



Machine Vision Application Requirements

Global Common

SD-1061

ISSUED

October 7, 2021

REVISED

August 15, 2025

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1 Scope

1.1 This specification details general requirements and guidelines for the design, implementation, and validation of Machine Vision Applications included in Nexteer Manufacturing processes. Machine Vision includes part inspection and robot guidance. Part inspections can be categorized as location, counting, measuring, and decoding. Machine Vision Applications shall be specified in the Machine Equipment Purchase Specification (commonly referred to as the Machine T-Spec).

1.2 The use of the word "shall" indicates requirements and the use of the word "should" indicates recommendations. The use of the word "may" indicates permission or allowance and the use of the word "can" indicates a possibility.

2 Process

2.1 The goal of machine vision is to fulfill one or several of the following items. Detection and prevention quality related defects identified in the PFMEA. To detect part presence or absence of parts or objects to aid machine controls. To aid in part location for robot guidance.

2.2 Camera Selection

2.2.1 Camera Resolution and type Resolution

Selecting the correct resolution is vital for robust detection. The resolution should be based on the feature size and the desired field of view.

2.2.2 Color vs. Monochrome

Monochrome shall be the default camera type. Color shall only be used if it is required by the application.

2.2.3 Severity of Detection

Camera models used for detection of QCL items shall have FTP file transfer capability and variable data output functionality.

2.3 Machine MQ Flow

The Nexteer Equipment Engineer shall request support from the Manufacturing Machine Vision Engineer (Vision SME) prior to defining the scope definition within the T-Spec. Vision SME support assignment will be made through TeamCenter Manufacturing (TcM) and MEED indicating Vision is included in the machine design.

2.4 Vision and Robotics

The Nexteer Equipment Engineer shall request support from the Core Controls and Automation Group for any robotics application that involves vision. This is accomplished through TcM by indicating Vision and Robotics is included in the machine design. Robotic Engineer assignments will be made in TcM and MEED.

2.5 Vision Guidance Robotics

2.5.1 The Equipment Supplier (OEM) is responsible to develop Robot User Frames-Vision System coordinates configuration procedures. This procedure shall be performed and documented prior MQ2. These procedures are to be used to provide proper training to Plant personnel. Proof of Concept Report and Reliability Study

2.5.2 Machine Vision Inspection (T-Spec)

The Equipment Engineer shall describe the general functionality of the Machine Vision Application to be included in the manufacturing process in the T-Spec.

2.5.3 Scope of the Application

The Equipment Engineer shall clearly define all attributes to inspect and the criteria of acceptance / rejection for the Machine Vision Application.

2.5.4 Proof of Concept

Prior to Machine Design Review, an Application Feasibility and Reliability Report shall be created. The report shall include basic setup information, including, but not limited to camera model, working distance and angle from camera to part, light color, and lighting used.

2.5.5 Feasibility and Reliability Report

A Study of Reliability for the application shall be created. This report shall include proposals of the Machine Vision System that satisfies the requirements specified by the purchasing ME. The report shall include a detailed proof of concept and a detailed Study of Reliability including images representing the criteria of acceptance or rejection.

2.5.6 Samples for testing

Specimens or samples are required for Feasibility and Reliability testing. The Equipment Engineer shall provide GOOD and REJECT samples that clearly represent features or attributes to be inspected by the Machine Vision Application as identified in the PFMEA. It is required that parts represent conditions of regular production. These samples can be utilized to build the OK and NOT OK Masters required in section 4.1.3.

2.6 Additional Resources (Nexteer)

The Nexteer Vision Lab is available to conduct initial feasibility trials for Vision Inspection. Contact the Manufacturing Machine Vision Engineer (Vision SME) for assistance.

2.7 Additional Resources (External)

Vision Equipment Suppliers or Distributor shall be contacted by the Equipment Engineer or OEM to request support during the Machine Vision Application proof of concept. Proof of concept shall include basic setup information, including, but not limited to working distance and angle from camera to part, light color, and lighting used.

2.8 Design Review

Once the Feasibility report and Study of Reliability are submitted, a Design Review meeting shall be conducted by the Equipment Engineer and include the OEM, assigned Controls Engineer, and the

vision company prior to implementation. Additional support from the Vision Subject Matter Expert or Robotics Engineering shall be requested, if applicable.

When external lighting is used it shall be wired to only be on when the camera is triggered, and an image is being captured. The light shall not be wired for continuous unless specifically requested by equipment ME or plant ME.

When applications require UV light the application shall be designed so that the light is not directed at or near any operator's eyes. All other visible lighting used should be directed away from any operator's eyes.

2.9 Components Compliance

All components for the Vision Application shall comply with Nexteer Specification SD-007 or SD-2007 for AP specific applications. Any component used in the design that does not comply with SD-007 shall be pre-approved by the Equipment Engineer, Vision Subject Matter Expert Engineer, and Controls Engineer supporting the project.

3 Programming

3.1 A clean and structured programming is critical for the deployment and maintenance of any Machine Vision Application in a plant environment. Program shall use a logical sequence, comments, and descriptors to facilitate troubleshooting and diagnostics. The OEM is responsible to follow recommendations, templates and references provided by camera manufacturers and Nexteer Machine Vision SME. See section 7.2 for additional references.

3.2 Programming shall not include any inverse logic to determine if a part is good. The program shall pass based on the presence of good part features and not absence of bad features. An example of inverse logic is using a pattern search for features on a bad part and if feature is not present, and pattern search fails, then labeling part as good. This logic results in false acceptance of reject parts if part is not in FOV, image light is changed along with several other items.

Programming logic shall ensure that pass bits are reset and not retained from previously passed images retained data. All logic needs to fail if an upstream error in the program is present. See figure 1 of bad example.

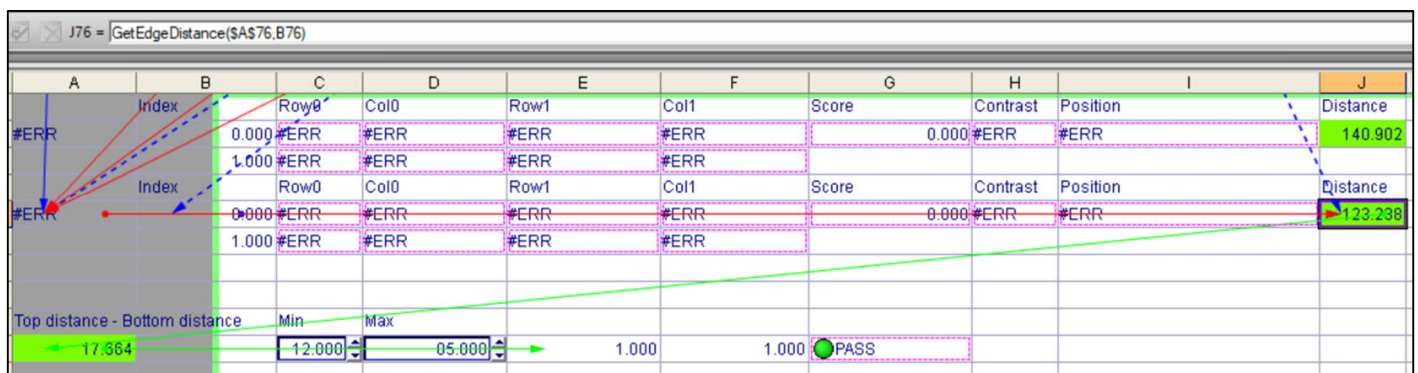


Figure 1: Retained Pass Bit Example

Where applicable, error counting or monitoring should be used and added as an additional condition for pass status. See Figure 2 for example.

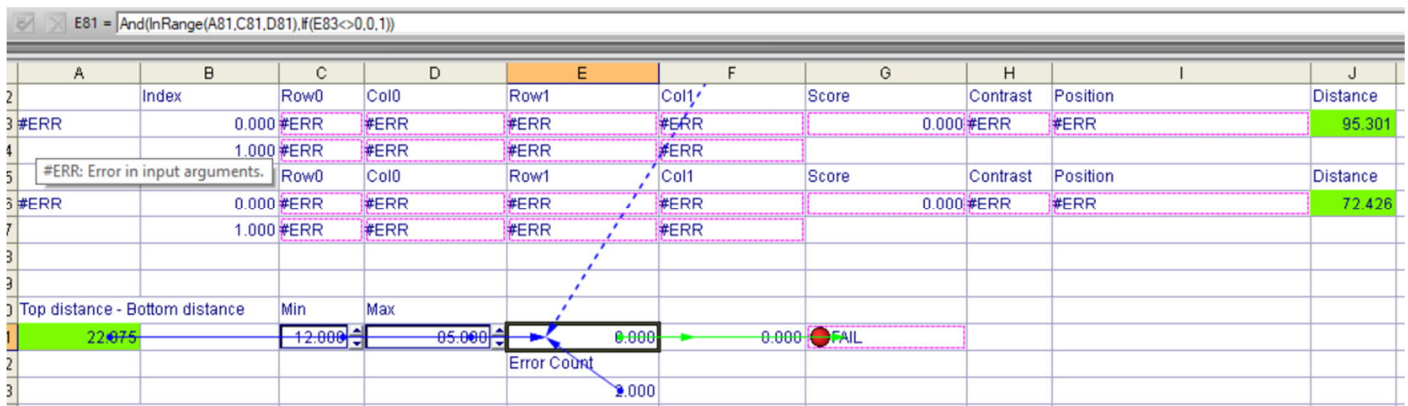


Figure 2: Error monitoring used to prevent retained pass bit.

3.3 Naming Convention

When possible, cameras should be renamed with the following format:

- Machine Asset number (SDxxxxxx)_OP (OPxxx) or station number (STAxixx)_Description
- Example:** SD123456_OP190_Final_Inspection

Camera programs should follow the following naming convention:

- Cognex Program name Example: 01_IS7600_OP140_RTV_13FEB25
- First two characters are program number: 01 – 99
- Camera model: Example: IS7600
- OP or station number: OPxxx or STAxixx
- Description: Example RTV
- Creation or revision date DDMMYY: Example 18JL24
- Keyence Program name Example: CAHX200M_OP140_RTV_13FEB25
- Camera model: Example: CA-HX200M
- OP or station number: OPxxx or STAxixx
- Description: Example RTV
- Creation or revision date DDMMYY: Example 18JL24

3.4 Use of AI vision tool Image Database

When Edge Learning, Deep Learning, or other vision tools commonly referred to as AI tools are used an Image database of all images used to train the tools shall be saved and provided to the Equipment ME and a copy saved in Teamcenter / GMEP. These images should be saved in a secure location so that they can be used to recreate vision program if necessary.

4 Qualification / Documentation

4.1 General Requirements for Machine Vision (pre MQ1/MQ2)

4.1.1 Implementation

Reliability of a Machine Vision Application is crucial for a successful and robust Error Proofing Device functionality. Therefore, it is imperative the OEM provides the best and optimal solution to be implemented.

4.1.2 Error Proofing Verification.

4.1.3 The OEM is responsible to include an Error Proofing Verification sequence in the machine function. This function will be used to validate system performance, reliability and any adjustments made to the system once the equipment is released into production. Camera program functionality shall be tested for the following items prior to MQ1. Camera program shall not pass with complete black image, white image, with part not in focus, or part not in image. GOOD and REJECT Part Masters

The OEM is responsible to work with engineer in charge to provide GOOD and REJECT part Master(s) to be used for the Error Proofing Verification (EPV) routine. Master ID is required (2D code) for stations that require 2D code reading. Rust prevention for master(s) is required. If applicable, Masters can be painted Red or Green avoiding features that are inspected.

When a vision system is used with AI (Edge learning, Neural Networking, or Deep Learning) capabilities the REJECT part Master(s) shall not be used to train and setup any AI tools. Other REJECT parts shall be used.

4.1.4 MQ setup Image files

At least 100 GOOD images and 50 REJECT images per model are required in a folder. Images shall be stored electronically in a BMP format. Name of the file shall contain the prefix GOOD or REJECT for each image.

4.2 Machine Qualification 1 (MQ1)

Reliability of a Machine Vision Application is crucial for a successful and robust Error Proofing Device functionality. Therefore, it is imperative that Nexteer Engineer in charge documents functionality of Machine Vision incorporated as Error proofing.

4.2.1 Inspection Repeatability Study

Acceptable Gage R&R for vision measuring applications or gage attribute capability study for vision attributes inspection shall be documented in Runoff Book.

The Repeatability and limit verification study required is the same for all applications and shall follow the steps below. The number of data points required will be based on severity level of failed detection.

4.2.1.1 Repeatability and Limit verification Process

The images used for data points should include all variation in lighting. If operator lights are available, then images should be included with the lights on and off. If the receiving plant will have skylights, then an added external light should be used to simulate a skylight with direct sunlight on the part.

The average value of all the good parts shall be calculated along with the sample population standard deviation. A six-sigma distribution range shall be calculated.

The average value of each failure mode bad part shall be calculated along with the sample population standard deviation. A six-sigma range of each failure mode shall be calculated and compared to the six-sigma distribution of the good parts. There should be separation between the bad part and good part ranges.

The camera program shall have limits set to fail all six-sigma range values of the reject parts for all failure modes. There should be no good parts rejected by setting the limit in this way, meaning the set limit(s) should not be placed within the good part distribution. The ideal camera application should have separation between good part distribution and bad part distribution(s). See Figure 3 for example of acceptable results in graphical form.

The limits should be set conservatively, meaning that the limit should be closer to the edge of the good part distribution range and further away from the bad part distribution(s).

The set limits shall be used to calculate the Cpk and Ppk and included in the Runoff book. Requirements are per SD-002.

If there is an overlap between good and bad part distribution ranges the camera and lighting setup should be improved to increase contrast between good and bad parts or the camera program changed to improve performance, and the study repeated. If a small amount of overlap cannot be avoided, then the receiving plant ME & QE team will need to sign off on the machine vision application in MQ plan. Include calculated FTQ in MSD plan. See Figure 4 for example of overlapping distribution example.

4.2.1.2 Part Gauging Applications

In applications where the vision system will be acting in place of a gage a gage R&R shall be performed per SD-002.

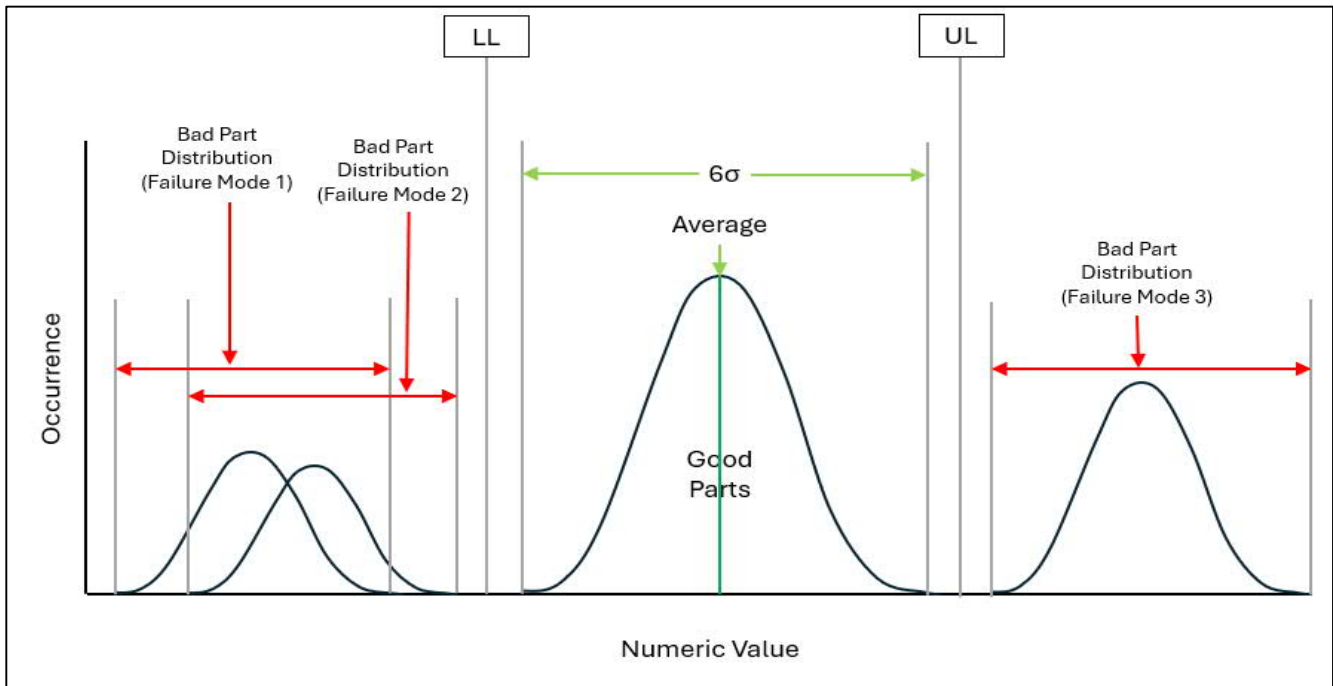


Figure 3: Example of Good and Bad part value distributions.

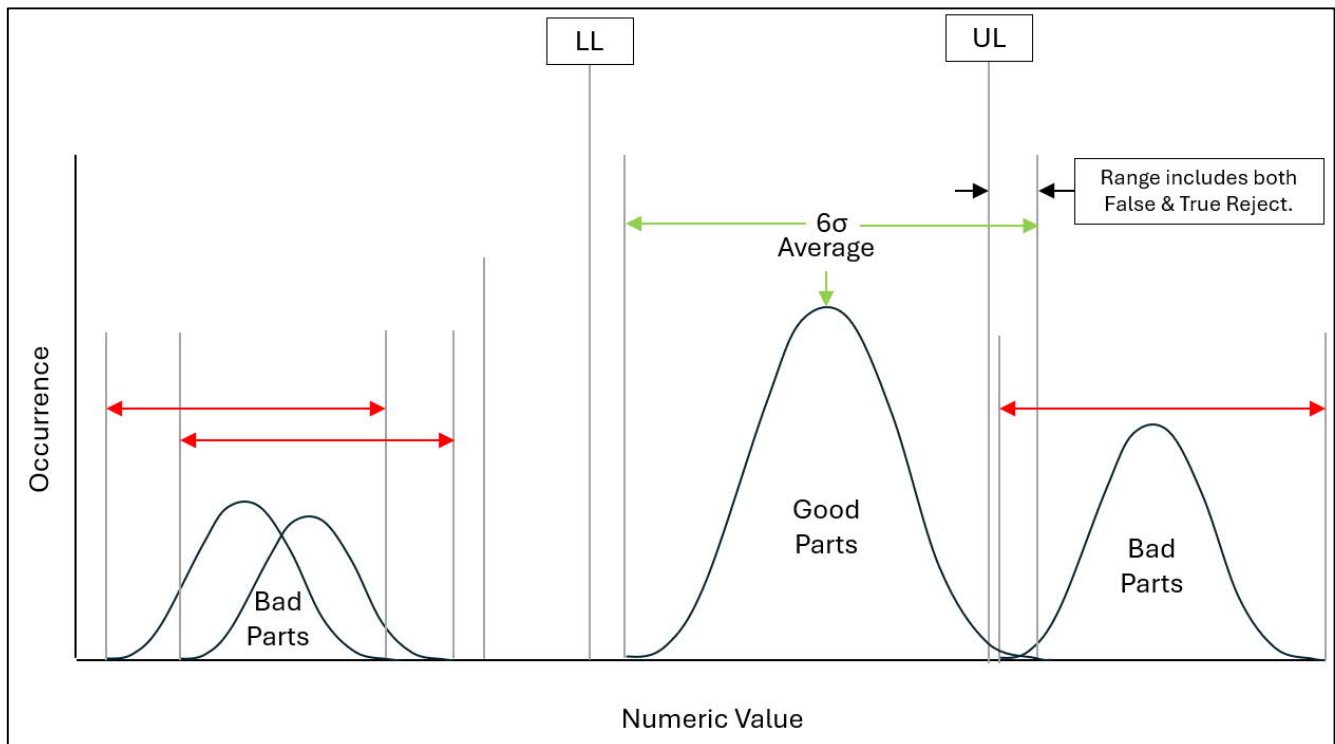


Figure 4: Overlapping Distributions Example.

4.2.1.3 SEV 9/10 items:

A minimum of 45 good part data points and a minimum of 20 data points from each failure mode identified in the PFMEA. If the occurrence of certain failure modes are higher than 3 in the PFMEA, then it is recommended to collect more than the minimum required data for that failure mode.

4.2.1.4 For all other KCC items:

A minimum of 30 good part data points and a minimum of 10 data points from each failure mode identified in the PFMEA. If the occurrence of certain failure modes are higher than 3 in the PFMEA, then it is recommended to collect more than the minimum required data for that failure mode.

4.2.1.5 For all other items:

A minimum of 18 good part data points and a minimum of 6 data points from each failure mode identified in the PFMEA. If the occurrence of certain failure modes are higher than 3 in the PFMEA, then it is recommended to collect more than the minimum required data for that failure mode.

4.2.1.6 The failure modes that are closest to the good parts should be focused on. A limited number of samples can be evaluated to determine which failure modes are closest to the good parts and the failure modes that are furthest from the good parts can be ignored until more sample parts are available.

4.3 Machine Qualification 2 (MQ2)

4.3.1 Installing Machine Vision Application in the plant.

Plant environment and lighting conditions are critical for any Machine Vision Application and its reliable performance. The OEM is responsible for eliminating such lightning variation by design. Image files can be used at this point to replicate MQ1 conditions.

4.3.2 Attributes Inspection Capability Study

An acceptable Gage R&R or Repeatability and limit verification study applied to all inspected features or attributes shall be documented in Runoff Book. This study shall demonstrate system reliability and shall follow the requirements outlined in section 4.2.1 at a minimum.

4.3.3 The OEM is responsible for providing camera system configurations, libraries and application backups to the Equipment Engineer.

4.3.4 The Equipment ME shall share system backups and images libraries to the Plant ME and Controls Engineer. System backups shall also be saved in the MQ workflow as a PRG file. All this information shall be included in the Machine Process Sheet (MPS).

5 Onsite Training

- 5.1 Proper training shall be provided by the OEM to the Plant Team. Training shall include basics on functionality, setup, and system recovery installed in Nexteer Equipment.
- 5.2 Basic Machine vision training material is available from the Vision SME. Hands-On Training can be shared or provided to the teams.
- 5.3 Additional training on Nexteer preferred vision systems (refer to Nexteer Specification SD-007) is available on the Supplier websites. Specific training shall be requested to local Machine Vision representatives.

6 General Requirements for Machine Vision in Production.

6.1 Plant ME

The Plant Receiving ME is responsible to review and approve the MQ2 Runoff Book and additional documentation related to the Machine Vision Application.

6.2 Machine Vision Subject Matter Expert in Plant

The Plant shall designate a Manufacturing Engineer or Controls Engineer as the Subject Matter expert in Machine Vision. This person will be responsible for maintaining and managing machine vision systems in the Plant.

6.3 Preventive Maintenance

The Plant ME is responsible to design and schedule the frequency for the proper PM for the Machine Vision Application. PM shall be designed accordingly to the Machine Vision Application considering machine and plant environment.

6.4 Use of MQ1/MQ2 Image Database as Reference

An Image database can be used as reference in order to maintain Machine Vision Acquisition. Image quality degradation can be identified by comparing images from MQ runs.

6.5 Camera Alignment & Verification.

An additional camera program can be created to aid in re-aligning a camera's position to its original position if required. This program can use a series of edge/ line tools along with graphic display tools that align with distinct background objects or master part features. See Figures 5 & 6.

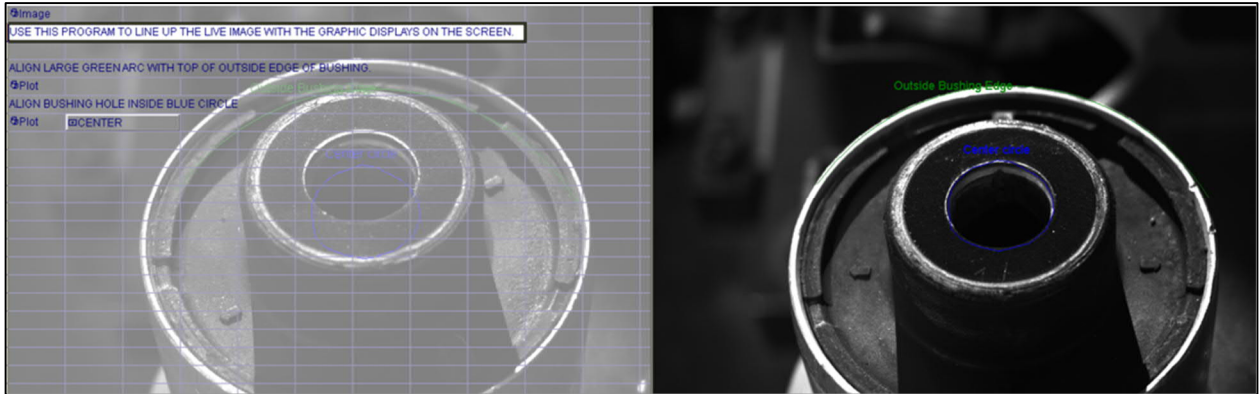


Figure 5: Cognex Alignment Program Example

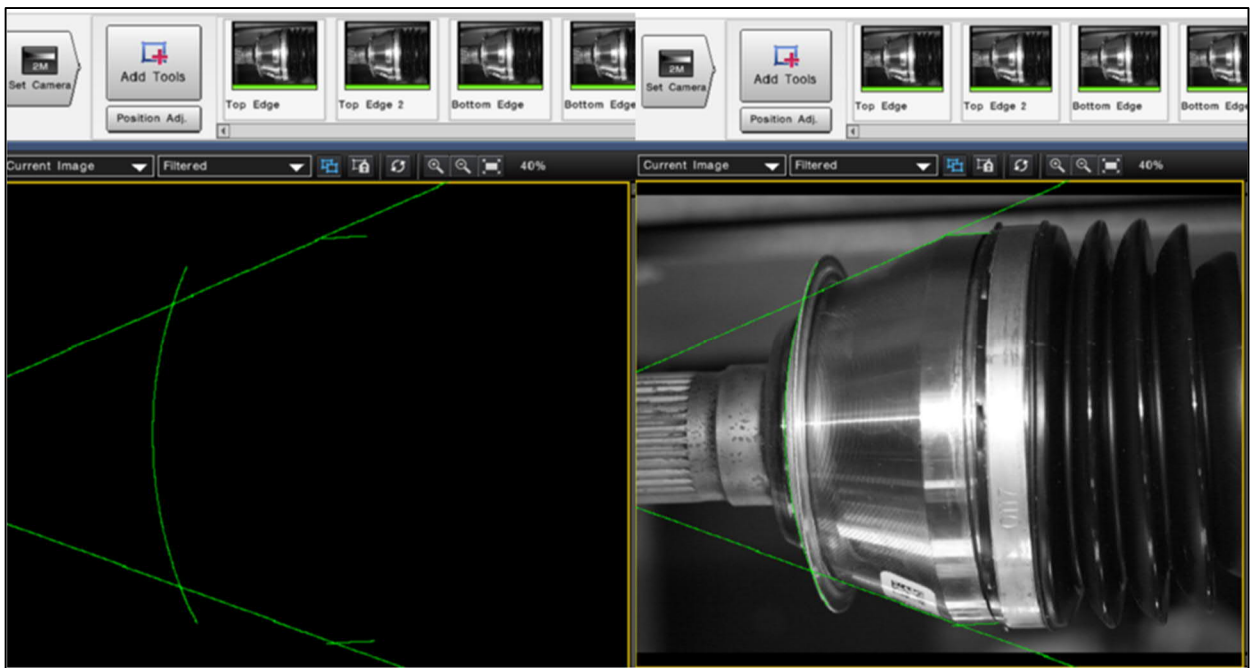


Figure 6: Keyence Alignment Program Example

7 Additional References.

7.1 Machine Process Sheet (MPS) Example:

MPS - Machine Process Sheet

This document to contain the key process parameters/features to assure standardized output for this process
All KCC's shall be updated for changes per PCT's and documented in tables below identified by green fill. All other settings are as reference
Note: All process controls - gaging, error proofing, calibration and verification on OCP

Form: 07-1-5-F1

Program:	WL	Severity	9 - 10
Machine / Function:	Machine Vision		
Plt / Dept / Group:	3/44/Saginaw		
SD # (s)	SD803206	Compliance to	SD1061
Rev:	001		
Rev Date:	6/5/23	Yes	

Page: 4

Camera Parameters: Presence/Absence of Continuous RTV bead

Diagram illustrating the camera setup and field of view (FOV) dimensions. The diagram shows a camera mounted on a stand, with a light source and optics (lenses) positioned above the work area. The FOV is defined by the height and width of the camera's field of view, with labels for FOV Height and FOV Width.

Photograph showing the camera setup in a factory environment, illustrating the physical installation of the camera and its field of view.

Inspection Description	Brand	Type	Model Number
The vision system shall find the absence or presence of an RTV bead. This bead will be inspected to make sure it is within specification with no breaks or smear of the bead.	Cognex	Vision System	In-Sight 8505P

Vision & Lighting System Installation

Camera Mounting	Lighting Mounting
Focal Length (Lenses)	55 mm (Blue Polarized Filter)
Working Distance	762 mm
FOV(Field of View) Height	99 mm
FOV(Field of View) Width	119 mm
Angle	90 Deg. (Perpendicular to Part)
Type	Polarized Brick Light
Color	Blue
Model	S75-470
Mounting Distance	762 mm
Mounting Angle	90 Deg.

Communications

IP Address	192.168.126.202
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PLC Interface (Tag)

Logic Software: Cognex provided AOP

<ul style="list-style-type: none"> Cognex_Sta30_RTV_Inspect1 Cognex_Sta30_RTV_Inspect1.Status Cognex_Sta30_RTV_Inspect1.InspectionResults 	<ul style="list-style-type: none"> Cognex_Sta30_RTV_Inspect0 Cognex_Sta30_RTV_Inspect0.Control Cognex_Sta30_RTV_Inspect0.UserData
--	--

Pre-MQ Check list

Check	Complete Y / N	Pass / Fail	Date
Confirm camera program fails with lens covered or with black image.	YES	Pass	6/23/2022
Confirm camera program fails with no part in view.	YES	Pass	6/23/2022
Confirm camera program fails with complete white image.	YES	Pass	6/23/2022
Confirm camera does not retain pass bit from previous image if ERR is present.	YES	Pass	6/23/2022

ALL REFERENCE PROGRAM BACKUPS SHALL BE IN TCM UNDER SD NUMBER IN "PROGRAM FILES" FROM MQ2

Backup Program	Rev Date	Saved in TcM	MQ2 Images	
SD803206_STA30_12JUN2023b.job	12/9/22	NO	Good	Bad
			N/A	N/A
Software Version:			6.1.0	
Good Image			Bad Image	

Camera Programming and settings

Image Acquisition / Capture

Description	Setting	Unit	Notes
Trigger	Industrial Ethernet		
Trigger Delay	0	msec	Disabled
Trigger Interval	500	msec	
Exposure	C2*N27+C3*N28+C3*N29+C3*N30	msec	\$CS4
Star Row	0		
Number of Rows	2048		
Gain	D2*N27+D3*N28+D3*N29+D3*N30		\$CS5
Focus Controls	Manual		
Focus Position	0		
Save Focus Position with Job	Enabled		
HDR Mode	Disabled		Disabled
Light Settings	External		
Polarity			
Intensity			
Strobe Star Position			
Red Zone			
Lens focus			

How This Camera Works

File	Edit	View	Insert	Format
<p>400 This camera takes four different pictures, designated by "Inspection Number" from the PLC.</p> <p>401 Basic Machine Sequence is as follows:</p> <p>402 Part indexes into this station</p> <p>403 Inspection Number 1, with unpolarized light, verifies three screws are present</p> <p>404 Inspection Number 2, with polarized light. No analysis, just captures a pre-RTV picture</p> <p>405 RTV is Dispensed</p> <p>406 Inspection Number 3, with polarized light Analysis is done on differences between this image and pre-RTV image.</p> <p>407</p> <p>408 Inspection Number 4, only for RTV EPV, analysis is done on raw picture with polarized light,</p> <p>409 since there is no pre-RTV picture</p>				

MPS Example continued.

Part Location / Position Adjustment			
Tool 1 Used:	Pattern Match	Unit	FindPatterns
Description	Setting		Notes
Image	\$A\$0		
Fixture	(0,0,0)		
Model Region	(-29.882,-1159.332,150,150,-0.249)		
Model Settings	(Edge model, Medium, Medium, 0,0,0)		
Find Region	(944.057,591.635,305.436,286.998,-0.249)		
Number to Find	1		
Angle Range	15		
Scale Tolerance	Enabled		
Thresh: Accept	50		
Thresh: Confuse	70		
Time out	5000		
Show	hide all		

Index	Row	Col	Angle	Scale	Score
9 Patterns	0.000	1121.961	745.801	6.113	104.688
					0.000

Inspections / Vision Tools			
# of Tools Needed	10		
#1 Tool Used:	Clocked Data Storage	Unit	Latch Image
Description	Setting		Notes
Image	\$A\$0		
Fixture	(0,0,0)		
Region	(0,0,1944,2448,0)		
Event	SCS34		
Colorize	Disabled		Enabled
Show	hide all		

Description of Inspection: Captures Image before RTV is dispensed in order to compare it later when RTV is present. Latch image was used because the metal, shiny surface made it hard to see the RTV. (May not be needed for other applications).

#2 Tool Used:	Image	Unit	Image Math
Description	Setting		Notes
Image 1	\$A\$36		
Image 2	\$A\$0		
Operation	Difference		
Display Row	0		
Display Column	0		
Show	hide all		

Description of Inspection: Comparing the PreRTV image and the RTV image and output the difference between the two images.

#3 Tool Used:	Image	Unit	Filter
Description	Setting		Notes
Image	\$A\$40		
Fixture	(0,0,0)		
Region	(336.625,293.302,1526.749,1740.049,0)		
Filter Type	Binarize		
Kernel Rows	3		Disabled
Auto Threshold	Disabled		Enabled
Min.	128		Disabled
Max.	128		Disabled
Gain	1		Disabled
Smoothness	1		Disabled
Show	hide all		

Description of Inspection: Filter used to make more contrast where there are more defined edges.

#4 Tool Used:	Image	Unit	Filter
Description	Setting		Notes
Image	\$B\$40		
Fixture	(0,0,0)		
Region	(336.625,293.302,1526.749,1740.049,0)		
Filter Type	Open		
Kernel Rows	11		Disabled
Auto Threshold	Enabled		Disabled
Min.	128		Disabled
Max.	128		Disabled
Gain	1		Disabled
Smoothness	1		Disabled
Show	And(Not(O33),N26=3)		

Description of Inspection: Cleaning up the image so that only the bead of the RTV can be seen. Adds on from previous filter.

MPS Example continued.

#5 Tool Used:	Inspect Edge		Bead Find	Description of Inspection	Notes
Description	Setting	Unit	Notes		
Image	\$A\$41				Uses a POLARIZED light in order to Find and outlines the left side of the RTV bead in order to train the bead inspection.
Fixture	(0,0,0)				
Background Image	0				
Bead Sample Location	(934.570,491.896,70.946)				
Max Width Deviation (%)	30				
Bead Finding Tolerance	3				
Bead Find Optimizations	(0,Light On Dark,70,10)				
Max Bead Paths to Find	5				
Find Bead Paths	Enabled				
Selected Bead Path	0		Disabled		
Edit Bead Path	Enabled				
Bead Train Optimizations	(10,7)				
Train Bead Path	Enabled				
Show Graphics	(1,0,0,0,0)				

#6 Tool Used:	Inspect Edge		Bead Inspect	Description of Inspection	Notes
Description	Setting	Unit	Notes		
Image	\$A\$41				Inspects the left side bead to make sure it is continuous and uniform.
BeadFind	\$A\$47				
Edit Inspection Areas	Disabled				
Bead Edge Position Tolerance (%)	40		Disabled		
Contrast Threshold	10		Disabled		
Defect Limits	(1,65,1,160,1,65,1,160,1,20,5)				
Show	(0,1,0,0,1,1,1,1)				

#7 Tool Used:	Inspect Edge		Bead Find	Description of Inspection	Notes
Description	Setting	Unit	Notes		
Image	\$A\$41				Finds the top and right side of the bead to train the inspection.
Fixture	(0,0,0)				
Background Image	0				
Bead Sample Location	(521.859,1322.854,74.141)				
Max Width Deviation (%)	30				
Bead Finding Tolerance	3				
Bead Find Optimizations	(0,Light On Dark,70,10)				
Max Bead Paths to Find	5				
Find Bead Paths	Enabled				
Selected Bead Path	1		Disabled		
Edit Bead Path	Enabled				
Bead Train Optimizations	(10,7)				
Train Bead Path	Enabled				
Show Graphics	(1,0,0,0,0)				

#8 Tool Used:	Inspect Edge		Bead Inspect	Description of Inspection	Notes
Description	Setting	Unit	Notes		
Image	\$A\$41				Inspects the bead top and right side that was trained in bead find to make sure the bead isn't smeared or broke.
BeadFind	\$A\$53				
Edit Inspection Areas	Disabled				
Bead Edge Position Tolerance (%)	40		Disabled		
Contrast Threshold	10		Disabled		
Defect Limits	(1,65,1,160,1,65,1,160,1,20,5)				
Show	(0,1,0,0,1,1,1,1)				

MPS Example continued.

#9 Tool Used:	Inspect Edge	Unit	Bead Find	Description of Inspection
Description	Setting		Notes	Train and find the overlap of the RTV bead that is on the circuit board.
Image	SA541			
Fixture	(0,0,0)			
Background image	0			
Bead Sample Location	(1703.071,778.290,70.993)			
Max Width Deviation (%)	90			
Bead Finding Tolerance	6			
Bead Find Optimizations	(0,Light On Dark,75,10)			
Max Bead Paths to Find	5			
Find Bead Paths	Enabled			
Selected Bead Path	1		Disabled	
Edit Bead Path	Enabled			
Bead Train Optimizations	(10,7)			
Train Bead Path	Enabled			
Show Graphics	(1,0,0,0,0)			

#10 Tool Used:	Inspect Edge	Unit	Bead Inspect	Description of Inspection
Description	Setting		Notes	Inspects the quality of the overlapped portion of the RTV bead to make sure it doesn't break or smear.
Image	SA541			
BeadFind	SA559			
Edit Inspection Areas	Disabled			
Bead Edge Position Tolerance (%)	40		Disabled	
Contrast Threshold	10		Disabled	
Defect Limits	(1,65,1,180,1,65,1,180,1,20,8)			
Show	(0,1,0,0,1,1,1,1)			

Description	Setting	Unit	Notes
Active Exposure	C2*N27+C3*N28+C3*N29+C3*N30	msec	Exposure based on inspection
Active Gain	D2*N27+D3*N28+D3*N29+D3*N30		Gain based on inspection
Row	C28+H45		Used as Fixture
Col	D28+H45		Used as Fixture
Image	W(N28+4,AD,C40)		Toggie Filter (SA541)

Description	Setting	Unit	Notes
Event	FormatInputBuffer		
Buffer	FormatInputBuffer		
UserData	ReadUserDataBuffer		

Event	Buffer	Protocol	Byte/Word Order
Trigger	Soft 0		
Manual			

Event	Buffer	Protocol	Byte/Word Order
Event	SA514		
Buffer	SB514		
Protocol	Ethernet/IP		
Validate Connection			
Byte/Word Order	Default		

Description	Setting	Unit	Notes
Event	WriteImageFTP		
FTP	WriteImageFTP		

Event	Buffer	Protocol	Byte/Word Order
Trigger	Acquisition Job Complete		
Manual			

Event	Buffer	Protocol	Byte/Word Order
Event	SA565		
Host Name	SB570		
User Name	SB571		
Password	SB572		
Image	SA50		
File Name	SA579		
Max Append Value	1007		
Reset			
Data Format	FA67+1.KIN26+1.D02.D02		
Save Graphic Overlays			
Resolution	Full		
Disable FTP Queuing			

MPS Example continued.

Execute Conditions Settings (Sequence)			
Description	Setting	Unit	Notes
Compares before and after RTV			
Filters the image			
Finds RTV bead			
Inspects RTV bead			

Format Output Data			
Description	Setting	Unit	Notes
Buffer	FormatOutputBuffer	bit	
WriteResults	WriteResultBuffer		

Returning Outputs to PLC
Buffer and WriteResults extracts the Data to Send to the PLC

Buffer WriteResults

Cell(s)	Total Size (bytes)	Data Type
\$N531	1	Bit
\$N532	1	Bit

Event	\$A565	= Event
Buffer	A59	= Buffer
Result Code		
Protocol	EtherNet/IP	
Byte/Word Order	Default	

7.2 Program Logical Sequence Example:

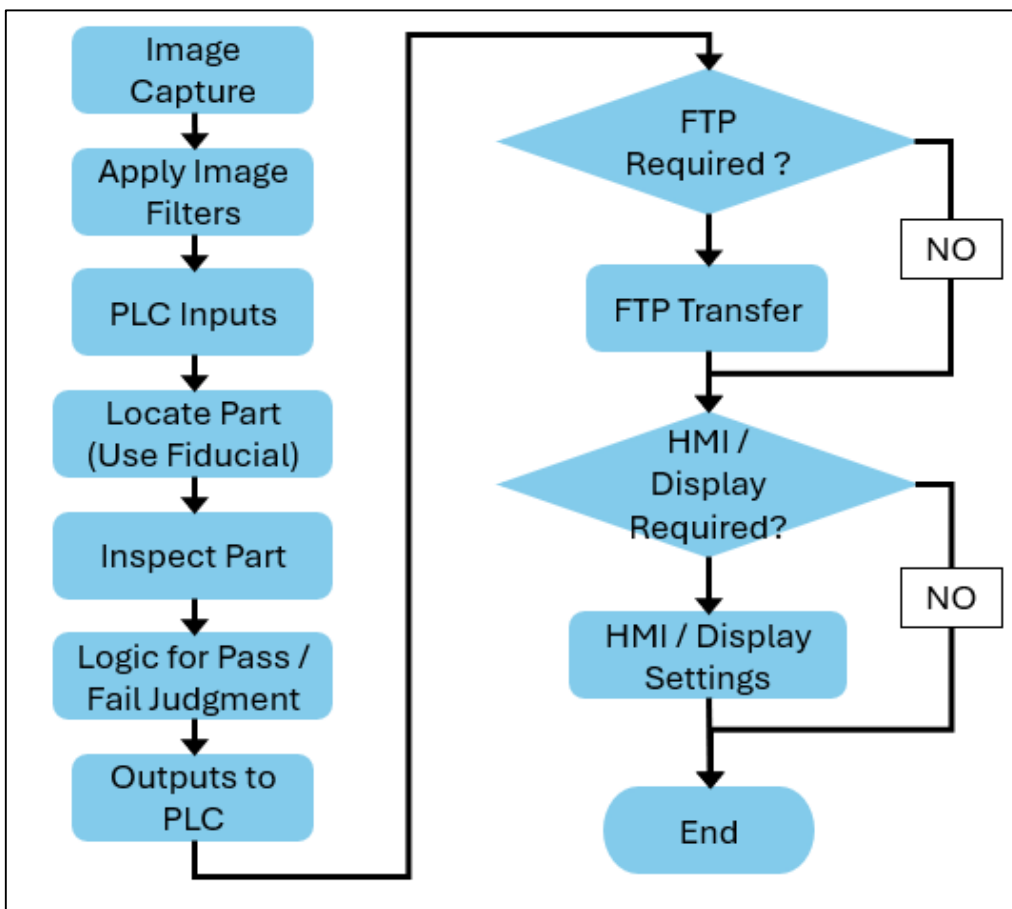


Figure 7: Camera Program Sequence Logic

A. Appendix**A.1 Programming Requirements**

- A.1-1 Lenses and Lighting system shall be documented or commented in the program if the software is capable. Language used shall be in English, or language of receiving country.
- A.1-2 All programs shall be documented with descriptors. Vision tools and their functions shall be clearly documented in the program where the software is capable.
- A.1-3 All program structures shall follow a logical sequence. Image acquisition, part location, part inspection and communications shall be clearly defined in the structure. The program sequence of operation shall be included and documented. The program sequence can be stored in the Images Folder.

A.2 Machine Vision Image Visualization and System Access.

- A.2-1 A vision monitor/panel should be installed in the machine for image visualization and the system performance monitoring.
- A.2-2 The vision monitor/panel shall display the key inspected features including OK or Not-OK status indicators for an easy visualization for the operator.
- A.2-3 For multiple vision systems within a cell or machine, an industrial PC monitor with the most recent Vision Software version shall be provided with the equipment.
- A.2-4 The access to the vision programming software shall be password protected.

A.3 Image Storage

- A.3-1 The OEM and Nexteer Equipment Engineer are responsible to define image storage in the Plant. Unless required by Nexteer's End Customer, images are not to be stored in the Traceability Database and shall follow the Data Retention Policy.

A.4 PM Recommendations

- A.4-1 The OEM is responsible to provide recommendations for cleaning, if required.
- A.4-2 Plant ME is responsible to document PM recommendations.
- A.4-3 MPS shall include setup and a camera machine installation sketch relative to the part.
- A.4-4 Plant ME is responsible to maintain and update the MPS.

A.5 Glossary

- A.5-1 OEM: Original Equipment Manufacturer
- A.5-2 MQ1: Machine Qualification I
- A.5-3 MQ2: Machine Qualification II
- A.5-4 EPV: Error Proofing Verification
- A.5-5 SOP: Start of Production
- A.5-6 SME: Subject Matter Expert
- A.5-7 ME: Manufacturing Engineer
- A.5-8 TcM: Teamcenter Manufacturing
- A.5-9 MPS: Machine Process Sheet
- A.5-10 PM: Preventive Maintenance
- A.5-11 QCL: Quality Control Level

RECORD OF REVISIONS

Revision No	Date	Section	Description
001	07OC21	ALL	Initial Release.
002	15AU25	ALL	Restructured with multiple updates
003			
004			
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