accurate temperature reading from a reliable thermometer that is located in the same area as the moisture sensor. On Ag Leader[®] yield monitors you will find the temperature sensor on the moisture sensor itself. If you have a bypass unit you should remove the sensor from the housing or place the reference thermometer into the housing.

After you have calibrated your temperature sensor you should not change it; especially after you calibrated the moisture sensor, as the two readings are dependent upon one another.

(MOISTURE)

When calibrating moisture it is especially important to use a RELIABLE reference moisture sensor. Generally, it is best to use the same sensor you are going to use as a reference throughout the season. If you are going to compare your monitor readings to an elevator's estimates, then you should take your calibration samples to the elevator for analysis.

When calibrating the moisture sensor, harvest approximately a hopper load of grain. Pick an area of a field expected to have relatively consistent moisture content. Watch the instantaneous moisture readings as you harvest. If you see fluctuations of greater than 3 to 5 percent consider redoing the calibration in another area with less variation. If you have an Ag Leader[®] yield monitor make sure you have created a new load/region for this calibration load. If you have a GREENSTAR[®] try using the first hopper load in a field.

For farms operating more than one combine in a field at the same time, proper calibration of each system's moisture is **very** important. To properly calibrate each, have one combine follow the other and harvest grain in similar areas during the calibration process.

While emptying the hopper use a bucket and catch several (20-30) handful-sized samples as the grain exits the unloading auger. Perform this sampling throughout the emptying process. This usually results in a 5-gallon bucket being about half full. Thoroughly mix the grain in the bucket and perform at least five moisture readings using the reference moisture tester. Again be wary of readings that exhibit variability of greater than 3 to 5 percent. Consider redoing the grain collection if this happens. Average the five readings and plug this value into the yield monitor as the calibrated value.

Throughout the season, beware of changing your monitor's calibration factor based on the slips you get back from the elevator. When the elevator samples a semi-truck they may take one or two probes of the whole load while your yield monitor has taken a representative sample from the entire load. Only consider changing the calibration if the monitor is consistently reading significantly the same amount for many loads. To properly recalibrate, redo the process outlined above.

Grain Flow Sensors

Of all the sensors that are involved in yield monitoring systems, none are of greater importance to the overall accuracy of the system than the flow sensor. In spite of its importance, there is a significant lack of understanding of how it operates by most of those who employ it.



This sensor, located at the top of the clean grain elevator, is used to measure the amount of material coming through the machine at any given time. The pressure exerted on the flow sensor is converted to an electrical signal in non-linear proportion. This means that if one pound of force on the sensor is the result of ten bushels of grain flowing through the machine, two pounds of force does not equal twenty bushels. It may be twenty-five or some other amount. The purpose of calibrating this sensor is to mathematically define the relationship between the electrical outputs of the sensor to pounds of grain coming through the machine. This is why it is very important to understand what force you are exerting on the sensor during calibration and properly plan to *teach* the monitor with correct forces or flows. Flow, short for grain flow, is another term that can be used interchangeably with force.

Flow of material through the combine is proportional to two variable factors, combine speed and crop yield. If there is an increase in one or both of the two components, the overall flow increases. A decrease in one or both of the two components results in a reduced flow. This is what is happening continuously as you harvest your crops. As the combine travels into a low yielding area the grain flow decreases. You may then speed up which in turn keeps your flow more consistent. In high yielding areas you may slow down and flow again moderates based on the changes you make. Generally, operators of

Changes in Flow Resulting from Variances in Yield or Ground Speed

	Reduce Speed	Maintain Speed	Increase Speed
Reduce Yield	Significant Decrease	Decrease	Little or No Change
Maintain Yield	Decrease	Unchanged	Increase
Increase Yield	Little or No Change	Increase	Significant Increase

combines tend to make these changes to keep the threshing system operating with maximum efficiency. However, they are not always diligent with speed changes so there are bound to be instances where variation in flow is inevitable. Proper calibration will help minimize the effects these changes have on the accuracy of the yield data.

During calibration you are trying to teach the monitor how to properly react to these changes in flow. With an Ag Leader[®] yield monitor you have the opportunity to use several calibration loads, each with a unique flow rate. The varying flow rates of each calibration load should properly represent the flows you expect to encounter during harvest. You should prepare to drive slowly enough to represent the areas of low yield and fast enough to represent the areas of high yield given your *normal* harvest speed.

The GREENSTAR[®] employs two calibration loads. The first should be run with a high flow rate and a second run at a reduced flow rate. When executing the higher flow calibration load, you should plan to achieve the same flow rate that you targeted with your setup of the threshing system of your combine. This setting is usually approximately equal to eighty percent of the machine's overall threshing capacity. The low flow rate load, called "low flow compensation", should be run to achieve a flow that is between fifty and sixty-six percent of the high flow load.



You should plan to calibrate your yield monitor at least once per season per crop. Changes in yield conditions may also warrant development of new calibrations within a season. If this situation arises, those who use Ag Leader® systems should change grain types (Corn2 or Soybeans2) and recalibrate moisture and grain flows. For those with GREENSTAR® notes should be kept as to when calibration changes were made and for what reasons. This will allow the users to go back in the desktop software and apply proper calibration corrections to each field after the harvest is through. Whether you have an Ag Leader® or GREENSTAR® system, proper planning is needed prior to calibration to achieve maximum accuracy.

Grain Flow Sensor Calibration

Before you begin grain flow calibration, be sure that you have properly calibrated the yield monitor system for vibration. GREENSTAR® systems use a fixed vibration factor based on the combine model and header you choose during setup. The Ag Leader® yield monitors require you to run a simple calibration process. Refer to your owner's manual for more detail.

Simplified Technology Services has developed calibration planning sheets that The Iowa Soybean Association has licensed to help properly calibrate yield monitoring systems. These sheets are available at www.isafarmnet.com. The documents are designed to help you decide what flows to use for each of your calibration loads.

For Ag Leader® yield monitors you are going to run five separate calibration loads each with a unique and consistent speed. These loads should be run in a consistent yielding area of a field. The load size for each should be between 3,000 to 8,000 pounds. Care should be taken to keep each load the same size. Do NOT use semi-load sized loads in your calibration!

For the GREENSTAR® yield monitor you should run one calibration load of about 5,000 to 10,000 pounds in a consistent yielding area of a field. The speed you drive should result in a flow that is approximately equal to eighty percent of your machine's threshing capacity. Once you have completed the higher flow calibration follow your manual's instruction on how to perform the low flow compensation. You will find that you need to run another 5,000 to 10,000 pound load in the same area of the field, running a speed somewhere between fifty and sixty-six percent of the speed you ran for the high flow load.

When using either system you should be consistent with your speed within each load and use reliable scales to measure the actual weights.

Conclusions

Yield monitors are often seen as the logical entry point for someone who wants to become involved in Precision Agriculture. This is usually due to their ability to assess the variability within each field on a minute scale. However, without accurately calibrating the monitor, the data used for assessment will be incorrect. If calibration is accounted for, the variability in each field is what business savvy growers will manage in order to maximize profit. The true value of any Precision Agricultural endeavor rests with what you do with accurate data.

