

Cubiscan Contour Pro



Operations and technical manual

Version [1.1]

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Cubing and weighing systems

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CUBISCAN®

Cubiscan Contour Pro operations and technical manual

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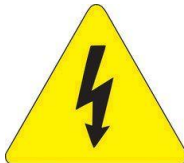
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CAUTION

The Cubiscan Contour Pro should only be serviced by qualified personnel.

Observe precautions for handling electrostatic sensitive devices when setting up or operating the Cubiscan Contour Pro.



WARNING

Disconnect all power to the Cubiscan Contour Pro before servicing or making any connections.



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CHAPTER 1

PRODUCT DESCRIPTION

The Cubiscan Contour Pro is a pallet dimensioning system that excels at measuring protrusions, freight overhang, freight positioning, and tilt within pallet loads. It has two laser-based sensors that view the freight from above and additional sensing that inspects the pallet. An optional third laser sensor can measure the position of the freight in relation to the pallet.

Based on that data, the Contour Pro can identify pallets that are broken, freight that wasn't loaded properly, or freight that are leaning outside a specified parameter. That data and insight is pivotal when using AGVs (automated guided vehicles) to transport, stack, and store pallets within your warehouse or inside a truck.

The Contour Pro can accurately analyze three parcel types: palletized freight, large crates, or large irregular items. It can be used for transporting, stacking, and storing palletized freight with AGVs. It can also be used for a pass/fail inspection based on contour data and creation.



Figure 1
Contour Pro

The Contour Pro can be floor mounted or ceiling mounted above the conveyor. The dimensioning arm that houses the sensors can be static or dynamic based on customer preference and warehouse line configuration. In a static configuration, the Contour-AKL will dimension palletized freight as it passes under the measurement arm. Conveyor speeds can go up to 90 ft/min in this configuration.

In a dynamic configuration, the conveyor pauses for a few seconds as the measurement arm passes over the palletized freight. The conveyor then proceeds with moving the freight as the dimensional data is calculated.

Specifications



Power Requirements

95-240 VAC, 47-63 Hz, Single phase

Environmental

Operating Temperature: 32° to 95° F (0° to 35° C)

Humidity: 0 to 90% non-condensing

Measuring Sensor

Three LiDAR sensors to build full point cloud of load & pallet. Each has an infrared laser scanner, 905 nm, Class 1, (eye-safe), according to DIN EN 60825-1

Measurement Capacities

Measurement Capacities	Max Length	Max Width	Max Height*
Contour Pro 5 Feet	66 in	60 in	130 in
Contour Pro 7Feet	90 in	84 in	130 in

*Includes Pallet and Conveyor

Dimensional Increment: 0.5 in (1.27 cm)

Measurement Time: < 6-7 seconds

Protrusion Detection

Length: > 1.0 in or 2.5cm

Width: > 1.0 in or 2.5 cm

Height: > 0.4 in or 1.00 cm

Detectable “protrusions” are **2.5 cm x 2.5 m x 0.4 cm** (length, width, height), meaning that a protruding element that is > 2.5 cm in length and width will be securely detected as part of the object.

Physical

Standard Version

Length: 5 - 7 ft (1.5 m to 2.1 m)

Width: 10 ft (3 m)

Height: 11 to 13 ft (3.4 to 3.9 m)

Weight: 315 lb (143 kg)

User Interface

A TFT, LCD touchscreen displays the barcode, keypad, L, W, H, and an image of the freight, among other things.

Safety Precautions



Definitions

Safety definitions are designed in adherence to American National Standards Institute (ANSI) safety sign standards in order to ensure that the Cubiscan is operated and maintained correctly and safely.



DANGER: Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury. Includes hazards that are exposed when guards are removed.

WARNING: Indicates a potentially hazardous situation that, if not avoided, could result in serious injury or death. Includes hazards that are exposed when guards are removed.

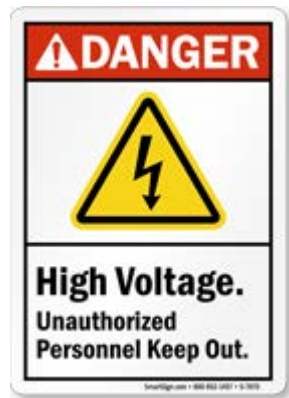
CAUTION: Indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury.

IMPORTANT: Indicates information about procedures that, if not observed, could result in damage to equipment or corruption to and loss of data.

Labels

Labels are provided with the Cubiscan to alert operators of potential hazards. Ensure that the labels are properly displayed on the unit and in its vicinity. Do not remove or alter labels for any reason without first consulting a Cubiscan representative.

Danger High Voltage



Electric Shock



Caution



Warning



Do not use Cubiscan near electronic devices that handle high-precision control or weak signals as it may affect electronic devices leading to malfunction.

Do not allow foreign matter or liquids to get inside the Machine. Doing so may cause short circuit or smoke, resulting in fire, electric shock, or malfunction. If foreign matter or liquid gets inside the Cubiscan, immediately turn off the machine and unplug it from the outlet.

If the Cubiscan is dropped or suffers a strong impact, immediately turn it off and unplug it from the outlet. Continued use may cause fire, electric shock, injury, or malfunction.

Do not operate the touch panel with sharp objects. Pressing the touch panel strongly with a sharp object may cause damage, leading to malfunction.

Do not climb onto or lean on the Cubiscan. Doing so may cause injury.

Regular cleaning and calibration tests are required to maintain accurate measurements. Run calibration tests after any maintenance work.

Turn off power to the Cubiscan and unplug it immediately if the machine gives off an odd smell, makes unusual sounds, emits smoke, or overheats. Call **Cubiscan Technical Assistance** at **801.451.0500** for assistance. Failure to do so could result in fire, accidental electrocution, and possible machine damage.

Electrical Hazards

Avoid handling electric cables, plugs, and other electrical components when connected to a live power source. Follow these safety standards when working with electrical components of the Cubiscan:

- Turn off the power to the machine before unplugging.
- Be sure to hold the plug, NOT the power cable, when unplugging.
- Whenever handling electrical cables or components, do so with care.
- Never place cables and other electrical components near a heat source.
- Ensure that grounding wires are in place and secure before operating the Cubiscan.
- Avoid stepping on or placing heavy objects on cables.
- Do not modify, bend, or otherwise tamper with cables and other electrical components.

If damage is observed from a cable, plug, or other electrical component, turn off the machine immediately and unplug it from the power source. Consult a Cubiscan trained technician for replacement.

If you do not use the unit for a long time, disconnect the power plug from the outlet to ensure safety. Allowing it to remain plugged in over a long period of time without use may cause fire or electric shock.

Failure to observe safe electrical standards may result in accidental electrocution, damage to the machine, fire, and possible injury or death.

Heat Warning

Motors and other electrical components, especially batteries, heat up during use. If the unit is used extensively, these parts may become overheated causing a potential hazard to the machine and the operator.

To avoid injury, when working around motors and other electrical components, avoid contact with these parts during operation and shortly after. Even with the power off heat may be retained in the part for several minutes after operation.

If you find certain parts are heating well beyond the temperature threshold, shut down the unit to prevent injury. Ensure that the problem is not a result of the surrounding environment. If it is, move the unit to a more suitable environment. If the problem persists, consult a Cubiscan technician.

Environment

The Cubiscan should not be installed in any environment where excessive heat, humidity, or dust is present. Variations in temperature or direct exposure to sunlight may cause inaccuracies in measurements and could damage sensors. Do not install near fans where temperatures may fluctuate, causing variations in measurements.

Do not install the Cubiscan in a location that is inclined as this will affect the precision of its measurement and may contribute to instability resulting injury if the unit tips over. Install the unit on a flat surface and stable location, where it can easily be leveled.

Some setups will require multiple cables running to the Cubiscan. This may cause a potential tripping hazard that can damage the unit and cause injury. Install the unit in a low traffic area, where wires may be tucked against a wall or some other inconspicuous place. If wire must be run in a traffic area, take precautions to prevent tripping such as taping down the cables or providing a cable ramp or other protective cover.

Accessories

Certain accessories used with the Cubiscan may pose risk outside the scope of the standalone unit. These may include but are not limited to: scales, portable batteries, camera units, shrink wrappers, etc. Please consult additional documentation for the individual units. A collection of this documentation for each accessory sold with the unit may be found on the Cubiscan website:

<https://cubiscan.com/guides-accessories/>

Cubiscan is not responsible for third party accessories used with the unit. Before using third party accessories, consult a Cubiscan sales representative or technician to ensure that the implementation of the accessory will not pose a safety risk, harm the Cubiscan, or potentially void the warranty.

Laser Eye Safety Classification



"Complies with FDA performance standards for laser products except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dates May 8, 2019."

Class 1 Laser

This Cubiscan is a Class 1 lasers product under IEC 60825-1. According to IEC guidelines, a Class 1 laser is considered safe in all applications. The levels of optical radiation emitted from a Class 1 laser are above the exposure limits for the eye under any exposure condition.

CAUTION

"Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure"

Note: there is no exception for this statement based on Class of radiation or the applicability of actual controls on the product.

For safety reasons, the laser within the Cubiscan is not serviceable. Do not attempt to repair the laser yourself, remove it from its casing, or tamper with it in any way. Doing so may expose you to harmful radiation and will potentially damage the laser.

If the laser is suspected to be damaged, call **Cubiscan Technical Assistance** at **801.451.0500** for assistance. A Cubiscan certified technician will assist you.

Whenever performing maintenance on the Cubiscan, power it down and unplug it. This will ensure the user is not exposed to harmful radiation during maintenance.

CHAPTER 2

GETTING STARTED

The purpose of Contour Pro is to provide 3D measurements of payloads (customer product) on pallets to assess whether the payloads are of sufficient quality and size to successfully transport and store.

Conveyors



The Contour Pro is integrated with independent conveyor systems.

Load specifications

Each supplied conveying system has been designed to handle CHEP wooden pallets (nominal size: 48" wide x 40" long x 5.6" high) and non-CHEP pallets. Pallets will carry a payload (customer product). The approximate maximum combined height of a pallet and payload placed on the pallet is 108 inches.

All loads on top of pallets should be stretch wrapped with maximum weight (pallet + payload) no more than 2650 lbs. Place pallets in conveyor scanning station within +/-15mm left/right and +/- 15mm front/back.

Bar Code Scanner and Weigh Scale

Contour Pro may include a bar code scanner and weigh scale. These units may be linked directly with an SGV management software for an automated guided vehicle (AGV) system. They are completely separate from the Cubiscan units and are not the responsibility of Cubiscan to integrate.

Cubiscan Scanning System



The Contour Pro comes in 5ft and 7ft lengths. While each model has a max height of 130 in, they may differ in max length and width. See the following table for details:

Model Description	AKL Model	Max Length	Max Width	Max Height*	Tolerance
CS Contour Pro, 5 FT	APA581	66 in	60 in	130 in	+/- 12.7mm
CS Contour Pro, 7 FT	APA561	90 in	84 in	130 in	+/- 12.7mm

*Includes Pallet and Conveyor

Cubiscan Measurements

The Contour Pro is designed to determine the position of the pallet in relation to the payload while also measuring the payload on each pallet. For clarity, "Pallet" refers to the wooden pallet and "Payload" refers to customer product stacked on top of the pallet.

The following is a description of the measurements and data that is provided by the Contour Pro for each Pallet/Payload unit. Examples are provide.

Smallest Bounding Box

The maximum dimensions of the payload on top of a pallet describe the minimum size box within which the payload will fit. The following schematic illustrates measurements relative to the pallet/payload:

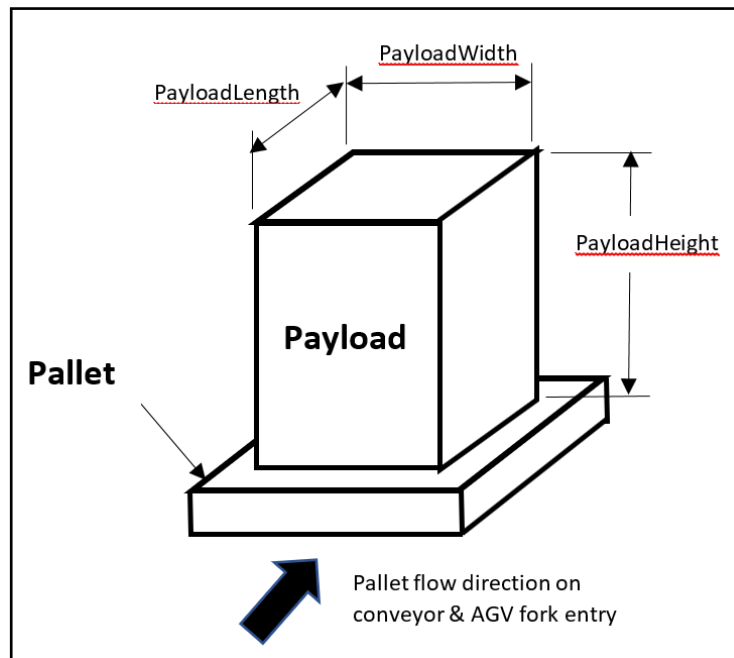


Figure 2
Pallet/payload

Detectable protrusions, parts of the payload that stick out from any side, are included in the calculation of the bounding box as long as those protrusions are detectable. Detectable protrusions are no smaller than: 2.5cm x 2.5cm x 1cm (length, width, height).

Height is the amount which the protrusion extends out from the payload. Objects smaller than this may be ignored in calculating the bounding box dimensions. The protrusion detection dimensions can be increased if the application requires this.

Payload Overhang

The payload rests on the pallet and may extend beyond the pallet in a horizontal plane in any direction. This extension of the payload beyond the pallet is called payload overhang.

The Contour Pro measures the maximum payload overhang on the four sides of the pallet. Overhang is calculated by determining how much the bounding box extends beyond each edge of the pallet. The dimensions as depicted in the table describe the payload overhang range and tolerance as would be defined by the customer's needs. To see how this relates to the pallet, refer to [Figure 3 on page 14](#).

Description	Range	Tolerance
RightOverhang	0-254mm (10.0")	+/- 12.7mm
LeftOverhang	0-254mm (10.0")	+/- 12.7mm
FrontOverhang	0-254mm (10.0")	+/- 12.7mm
BackOverhang	0-254mm (10.0")	+/- 12.7mm

The measurement is for overhang only. If the payload is inset from the pallet edge it will be considered an overhang of 0mm.

The following schematic defines these measurements relative to the pallet/payload.

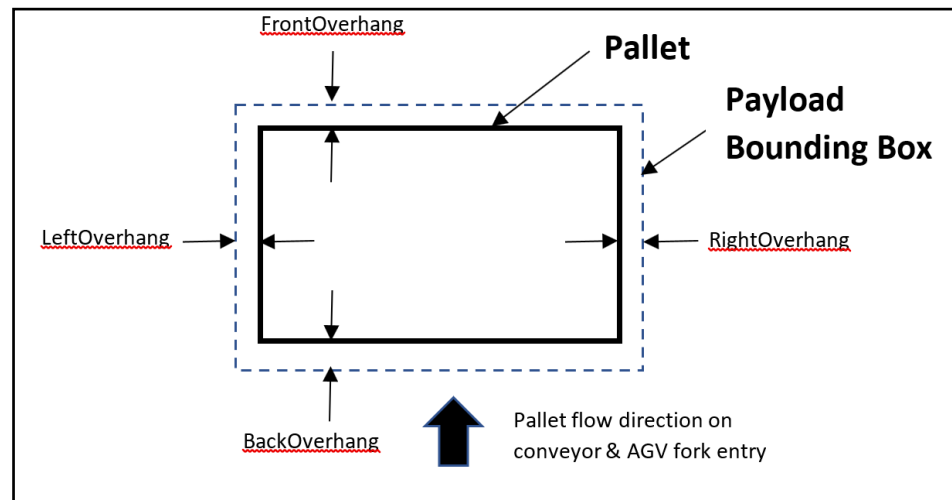


Figure 3
Smallest Bounding Box

Top of Payload

The dimensions of the top of the payload are provided along with the offset of the geometric center of the top of payload relative to the geometric horizontal center of the pallet.

In addition, the offset of the top of the payload relative to the payload center is also provided. This value is determined by taking the difference between the TopXAxis and PayloadXAxis with +/- indicating direction. The same calculation is done for the Y axis.

The measurements of the top of the payload give an indication of the lean of the payload.

Measurements will be as follows (defined by customer):

Description	Range	Tolerance
TopWidth	0-1700mm (66.9")	+/- 12.7mm
TopLength	0-1500mm (59.1")	+/- 12.7mm
TopXAxis	0-254mm (10.0")	+/- 12.7mm
TopYAxis	0-254mm (10.0")	+/- 12.7mm
Top2PayloadXAxis	N/A	N/A
Top2PayloadYAxis	N/A	N/A

The following schematic defines these measurements relative to the pallet/payload. The origin of the offset is the geometric center of the pallet.

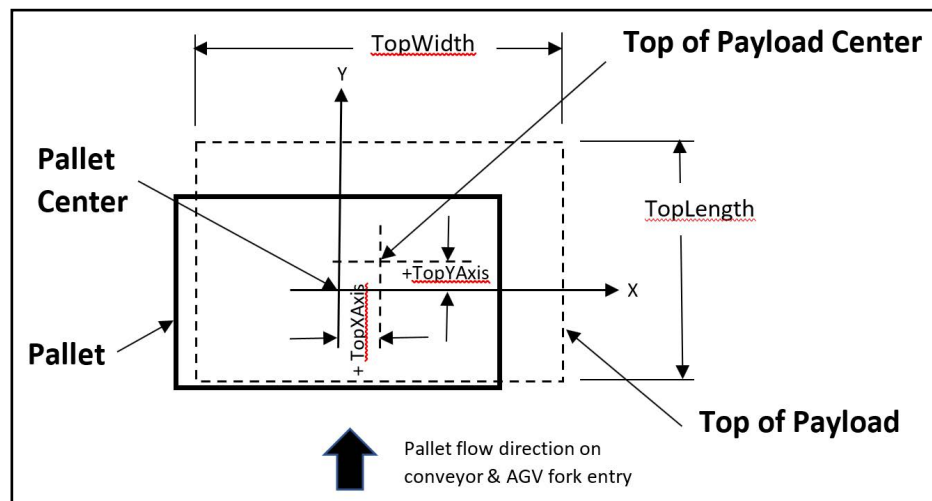


Figure 4
Top of payload

Payload Center

The offset of the center of the payload relative to the center of the pallet describe the horizontal offset of the center of the Bounding Box relative to the horizontal center of the pallet.

Measurements will be as follows:

Description	Range	Tolerance
PayloadXAxis	0-254mm (10.0")	+/- 12.7mm
PayloadYAxis	0-254mm (10.0")	+/- 12.7mm

The following schematic defines these measurements relative to the pallet/payload. The origin of the offset is the geometric center of the pallet. The X & Y offsets are the load Bounding Box horizontal geometric center relative to the pallet horizontal geometric center.

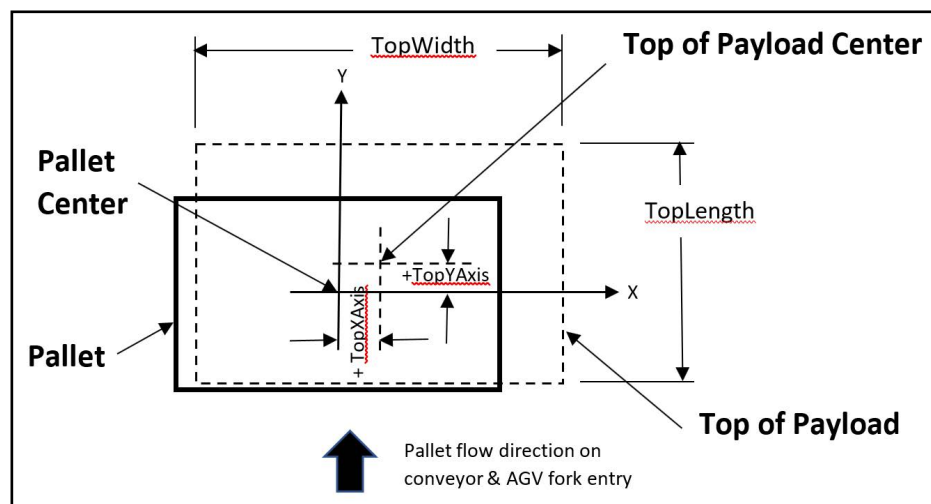


Figure 5
Payload center

CHAPTER 3

OPERATION

This chapter provides instructions for powering the Contour Pro on and off. It also describes the different windows and functions that are found on the home screen and how to access images on the system.

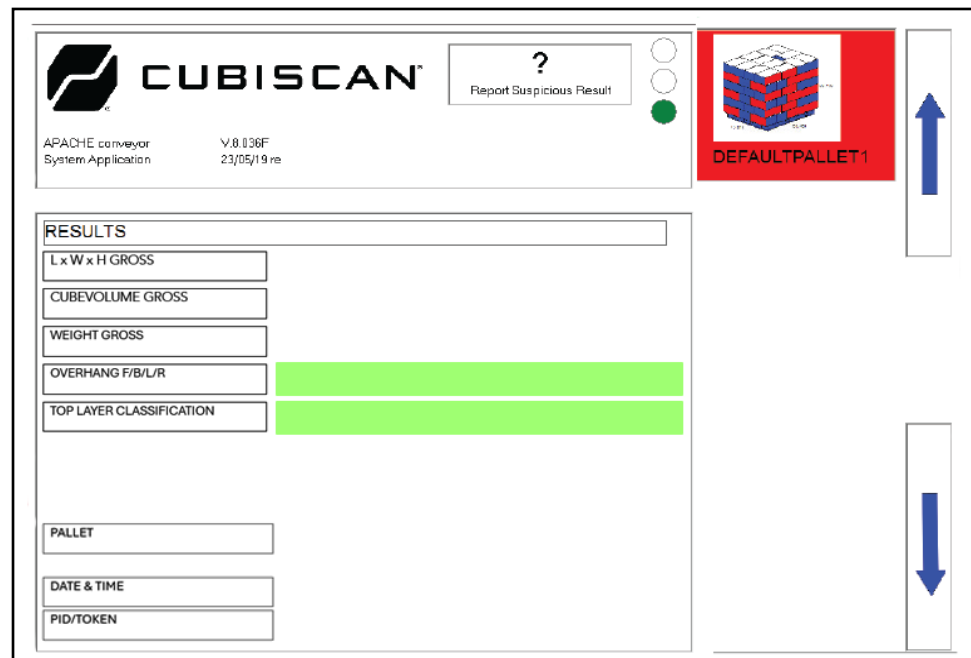


Figure 6
Home screen

NOTE >

The following screenshots have been taken from a non-standard version of the Contour Pro and may appear slightly different from your own.

Powering the Contour Pro On/Off

The Contour Pro is equipped with a safety-rated AC mains power cord and may only be connected to an earthed power socket. Permanently installed devices must be permanently connected to the operator's power mains by terminals. The operator's mains

voltage range must be consistent with the local country's main voltage.

The power cable plug or the red-and-yellow turn switch must be easily accessible so as to allow complete disconnection from the power mains. For the device to be truly disconnected from the power, the power to the device must be severed by unplugging or by turning the switch.

When installing, the environmental conditions must be taken into consideration. Never connect or disconnect power and data transmission lines during an electrical storm as this may result in electrical discharge.

Powering on System

Before powering the system on or off, ensure that the conveyor is clear.

To turn the Contour Pro on, locate the red knob located on the control box, see Figure 7. Turn the red knob clockwise into the ON position.



Figure 7
On/Off Knob

Once the system has been powered on, it will display the home screen. The stacklight will indicate when the Contour Pro is ready to measure.

Powering off System

To turn the Contour Pro off, touch the **Cubiscan** logo located in the information bar. The following message will appear:

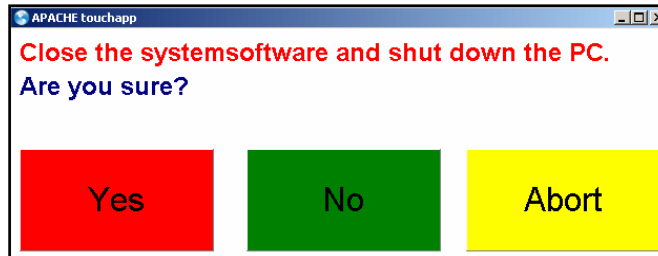


Figure 8
Shutdown popup

To confirm the shutdown, tap **[Yes]**. The system will shut down. After the system has shutdown, turn the red knob counterclockwise into the off position. Allow at least 20 seconds to pass to ensure that all power has been drained from the system before turning it back on.

Cubiscan Display

Each Contour Pro has a display which shows all measurement data and errors after each pallet scan. The following is the displayed data and a short description of the data.

Measurement Results	Description of Data
Total Height (INCL Pallet)	Equals Payload H + Pallet H
Payload L x W x H	Bounding box size
Payload X-axis & Payload Y-axis	Bounding box offset from pallet center
Payload CubeVolume	Equals bounding box volume
Overhang (front, rear, left, right)	Overhang of bounding box from pallet
Top L x W	Top layer length & width
Top X-axis & Top Y-axis	Top layer offset from pallet center

Top2 Payload X-axis	Top layer X offset from bounding box center
Top2 Payload Y-axis	Top layer Y offset from bounding box center
Top Layer Missing Case L x W x H	Size of missing top layer case if recipe specifies
Date & Time	Time stamp of measurement.

Contour Pro Touchscreen

While the Contour Pro is designed to work autonomously, a touchscreen is provided located on the control box to operate and configure the Contour Pro.

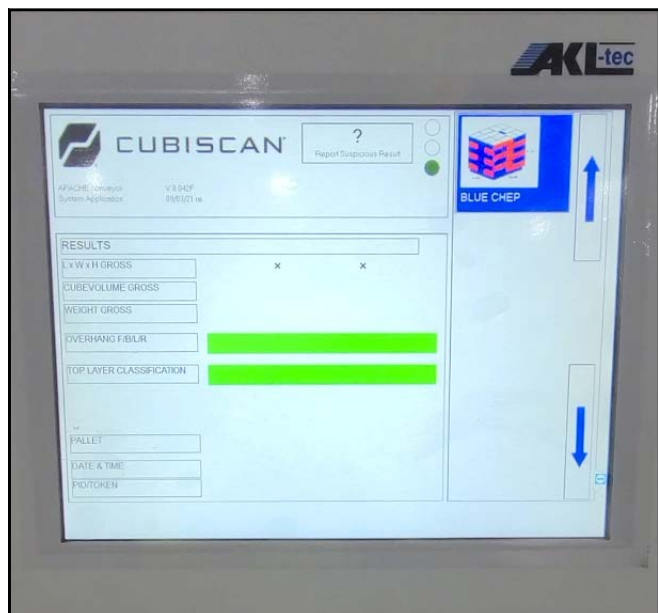


Figure 9
Touchscreen

Never use a sharp or hard-tipped object to tap on the touchscreen. It is fragile and can scratch or break. You can tap lightly on the screen with your fingertip, or you can use the eraser end of a pencil or a stylus with a soft point. Use a light touch just hard enough for the screen to respond.

Contour Pro Interface

Contour Pro is designed to be used in fully automated systems. An interface is provided to display results of measurements, adjust settings, and report anomalies in measurement.

This section describes the different areas and windows found on the home screen.

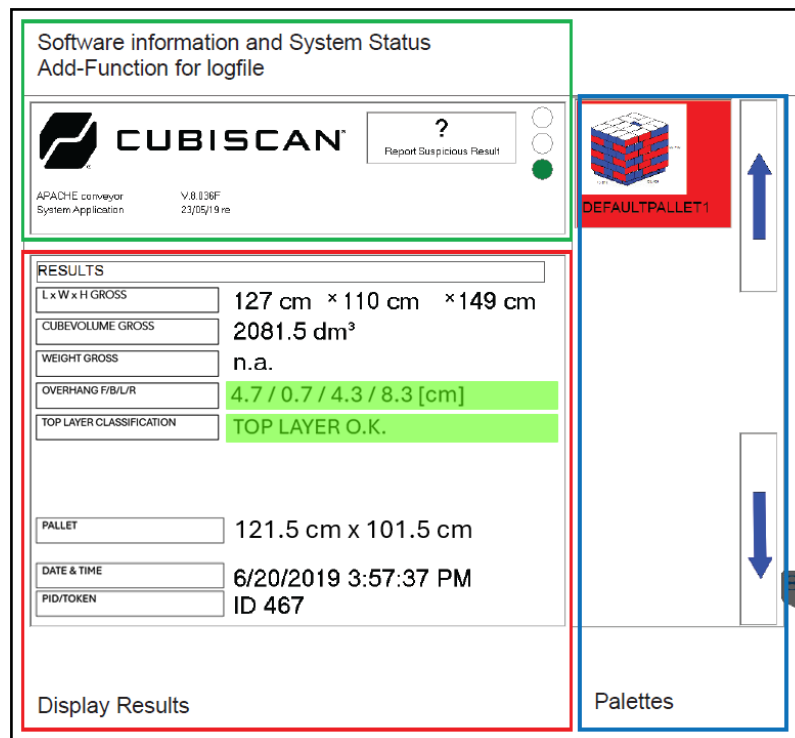


Figure 10
Home screen

System Information

The System Information reports the Contour Pro's current status. This section of the main screen also displays the status button.



Figure 11
System status

Software Information

The system information section of the home screen displays the version and revision date of the Contour software.

APACHE conveyor	V.8.036F
System Application	23/05/19 re

System status

The system status indicates the state of the Contour Pro. There are three states: **ready and waiting**, **calculating**, and **measuring**.



Green LED -> System ready, waiting.



Yellow LED -> System is calculating.



Red LED -> System in measuring process.

Measurement results

The measurement window displays the results from the previously measured pallet. The following information is displayed in the window:

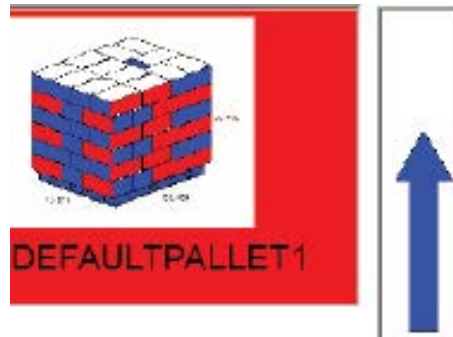
RESULTS	
L x W x H GROSS	127 cm × 110 cm × 149 cm
CUBE VOLUME GROSS	2081.5 dm ³
WEIGHT GROSS	n.a.
OVERHANG F/B/L/R	4.7 / 0.7 / 4.3 / 8.3 [cm]
TOP LAYER CLASSIFICATION	TOP LAYER O.K.
PALLET	121.5 cm x 101.5 cm
DATE & TIME	6/20/2019 3:57:37 PM
PID/TOKEN	ID 467

Figure 12
Measurement results

L x W x H GROSS	Displays the measured gross values for each dimension length, width, and height measured in centimeters.
CUBE VOLUME GROSS	Displays gross cube volume, which is the product of the length, width, and height measured in cubic decimeters.
WEIGHT GROSS	Gross Weight is not used on the Contour Pro.
OVERHANG F/B/L/R	Displays measured overhang of the pallet on all four sides: front, back, left, and right side.
TOP LAYER CLASSIFICATION	Indicates whether top lay of the pallet are within specifications or if pallet is flagged as being out of spec.
PALLET	Displays the dimensions of the pallet as determined by the pallet type.
DATE & TIME	Displays the timestamp for the measurement. This timestamp will be recorded in the log file.
PID/TOKEN	Displays the internal ID Number for the measured pallet.

Pallets field

The pallets field allows for the selection of pallet type from a list of pre-determined pallet types. Use the blue up and down arrows to scroll through the pallet types.



Add-function

The add-function allows the user to add a comment to the logfile on flagged pallets that are out of spec. Complete the following steps in order to add a comment to a flagged pallet:

1. Click of the button **[Report Suspicious Result]**.



2. A new window will open with scripted comments. Select a comment for the flagged measurement.

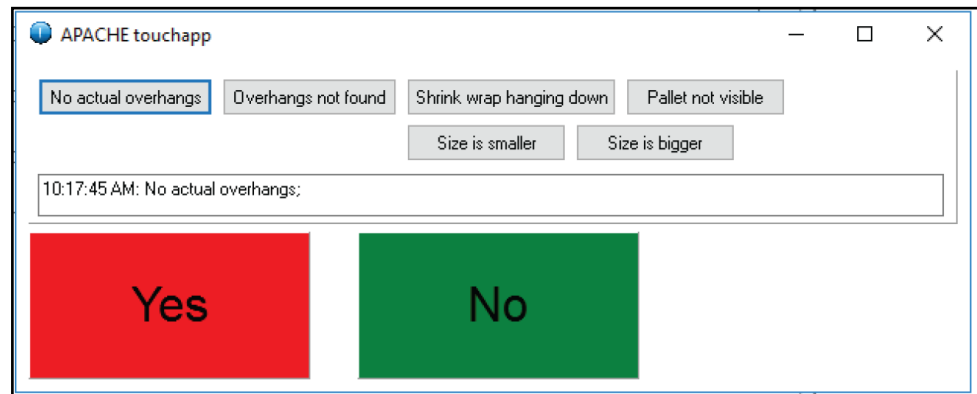


Figure 13
Flagged measurement

3. After selecting the appropriate comment, click **[Yes]** if an issue exists with the pallet or click **[No]** if there is no issue.

Accessing Photos



The Contour Pro is equipped with an Axis camera, which may be used to take pictures of product as part of the measurement process. These images may be set up to push to a network source or may be retrieved directly from the Contour Pro.

To retrieve the images from the Contour Pro, first, plug in a keyboard to the PC unit found in the control cabinet of the Contour Pro.



Figure 14
PC input

Plug the keyboard into one of the free USB slots on the back of the PC unit. You may also plug in a flash drive to store the images on.

Once the keyboard is plugged in, hit **Shift-Esc** on the keyboard to exit the main screen and access the home screen for the underlying operating system. From here you may access the file explorer by running it from the command prompt or the apps menu.

With the file explorer up, look for the APA folder on the local disk (typically designated as the C:\ drive).

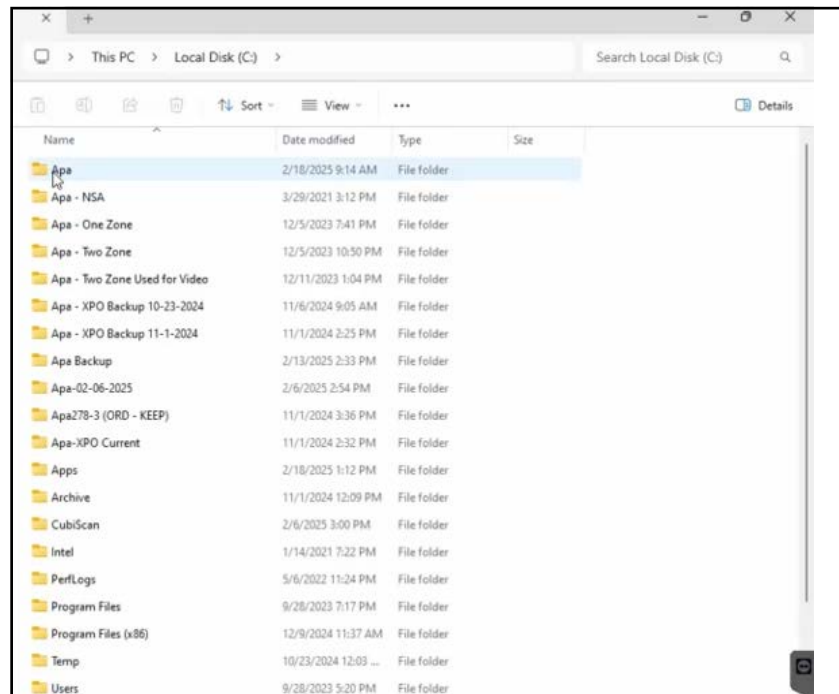


Figure 15
APA folder

Within the APA folder find the images folder. Once found, access the image folder to find the images acquired by the Axis camera.

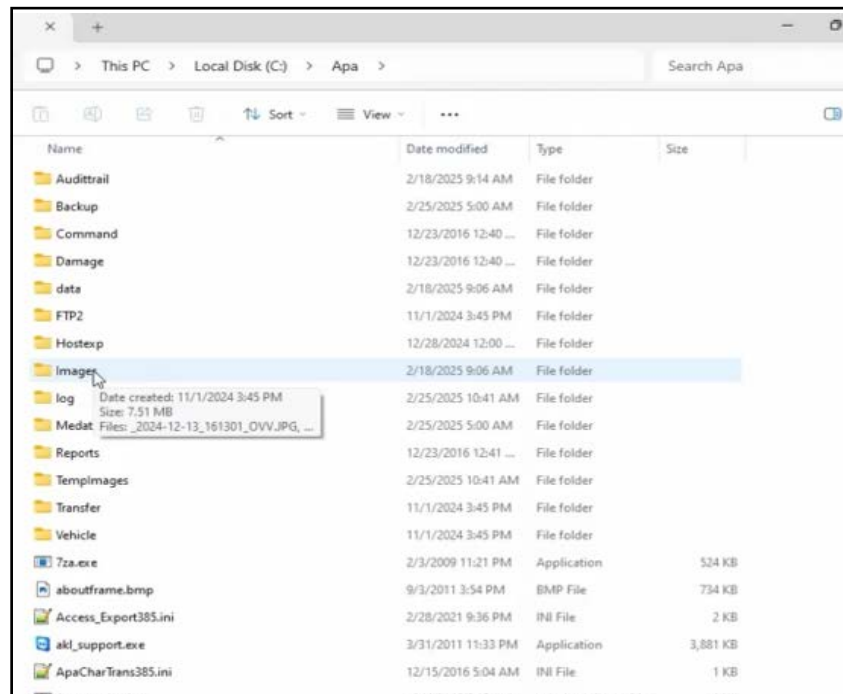


Figure 16
Images folder

Each image is labeled with a series of numbers that identify certain information for each of the images. The label is made up of the

barcode identifier + sequence number + date the image was required.

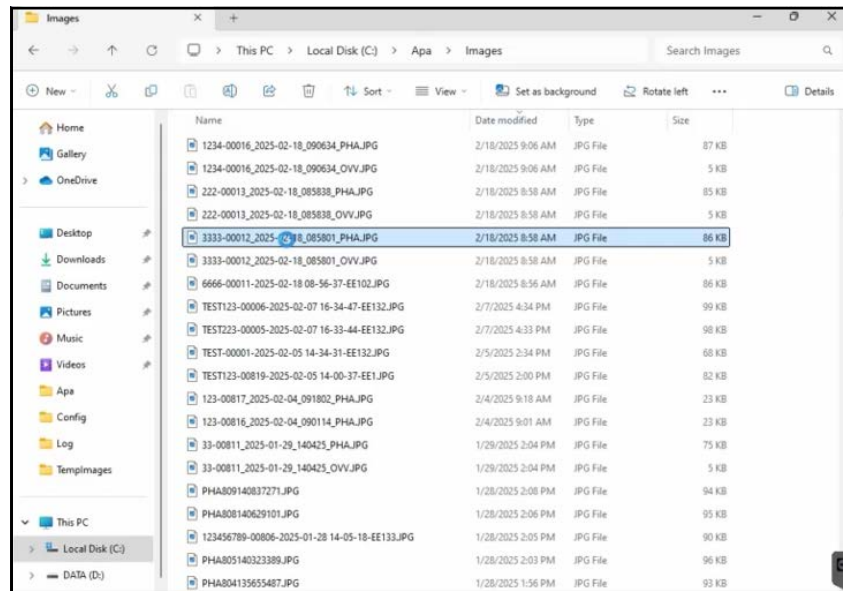


Figure 17
Image file

The images may be moved to a flash drive to transfer to another storage device.

CHAPTER 4

CONFIGURATION

This chapter provides instructions for using the Contour Pro touchscreen to set up preferences and operate special features that the Contour Pro offers.

Integrated Scale



The Contour Pro can be integrated with a conveyor scale. When a scale is set up with the Contour Pro, the weight is displayed in the measurement results window. If you would like to configure your Contour Pro with a conveyor scale, contact your system integrator or call **Cubiscan Service and Support** at (801) 451-0500 for assistance.

Payload Pass/Fail Criteria



After loads are measured by the Contour Pro, data will be reviewed and compared to specified parameters to establish a pass/fail of the payload. Cubiscan will directly establish pass/fail of the payload according to default settings or customer specification according to a predetermined recipe.

The default process and pass/fail criteria are defined below. Default criteria may be adjusted through recipes uploaded to the Cubiscan system. Recipes may be defined according to customer needs in order to provide accurate measurement data for product management or to provide feedback for an automatic guided vehicle (AGV) system.

Payload Overhang

The maximum allowable overhang in any direction will be defined by the parameters set for the customer. The overhang measurement tolerance is +/- 12.7mm (+/- 0.5 in). Therefore, to ensure that overhang does not exceed 50.4mm, the overhang measured by Cubiscan cannot exceed $50.8\text{mm} - 12.7\text{mm} = 38.1\text{mm}$.

Since the value provided can be +/- XX due to the direction of the measurement, then the absolute value of the measurement should not exceed 38mm. The Contour Pro will measure and communicate actual Payload Overhang values.

Cubiscan will automatically fail any Payload Overhang that exceeds the customer defined parameter.

The following criteria will be used to establish pass/fail of the payload. Pass/Fail criteria may need to be adjusted to allow for actual field conditions.

Overhang Pass/Fail Criteria

The following formulas established the pass criteria for payload overhang. If the payload does not meet all these criteria, it will be rejected.

Absolute Value	Maximum Offset
RightOverhang	< param*
LeftOverhang	< param*
FrontOverhang	< param*
BackOverhang	< param*

*customer defined

Payload Center

The maximum allowable offset of the bounding box relative to the pallet in any direction will be defined by customer needs. The bounding box measurement is +/- 12.7mm (+/- 0.5"). Therefore, to ensure that offset does not exceed 76.2mm, the payload offset measured by Contour Pro cannot exceed $76.2\text{mm} - 12.7\text{mm} = 63.5\text{mm}$.

Since the value provided can be +/- X due to the direction of the measurement, then the absolute value of the measurement should not exceed 64mm.

The following criteria will be used to establish pass/fail of the payload. Pass/Fail criteria may need to be adjusted to allow for actual field conditions.

Payload Center Pass/Fail Criteria

The following formulas established the pass criteria for Payload Center. If the payload does not meet all these criteria, it will be rejected.

Absolute Value	Maximum Offset
PayloadXAxis	< param*
PayloadYAxis	< param*

*customer defined

Payload Lean

After a payload is measured, the Contour Pro sends measurement data which includes the Actual Offset which is the top of load center relative to the payload center. These variables are called the Top2PayloadXAxis and Top2PayloadYAxis. These values are then compared to calculated Allowable Offsets that take into consideration the measurement tolerance and height of the load.

The Actual Offset cannot exceed the Allowable Offset. The following is the calculation for the Allowable Offset. The variables below are used in these calculations:

Variables:

PayloadHeight Payload height as measured by Cubiscan

θ Represents allowable lean vertical angle. Adjusting this increases allowable offset of top of load with height.

X Offset	Adjusts for width measurement tolerances
Y Offset	Adjusts for length measurement tolerances
Allowable X Axis Offset	$X \text{ Offset} + \text{Payload Height} * \tan(\theta)$
Allowable Y Axis Offset	$Y \text{ Offset} + \text{Payload Height} * \tan(\theta)$

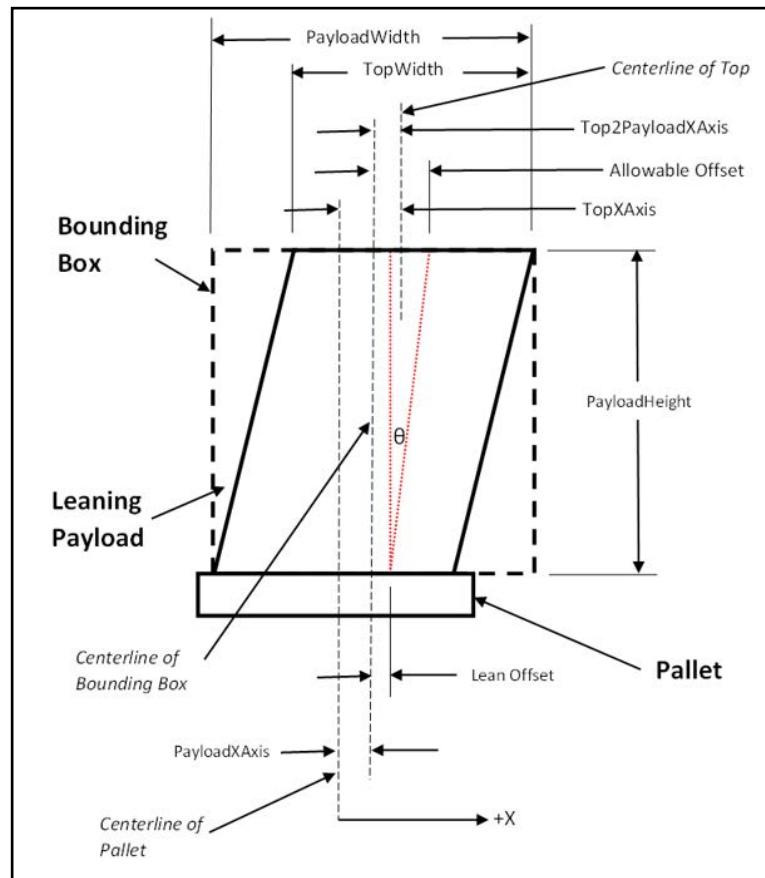


Figure 18
Width of payload lean

Below is the calculation to determine the actual offset of the Top of Payload relative to the Bounding Box base for width and length using Cubiscan measurement data.

$$\begin{aligned}\text{Actual X Axis Offset} &= | \text{Top2PayloadXAxis} | \\ \text{Actual Y Axis Offset} &= | \text{Top2PayloadYAxis} |\end{aligned}$$

The following formulas established the pass criteria for Payload Lean. If the payload does meet all these criteria, it will be rejected. The value of theta (θ) will be fixed at 1° while the value of both X & Y

offsets will be 25mm. This criterion will be used to establish pass/fail of the payload but may need to be adjusted in the field to compensate for actual conditions. When inserting the values into the above formula we get:

$$\begin{aligned} |\text{Top2PayloadXAxis}| &< 25\text{mm} + (\text{PayloadHeight} * \tan(1^\circ)) \\ |\text{Top2PayloadYAxis}| &< 25\text{mm} + (\text{PayloadHeight} * \tan(1^\circ)) \end{aligned}$$

For reference, the following table shows allowable offsets at various height loads for an Offset of 25mm and Theta (θ) of 1° . Note these are typical values that may vary depending on customer defined parameters.

Payload Height (mm)	Offset (mm)	Theta (θ)	Allowable Offset (mm)
500	25	1°	34
1000	25	1°	42
1500	25	1°	51
2000	25	1°	60
2500	25	1°	69

Payload Size

The Contour Pro measures the payload and provides information that defines the minimum size bounding box that the payload will fit into. These measurements (PayloadWidth & PayloadLength) need to be compared to the expected width and length as defined in the pallet recipe. This is necessary because payloads may appear straight under the payload lean test but are excessively bowing or sticking out at the middle height of the load.

The following formulas established the pass criteria for Payload Size. The parameters varWidth and varLength are customer defined parameters used here for illustrative purposes. If the payload does not meet the defined criteria, it will be rejected.

$$\begin{aligned} \text{PayloadWidth} &< \text{varWidth} + 75\text{mm} + (\text{PayloadHeight} * \tan(1^\circ)) \\ \text{PayloadLength} &< \text{varLength} + 75\text{mm} + (\text{PayloadHeight} * \tan(1^\circ)) \end{aligned}$$

Missing Case in Top Layer

The Contour Pro can detect missing cases in the top layer of a payload. This is only done if a request is made to do so for each pallet. This is accomplished by specifying a recipe through the Cubiscan ContourID command.

Recipes are predefined and the Contour Pro system holds this information in memory. Each recipe identifies a specific case size. The customer specifies case sizes for each recipe. When the Cubiscan system scans a payload, it will then look for an opening in the top layer that is equal to or greater than the specified recipe case size. If there is a missing case, the Contour Pro will fail the load.

[APPENDIX B "RECIPES" on page 59](#) contains an initial list of recipes and the associated case sizes. Recipe "Default" will be used in production and does not include scanning for a missing case from the top layer of the Payload.

Adjustable Pass/Fail Parameters

In the proceeding Pass/Fail sections, adjustable parameters have been defined which determined whether payloads will pass or fail the measurement process. These parameters align with the specifications of the project. During production testing many payloads will be scanned, trends will likely surface which may require the adjustment of these parameters.

The following is a summary of these parameters and their initial value which can be adjusted to accommodate actual pallet and payload trends to accommodate production conditions.

Adjustable Parameter	Initial Value*
Maximum Overhang - 4 sides	38mm
Payload X & Y offset relative to pallet center	64mm
SKU height, width, & length tolerance	+/- 50mm
Payload lean maximum angle	1°
Payload lean measurement tolerance - payload offset	25mm
Payload size offset	75mm

Adjustable Parameter	Initial Value*
Payload size maximum angle	1°

*customer defined

Payload Scanning Process



The following flow chart provides a high-level schematic of the payload scanning process. It starts when a load is manually dropped at the inbound station of the conveying system. It is then advanced

to the Cubiscan profiling location and then moved to the reject location or storage pickup location for movement.

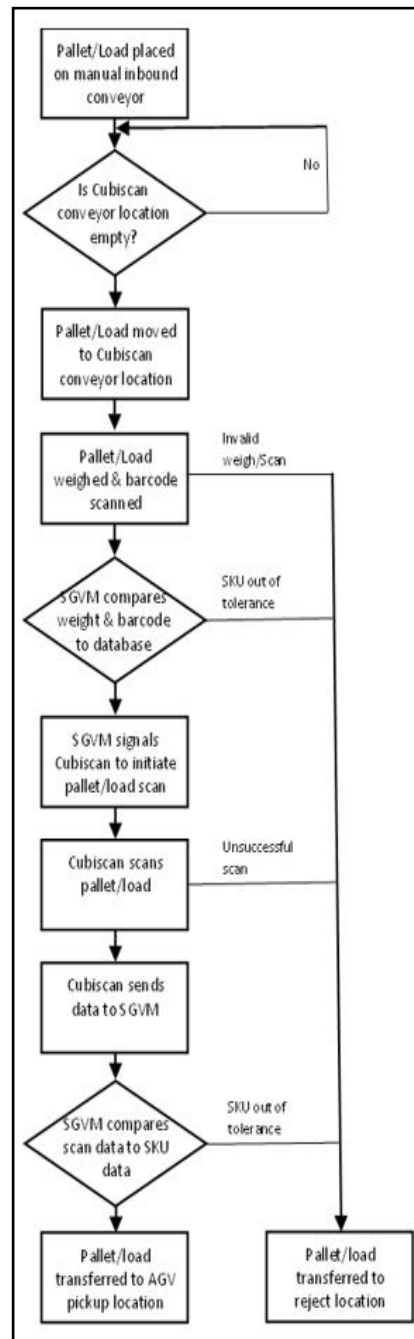


Figure 19
Flowchart

Data Collection

Measurement data may be sent to an automated guided vehicle AGV system for picking up a pallet. This information will be used to adjust the system software to accurately and safely store and retrieve pallets in the warehouse.

Payload Center

Payload Center measurements will be sent to the system for each pallet. This data includes the offset of the payload Bounding Box relative to the center of the pallet. The system may use this information to stack loads so that payload centers can be aligned.

The following table show the data that will be provided. Note, the values will differ according to customer defined parameters.

Description	Range*	Tolerance*
PayloadXAxis	0-102mm (4.0")	+/- 12.7mm
PayloadYAxis	0-102mm (4.0")	+/- 12.7mm

*customer defined

Load Height

Payload height will be sent to the system for each pallet being picked up. This is the height of the payload Bounding Box but does not include the height of the pallet. The system may use this information to stack loads so that payload centers can be aligned when stacking loads.

The following table show the data that will be provided. Note, the values will differ according to customer defined parameters.

Description	Range*	Tolerance*
PayloadHeight	0-2601mm (102.4 in)	+/- 12.7mm

*customer defined

Payload Overhang

Payload overhang will be sent to the system for each pallet being picked up by the system. This is the Payload Overhang on all 4 sides of the pallet. The system may use this information to adjust pallets when storing and retrieving in racking.

The following table shows the data that will be provided. Note, the values will differ according to customer defined parameters.

Description	Range*	Tolerance*
RightOverhang	0-102mm (4.0 in)	+/- 12.7mm
LeftOverhang	0-102mm (4.0 in)	+/- 12.7mm
FrontOverhang	0-102mm (4.0 in)	+/- 12.7mm
BackOverhang	0-102mm (4.0 in)	+/- 12.7mm

*customer defined

Data Output Protocols



The Cubiscan Pro may be configured to use a direct hardware interface, serial connection, or ethernet. The Cubiscan uses the typical communications protocols of Ethernet IP, Ethernet TCP/IP and Modbus TCP.

The following section outlines connection methods and communication protocols used by the Contour Pro.

TCP Socket

Default (with static IP address, can be configured)

IP Address	Subnet	Gateway	Port
10.1.100.100	255.255.255.0	10.1.100.1	1050

Serial

RS-232

Baud Rate	Parity	Data Bits	Stop Bits
9600	None	8	1

USB

For Cubiscans that support an HID connection, use the following VID and PID:

Vendor ID	Product ID
0x1FC9	0x0081

HTTP Requests

Measurements can be retrieved from the Cubiscan using HTTP requests. This can be accessed by visiting the Cubiscan's IP address followed by the related route. A complete outline is provided in the section entitled ["Communication Protocols" on page 41](#).

Measurement Format

When connected with a TCP Socket, Serial, or USB, the Cubiscan will frame all communication packets starting with <STX> and ending with <ETX><CR><LF>. This includes measurement packets. Definitions for these symbols are outlined below:

Character	ASCII Dec	ASCII Hex	Escape Character	Description
<STX>	2	02	\x02, \u0002	Start of Text
<ETX>	3	03	\x03, \u0003	End of Text
<CR>	13	0D	\r	Carriage Return
<LF>	10	0A	\n	Lines Feed

Likewise, all data packets received from the Cubiscan must be framed in the same format.

Requesting Measurements

When connected with a TCP socket, Serial, or USB, a measurement can be requested by sending 'M' in the proper command frame, like so:

Command	<STX>M<ETX><CR><LF>
Using Escape Characters	\x02M\x03\r\n OR \u0002M\u0003\r\n
Command as Bytes	02 4D 03 0D 0A

Communication Protocols



The Contour Pro is compatible with various communication protocols. These include Modbus TCP, Ethernet IP, and Ethernet TCP/IP. The following section will cover the Modbus TCP protocols. If you require the use of Ethernet IP or Ethernet TCP/IP, please contact **Cubiscan Service and Support** at (801) 451-0500 for assistance.

CUBISCAN to PLC

Defined Variables

Variable	Definition
Status	DINT, 0=Ready, 1=In Progress, 2=Good Pallet, 3=Bad Pallet or not measurable
ErrorCode	DINT, When Status = 3
PayloadHeight	DINT , mm
PayloadWidth	DINT , mm
PayloadLength	DINT , mm
RightOverhang	DINT , mm
LeftOverhang	DINT , mm
FrontOverhang	DINT , mm
BackOverhang	DINT , mm
TopWidth	DINT , mm
TopLength	DINT , mm
TopXAxis	DINT , mm
TopYAxis	DINT , mm
PayloadXAxis	DINT , mm
PayloadYAxis	DINT , mm
LeanXAxis	(DINT , %)
LeanYAxis	(DINT , %)

Memory map

Allocated 80 bytes starting in position 16, skipping positions 0-15. The first 16 bytes are skipped due to alignment reasons. Each variable is represented with 4 bytes so "Status" will start in position 4 where each position is defined with 4 bytes. Positions 0-3 (16 bytes) are skipped.

PLC to CUBISCAN

Defined Variables

Variable	Definition
Command	DINT, PLC control as to whether the Cubiscan is triggering when a Pallet arrives
ContourID	DINT, for remote pallet recipe selection for future use if ever needed

Memory map

Allocated 80 bytes starting in position 200. Each variable is represented with 4 bytes so "Command" will start in position 200 where each position is defined with 4 bytes.

Handshake Expected – Normal Execution

PLC to CUBISCAN	Command = 1	Measurement request
CUBISCAN to PLC	Status = 1	Measurement in Progress
CUBISCAN to PLC	Status = 2	Measurement Successful
PLC to CUBISCAN	Command = 2	Measurement Successful Acknowledge
CUBISCAN to PLC	Status = 0	Ready and waiting...

Handshake Expected – Failed

PLC to CUBISCAN	Command = 1	Measurement request
CUBISCAN to PLC	Status = 1	Measurement in Progress
CUBISCAN to PLC	Status = 3	Measurement Failed
PLC to CUBISCAN	Error Code	Error codes provided below
CUBISCAN to PLC	Command = 3	Measurement Failed Acknowledge

Note: When a measurement fails (Status=3), it either failed because the pallet was not able to be measured or the pallet failed the contour check. If it was not able to be measured the overhang and size fields will be filled with zeroes, otherwise they will contain results.

Error Code

```
0000.0000.0000.0000.0000.0000.0000.0000
-----SYSTEMERROR_ID.0000.000M.RLBF.0ABC
*****HIGHWORD*****.*****LOWWORD*****
```

F=1 → Overhang Front (swappattern regarded)
B=1 → Overhang Back (swappattern regarded)
L=1 → Overhang Left (swappattern regarded)
R=1 → Overhang Right (swappattern regarded)

A=1 → Maximum length exceeded
B=1 → Maximum width exceeded
C=1 → Maximum height exceeded

M=1 → Top layer has missing part

SYSTEMERROR_ID is 0 for a good measurement. In case of error it can have a number >=1 whereas the most common numbers are

1	Time Out
2	Checksum Calibration File
3	Filesize Calibration File
4	Exception in Volume Processing
5	Angle Resolution LMS1 not at HIRES
6	Angle Resolution LMS2 not at HIRES
7	Improper SerialID LMS1
8	Improper SerialID LMS2
9	Too many empty scans LMS1
10	Too many invalid scans LMS1

11	Too many empty scans LMS2
12	Too many invalid scans LMS2
13	Head counter value too low LMS1
14	Head counter value too low LMS2
15	Error in Parameter File
27	Error during Comport Initialisation LMS 1
28	Error during Comport Initialisation LMS 2
39	Dirty head LMS1
40	Dirty head LMS2
41	Interface/Host no response!
54	Error DongleRead
55	Error DongleWrite
59	Error object exceeds border (too large)
60	Error object exceeds maximum height (too tall)
61	Initial zeroing failed.
62	Checksum Error in Exe-File
63	Error while generating Exe-Checksum
64	Error reading Masterdata
65	Error in language file
69	LMS Dirty Head
71	Error generating checksum for %SystemRoot%
72	Checksum Error Filenames in %SystemRoot%
106	Control Voltage Down (Emergency Stop)
108	Error Gap inside object
109	Conveyor Speed out of Range
110	Error during Comport Initialisation HOST
115	CONTOUR: No pallet found.
116	CONTOUR: Result not plausible.
118	Error Contourdefinition unknown
120	Error Object exceeds maximum length
121	Error Object exceeds maximum width
122	Error More than one object (DUST)
123	Error Object too small
124	Error Permanent Object in LMS
130	Error object exceeds border (BACK/ZMIN)
131	Error object exceeds border (FRONT/ZMAX)
132	Error object exceeds border (LEFT/XMIN)
133	Error object exceeds border (RIGHT/XMAX)
134	Angle Resolution LMS1 not at HIRES
135	Dirty head LMS3
136	Head counter value too low LMS3
137	Too many invalid scans LMS3
138	Invalid Product Licence
140	Conveyor is blocked.
143	Object too big

145	Contour: Rotate Snapshot
146	Data Process Error
147	Rotate Contour Snapshot
148	Data Process Error
149	No Payload

CHAPTER 5

MAINTENANCE

This chapter provides information on the care and maintenance of the Contour Pro. Routine maintenance and careful handling will help keep the Contour Pro in good operating condition and prevent service call or repairs.

Touchscreen Care



To clean the touchscreen, moisten a soft cloth with water, then gently wipe the screen clean with the cloth, do not spray liquid directly on the touchscreen.

Do not let the touchscreen come into contact with any sharp objects.

Cleaning the Contour Pro Lasers



The laser heads should be kept clean. While some dust normally won't interfere with sensor operation, they should be cleaned routinely to prevent the possibility of interference. The frequency with which the laser heads should be cleaned depends on the Contour Pro's operating environment. Typically, the laser should be cleaned at three month intervals.

To clean the laser heads, you will need the following.

- Ladder (or another means of reaching the Contour Pro laser heads)
- Clean, dry microfiber cloth

Once the laser heads are within reach, gently wipe the probe visor with a dry microfiber cloth.



Figure 20
Probe visor

When you clean the laser heads be sure that you are following all required safety regulations.

Change the Control Box Filters



This section provides information on how to change the control box filters. These filters should be changed as needed, depending on the Contour Pro's operating conditions.

To change the filters, complete the following steps:

1. Locate the two filters located on the front and side of the control box (shown below).



Figure 21
Control Box Filter

2. To remove the top filter, press the black tabs on the four sides of the filter and gently wiggle the filter guard free. It should simply pop out.



Figure 22
Control Box Filter (inside)

3. To remove the bottom filter, first turn power off. Then, detach the fan by removing the four screws on each corner of the fan. Once the fan is detached, the bottom filter may be removed the same as the top filter.
4. Press the tab on the filter and pull outward to slide filter from the filter guard.

5. Clean the filters or replace them with new ones.

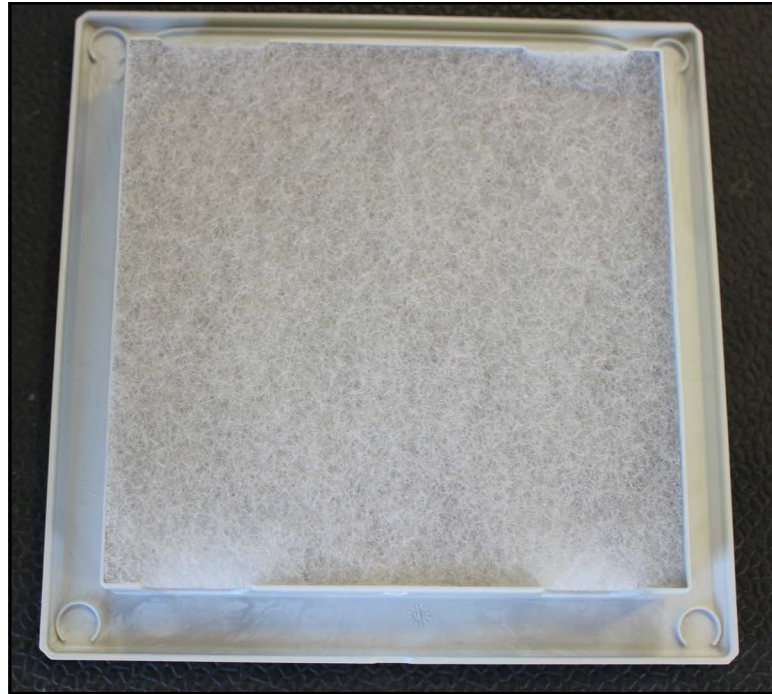


Figure 23
Filter

6. Slide the filter back into the filter guard. Snap the filter guards back into place.

Maintaining the Computer System



Maintenance on the computer system of the Contour Pro can only be performed by the Cubiscan supplier. For maintenance purposes once a measuring system is successfully installed, the customer enters a service agreement with Cubiscan, in which the service and monitoring intervals and arising costs are specified.

In the scope of preventative maintenance, the hard drives and laser diodes of the probes can be exchanged. All components used are standard components.

Stored data and the operating system must undergo regular system maintenance. A regular checkup of the computer system allows early recognition of possible causes of faults.

CHAPTER 6

TROUBLESHOOTING

This chapter provides assistance in identifying and solving common problems with the Contour Pro. If you encounter problems not covered in this chapter, or if a defect is suspected, contact your system integrator or call **Cubiscan Service and Support** at (801) 451-0500 for assistance.

General Information



Keep debris out of the measurement area.

If you have a scale and scale guard, ensure that the scale guard is not touching the sides of the scale.

Object Exceeds Border

This error message occurs when there is an object in the measurement field that exceeds the measurement area's borders.

Typically the error message also includes the side that is causing the error message to occur.

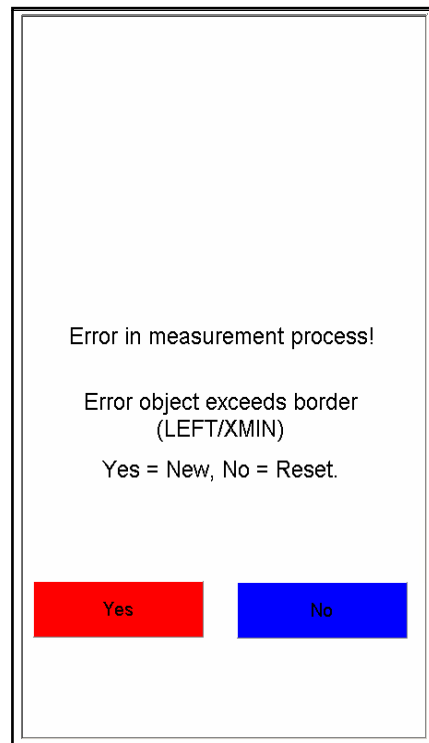


Figure 24
Object Exceeds Border

The above example reads **(LEFT/XMIN)**, indicating where the object exceeded the measurement border. The following errors may occur:

- | | |
|-------------------|--|
| Left/Xmin | the left side of the payload bounding box was exceeded. |
| Right/Xmax | the right side of the payload bounding box was exceeded. |
| Front/Zmin | the front side of the payload bounding box was exceeded. |
| Back/Zmax | the back of the payload bounding box was exceeded. |

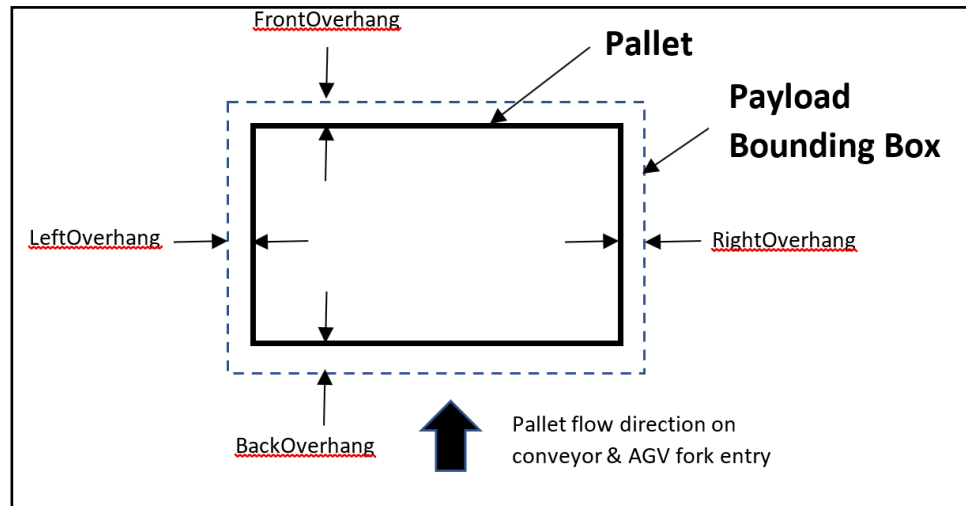


Figure 25
Pallet diagram

When this error occurs, ensure there is no debris in the measurement area. Then, choose one of the following options:

Tap **[Yes]** if you'd like to start a new measurement.

Tap **[No]** if you'd like to try measuring again using the same barcode.

If the object does not appear to exceed the measurement area and error persists, contact **Cubiscan Service and Support** at (801) 451-0500 for assistance.

Contamination on Lasers



This error message may occur when there is more than one object in measurement area or contamination on the lasers. This error

message may come in a variety of forms but will typically include **DUST** as part of the error message.

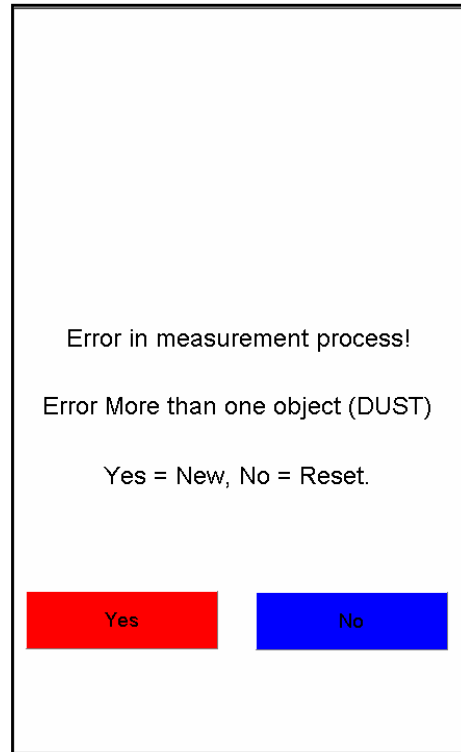


Figure 26
Contamination on Lasers

This means that the lasers are blocked, either by dust or another object. To resolve the error, ensure there is no debris in the measurement area and only one object is being measured at a time. To clean the laser sensors, see ["Cleaning the Contour Pro Lasers" on page 47](#) for more information.

Contour Pro Is Not Responding



If the Contour Pro is not responding, try powering it off. For information on how to do this, see ["Powering the Contour Pro On/Off" on page 17](#).

Make sure that the power switch is turned off for 20 seconds or more to ensure that all power has been drained from the system.

If powering the Contour Pro off does not work, contact **Cubiscan Service and Support** at (801) 451-0500 for assistance.

List of Errors



The following table lists common errors associated with the Contour Pro:

Error #	Error Message	Error Meaning
1	Time Out	Measurement not completed after set amount of time
2	Checksum Calibration File	Software needs to be authenticated
39	Dirty head LMS1	Need to clean LMS1 sensor
40	Dirty head LMS2	Need to clean LMS2 sensor
	Dirty head LMS3	Need to clean LMS3 sensor
59	Error object exceeds border (too large)	Item too large
60	Error object exceeds maximum height (too tall)	Item too tall
115	CONTOUR: No pallet found.	Pallet not seen on conveyor
116	CONTOUR: Result not plausible.	Point cloud data collection was unsuccessful
118	Error Contour definition unknown	The pallet recipe was not found
120	Error Object exceeds maximum length	Object too long
121	Error Object exceeds maximum width	Object too wide
122	Error More than one object (DUST)	More than one object in measurement area

Error #	Error Message	Error Meaning
123	Error Object too small	Object too small
130	Error object exceeds border (BACK/ZMIN)	The back of the measurement area was exceeded.
131	Error object exceeds border (FRONT/ZMAX)	The front of the measurement area was exceeded.
132	Error object exceeds border (LEFT/XMIN)	The left side of the measurement area was exceeded.
133	Error object exceeds border (RIGHT/XMAX)	The right side of the measurement area was exceeded.
147	No Payload	No payload on pallet

APPENDIX A

PARTS LIST

Following is a list of parts that can be purchased for the Contour Pro as spare parts or if replacement is necessary.

Part No.	Description	Quantity/Unit
13579	LMS500-20000 Laser	3
13821	DISPLAY, TOUCH 15in, AKL	1
13822	INVERTER, VARIABLE	1
13824	ENCODER,1024 24V 12mm, AKL	1
13825	SENSOR ASY, PROXIMITY, AKL	3
13917	MOTOR, SPIROPLAN	1
15884	PC, EMBEDDED, AKL CTRLR,	1

APPENDIX B

RECIPES

Contour ID Recipes and Case Sizes

There are two recipes that have been specified for the project. The following provides the details for each recipe. The first recipe is the default configuration. It defines the maximum measurement ranges for the Cubiscan system.

If the pallet and payload exceed these measurements, then the result will be reported as a failed scan. These dimensions are significantly larger than the actual anticipated pallets and payloads as the SGVM software will be responsible for using data from the Cubiscan units to separately accept or reject pallets.

The second recipe is optional. It defines the minimum size missing case in the top layer of the payload that the Cubiscan unit will look for. If an opening in the top layer of the pallet is equal or greater than 15cm x 15cm x 15 cm, the load will be rejected. This recipe will not be used for production but is a capability that can be available if needed.

Recipe 1- DEFAULT

```
// 04/18/23 Initial Creation of file during testing @Cubiscan
//
// ContourDefinition "Defaultpallet"
//
NAME DEFAULT
HINT This is the blue CHEP pallet
ID 0
PICTOGRAM_FNAME c:\apa\contours\defaultpallet.bmp
//
//All values in cm
//LENGTH is the direction of conveyor transport
MAX_LENGTH 142
MAX_WIDTH 162
MAX_HEIGHT 280
PALLET_LENGTH 101.6
PALLET_WIDTH 121.9
```

```
PALLET_HEIGHT 14.5
MAXOVERHANG_ZMIN 20
MAXOVERHANG_ZMAX 20
MAXOVERHANG_XMIN 20
MAXOVERHANG_XMAX 20
GENERAL_OVERHANG_BIAS 0
//
//Per user:
//Sum of Overhangs not to exceed 40cm / 16"
//Individual Overhangs not to exceed 20cm / 8"
//
MINITEM_LENGTH 60.0
MINITEM_WIDTH 70.0
MINITEM_HEIGHT 36.0
//
TOPLAYER_HEIGHT_OFFSET 10.0
//the point where we measure the size is the measured height -
toplayer_height_offset
//
```

Recipe 2- Example RECIPE1

```
// 04/18/23 Initial Creation of file during testing @Cubiscan
//
// ContourDefinition "Defaultpallet"
//
NAME RECIPE1
HINT This is the blue CHEP pallet
ID 0
PICTOGRAM_FNAME c:\apa\contours\defaultpallet.bmp
//
//All values in cm
//LENGTH is the direction of conveyor transport
MAX_LENGTH 142
MAX_WIDTH 162
MAX_HEIGHT 280
PALLET_LENGTH 101.6
PALLET_WIDTH 121.9
PALLET_HEIGHT 14.5
MAXOVERHANG_ZMIN 20
MAXOVERHANG_ZMAX 20
MAXOVERHANG_XMIN 20
MAXOVERHANG_XMAX 20
GENERAL_OVERHANG_BIAS 0
//
```

```
//Per user:
//Sum of Overhangs not to exceed 40cm / 16"
//Individual Overhangs not to exceed 20cm / 8"
//
MINITEM_LENGTH 15
MINITEM_WIDTH 15
MINITEM_HEIGHT 15
//
TOPLAYER_HEIGHT_OFFSET 10.0
//the point where we measure the size is the measured height -
toplayer_height_offset
//
```