



51R84S & 51R85S VISION SYSTEM OPERATING MANUAL

DECEMBER 2022



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51R84S & 51R85S - OPERATING MANUAL TABLE OF CONTENTS

Section Number	Description	Page Number
1.0	DESCRIPTION	1-1
1.1	DESCRIPTION	1-1
2.0	INITIAL HOOK UP & SET UP	2-1
2.1	INITIAL HOOK UP & SET UP	2-1
3.0	INTRODUCTION TO THE MAIN PAGE	3-1
3.1	INTRODUCTION TO THE MAIN PAGE	3-1
4.0	OPERATION	4-1
4.1	OPERATION	4-1
4.1.1	SETUP	4-2
5.0	EXTENDED OPERATION	5-1
5.1	EXTENDED OPERATION	5-1
5.1.1	UNDERSTANDING THE DIAGNOSTIC MENU	5-1
6.0	SECURITY	6-1
6.1	SECURITY	6-1
7.0	TROUBLESHOOTING	7-1
7.1	TROUBLESHOOTING	7-1
8.0	TECHNICAL ASSISTANCE	8-1
8.1	TECHNICAL ASSISTANCE	8-1

1. DESCRIPTION

1.1 Description

The Vision System is based upon a standard PC platform. The Industrial PC (IPC), which contains an Intel® i7-6700TE processor and 6 onboard network ports, is designed for machine vision and automation.

This system includes three Basler acA1440-73gc area scan, full frame, color cameras. They each have a 1/3" CMOS sensor with 1440 x 1080 resolution.

There is one white 4" x 8" LED backlight and two 4" x 4" backlights mounted in the camera enclosure opposite the cameras. As this vision system has an encoder to track a defective product as it moves along the conveyor belt, an Allen Bradley Micro Logix 1400 PLC is included. The PLC triggers the camera and tracks the bottles until the defective parts are opposite the reject station.

To reduce weight and the potential for voltage irregularities, an air to air heat exchanger is used in place of an air conditioner. To further pull heat out of the control enclosure a water to air heat exchanger is attached to the CPU.

The operating system is Windows® 10 IoT. The operator interface consists of .NET application. The functionality consist of Silgan's optimized machine vision inspections.

2. INITIAL HOOK UP & SETUP

2.1 Initial Hook up & Setup

As this system uses an industrial PC, the cabling to the monitor, mouse and keyboard are standard connections. A roll up keyboard is included with the system. These are used only to access applications other than the vision program. All programming for the vision application is performed with the touchscreen.

The main power connects through a 3/4" watertight connector, and requires 10 amps at 120VAC. If remote monitoring of the collected data is needed, a network cable can be fed through the 3/4" watertight connector that shares the encoder cable and into the control enclosure.

The standard encoder, provided with the Vision System, has 600 pulses per revolution (ppr). It works well with conveyor sprockets from 3.5" to 6" in diameter. Sprockets smaller than this should use a 300 ppr encoder. Sprockets above 6" should use 900 ppr. Conveyor speeds can be at 150' per minute or below. Higher speeds with a sprocket smaller than 3.5" will require an encoder with less than 600 ppr. The encoder has a quick disconnect connector, and a cable length of 25 feet.

The control enclosure is mounted on a stainless steel pole. It must be located within 10 feet of the camera enclosure. From a usability standpoint, the nearer the control enclosure is to the camera, the better. The touch-screen is mounted inside the control enclosure. It pivots 320° and may be rotated to face the conveyor. The main connection between the control enclosure and the camera enclosure is through a 24 pin quick disconnect cable assembly.

The reject station must be located no further than 32 bottle diameters from the camera enclosure. Greater distances can be achieved but reprogramming the PLC will be necessary. The current eject signal out is 24VDC at 1 amp.

The Down Bottle Sensor should be positioned on the side where bottles enter the system. The Down Bottle Sensor must be placed half a bottle width before the Part Present Sensor that is mounted in the camera enclosure. As the bottle leaves the Down Bottle Sensor, the Part Present Sensor must be on. The reflector must be located directly across the conveyor from the sensor. To activate, choose **Ejector Settings -> Down Bottle Sensor** from the Main Page. Then check the Down Bottle Sensor checkbox.

3. INTRODUCTION TO THE MAIN PAGE

3.1 Introduction to the Main Page

- Status Bar:** The top row of buttons show the current status of the system and allow the states to be toggled. Change a recipe, toggle online/offline, login/logout by touching the button.
- Image Bar:** The second row of buttons includes functionality for manually triggering the cameras and determining which set of images to display.
- List of Inspections:** This lists all the inspections that the vision system is capable of performing. Touch an inspection to configure it.
- Inspection Results:** Green border indicates that particular inspection Passed, Red indicates failed, and Grey indicates that inspection was disabled.
- Function bar:** The bottom row of buttons include features for configuring the system.
- Step control:** Controls the amount of change made during configuration

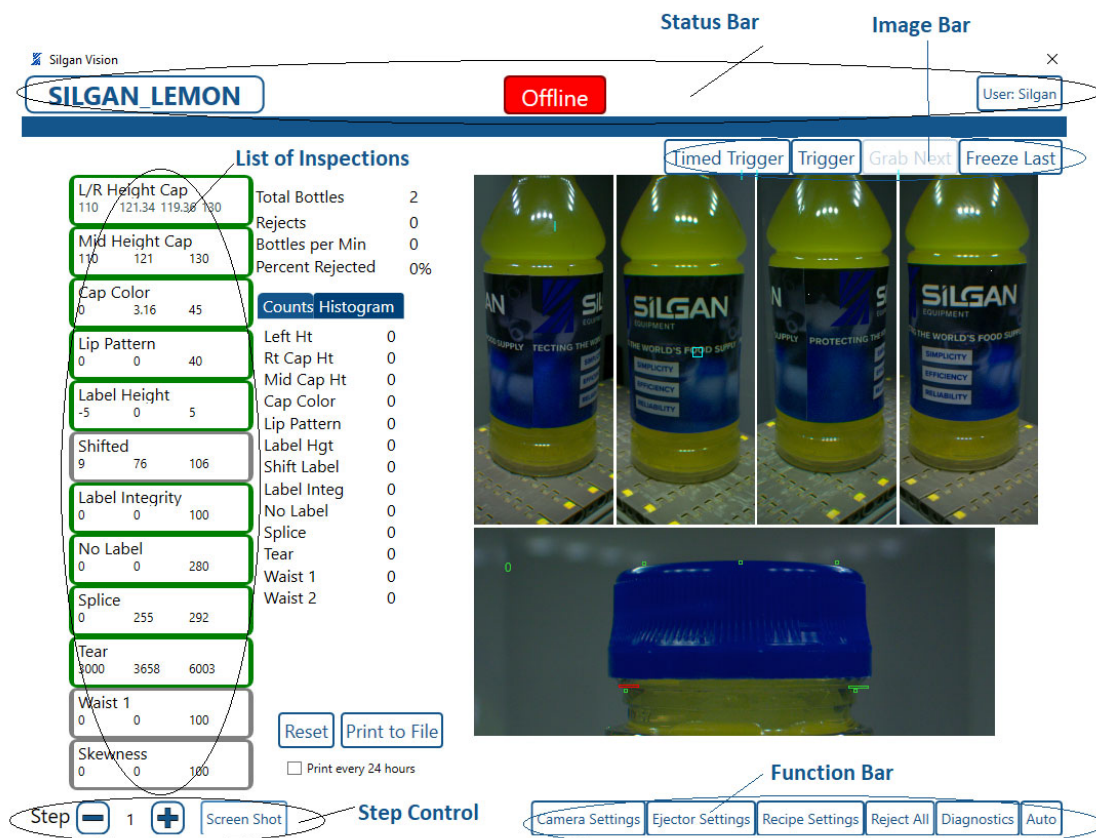


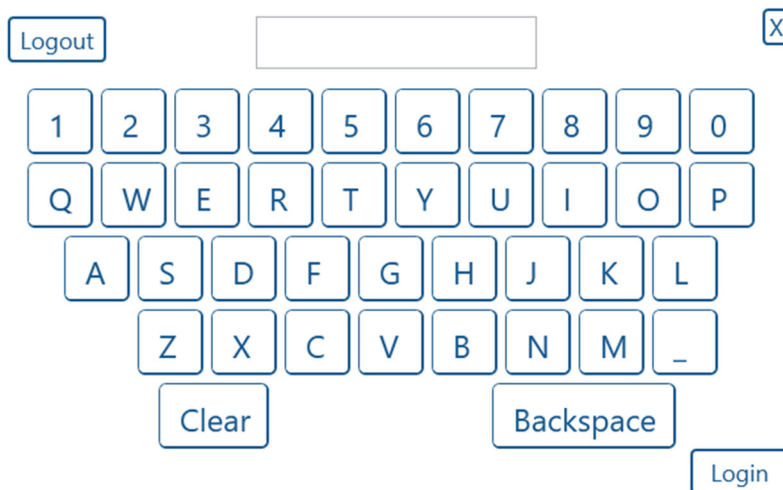
Figure 3-1: Understanding the Main Page

4. OPERATION

4.1 Operation

The vision application is scheduled to run after boot up. On startup, the operator is prompted to login (*Figure 4-1*). After the login process, the user must select a recipe (*Figure 4-2*). The main page will then load (*Figure 4-3*).

Note: You will need to familiarize yourself with the security system before you will be able to access the setup menus (*Section 6*).



The login page interface includes a 'Logout' button at the top left, a password input field at the top center, and a close button (X) at the top right. Below these is a numeric keypad (0-9) and an alphanumeric keypad (QWERTYUIOP, ASDFGHJKL, ZXCVBNM, and underscore). At the bottom are 'Clear' and 'Backspace' buttons, and a 'Login' button on the right.

Figure 4-1: Login Page



The 'Select a Recipe' interface features a title 'Select a Recipe:' at the top. Below the title is a large text area containing the text 'SILGAN'. At the bottom, there are three buttons: 'Create New Recipe', 'Copy Settings to New Recipe', and 'Load Recipe'.

Figure 4-2: Select a Recipe

4. OPERATION

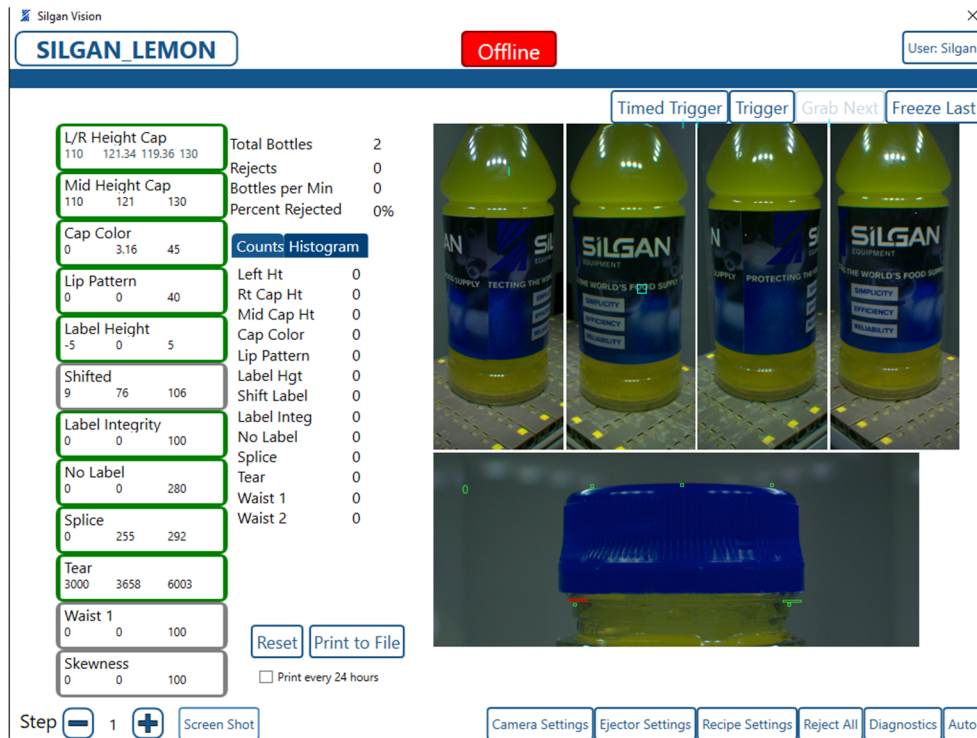


Figure 4-3: Main Page

4.1.1 Setup

Step 1 - Camera Configuration (First Time Set-Up)

Photo-eye Direction: This must be set to let the system know if the bottles are traveling from the right or the left.

Trigger Delay: This is the time between the bottle tripping the photo-eye and the time the picture is snapped. The delay setting should be set so that the bottle appears to be positioned the same distance from the center in both bottom camera windows.

Note: Be sure you double check this setting passing one bottle at a time. It is very easy to accidentally setup on the second bottle if there is a steady stream.

Ejector Settings: Adjust ejector settings. Touch the ejector button.

Digital I/O Setup: This allows the Vision System to be tied to another piece of equipment. Such equipment may kickoff a set number of bottles on startup, or signal when there are a specified number of consecutive rejects.

4. OPERATION

Recipe Settings: The current Recipe is displayed in the **Status** bar, in the top left (Figure 4-3). From the main page, touch the recipe name. The recipe dialog box will open (Figure 4-2). Select a **New Recipe**, enter a name and press the **OK** button. Any parameters changed from this point on will be saved with the current recipe.

Once a recipe has been set up and used, it will be saved for retrieval at a later date. To use the settings from this recipe for another recipe, select the recipe and touch **Copy Settings To New Recipe**. You will be prompted to enter the name of the recipe.

Step 2 - Adjust Enclosure Height

Place a bottle on the conveyor, so it is centered between the two bottom cameras. From the Main Menu, choose **Camera** then use the arrow buttons to **Adjust Enclosure Height**. Press up or down to adjust the height until the middle of the cap is level with the Part Present Sensor (Figure 4-4). After the height has been set, the value seen in the edit box will be saved. After opening a saved job, the height will automatically adjust back to the saved value when the start button is pushed. The start button will be displayed in a pop up dialog box.

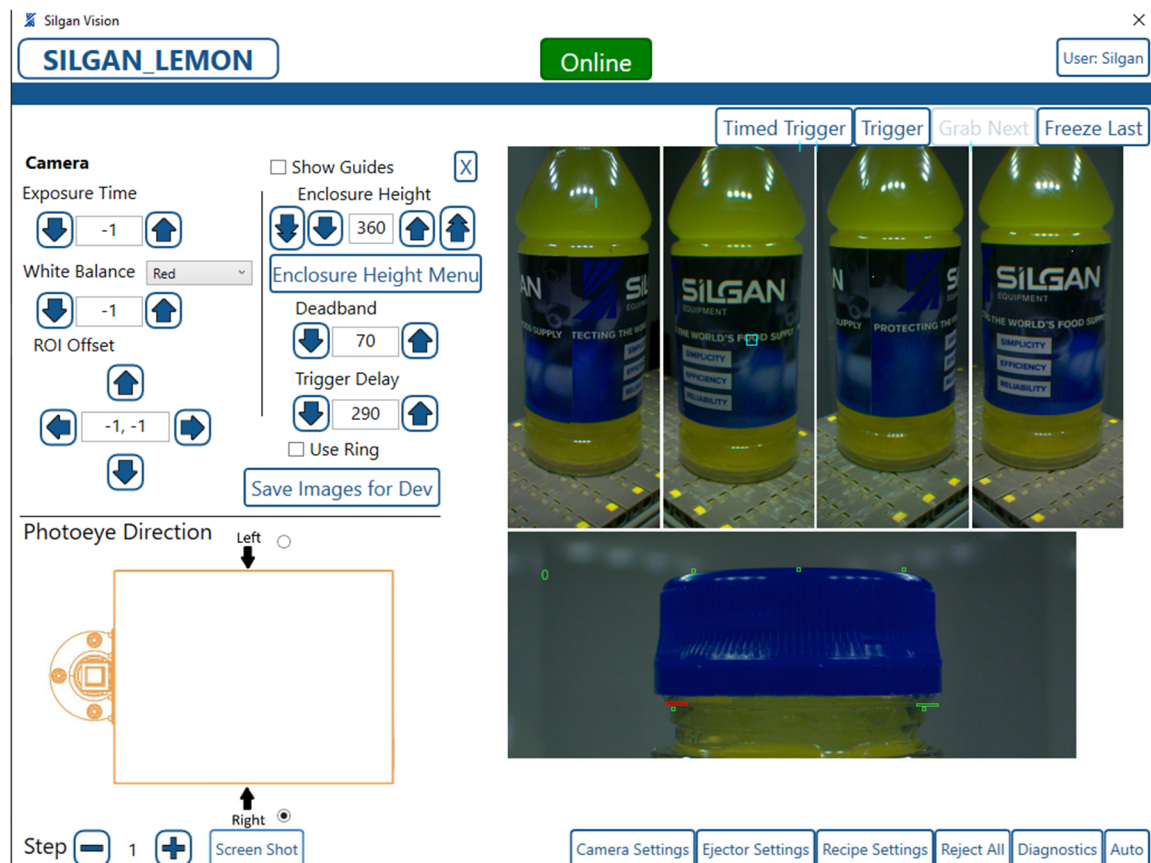


Figure 4-4: Adjust Enclosure Height

4. OPERATION

Step 3 - Adjust the Light Level

Adjust the light level by modifying the **Exposure Time**. Touch an image to select a camera, then using the up and down arrow buttons increase or decrease the exposure time until the bottle has dark edges around its entire perimeter. The software requires sharp contrast to reliably identify edges. The image can rarely be too dark unless the background at the edge of the picture starts to turn too dark (*Figure 4-4*).

If the arrows appear to do nothing when pressed, be sure there is a camera selected.

Note: The step control in the bottom left corner of the page controls how much the arrow buttons change the values.

4. OPERATION

Step 4 - Configure Height Inspections

Select one of the first four inspections by touching the box in the **Inspection List** on the left side. Configuration for those inspections will open.

1. The last acquired image will be used to “teach” the Vision System to recognize an acceptable bottle and cap combination. If this image is not useful, touch **Grab Next** to use the next image the vision system captures. Select an image of the bottle and cap that is relatively normal. Ensure it is not significantly different from the bottles to be inspected. The system is very tolerant and does not require sampling. However, the bottle neck and cap cannot be visually abnormal. **Trigger** and **Timed Trigger** will snap a picture of whatever is currently in front of the camera. Use this if the existing image in the dialog is not ideal.
2. First choose a filter for the inspection. Check the **Display Filter** box and choose the filter that offers the most contrast
3. Use the arrow buttons to move the blue lines for **Cap Corner**, & **Below Lip**. The Cap Corner, the vertical blue bar, should be positioned inside from the edge of the neck, not directly on the edge. The **Height Search Bar**, the gray dashed line, should be positioned so that all bottles fall below it. Press the **Teach Pattern** button. The end result is to show the right and left bottle lip clearly in the **Learned Lip Pattern** window. If this looks good, you may press the **OK** button and the setup is finished.
4. Move the **Below Lip** bar up or down with the buttons. Choose a spot in the middle of the neck just below the bottle flange. The Vision System uses this point to find the bottom of the flange (*Figure 4-5*).
5. Set the limits. The first two values are the **Height** distances from the top of the cap to the flange. In most cases, the **Min** can be left at 0. Initially, **Max** should be set at 5-7 values over the average real-time value. The average real-time value is shown in the results windows.

4. OPERATION

Silgan Vision X

SILGAN_LEMON Online User: Silgan

Timed Trigger Trigger Grab Next Freeze Last

L/R Height Cap
110 121.34 119.36 130

Mid Height Cap
110 121 130

Cap Color
0 3.16 45

Lip Pattern
0 0 40

Label Height
-5 0 5

Shifted
9 76 106

Label Integrity
0 0 100

No Label
0 0 280

Splice
0 255 292

Tear
3000 3658 6003

Waist 1
0 0 100

Skewness
0 0 100

Pullup Locations

Cap Corner
← 192 →

Below Lip
↓ 157 ↑

Learned Lip Pattern

Teach Pattern

Limits X

	Min	Max
☒ Cap L/R Height	110	130
☒ Cap Mid Height	110	130
☒ Lip Pattern	0	40

Sensitivity (Intensity thresholds)

Top L/R Threshold	112
Top Middle Threshold	102
Neck Threshold	101

☐ Use Sport Cap

Threshold 0

Position 0

Filters

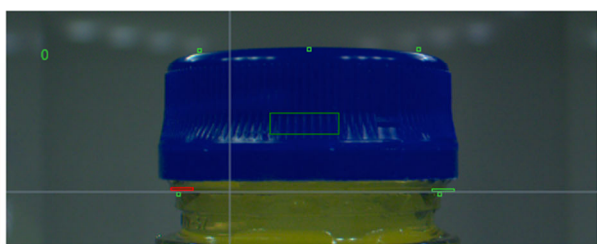
☐ Display Fitter

☐ Black & White

☐ Red Channel Only

☐ Green Channel Only

☒ Blue Channel Only



Step 1 Screen Shot Camera Settings Ejector Settings Recipe Settings Reject All Diagnostics Auto

Figure 4-5: Step 4 Screen Example

4. OPERATION

Step 5 - Set Cap Color

Start the **Color** and configuration by touching the box in the **Inspection List**.

1. Use the up & down arrows to position the color box over a section of the cap
2. Press the **Teach Color** button. The color swatch is displayed in the **Cap Color** box.
3. Set the limits. The limits represent how closely the color matches the taught color. The Min value will be 0 in most application and the Max will 20-30.

Note: The Step control in the bottom left corner of the page controls how much the arrow buttons change the values.

The screenshot displays the 'SILGAN LEMON' software interface. At the top, it shows 'Online' status and 'User: Silgan'. The main area is divided into several sections:

- Inspection List (Left):** A vertical list of parameters with numerical values and arrows for adjustment. Parameters include L/R Height Cap, Mid Height Cap, Cap Color, Lip Pattern, Label Height, Shifted, Label Integrity, No Label, Splice, Tear, Waist 1, and Skewness.
- Pullup Locations (Middle-Left):** Includes 'Cap Corner' and 'Below Lip' with directional arrows and numerical values (192, 157).
- Limits (Top-Right):** A box for 'Cap Color' with 'Min' (0) and 'Max' (45) values, and a 'Teach Color' button.
- Filters (Bottom-Left):** A section with a 'Display Filter' checkbox and radio button options: 'Black & White', 'Red Channel Only', 'Green Channel Only', and 'Blue Channel Only' (selected).
- Live Video Feed (Center-Right):** A real-time image of a blue cap with a green rectangular region of interest.
- Bottom Bar:** Contains a 'Step' control (1) with minus and plus buttons, a 'Screen Shot' button, and a row of navigation buttons: 'Camera Settings', 'Ejector Settings', 'Recipe Settings', 'Reject All', 'Diagnostics', and 'Auto'.

Figure 4-6: Color Configuration Screen

4. OPERATION

Step 6 - Set Label Height

Select the **Label Height** inspection configuration by touching one either **Label Height** or **Label Integrity** in the **Inspection List**. The first step is choosing a combination of filter and inspection method. This requires considering what features are present on the label and what contrast is available with different filters (*Figure 4-7*).

- **Pattern Match** Searches a defined area for a pattern of pixels
(requires high contrast within the label)
 - **Low/Hi Resolution** Searches for a pattern at a high and low resolutions
(requires high contrast within the label)
 - **Edge-based** Search a defined area for an edge
(Requires contrast between label and product)
 - **Band Letters** Search the top of the label for specific type of lettering
 - **Automatic Edge Based** Search a defined area for an edge
(Requires contrast between label and product, light product and dark label)
 - **Multi Low/Hi Resolution** Searches for a pattern at a high and low resolutions
(requires high contrast within the label)
1. Examine filters to determine the best contrast either between the label and the product or within the label. Check the box Display Filter and select different filters. Choose the filter and method combination that works best. The most common choice is Pattern Match.
 2. On the method tab for Pattern Match, Low/Hi Resolution, and Multi Low/Hi Resolution, select a camera by touching the picture and navigate to a unique feature of label using the up down, right, left arrows. The best features will not clear, offer a high contrast with the selected filter, and not be repeated. Teach the feature(s).
 3. On the method tab for Edge-based, choose Dark to Light if the product is darker than the label, choose Light to Dark if the product is lighter than the label. Threshold is represents the intensity of the edge, usually around 40.
 4. On the method tab for Automatic Edge-based, searches for a region is narrow region offset from the middle of the bottle a Light to Dark change. Configure the search box, over the region for the label. Configure the bottle region Y and Height values to search for the top of the label.
 5. On the Search tab, choose search area for the pattern or edge. When making this selection, consider the worst case of label placement (other than missing label). When a label is placed incorrect, the feature or edge should still be in the search area.
 6. Set the Limits. The value of the Label Height is the position in pixels of the label feature. The value for Label Integrity is a number indicating the quality of the match between 0...100.

4. OPERATION

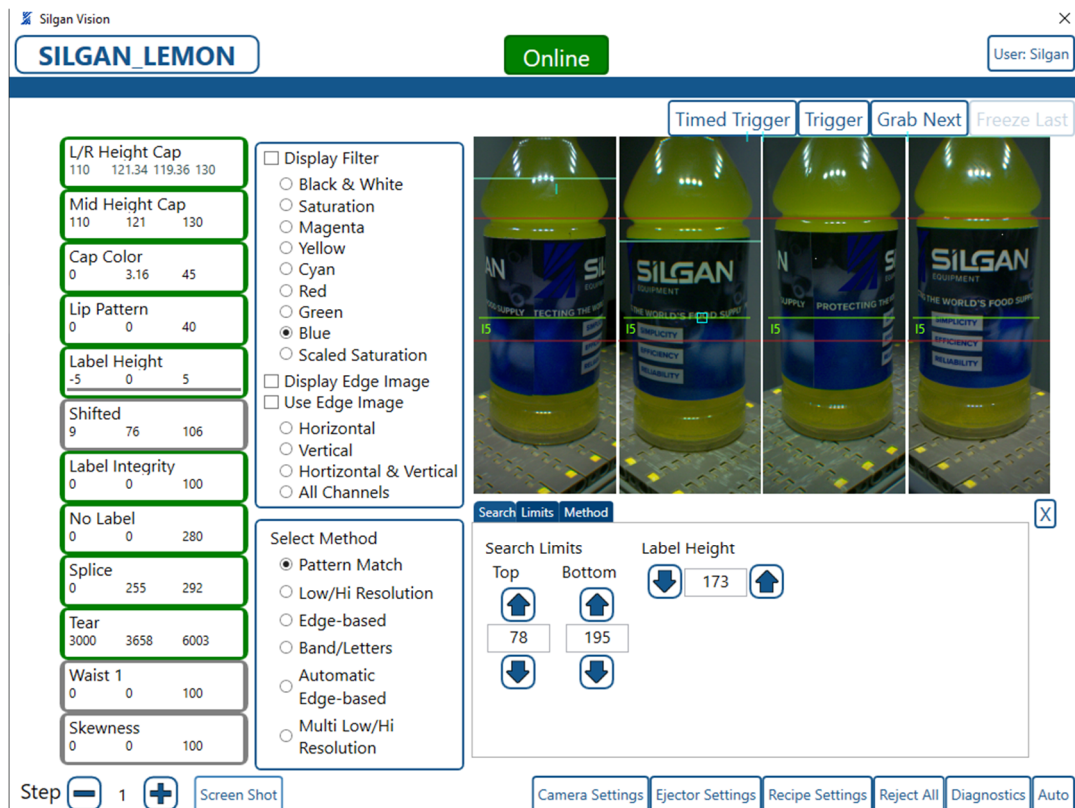


Figure 4-7: Set Lable Height

4. OPERATION

Step 7 - Shifted Inspection (for Square Bottles Only!)

Select the **Shifted** inspection configuration by touching **Shifted** in the **Inspection List**. Examine filters to determine the best contrast between the label and the product.

1. Check the **Show Edges** box. Select each camera by touching the image, then move the **Top** and **Bottom Limits** to encompass the label.
2. Adjust the **Horizontal Limits** for all four images. Set the Threshold for Red and Green Pixels, for most bottles it will be around 40.
3. Set the Limits. Use a bottle with a shifted label and a good bottle to find ranges for Min and Max.

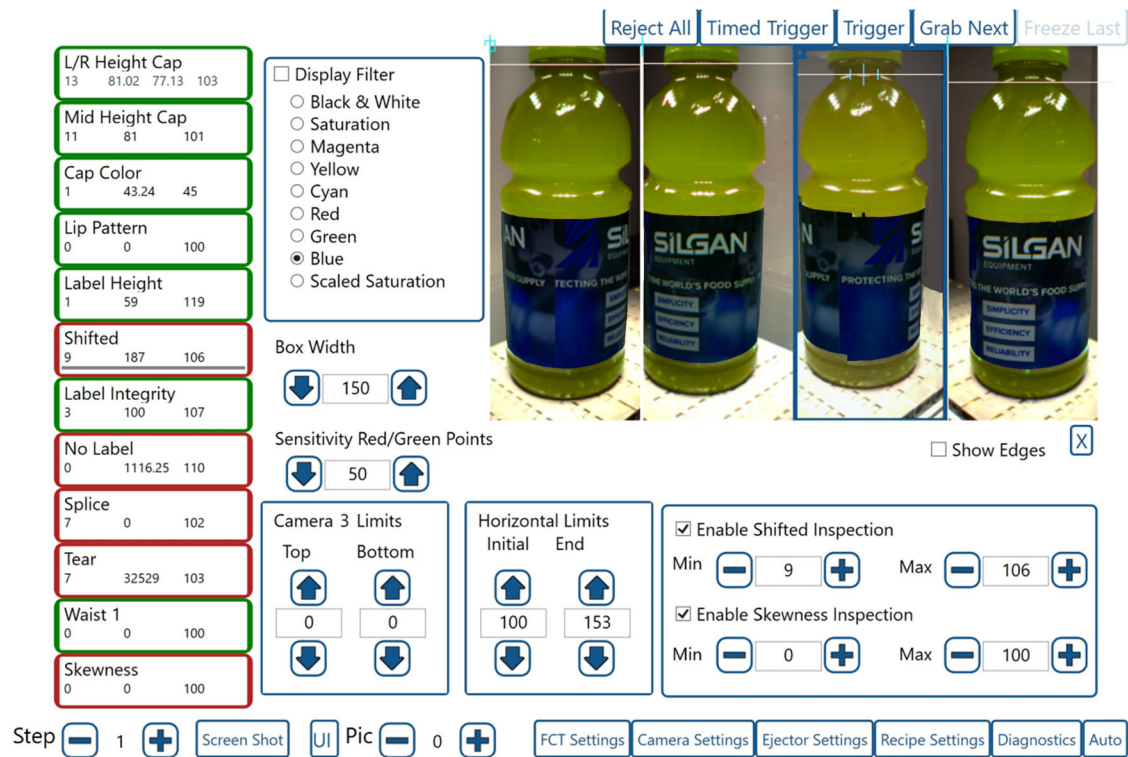


Figure 4-8: Shifted Inspection

4. OPERATION

Step 8 - No Label Inspection

Select the **No Label** inspection configuration by touching **No Label** in the **Inspection List**. Examine filters to determine the best contrast between the label and the product.

1. Adjust the **Y Position**, **Height**, and **Width** to change the area to search.
2. Set the **Threshold** based on the color of the product.
3. Set the Limits. Use a bottle with no label and a good bottle to find ranges for **Min** and **Max**.

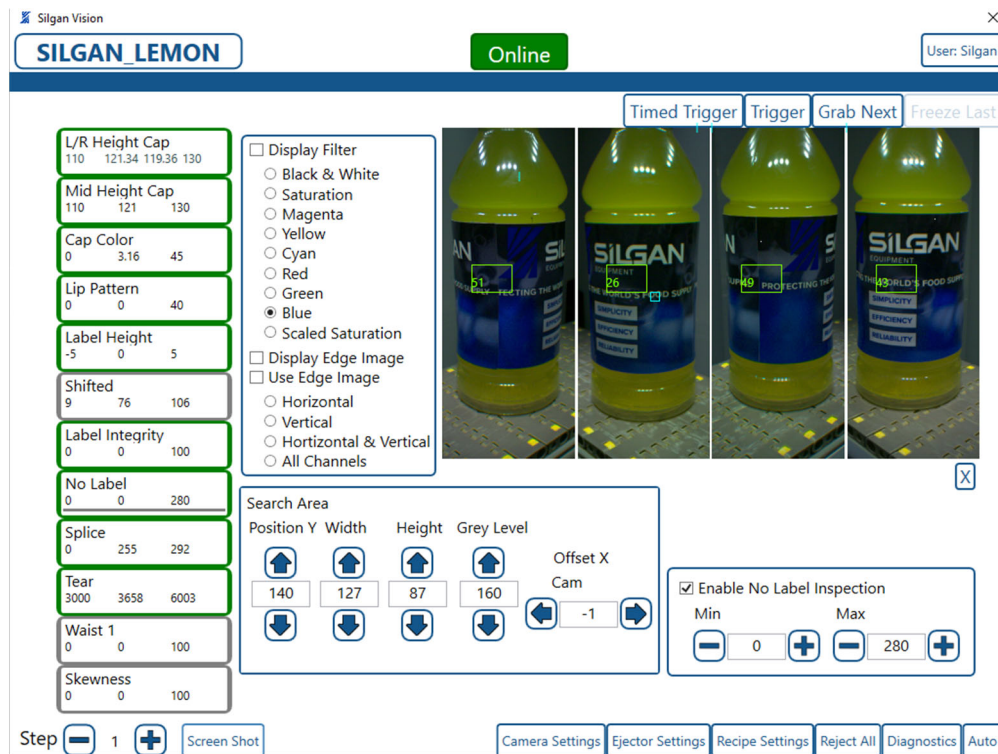


Figure 4-9: No Label Inspection

4. OPERATION

Step 9 - Splice Inspection

Select the **Splice** inspection configuration by touching **Splice** in the **Inspection List**. Examine filters to determine the best contrast within the label.

1. Adjust the **Y Position**, **Height** and **Width** to change the size of the search box. Adjust just the smaller box for measuring pixel variance.
2. Set the minimum variance.
3. Set the Limits. Use a bottle with a label splice and a good bottle to find ranges for **Min** and **Max**.



Figure 4-10: Splice Inspection

4. OPERATION

Step 10 - Tear Inspection

Select the **Tear** inspection configuration by touching **Tear** in the **Inspection List**.

1. Adjust the **Y Cam**, **Height**, and **Width** to change the size of the search box.
2. Evaluate different filters for **Light**, **Dark**, and **Edge** to find the combination of that make the label look mostly white and the product look black or vice versa.
3. Set the Limits. Use a bottle with a small tear and a good bottle to find ranges for **Min** and **Max**.

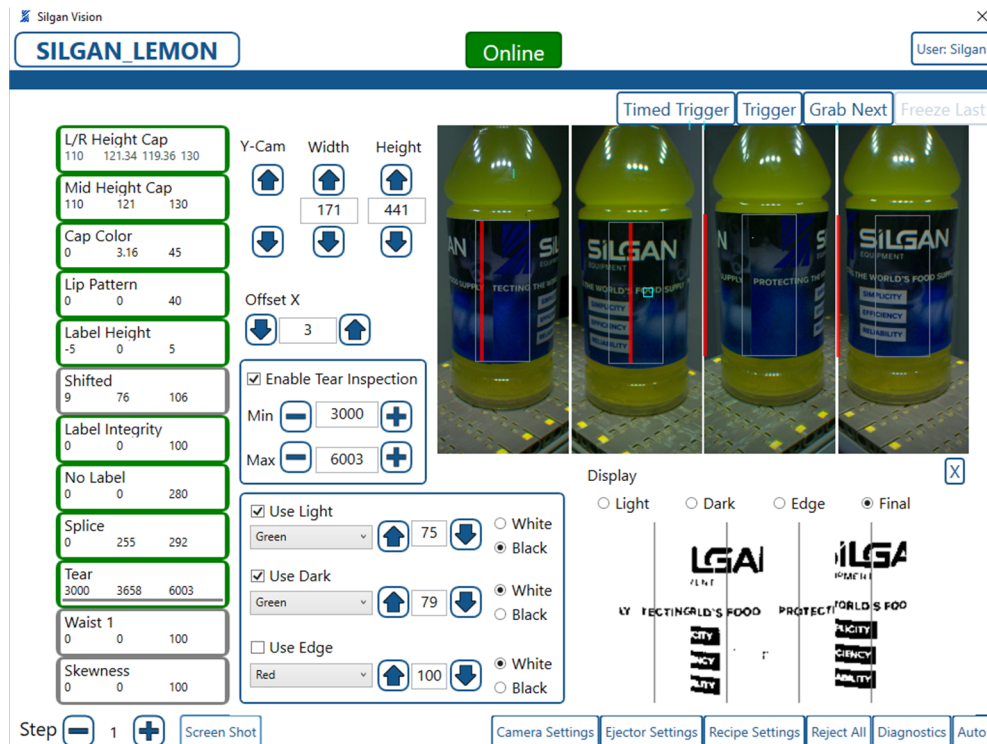


Figure 4-11: Tear Inspection

5. EXTENDED OPERATION

5.1 Extended Operation

5.1.1 Understanding the Diagnostic Menu

The diagnostic menu houses four options;

Recall Defective Pics, Serial Diagnostics, Align Cameras, and Shift Cameras.

Recalling Defective Pictures

The Vision system saves every defective picture to memory. To conserve space, only the last 512 pictures are stored. The Recall dialog box can be accessed by touching the Diagnostics button (*Figure 5-1*). Each picture displayed in the list is time-stamped. Clicking on a picture lists all of the inspections where it failed.



Figure 5-1: Diagnostic Menu

6. SECURITY

6.1 Security

There are three levels of security within the system. Each has a different level of access to the functions. Access to each level can be locked separately.

Level One - Master : With a password obtained from a Silgan Field Engineer, all the other passwords can be set. A new system comes with the passwords preset (*Figure 6-1*). This master password accesses all levels.

Level Two - Supervisor : This level allows access to modify runtime parameters, limits, and change jobs.

Level Three - Operator : Operators can only change jobs.

For more information regarding security level access, review the Access List (*Table 6-2*).

Logout

X

1 2 3 4 5 6 7 8 9 0

Q W E R T Y U I O P

A S D F G H J K L

Z X C V B N M _

Clear

Backspace

Login

Figure 6-1: Login Page

6. SECURITY

Access for:	Operator		Supervisor		Manager	
	Yes	No	Yes	No	Yes	No
Menus						
1 File - Exit	X		X		X	
2 Recipe	X		X		X	
3 Setup - Configure Inspections		X		X	X	
4 Setup - Color Chart		X		X	X	
5 Setup - Delay Trigger		X		X	X	
7 Setup - Global Settings - Eject		X		X	X	
9 Diagnostics - Pictures	X		X		X	
10 Security Login	X		X		X	
11 Security Logout	X		X		X	
12 Statistics	X		X		X	
Main Page						
15 Timed Trigger	X		X		X	
16 Trigger	X		X		X	
17 Reset Totals	X		X		X	
18 Freeze Last	X		X		X	
19 Show All	X		X		X	
20 On Line	X		X		X	
21 Off Line	X		X		X	
22 Reject All	X		X		X	

Table 6-2: List of Security Options for Each Level of Access

7. TROUBLESHOOTING

7.1 Troubleshooting

Troubleshooting		
Problem	Possible Cause	Action
The monitor shows a blank screen.	No power. There is a bad connection in the monitor cables. The monitor is bad.	Check the main circuit breaker. Check the connections for the monitor cable from the monitor to the video connection of the computer. Check for 120 VAC at the power connection to the monitor.
No mouse on the touch screen.	There is a bad connection between the USB port and the monitor. Driver setup has been lost.	Check the connections between the USB port and the monitor. Run the c:\programfiles\Elo\ELOVA.EXE diagnostic program and follow instruction.
Cordless mouse and keyboard do not work.	Batteries are dead. There is a bad connection.	Check the batteries. Check the transmitter/receiver connection to the USB port. Reinitialize the keyboard or mouse by pressing the button on transmitter/receiver and then on bottom of keyboard or mouse.
The strobe lights do not fire.	The fuse for the strobe is blown. There is a bad connection in the strobe cables.	Check the 24 VDC fuse #F2. If bad, replace. Check the connections at the strobe I/O module.
The image of the bottle is out of focus.	There are water spots or other debris on the camera windows.	Use a lint free cloth to wipe any water spots off the glass located inside the channel that the bottles pass through.
Images are not being acquired.	The bottles are not triggering the photo eye.	Make sure that foreign objects or debris are not obstructing the photo eye through beam. Make sure that the height of the machine allows the bottles to break the photo eye through beam when they pass in front of the bulkhead.

Table 7-1: Troubleshooting Table

8. TECHNICAL ASSISTANCE

8.1 Technical Assistance

For assistance in resolving issues not addressed by this manual, please contact your Silgan Field Service Engineer.

Should your Silgan Field Service Engineer be unavailable, call Silgan Equipment Company Customer Service at 847-336-0552. Your case will be directed to the next available Service Engineer.

For repair and replacement parts, call Silgan Equipment Company Customer Service at 847-336-0552.



For Technical Support, Call: 877.205.3225
www.silganequipment.com/vision/
Waukegan, IL USA