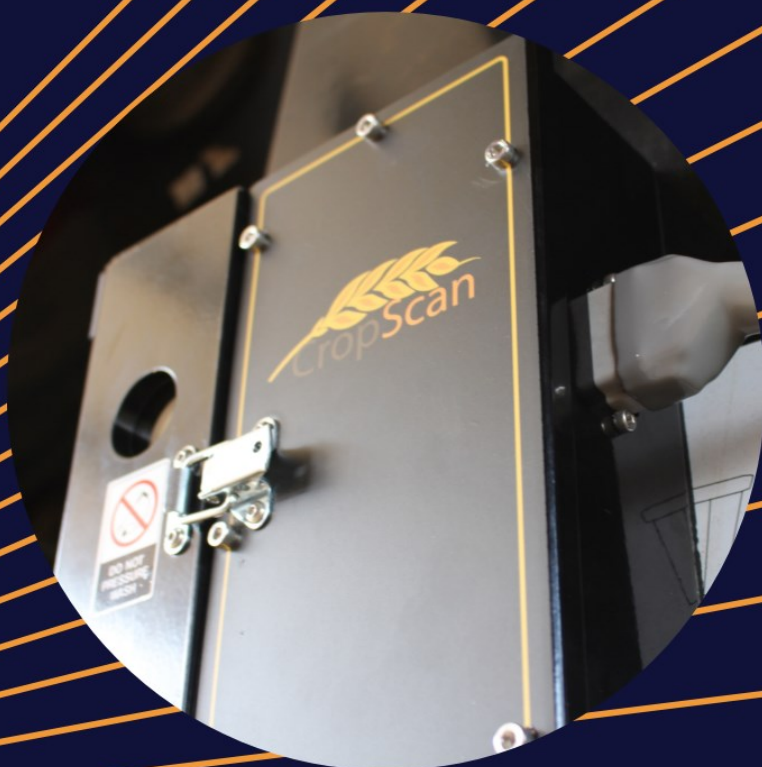




4000VT

ISOBUS Integration



ON COMBINE GRAIN ANALYZER

INSTALLATION MANUAL
CASE IH 50 SERIES COMBINES

www.cropscanag.com

CropScan 4000VT On Combine Grain Analyzer: Installation Guide

REVISION HISTORY

Initial Prototype	November	2022
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1.0 Product Description

1.1 Overview

This chapter gives an overview and description of the CropScan 4000VT On Combine Grain Analyzer's features:

- Virtual Terminal
- N-GAUGE App
- What to expect from a NIR Analyzer
- CropScan 4000VT Components

1.2 Description

The CropScan 4000VT On Combine Grain Analyzer has been developed and tested world wide for use in measuring grain Protein, Oil, Moisture, Starch and Fiber using NIR technology in a combine harvester.

The CropScan 4000VT comprises a Sampling Head, a Fibre Optic cable and an NIR Spectrometer. The Sample Head is mounted onto the clean grain elevator where an inlet hole is cut into the up side and an outlet hole on the down side of the elevator. As grain travels up the clean grain elevator a 500ml sub sample is collected. The NIR scan is collected for Protein, Moisture, Oil, Starch and Fiber every 3-4 seconds.

The NIR Spectrometer reads the Combine CANBUS messages for Crop Type, Grower Farm Field and Rotor Engage status to start the operation to begin collecting and present data on the combine monitor.

A steel flap and outlet motor controls the flow of the grain, when the remote sampling chamber is full the built in Sample Sensor (capacitive sensor) will be triggered and the sample scan will be analyzed.

While the grain is trapped, light passes through the sample of grain and the transmitted light is collected through the Fibre Optic cable to the NIR Spectrometer. The NIR Spectrometer separates the light into the NIR spectrum and CropScan software applies the calibration models for Protein, Oil and Moisture and displays the data in the CropScan Virtual Terminal run screens. Data is synced very Auger cycle or when the rotor is dis engaged to the CropScanAg Cloud for viewing in the N-GAUGE App software.

After the NIR scan is computed, the outlet flap opens and the grain drops out and returns to the downside of the elevator and a new sample is collected and the next NIR scan is collected.

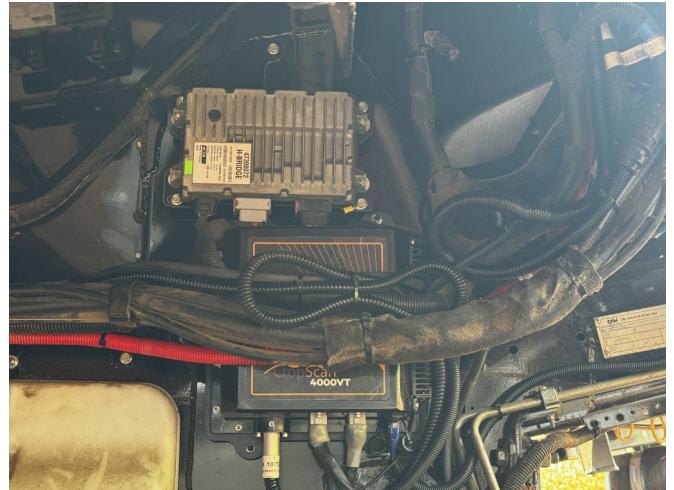


Figure 1.1 CropScan 4000VT On Combine Analyzer Spectrometer.



Figure 1.2 CropScan 4000VT On Combine Sample Head mounted to the Clean Grain Elevator.

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1.3 Technology

The CropScan 4000VT is a full spectrum NIR Spectrophotometer. The CropScan 4000VT uses a linear diode array detector and a spectrograph to provide the NIR transmittance spectrum from 720-1100 nm. Within this region of the electromagnetic spectrum, compounds such as Protein (1020nm), Moisture (970nm), Oil, (910nm) sugars (830nm), and other organic compounds absorb infrared energy. By measuring the intensity of the infrared energy that passes through a sample of grain, Protein, Oil and Moisture can be measured.

The NIR Spectrometer is based on a flat field spectrograph and a silicon photodiode array detector as shown in figure 1-3.

The advantage of the diode array spectrometer lies in that there are no moving parts. The spectrometer is robust enough to work in the harsh environment of a combine harvester, compact enough and powerful enough to provide data as good, if not better, than a bench top NIR Analyzer used in a laboratory. The Fibre Optic Cable allows the NIR spectra to be collected remotely thus removing the spectrometer from the Sampling Head.

1.4 Virtual Terminal

The CropScan Spectrometer controls and operates the system. The CropScan 4000VT Virtual Terminal displays the Protein, Moisture and Oil data for each sample and the results are presented to the combine operator in the Field Data and Tank Data run screens. The VT allows users to configure, calibrate, transfer data and run diagnostic functions from the combine monitor.

The CropScan Spectrometer includes a 64GB solid state hard drive for storing large amounts of field acquired data. The CropScan Spectrometer has an internal LTE Module and pre installed SIM Card to provide year round data connectivity. This provides data to be sent and pulled down from the CropScanAG Cloud. Data can be viewed in the N-GAUGE Harvest Manager and Nutrient Manager App's and Software and Calibration updates can be downloaded.

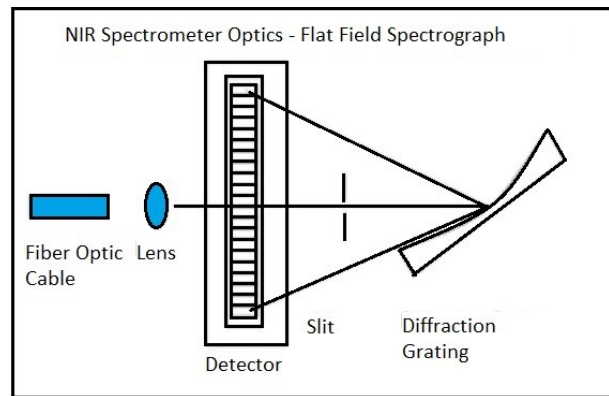


Figure 1.3 Schematic of the NIR Spectrometer Optics Layout.



Figure 1.4 Pro 700 CropScan VT—Setup



Figure 1.5 Pro 700 CropScan VT—Field Data



Figure 1.6 Pro 700 CropScan VT—Tank Data

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1.5 N-GAUGE Description

N-GAUGE provides real-time tracking of your grain inventory through to nutrient inputs. N-GAUGE delivers a dynamic platform to view, manage, and optimize your Grain Logistics and Variable Rate input operations. View and share your harvest data to your team, advisors and agronomists. The N-GAUGE has 2 levels of subscription, The Harvest Manager is included for 5 years with the 4000VT and Nutrient Manager is an optional subscription for advanced variable rate features.

1.6 N-GAUGE Harvest Manager (5 Year Subscription included)

The N-GAUGE Harvest Manager is included in all CropScan 4000VT On Combine Grain Analyzer kits, to advance your harvest data interaction, users can view tank by tank load data for the Protein, Moisture, Oil and the volume of each tank per field in the Grain Logistics Module. The user can create an On Farm virtual storage site to record and track the in loading and outloading of grain parcels to the site storage bins or silo's. Grain delivery contacts can be created and log the delivered grain to the grain buyer. The agronomic field data for protein, moisture oil and yield layers are viewable in the Nutrient Manager module by selecting a field boundary and using the layer picker to select a layer type to view and access the field maps.

1.7 N-GAUGE Nutrient Manager (Optional Subscription)

The N-GAUGE Nutrient Manager is an optional subscription to enhance the functionality of the Harvest Manager. When the Nutrient Manager license is activated additional features are available from the Nutrient Manager Module to enable users to create and send Rx prescriptions from the N-GAUGE App to the users Machinery Platform.

View and validate high density field maps with N-GAUGE Nutrient Manager. Generate insightful field performance maps and reports. Design soil testing locations with GPS waypoints. Create and export machine-ready prescriptions from your smart phone or tablet to your AFS/PLM Connect or John Deere Operations Centre Platform.

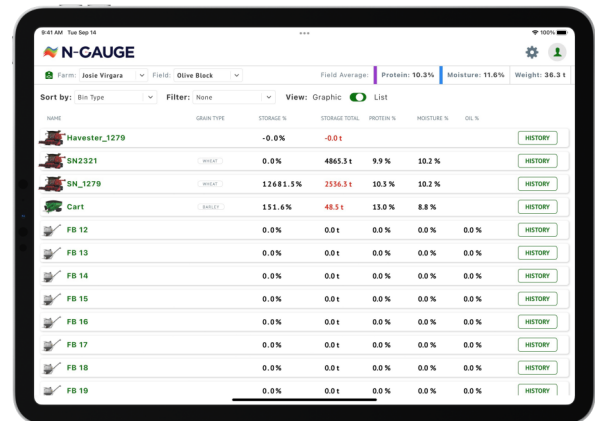


Figure 1.7 CropScanAg N-GAUGE Harvest Manager App

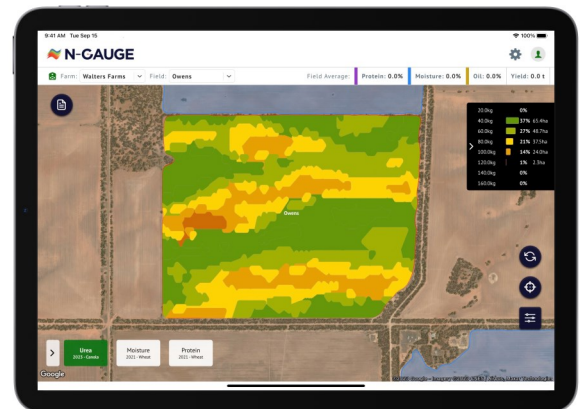


Figure 1.8 CropScanAg N-GAUGE Harvest Manager App

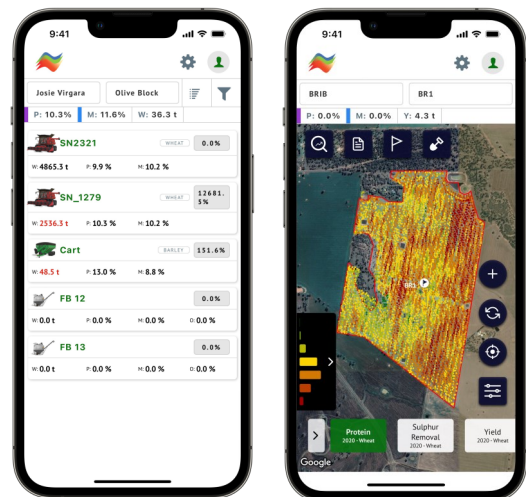


Figure 1.9 CropScanAg N-AUGE Harvest Manager App

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1.8 What to expect from a NIR Analyzer

NIR Analyzers are becoming more popular as on farm tools to measure the Protein, Moisture and Oil in wheat, barley and canola. So what should you expect from a NIR Analyzer?

Accuracy: Accuracy is defined as the difference between a reference method and the NIR analyzer. Typically 50 samples of grain are analyzed in duplicate by the reference method and then using the NIR analyzer. The Standard Deviation of Differences between the reference method and the NIR analyzer is referred to as the Standard Error of Prediction (SEP). The following values represent 95% confidence levels or 2 x SEP.

Wheat: Protein +/- 0.5%
Moisture +/- 0.4%

Barley: Protein +/- 0.6%
Moisture +/- 0.5%

Canola: Oil +/- 1.0%
Moisture +/- 0.5%

This means that for 95 samples out 100, the difference between the reference method and the NIR Analyzer will lie between these figures.

Precision: Precision is defined as the ability of an analyzer to measure the same sample twice. Typically 10 samples of grain are analyzed in duplicate on the NIR analyzer. The Standard Deviation of the differences between the duplicate readings is referred to the Standard Deviation of Differences (SDD). The following values represent 95% confidence levels or 2 x SDD.

Wheat: Protein +/- 0.3%
Moisture +/- 0.2%

Barley: Protein +/- 0.3%
Moisture +/- 0.2%

Canola: Oil +/- 0.5%
Moisture +/- 0.4%

These data are intended as guides only. Under laboratory conditions, using clean grain samples that are of good quality, then you should be able to achieve similar results. However temperature variations of the sample and the instrument have big effects on SEP and SDD. Weather damaged grain or dirty grain will give rise to larger errors. Poor mixing of a sample can result in excessive errors.

It should be noted that analyzing the same sample 5 or 10 times will cause the sample temperature to rise and the NIR predicted results will change dramatically. Precision tests should be performed on at least 3 clean samples in duplicate only.

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1.9 Components

The CropScan 4000VT On Combine Analyzer is provided with the following equipment:

1. NIR Spectrometer
2. Sample Head
3. Fibre Optic Cable
4. Sample Head Cable
5. Spectrometer Cable
6. Sample Head Outlet Port
7. 10 Inch Tablet Holders
8. 4 inch Ram Arm
9. Tablet Bracket
10. Accessories Kit
11. Instruction Manual

A packing list is included in the parts kit. Please tick off the items after opening the box. Any shortages should be referred to the CropScan technical support team member via: support@nextinstruments.net

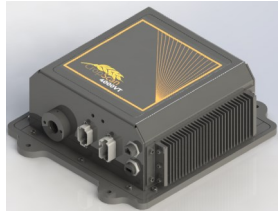








	
NIR Spectrometer P/N C4H0302	Sample Head, P/N C4H0301
	
Fibre Optic Cable P/N C3H0370	Sample Head Cables P/N C4H0401
	
2.0m Spectrometer Cable P/N C4H402	Sample Head Outlet Port P/N C3H0231
	
10 Inch RAM Tablet Holder P/N C4H0120	RAM Arm 4 Inch P/NC3H0093
	
Tablet Bracket with Ball P/N C3H0273	
	
Accessory kit P/N C4H0601	CaseIH User Manual PN C4H0560

Figure 1.10 CropScan 4000VT Parts.

CropScan 4000VT On Combine Grain Analyzer: Installation Guide

2.0 Installation

Unpack the CropScan 4000VT packing box and check off all the components against the provided packing list.

See Appendix 3.3 for installation drawings showing position and all dimensions.

Warning: Turn the combine harvester isolation switch to the OFF position before attempting installation steps.

2.1 Sample Head Installation

The Sample Head is fitted onto the outboard side of the clean grain elevator and positioned so that it crosses the up and down side of the elevator. The Sample Head inlet hole is on the left side of the elevator divider and the outlet hole is on the right side of the elevator divider. Check that the Sample Head positioning does not interfere with any doors or latches. To install the Sample Head, follow the instructions below:

- 1) Position and hold the supplied sample head alloy template so that the template aligns and sits on the aft edge and on top of the door bracket structure as shown in figure 2.1. Refer to the dimensions provided in Appendix 3.3 for a full size drawing.
- 2) Mark out and drill the 4 sample head attach holes using a 6mm drill bit.
- 3) Use a marker pen to mark out the 4 outer edges of the Inlet and Outlet holes for cutting guidance.
- 4) Remove the Sample Head template.
- 5) Drill the 4 corners of the Inlet and Outlet holes using a 6mm drill bit.
- 6) Cut the Inlet and Outlet holes out using an angle grinder with a thin cutting blade. File the edges so they are flush with the marked lines and deburr all holes and edges.
- 7) Insert the M6 Press Stud so that the thread is facing outwards. Install the supplied M6 Plain Nut and tighten so the Press Stud is imbedded into the Stainless Steel skin of the elevator.
- 8) Remove the M6 Plain Nut before fitting the Sample Head .

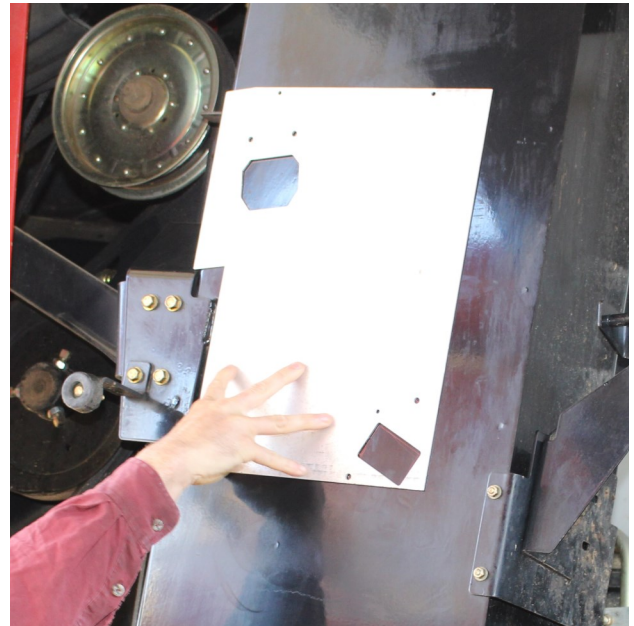


Figure 2.1. Sample Head installation template.

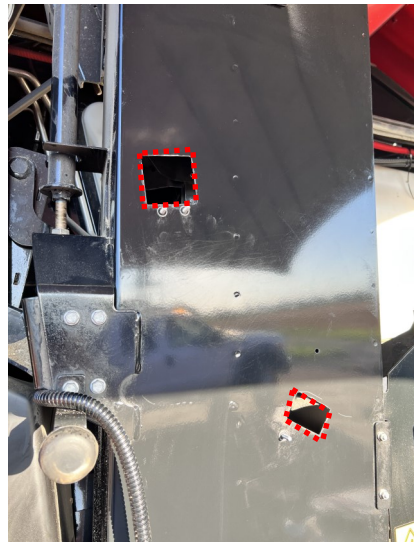


Figure 2.2. Inlet and outlets of the clean grain elevator.



Figure 2.3 M6 Press Studs installed to the clean grain elevator.

CropScan 4000VT On Combine Grain Analyzer: Installation Guide

- 9) Install the Sample Head onto the 4 x M6 Studs and Install the 4 x M6 Plain Nuts. Tighten nuts to secure the Sample Head to the Clean Grain Elevator.

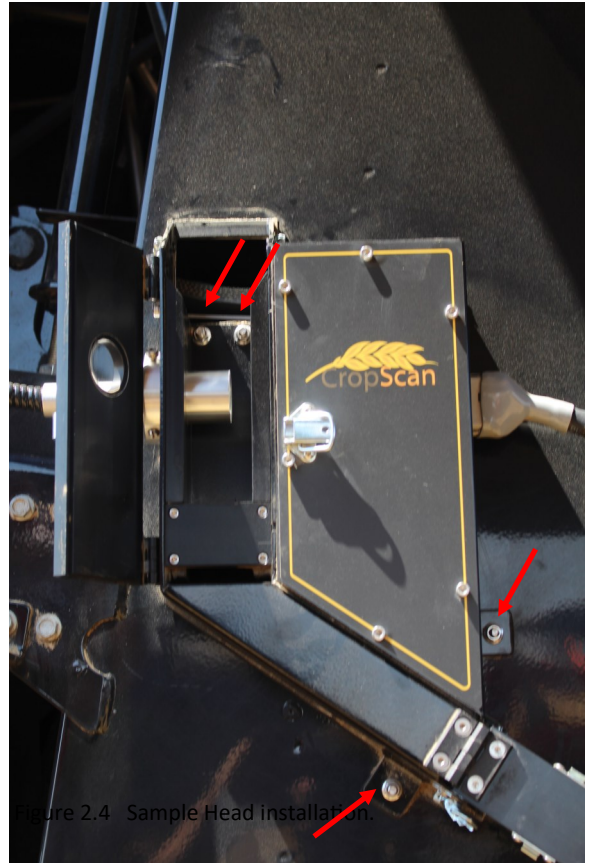


Figure 2.4 Sample Head installation.

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2.2 NIR Spectrometer Installation

The NIR Spectrometer is housed in a black alloy enclosure, 365mm x 310mm x 135mm. The NIR Spectrometer is to be located outside the cabin below the NAV Controller. To install the NIR Spectrometer follow the instructions below:

- 1) Position the spectrometer alloy template so that the 2 folds rest on the white plastic rotor intake over for lateral positioning and the horizontal structure shown in figure 2.6a.
- 2) Mark the 4 X M8 Spectrometer attach holes as per the alloy template.
- 3) Drill 4 x 8mm holes through the Combine wall structure. Deburr the holes to remove any sharp edges.
- 4) Install the 4 X M8 supplied bolts so that the threads are facing outwards and secure with the provide washers and plain nuts as shown in Figure 2.5.
- 5) Install the 4 rubber dampeners to the 4 X M8 attached bolts as shown in figure 2.6.

Note: Remove the NAV Controller connectors before mounting the NIR Spectrometer for access.

- 6) Mount the NIR Spectrometer to the 4 X M8 bolts and install 4 X M8 washers and 4 X M8 Nyloc nuts. Tight the M8 nuts to secure the Spectrometer to the M8 bolts and dampeners.

Note: A loose Spectrometer box could cause excessive vibration cause internal damage to the Spectrometer Optics.

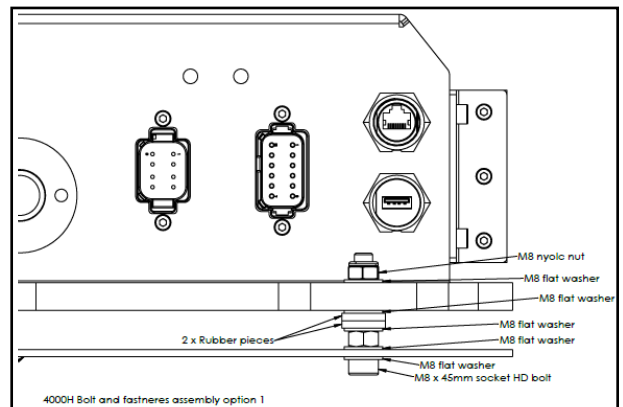


Figure 2.5. NIR Spectrometer Bolt and washer stack.

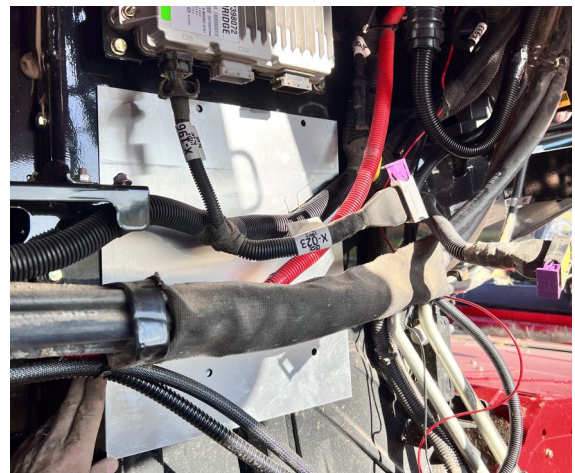


Figure 2.6a. NIR Spectrometer installation template.



Figure 2b. NIR Spectrometer attach studs.



Figure 2.7. NIR Spectrometer installation mounting

CropScan 4000VT On Combine Grain Analyzer: Installation Guide

2.3 Wiring Installation

See Appendix 3.2 for a detailed Block Diagram showing the connections between components.

Warning: Turn the combine harvester isolation switch OFF before attempting to install any wiring. Incorrect wiring installation could damage the Spectrometer.

Note: The Fibre Optic Cable is 5m in length, this length will dictate the Fibre Optic Cable routing.

2.4 Sample Head cabling

- 1) Insert the Fibre Optic Cable into the Fibre Optic Sample Head probe as shown in figure 2.8. Insert the Fibre Optic Cable so that the keyway aligns to the probe M4 grub screw. Push the Fibre Optic cable inwards so the Fibre Probe bottoms out and the key way is not visible. Tighten the M4 grub screw on the barrel of the Fibre Optic Probe. Apply a bead of silicon to the where the Fiber Optic cable and probe join as shown by the arrow in figure 2.8.

Note: Install the end of the Fibre Optic Cable with the serial tag into NIR Spectrometer.

- 2) Connect the 12 Pin Sample Head cable plug to the sample head plug receptacle as shown in figure 2.9. Route the Sample Head cable along the front edge of the clean grain elevator securing with cable ties every 30cm (1 Foot).
- 3) Route the Fibre Optic Cable, around the back side of the clean grain elevator. Secure the Fibre Optic Cable with cable ties to the Combines Automation Camera wiring looms. Route the Fibre Optic Cable up along the forward inner edge of the clean grain elevators vertical edge. Secure the Fibre Optic Cable and Sample Head cable with cable ties every 30cm (1 Foot).
- 4) Route the Sample Head Cable and Fibre Optic Cable up and over the top of the elevator and secure to the existing combines wiring looms to the NIR Spectrometer.
- 5) Route the cables forward towards the installed NIR Spectrometer. Remove the large cable clamps that secure the Combine Battery cables and install the Sample Head and Fibre Optic Cables to secure neat and tidy as shown in figure 2.10.
- 6) Connect the Fibre Optic Cable and Sample Head Cable connectors to the NIR Spectrometer as shown figure 2.11. Tighten the Fibre Optic Ring locking screw to secure.

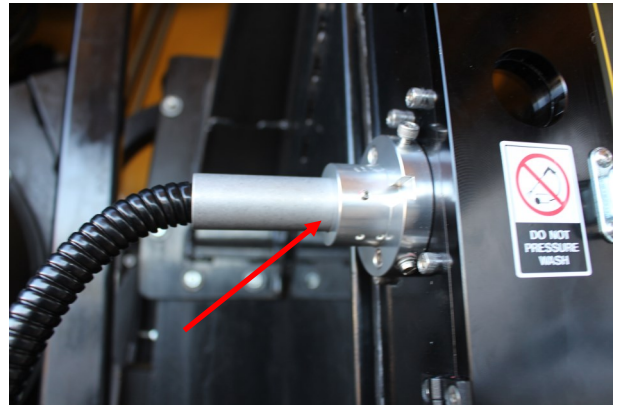


Figure 2.8 Sample Head—Fibre Optic connection.



Figure 2.9 Sample Head - Power Cable connection.

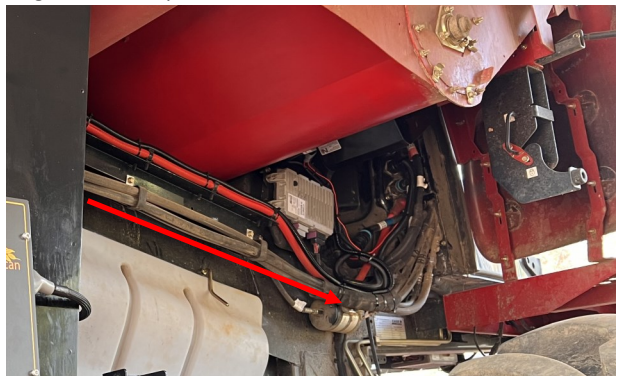


Figure 2.10 Sample Head Cable routing.



Figure 2.11 NIR Spectrometer connections.

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2.5 NIR Spectrometer Cabling

The NIR Spectrometer Cable Harness connects and splices the combine battery, ignition and CAN 1 and CAN 2 (NEMA 2000 GPS) to the CropScan NIR Spectrometer. This cable eliminates the need to use the serial GPS NAV controller as in the previous CropScan 3000H and 3300H models.

See Appendix 3.1 and 3.2 for detailed Block Diagram showing the connections between components.

- 1) Remove the X010S connector from the main cabin bulkhead connector plate as shown in figure 2.12 and figure 2.13.
- 2) Connect the NIR Spectrometer Cable connector end **(A)** to the main cabin bulkhead X010S connector.
- 3) Connect the main spectrometer cable bulkhead receptacle end **(B)** to the other end of the main cabin bulkhead X0101S connector cable.
- 4) Connect the wire ground terminal to the combine's main ground stud bolt. Tighten to secure the terminal. Refer to drawing 3.1 for more detail.
- 5) Connect the spectrometer 8 pin plug **(C)** to the middle NIR Spectrometer receptacle.

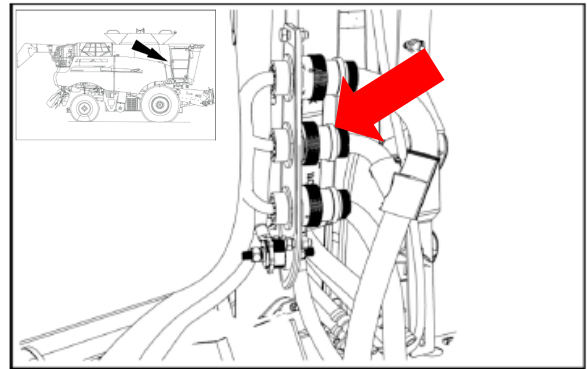


Figure 2.12 X010S Connector.



Figure 2.13 NIR Spectrometer Cable



Figure 2.14 Spectrometer Cable connections.

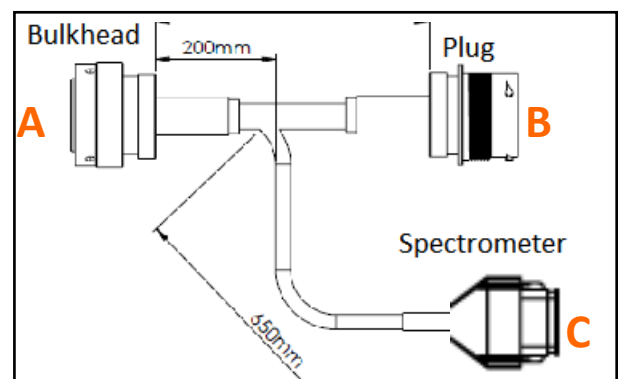


Figure 2.15 NIR Spectrometer Y Cable Schematic.

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3.1 CropScan 4000VT Wiring Diagram

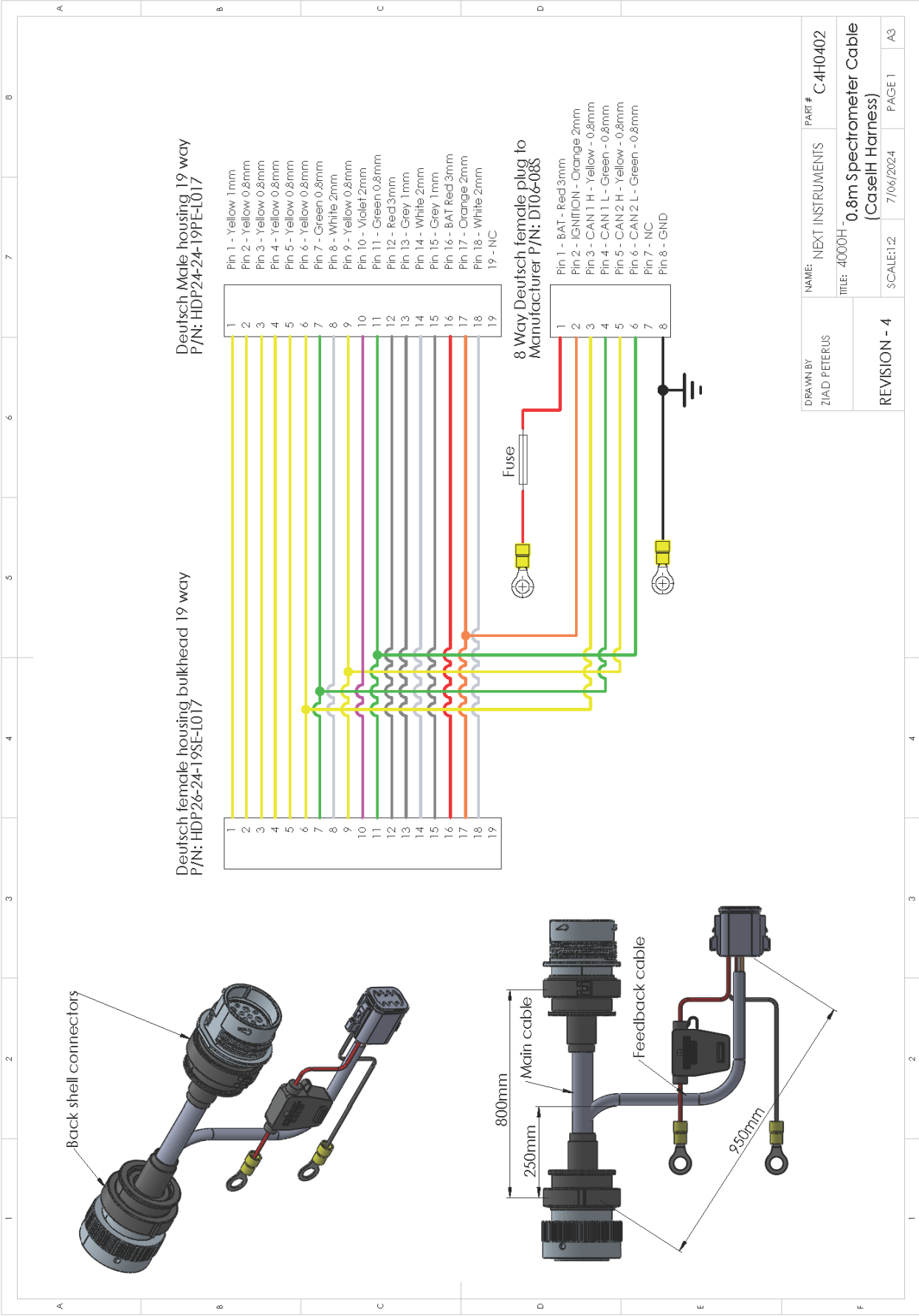


Figure 3.1. CropScan 4000VT Spectrometer Cable Wiring Diagram.

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3.2 CropScan 4000VT Block Diagram

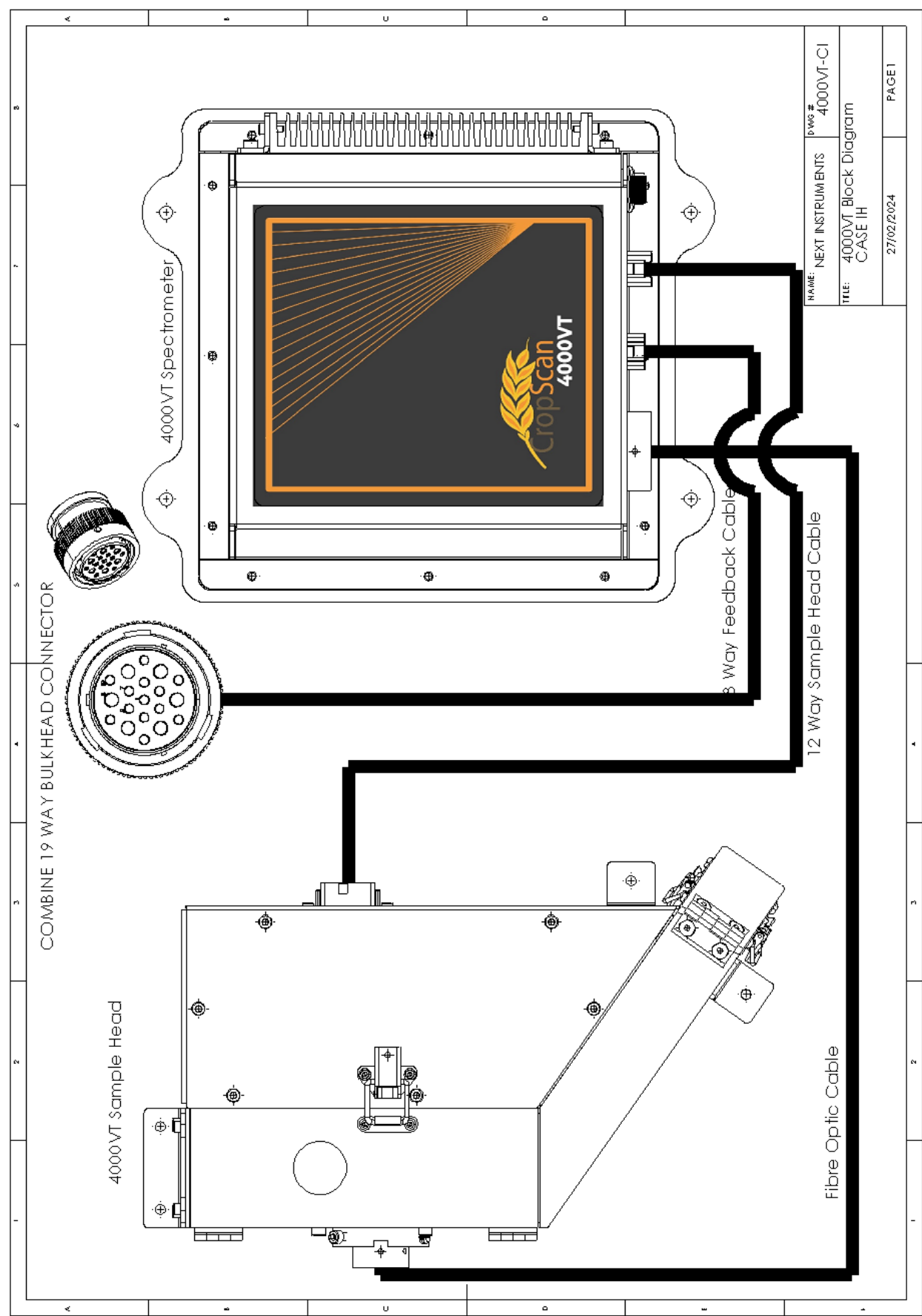


Figure 3.2. CropScan 4000VT Component schematic.

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3.3 Sample Head Mounting Diagram for CaseIH Combine's.

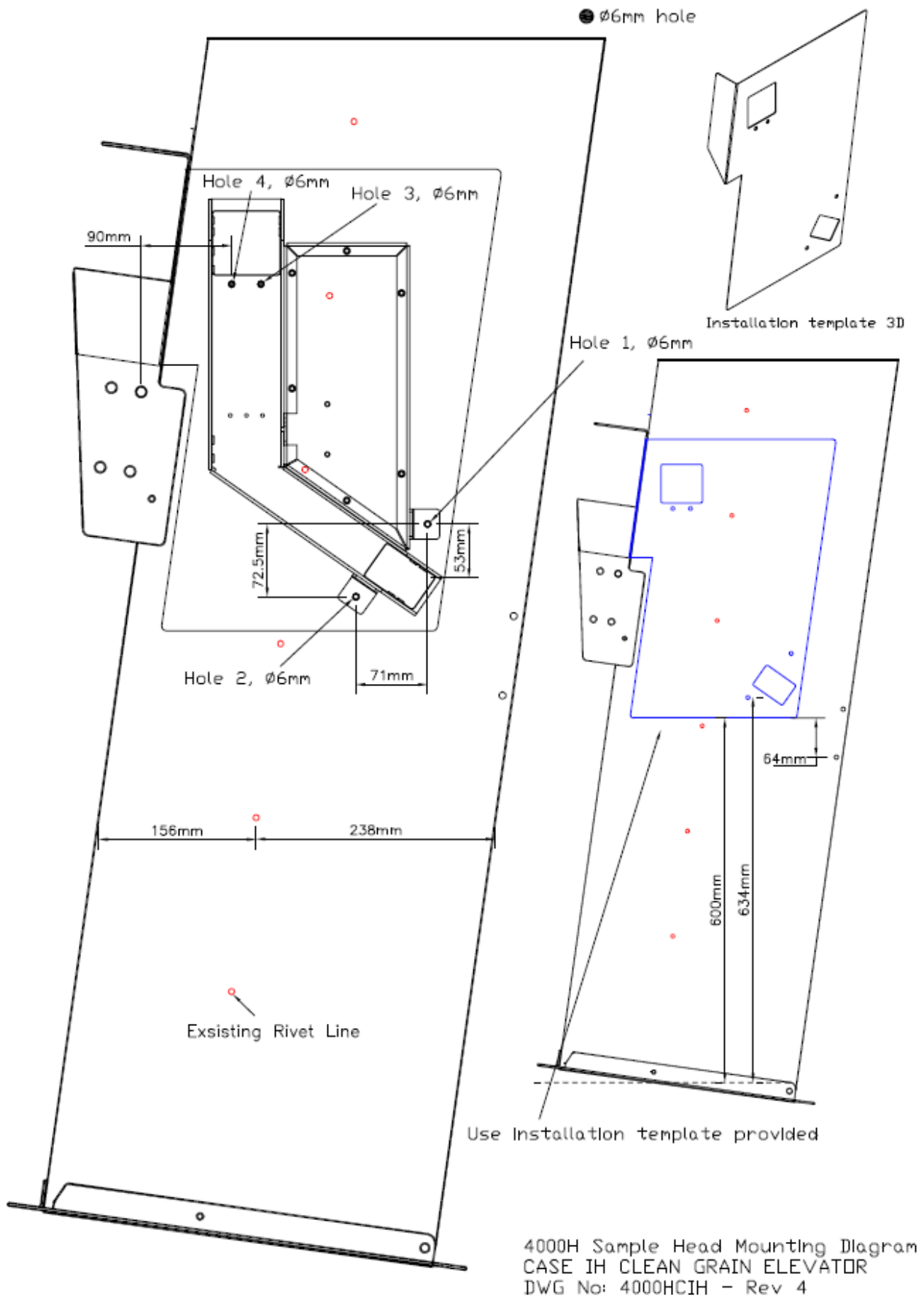


Figure 3.3. CaseIH Grain Elevator Drawing

3.4 Spectrometer Mounting Diagram for CNHi Combine's.

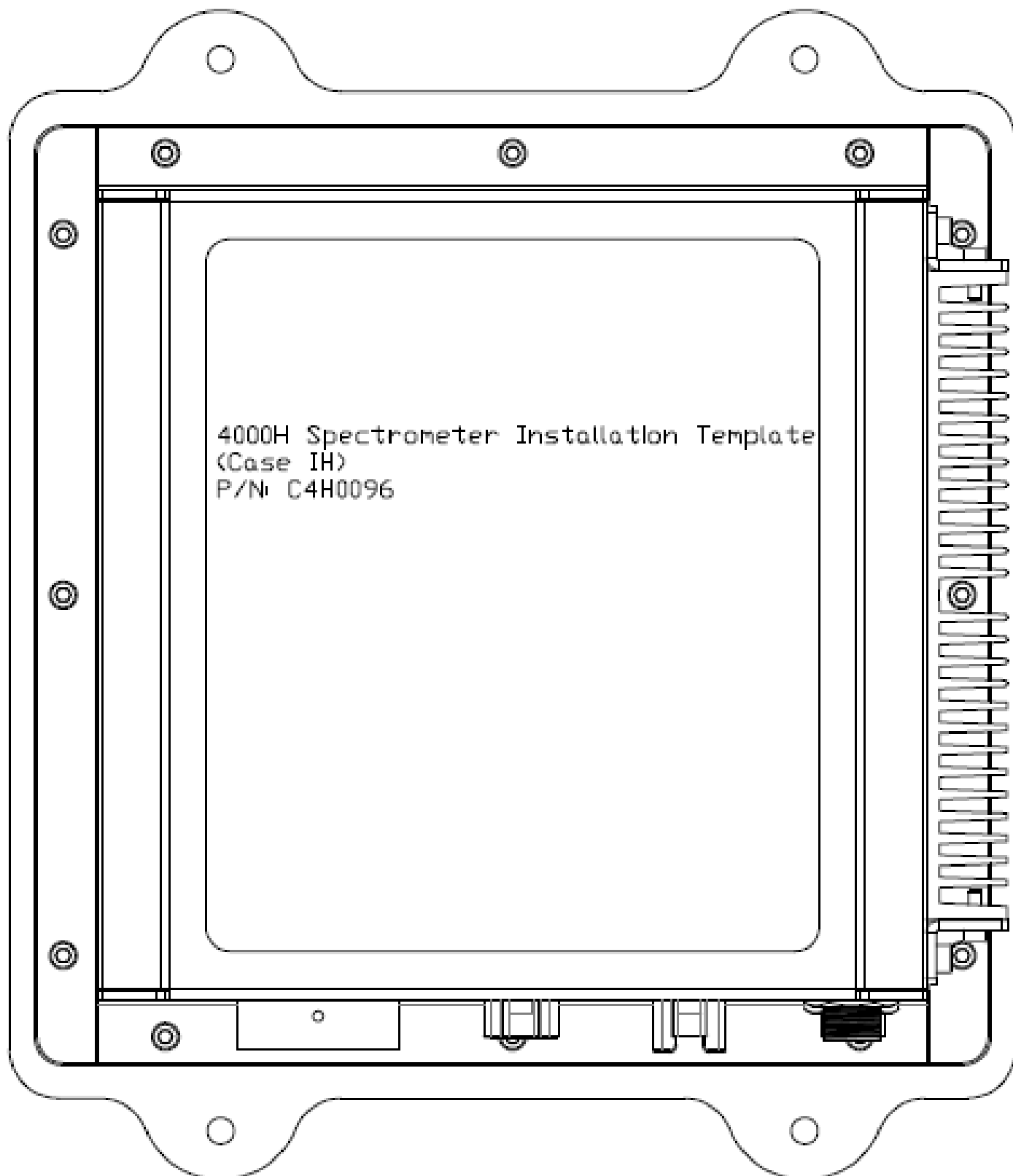


Figure 3.4. NIR Spectrometer installation layout drawing.

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3.5 Optional Tablet Mounting

The CropScan 4000VT kit includes a Tablet Mount Kit. A tablet mounting device can be installed next to the Pro 700 and secured to the rail mounting structure giving users the ability to run an Apple OS or Android tablet in order to view the CropScan data from the N-GAUGE Harvest Manager App. The tablet is then supported and held by the supplied RAM arm to the display bracket with ball mount. To install the CropScan Tablet Mount, follow the instructions below:

- 1) Remove the 2 M8 X rail mount bolts at the middle or forward rail attach position as shown in figure 3.6.
- 2) Install the supplied 2 x M8-35 Bolts, washers and nuts to secure the display bracket with ball mount to the display rail structure shown in figure 3.6.
- 3) Install the 4 inch RAM arm to the tablet bracket.
- 4) Install the CropScan Tablet Mount to the RAM arm and tighten the RAM arm handle to secure the CropScan Tablet Mount as shown in figure 3.5.



Figure 3.5 Case IH Cabin Layout optional Tablet Mounting.



Figure 3.6 Optional Tablet Display bracket installation.

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4.0 Configuration Menu

4.1 Overview

The **Configuration Menu** allows operators to set up the CropScan ECU to suit the user's farming operation. The user can set up an API connection to their CropScanAg Cloud account, set Seeding Month, set up the Wi-Fi connection, manage Data Storage, activate Outlier Detector and set the unit of measure for temperature and weight.

4.2 Temperature Unit

Select displayed temperature units (C or F) .

4.3 Volume Unit

Select crop weight units (Tonnes, Kilograms or Bushels).

4.4 Seeding Month

Select the month the seeding applications begin. The CropScan 4000VT Analysis Software will manage the harvest data in a 12 month period from this selected month.

Note: Select January for Northern Hemisphere users and June for Southern Hemisphere users.

4.5 Outlier Detection

(Recommended) The Outlier Detection option applies a filtering method to reject any samples where the result are below or above the crop type minimum or maximum range. E.g., Wheat (5- 20%)

4.6 Harvester ID

The Harvester ID parameter allows the renaming of the CropScan serial number displayed on the N-GAUGE Grain Logistic module. This allows the user to rename the CropScan to a Combine number ie "Combine 1" or the name of the operator "Tom".

- Press on the Harvester ID white box and enter the new name using the pop up keyboard.
- Press Enter to confirm and check the name change on the N-GAUGE App Grain Logistics Module.

4.7 N-GAUGE Setup

NOTE: Sign up at app.cropscanag.com

- Press the **N-GAUGE Setup** button to access the User Credential setup window.
- Enter the User email address used to create the CropScanAg Cloud account.
- Enter the User Password used to create the CropScanAg Cloud account.
- Press the **SAVE** button to connect the API between the CropScan ECU and the CropScanAg Cloud.

Note: If there is no internet connection to the CropScan ECU, then no access to the CropScanAg Cloud servers will be available.

Unit Of Temp °Celsius	UOM Tons
Seeding Month March	Outlier Det On
Harvester ID HEADER 1	
N-Gauge Setup	Logged In!
WiFi Setup	Connected!
Reset CropScan	

Figure 4.1 CropScan Virtual Terminal General Configuration screen

Unit Of Temp °Celsius	UOM Tons
Seeding Month March	Outlier Det On
Harvester ID NO.1	
N-Gauge Setup	Username Next Instruments
WiFi Setup	Wifi Password crb2200ni
Reset CropScan	Save

Figure 4.2 CropScan Virtual Terminal Unit of measure selector screen.

Unit Of Temp °Celsius	UOM Tons
Seeding Month March	Outlier Det On
Harvester ID NO.1	
N-Gauge Setup	Logged In!
WiFi Setup	Connected!
Reset CropScan	

Figure 4.3 CropScan Virtual Terminal General Configuration

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4.8 WiFi Setup

NOTE: Make sure a phone Hotspot is ON or with Wifi range to add a Wifi Profile.

- Press the **Wifi Setup** button to access the User Credential setup window.
- Enter the Wifi SSID (Wifi name).
- Enter the Wifi Password.
- Press the **SAVE** button to add the Wifi Hotspot Profile. The CropScan ECU will auto connect each time the added Wifi Hotspot is within range.

4.9 Field IDs

The CropScan VT can import a CN1 Setup file with the Grower-Farm- Field IDs. Loading a Grower Farm Field list to the CropScan ECU helps with syncing GFFs from the main combine run screen.

Grower-Farm-Field Import

The Grower-Farm-Field files can be uploaded from a USB device or from the Cloud.

- Save a CN1 Folder to the route directory of a USB memory device.
- Insert the USB device into the CropScan 4000VT NIR Spectrometer's USB port on the lower side of the box located outside of the cabin as shown in figure 4.5.
- Select the **Data Transfer** Menu to access the data transfer options.
- Press the Grower Farm Field (GFF) import option to read and import the Grower Farm Field list from the CN1 folder loaded onto the USB.
- Remove the USB from the NIR Spectrometer USB port once the data is complete the transfer.



Configuration	
Unit Of Temp °Celsius	UOM Tons
Seeding Month March	Outlier Det On
Harvester ID NO.1	
N-Gauge Setup	Username Next Instruments
WiFi Setup	Wifi Password crb2200ni
Reset CropScan	Save

Figure 4.4 CropScan Virtual Terminal General Configuration



Figure 4.5 CropScan NIR Spectrometer USB Port

Data Transfer	
Export Data	Export Data
Import Cal	Import Cal
Update App	Update App
Import GFF	Import GFF
Import INI	Import INI

Figure 4.6 CropScan Virtual Terminal Data Export screen

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5.0 Calibration

5.1 Overview

The CropScan 3300H CropScan Display stores the calibration models for each grain type. The models contain one or several components, e.g., protein, moisture and oil. Each of these calibration models have a Bias and Slope adjustment facility. The bias and slope can be adjusted in order to correct the calibration to some traditional reference method of analysis for each component, i.e. Kjeldahl for protein, Oven Drying for moisture and Soxhlet Extraction for oil.

5.2 Slope and Bias Description

Slope and Bias adjustment is used when all sample readings lie on a straight line but some samples read high and some read low as compared with the reference readings. The Slope and Bias is calculated by plotting the CropScan readings VS the reference readings in a Slope and Bias Calculator software. The Slope and Bias Calculator will calculate the best line of fit across the sample set, creating an equation = Slope and Bias.

Note: Slope and Bias adjustments require 5 samples with a range from low to high (9% - 15%). Slope and Bias adjustments should only be done by a trained technician.

The Slope and Bias is taken from the X and Y plot equation. Figure 5-5 shows the X Y equation as:

$$\% \text{Protein}_{\text{corrected}} = \text{Slope} \times \% \text{P}_{\text{orig}} + \text{Bias}$$

$$\text{Slope} = 1.385$$

$$\text{Bias} = -4.6$$

Using this equation the corrected prediction values for Protein % can be calculated. Figure 5.3 shows the new prediction values.

Applying the new Slope and Bias (S & B) we can decrease the standard error of prediction (SEP) or accuracy. The SEP shown in figure 5-4 to figure 5-6 improves protein error from 0.5 to 0.2 by apply the Slope and Bias equation.

The Slope and Bias Adjustment setting for each Crop Type can be accessed through the Calibration Adjustment Tab.

	3300H	Reference	Difference
Sample ID	Protein	Protein	Protein
1	10.5	10	-0.5
2	11.8	11.6	-0.2
3	12.6	12.6	0
4	13.2	14	0.8
5	13.8	14.5	0.7

$$\text{SEP} = \text{Accuracy} \quad 0.5$$

Figure 4.1 Cr4000VT VS Reference Protein Table

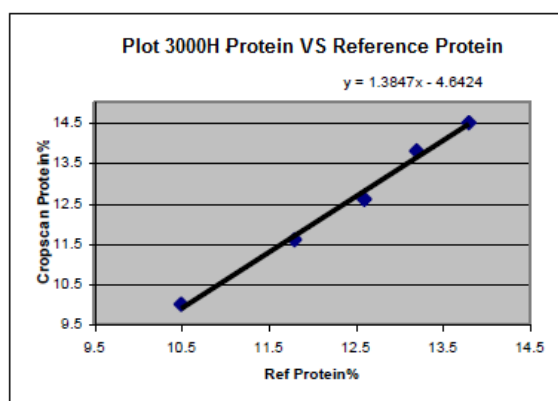


Figure 4.2 CropScan VS Reference X Y Plot

	CropScan	Refer-ence	Difference
Sample ID	Protein	Protein	Protein
1	9.9	10	0.1
2	11.7	11.6	-0.1
3	12.9	12.6	-0.3
4	13.7	14	0.3
5	14.5	14.5	0.0

$$\text{SEP} = \text{Accuracy} \quad 0.2$$

Figure 5.3 New predicted protein vales

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5.3 Accuracy

Accuracy is defined as the difference between a reference method and the CropScan predicted results. Typically, 50 samples of grain are analyzed in duplicate by the reference method and then by the CropScan. The Standard Deviation of Differences between the reference method and the CropScan are referred to as the Standard Error of Prediction (SEP). The following values represent 95% confidence levels or 2 X SEP.

Wheat

Protein +/- 0.5%

Moisture +/- 0.4%

Barley

Protein +/- 0.6%

Moisture +/- 0.5%

Canola

Oil +/- 1.0%

Moisture +/- 0.5%

5.4 Precision:

Precision is defined as the ability of an analyzer to measure the same sample twice. Typically, 10 samples of grain are analyzed in duplicate on the CropScan. The Standard Deviation of Differences between the duplicate readings is referred to the Standard Deviation of Differences (SDD). The following values represent 95% confidence levels or 2 X SDD.

Wheat

Protein +/- 0.3%

Moisture +/- 0.2%

Barley +/- 0.3%

Protein

Moisture +/- 0.2%

Canola +/- 0.5%

Oil

Moisture +/- 0.4%

These values are intended as a guide only. Under laboratory conditions, using clean grain samples that are of good quality, then you should be able to achieve similar results. However, temperature variations of the sample and the instrument have big effects on SEP and SDD. Weather damaged grain or dirty grain will give rise to larger errors. Poor mixing of sample can result in excessive errors. Excess chaff, straw, dirt, leaves etc. will also negatively affect the Accuracy and Precision.

	CropScan	Reference	Difference
Sample ID	Protein	Protein	Protein
1	9.9	10	-0.1
2	11.7	11.6	0.1
3	12.9	12.6	0
4	13.7	14	0.3
5	14.5	14.5	0.3

SEP = Accuracy	0.22
----------------	------

Figure 5.4 Example of Accuracy Calculation (SEP)

	CropScan	Lab Ref	Difference
Sample ID	Protein	Protein	Protein
1	9.9	9.9	0.0
2	11.7	11.8	0.1
3	12.9	12.9	0.0
4	13.7	13.9	0.2
5	14.5	14.4	-0.1

SDD = Accuracy	0.12
----------------	------

Figure 5.6 Example of Precision Calculation = (SDD)

Calibration Cont.

5.5 Calibration Adjustment

Calibration Adjustment enables operators to align the CropScan results to a grain buyers NIR or laboratory method. Users can increase or decrease the BIAS settings for each constituent in order to align the CropScan with local elevator sites. Operators can manually adjust the bias settings or use the Auto Calibration Bias adjustment function.

The following steps explain how to manually change the Bias values in the 4000VT.

i. Select the **Calibration** button as shown in figure 5.7.



ii. Select the Crop Type from the list. A screen will appear showing the existing Slope and Bias values for each constituent.

iii. Use the Up and Down arrows to adjust the Bias for each constituent.

iv. Press the Confirm button to save the new calibration Bias values.

Note: The Slope factor requires a password to be entered to make a Slope factor adjustment.

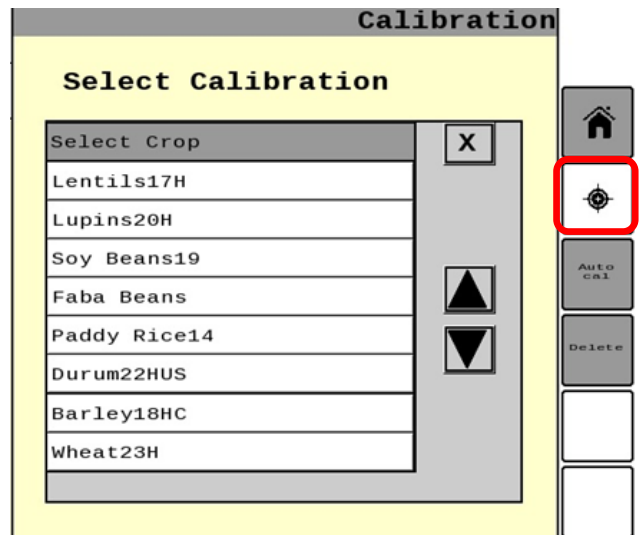


Figure 5.7 CropScan Virtual Terminal Calibration screen

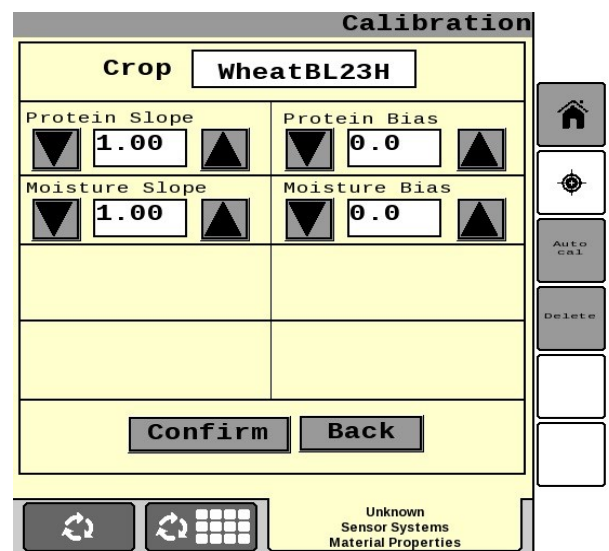


Figure 5.8 CropScan Virtual Terminal Bias Adjustment screen

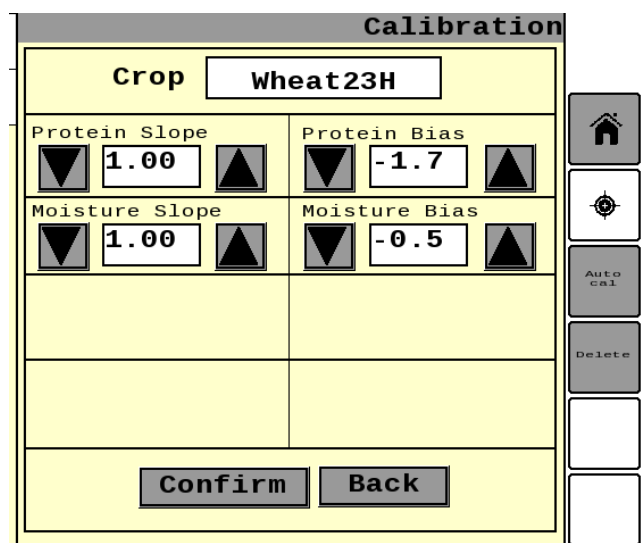


Figure 5.9 CropScan Virtual Terminal Bias Adjustment keyboard.

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5.6 Auto-Calibration

The Auto-Calibration function is a simple way of analyzing 5 samples in a row and entering the samples actual values after all the samples have been analyzed. The Auto-Calibration routine saves the data so that it can be easily exported after the Auto-Calibration routine is completed.

The CropScan 4000VT is pre-calibrated with 3 Crop Types: Wheat, Barley and Canola. Other crop calibrations are included however no Slope and Bias adjustments have been made to these calibrations.

Once the system is installed a set of 5 reference calibration samples should be tested using the Auto-Calibration function in order to align the CropScan to the 5 reference samples.

As well, prior to each harvest, a set of 3 to 5 validation samples should be run through the CropScan 4000VT to check and fine tune the calibrations.

Tools Required:

- 5 x Wheat Samples,
- 5 x Barley Samples,
- 5 x Canola Samples,
- 1 x Bottom Sample Shute (supplied in the kit)
- 1 x Funnel, 2 x 1 Litre plus sized containers

Operation:

- Press the Autocal button.
- Select the Crop type from the pull down menu.
- Select the number of samples to be used. i.e., 1- 5.
- Press Start to confirm Crop Type and number of samples..

The operator needs to go to the CropScan Sample Head located on the clean grain elevator. Remove the inlet cap at the top of the Sample Head and fit a funnel. Release the Outlet Door and install the Outlet Port Shute.

Pour the first grain sample into the funnel and use the 2 liter (2 quart) container to collect the grain at the Outlet Shute. The system will scan 10 sub samples to be analyzed for each sample. After each sample of grain is completed, the flap will open and the grain will flow out of the Sample Head. The lamp inside the Sample Head will flash four times to instruct the operator to pour in the next grain sample.

When all the reference samples have been run through the CropScan Sample Head, return to the screen inside the cabin.

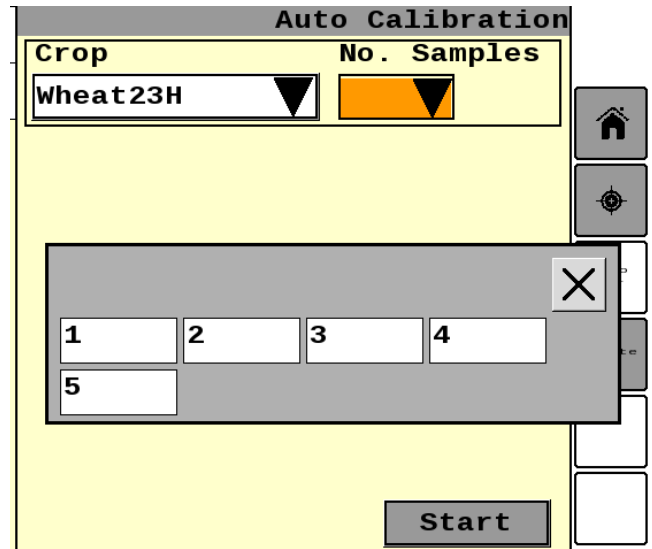


Figure 5.10 CropScan Virtual Terminal Auto Cal screen



Figure 5.11 Certified Reference Samples



Figure 5.12 Auto Calibration Sample pouring

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Calibration Cont.

The 4000VT screen will display the predicted Protein, Moisture, Oil etc. for each sample. Below each Actual Reading there is a box to type in the Reference Values. Enter the reference values for each constituent and press Next.

A window will appear showing the Old Bias and the New Bias.

If the SEP for each constituent is 0.3% or less than the Old Bias values are considered to be within acceptable error range and press Cancel to not change the bias factor.

If the SEP for 1 or any constituent is greater than 0.3% then press Next to save the new Bias values.

5.7 Delete

To remove a calibration from the CropScan ECU and listed in the CropScan VT.

- Press the Delete button.
- Select the Calibration/s to be deleted. A tick will appear alongside the Crop type.
- Press Confirm to delete the calibration.

Note that the Deletion operation is final. It cannot be reversed. The original calibration can be reloaded. If a Calibration is deleted incorrectly, import a new calibration from the supplied

Auto Calibration					
Crop		No. Samples			
Wheat23H		5			
	P %	M %			
1 Act	16.9	12.5	---	---	
1 Ref	15.1	12.0			
2 Act	11.4	11.1	---	---	
2 Ref	9.8	10.4			
3 Act	11.9	11.6	---	---	
3 Ref	10.3	11.0			
4 Act	9.3	11.3	---	---	
4 Ref	7.5	11.0			
5 Act	11.0	10.9	---	---	
5 Ref	9.2	10.5			
Cancel Next					

Figure 5.13 Auto Calibration results screen

Auto Calibration			
Crop		No. Samples	
Select Crop			
Constituent	Old Bias	New Bias	SEP
Protein	---	---	---
Moisture	---	---	---
Oil	---	---	---
Starch	---	---	---
Cancel Next			

Figure 5.14 Auto Calibration new Bias Factor screen

Delete Calibration	
Calibraion Name	X
Lentils17H	
Lupins20H	
Faba Beans	
Paddy Rice14	✓
Mung Beans19H	
soybean19	
Wheat22H	✓
Wheat23H	
Delete	

Figure 5.15 Calibration Delete Menu

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6.0 Data Transfer

6.1 Data Transfer Overview

The Protein, Moisture, Oil and Yield data are stored in the CropScan ECU internal hard drive. The data files can be transferred to and from a USB memory device or the CropScanAg Cloud Server. The user is required to set up a CropScanAg Cloud Server account at app.cropscanag.com.

The **Data Transfer** menu is designed to allow operators to Export and Import data or files to and from CropScan ECU or to the CropScanAg Cloud.

The following data files can imported to the NIR ECU hard drive from a USB or the CropScanAg Cloud servers.

- Import Cal files
- Update N-GAUGE Apps
- Import INI files
- Import Cal files
- Import GFF (CN1 Grower-Farm-Field)

The following data file can be exported from the NIR ECU hard drive to a USB or the CropScanAg Cloud servers.

- Export Data

Note: The CropScan ECU will read and write to a USB storage device. The USB is required to have pre loaded folders to read and write to:

- **Calibration**
- **Software**
- **ConfigurationFiles**

6.2 Export Data

Select the Data Transfer icon.

- Insert USB Stick into CropScan 4000VT NIR Spectrometer USB port
- Press the Export Data icon
- Select CropScan Data or Log Data
- Select the Log Data to export Logs and reference scans.

6.3 Import Calibration

(Note: Create a Folder named Calibration on the root drive of the USB)

- Copy the new Calibration Bin files onto the Calibration folder on the USB device.
- Insert USB Stick into CropScan 4000VT NIR Spectrometer USB port .
- Press "Import Cal" (USB) or (Cloud) icon.
- Click on the Calibration you wish to import from the USB or Cloud.
- Wait for the Import to be completed.

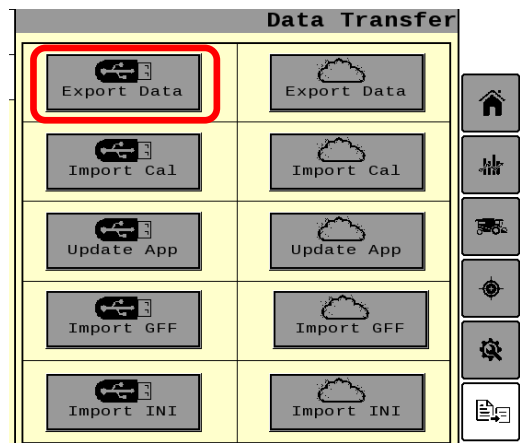


Figure 6.1 CropScan Virtual Terminal Data Transfer menu.

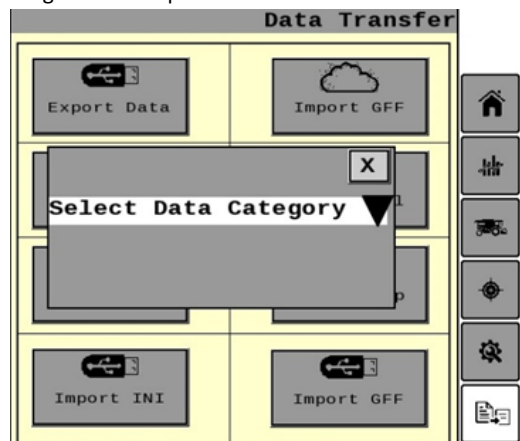


Figure 6.2 CropScan Virtual Terminal Export Data.

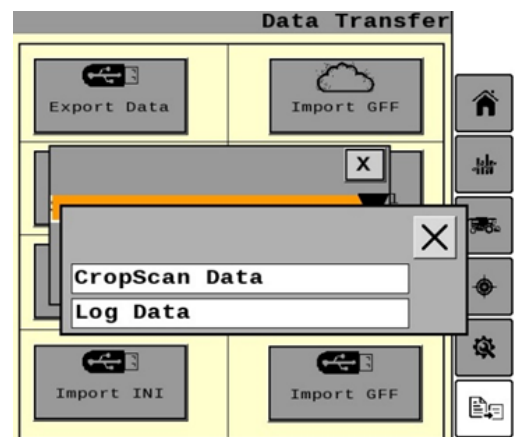


Figure 6.3 CropScan Virtual Terminal Export Data.

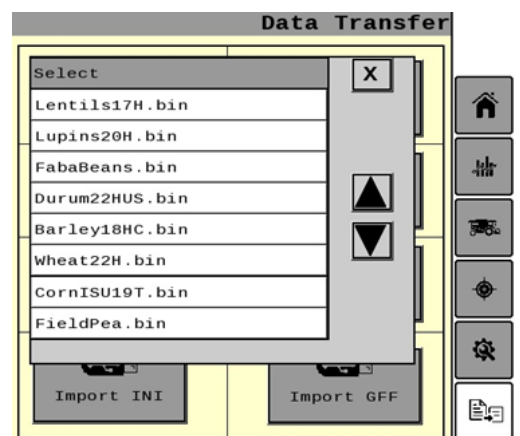


Figure 6.4 CropScan Virtual Terminal Import Calibration.

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6.4 Update Virtual Terminal App

Note: Copy and paste the CropScanAg App file to the Software Folder of a USB memory device for USB import.

- i. Copy and paste the CropScanAg App file onto USB memory device Software folder.
- ii. Insert USB memory device into CropScan 4000VT NIR Spectrometer USB port.
- iii. Delete the VT Object pool before updating the CropScan 4000VT App. Access the Diagnostic's menu from the combine monitor. Select the VT option NVM browser and delete the CropScan object pool as shown in figure 6.6.
- iii. Return to the CropScan VT Data Transfer icon on the 4000VT screen.
- iii. Press the Import App Update (USB) icon for USB Update or App Update (Cloud) icon for cloud sync on the 4000VT screen.
- iv. The system will automatically upload the CropScan VT App from the Software Folder or cloud to the CropScan 4000VT ECU.
- v. Wait for the CropScan VT complete reading the CropScanAg App file and auto re boot process.

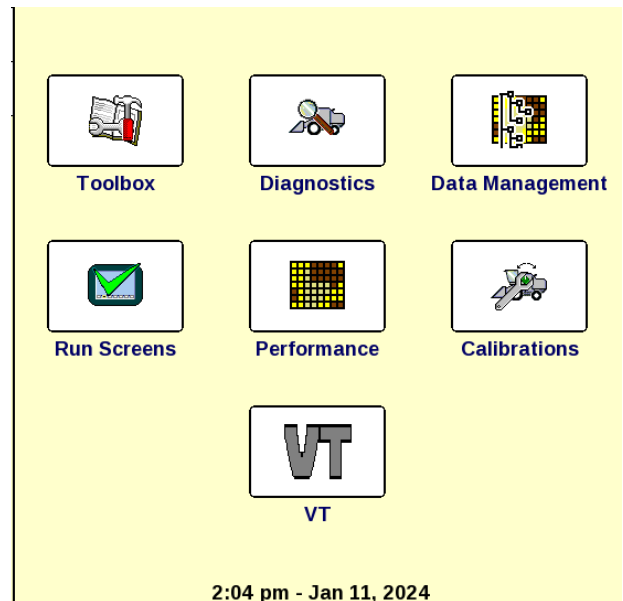


Figure 6.5 Combine monitor menu screen.



Figure 6.6 NVM Browser screen.

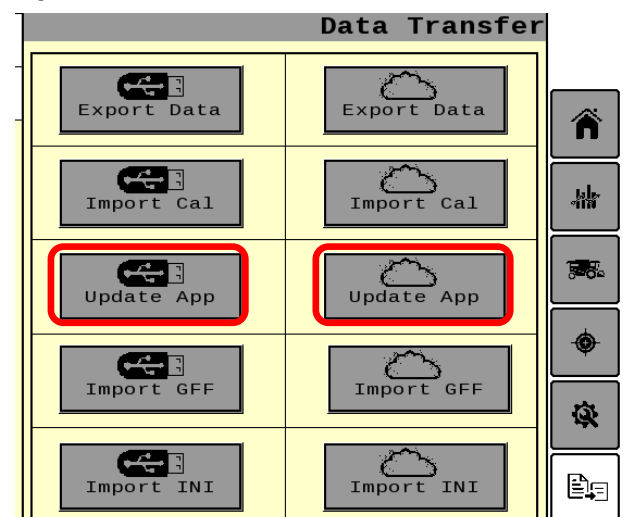


Figure 6.7 CropScan Virtual Terminal Data Transfer menu.

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6.5 Import INI

Note: Copy and paste a Default.ini file to the Configuration Folder of a USB memory device for USB import.

- Copy and paste a Default.ini file to the Configuration Folder of a USB memory device.
- Insert USB memory device into CropScan 4000VT NIR Spectrometer USB port.
- Press the Import INI (USB) icon for USB import or INI (Cloud) icon for cloud sync on the 4000VT screen.
- The system will automatically upload the Default.ini file from the USB or cloud to the CropScan 4000VT ECU.
- Wait for the CropScan VT complete reading the CN1 folder or cloud sync process.
- Wait for the CropScan VT to re boot.

6.6 Import GFF (USB) or (Cloud)

Note: Copy and paste a CN1 folder with Setup data to the root drive of a USB memory device for USB import.

- Copy and paste the CN1 file onto root directory of the USB memory device.
- Insert USB memory device into CropScan 4000VT NIR Spectrometer USB port.
- Press the Import GFF (USB) icon for USB import or GFF (Cloud) icon for cloud sync on the 4000VT screen.
- The system will automatically upload the SetUp Data from the CN1 file or cloud to the CropScan 4000VT ECU.
- Wait for the CropScan VT complete reading the CN1 folder or cloud sync process.

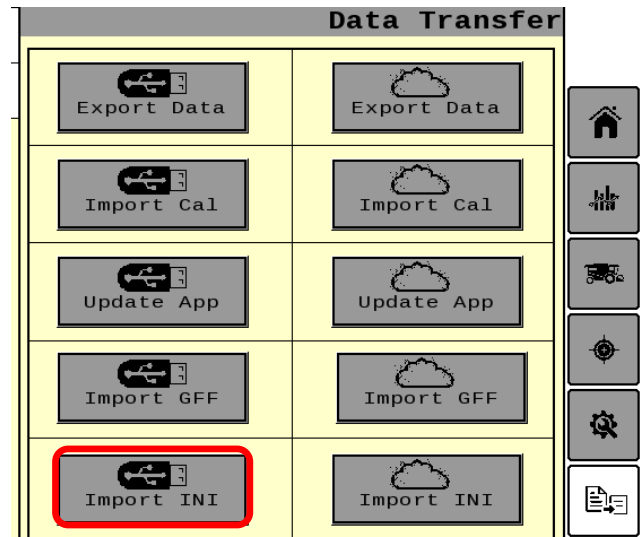


Figure 6.8 CropScan Virtual Terminal Import INI

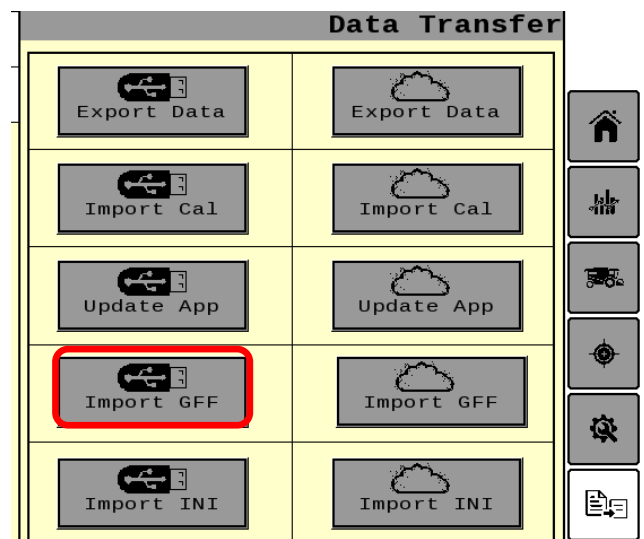


Figure 6.9 CropScan Virtual Terminal Import GFF