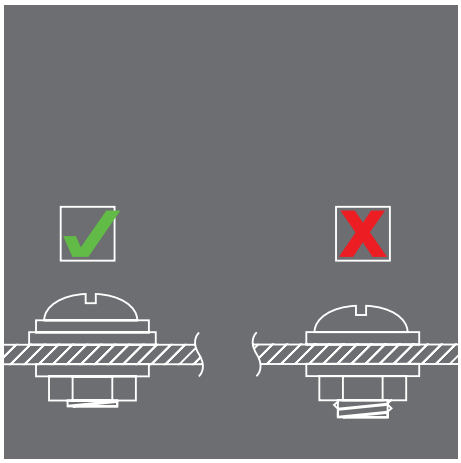
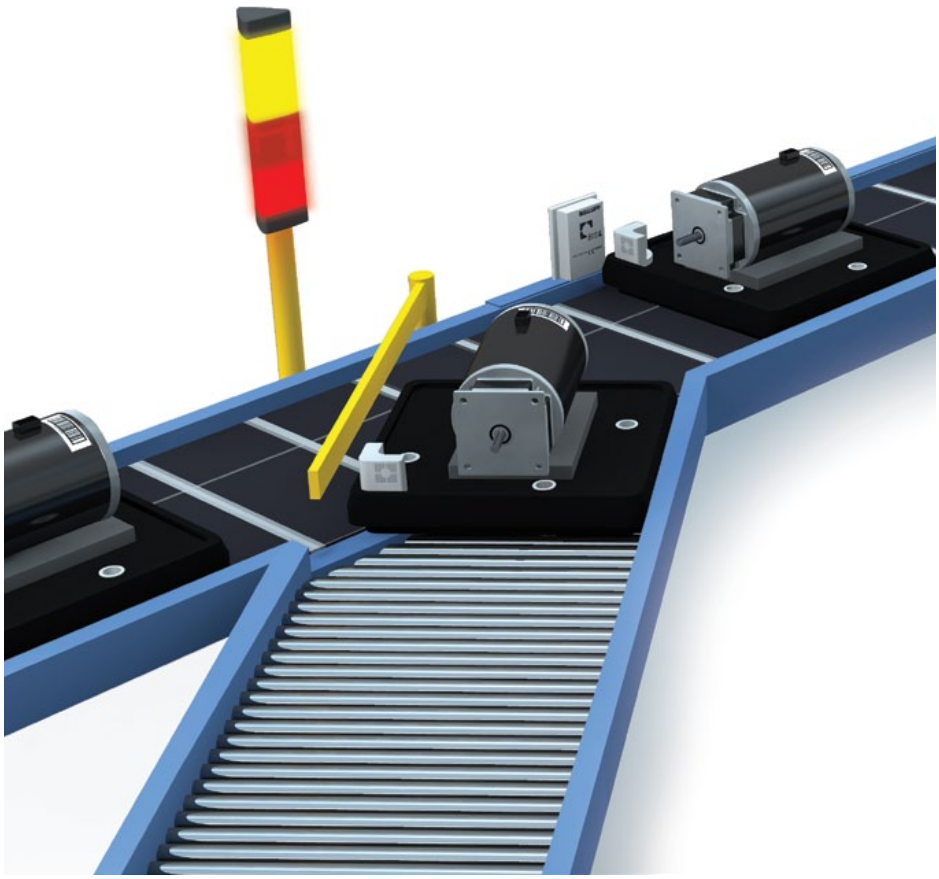
BALLUFF

sensors worldwide

Error Proofing Assembly Processes

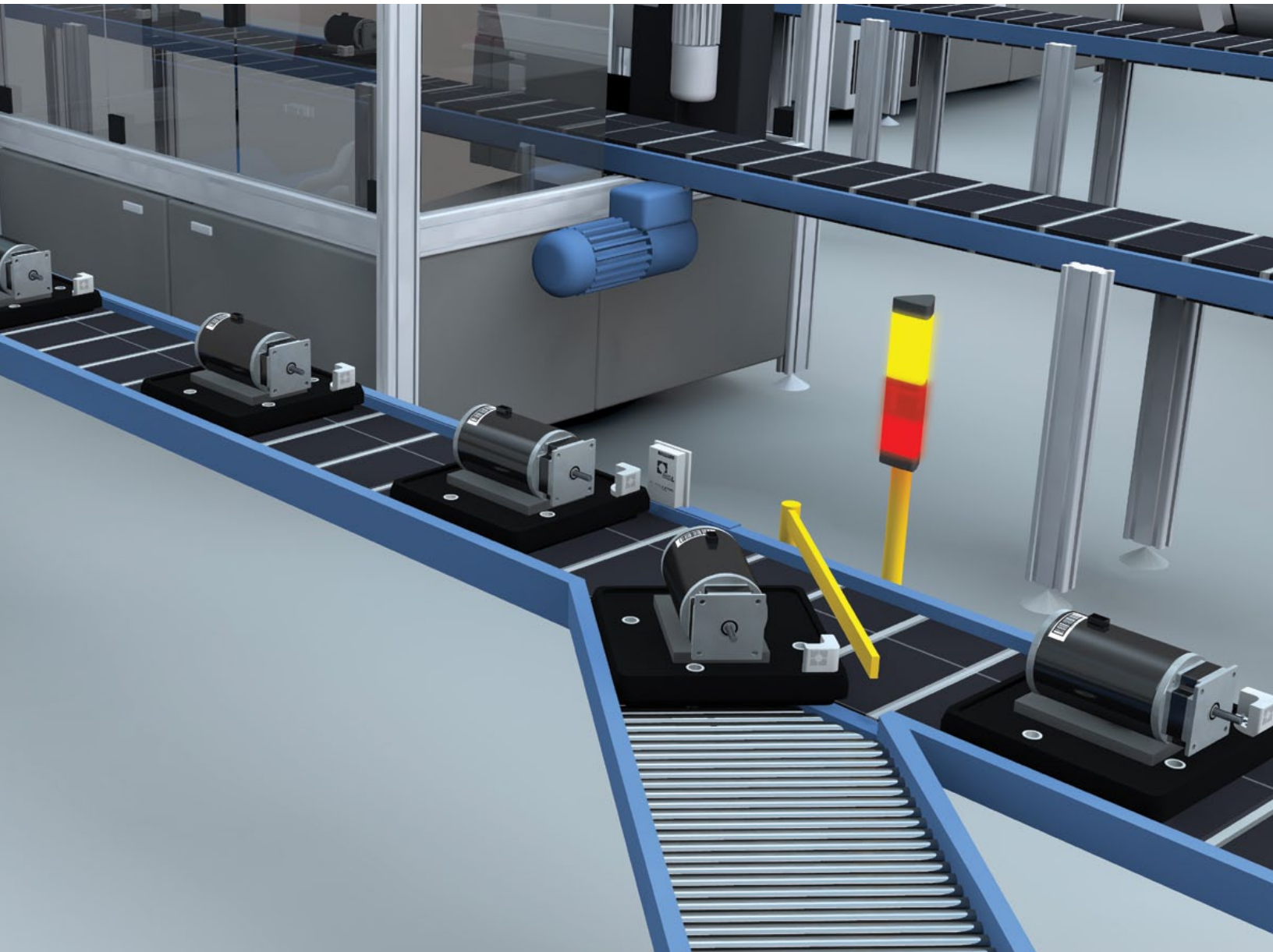
Manufacturing with ongoing quality and productivity





Error Proofing Assembly Processes

Commitment to ongoing quality
Total quality management



Error Proofing: Key to Quality

Quality demands on manufacturers have been high for years, and the future will see those demands continue to rise. It is no longer good enough just to produce a high quality product. Expectations have climbed to a point where that high quality product also has to be delivered Just-in-Time (JIT), in the proper sequence (mainly for sub components), and provide a level of traceability that enables visibility to all stakeholders.

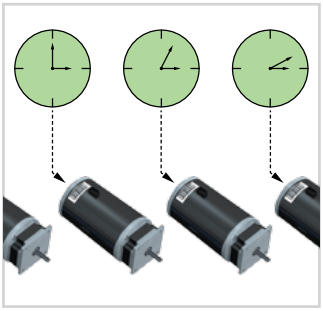
There is no mistake – quality is an ongoing, fundamental part of any manufacturing process. It means continuous improvement. It also means that quality is everyone's responsibility, it's not just one department or only done at the end of the process. Error proofing devices, referred to as Poka-Yoke devices, such as sensors, need to be integrated into the process with complete traceability throughout. Also, provisions have to be in place to quickly and easily add new Poka-Yoke devices and additional traceability as requirements evolve.

Error Proofing is:

Quality

Sequencing

Just-in-Time



Traceability

⚠ WARNING

- Read, understand, and follow warnings and manual. Failure to do so could result in serious injury or death.
- NEVER USE AS A SENSING DEVICE FOR PERSONNEL PROTECTION
- Does NOT include self-checking redundancy circuitry required for use in personnel safety applications
- Does NOT meet OSHA and ANSI standards for point-of-operation devices

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The Process

Error proofing is a simple 1-2-3 process: Identify, Detect, and Contain

During the development of the manufacturing line, trouble spots are projected based on experience. However, during the life of a manufacturing line, additional trouble spots will inevitably surface. Simply identify those spots, implement a detection method, and develop a means to contain it.

1: Identify Trouble Spots
Errors in manufacturing and assembly processes happen and need to be identified or predicted before you can take action.

2: Implement Detection
Active error-proofing uses sensors and vision systems to actively verify that a process is completed correctly.

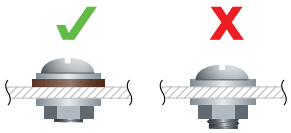
3: Contain Discrepancies
There are three main ways to contain discrepancies: scrap, reclassify, or rework the part.

1: Identify Trouble Spots

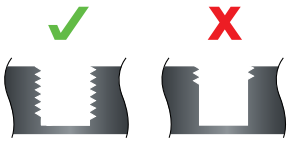
In the world of error proofing, any manual operation has the potential to induce human error. This includes any manual assembly operation and manual machine setup tasks. These areas require evaluation to ensure they meet appropriate quality standards such as Total Quality Management (TQM). As a general rule, every manual assembly operation should have at least two Poka-Yoke checks.

Some Common Trouble Spots Include:

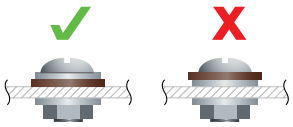
Missing or wrong parts:
Many parts are small with little visible distinction. Operators have trouble if systems are not in place to detect the wrong or missing parts.



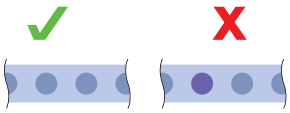
Missing or incomplete threads:
Threads are a common problem in manufacturing. Missing or incomplete treads can occur with bolts, studs and tapped holes.



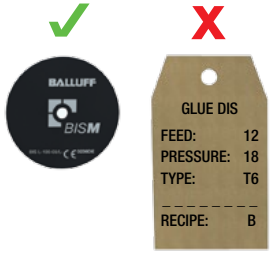
Installation sequence:
Repetitive installation sequences are often identified as troublesome areas. Most common are operations where multiple parts such as washers, spacers, O-rings and fastening devices are stacked on a common component.



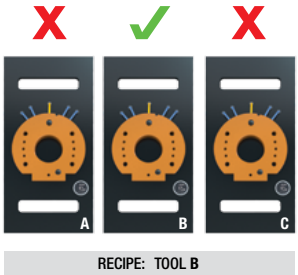
Evaluating color:
Over a short period of time, an operator becomes desensitized to colors. Color sensors are proven reliable in situations where repetitive color selection is required.



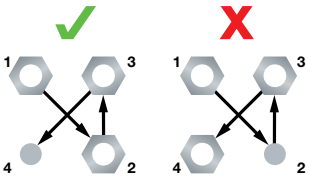
Manual data entry:
The average error rate for keystroke entry is 1%, or one error in every 100 keystrokes. The best method to prevent errors is to eliminate data entry by using RFID or bar code systems.



Manual machine setup problems:
Mistakes with manually switched over machine change parts or manual entered configuration data can cause immediate machine malfunction, but worse yet are the ones not caught immediately. These errors can make their way down the process, compounding the error costs. Automatic identification with RFID or bar code is a simple and effective means to ensure the machine is set up correctly before the machine goes back into production.



Critical fastener torque and sequence:
Electric torque controllers are a step in the right direction, but issues can still arise. The main problem is in knowing the exact bolt that a specific torque is being applied to and the tightening sequence. Spatial positioning for torque tools has proven effective to handle this situation.

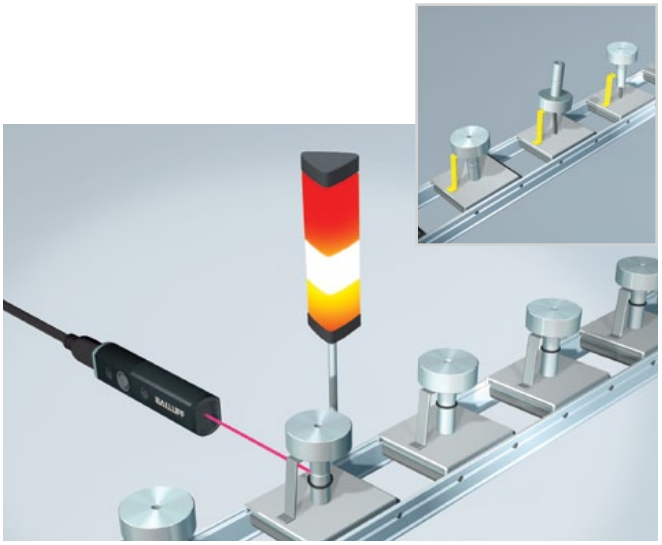


Products being mislabeled or mismarked:
Anytime there is manual marking or labeling, there is potential for errors. These possible errors can be avoided with a simple traceability system.

2: Implement a Detection Method

There are two types of error proofing used in manufacturing – passive and active. Passive error proofing uses mechanical keying that ensures a process cannot be performed incorrectly. This is an effective and economical option; however, it's not very flexible.

Active error proofing uses sensors and vision systems to actively verify that a process is completed correctly. Active error proofing is much more flexible and can provide more data than a passive device. Furthermore, traceability is easily integrated with active error proofing. Implementing active error proofing is accomplished by using either a discrete or analog sensor, color sensor, or a vision based sensor. Sensors are simple and cost effective, while vision based sensors are capable of more detailed inspections.

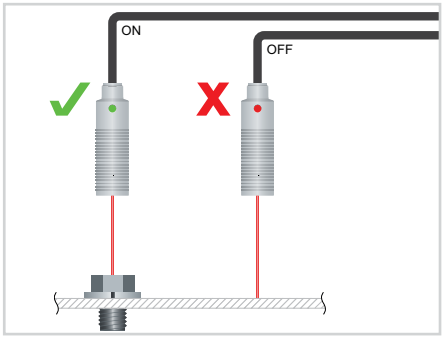


Passive vs. active error proofing

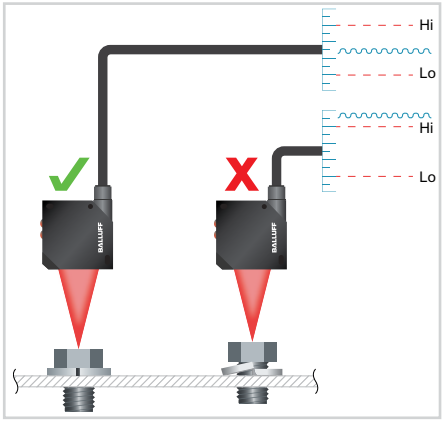
Implementing Sensors

Sensors provide standardized outputs that are either discrete (yes/no) or analog (measurement). Which one to use depends on the level of error proofing needed. Discrete sensors are simple and extremely easy to integrate. Analog sensors are able to convey actual measurements or product position information. Either of these outputs can interface directly to a modular expandable I/O system that interfaces to the lockout or rework diverter functions. Simple indicator lights, panel meters, or a man machine interface can also be used.

- **Discrete sensors provide an on-off signal to indicate non-conformance.**



- **Analog sensors take an actual measurement ideal for highly flexible applications or statistical process control.**

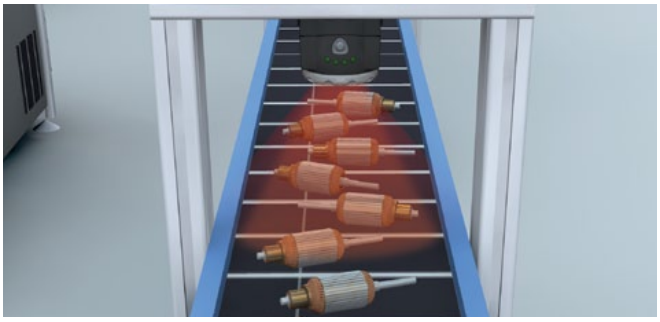


Implementing Vision

Vision based sensors take over where traditional sensors leave off. Vision can be generally divided into two basic categories: Vision Sensors and Vision Systems. Vision sensors such as Balluff's BVS line are ideal for error proofing applications. They are simple, cost effective, and flexible. Vision systems are designed for complex operations such as robot guidance, image analysis, and image capture and storage.

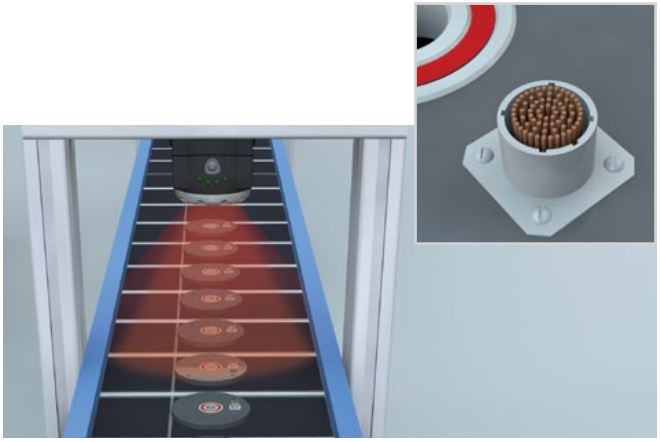
Situations that require the use of vision include:

- **Parts are not well fixtured**
  If the part is not contained in a fixture, or there is no opportunity to bring the part into an inspection station that has better tolerance, then a vision system is the best choice. Example: parts directly on moving conveyor belt.



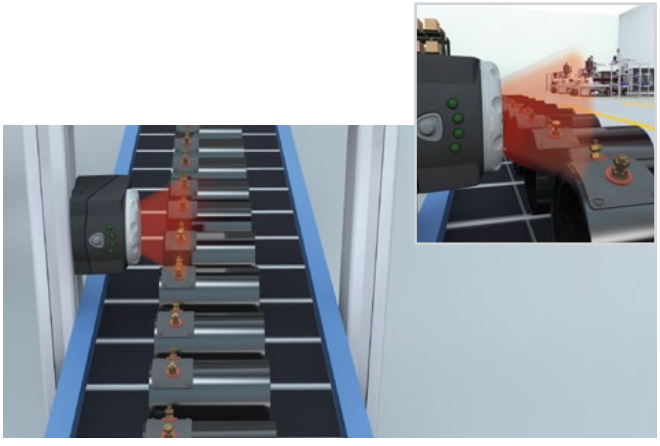
Parts on free conveyor

- **Multiple inspection points per part**
  If there are multiple details on the part to error proof, vision systems are recommended. Example: inspecting multiple pins in a connector.



Detecting multiple pins in a connector

- **Location of detail is not known or is random**
  If the location of the detail on the part in question is not constant or its location is random, then vision systems are an ideal choice. Example: random location of bolt on stud.



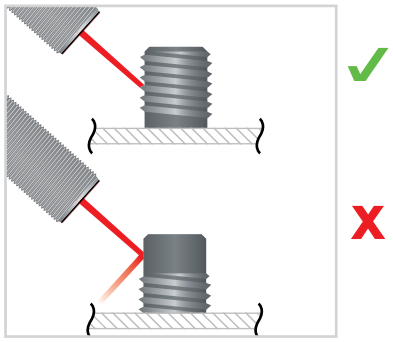
Detecting randomly located nuts

Sensor Based Detection

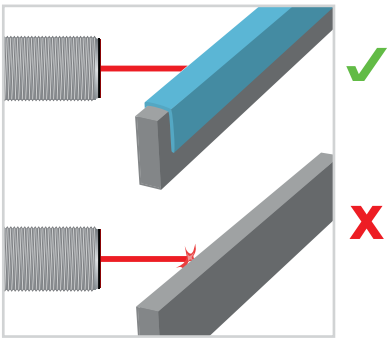
Yes/No – discrete sensors

Simple and effective, discrete sensors provide yes/no results for many applications. These sensors are ideal when parts are fixtured well.

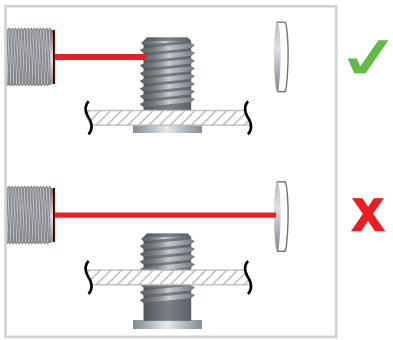
Thread detection
Standard diffuse laser is used to look for the threaded surface.



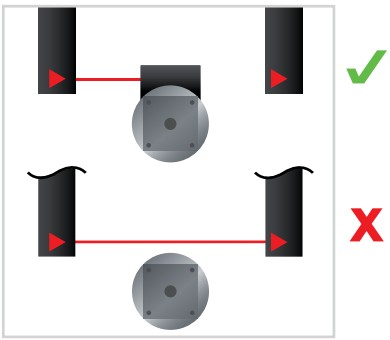
Trim install
Standard diffuse laser is used to see the shade and/or texture difference of an install trip piece.



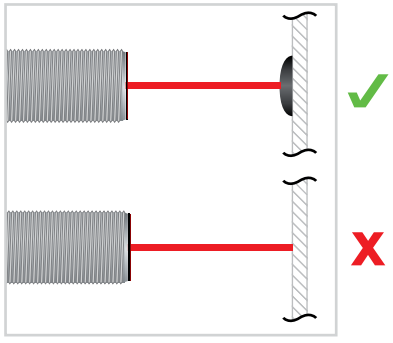
Part position
Laser retro-reflective sensor is used to ensure fastener is completely seated in place.



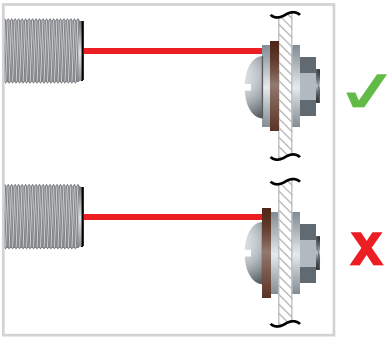
Missing part
Laser though-beam is used to ensure critical component is in position.



Missing part
Background Suppression (BGS) laser is used to detect small component on close background.

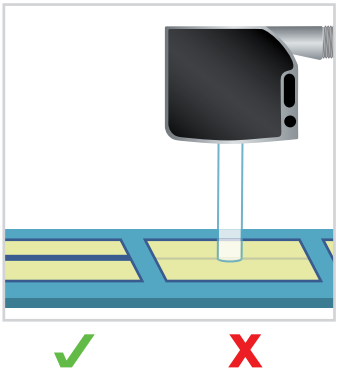


Installation sequence
Standard diffuse laser is used to see the shade difference between the metal washer and the black sealing washer.

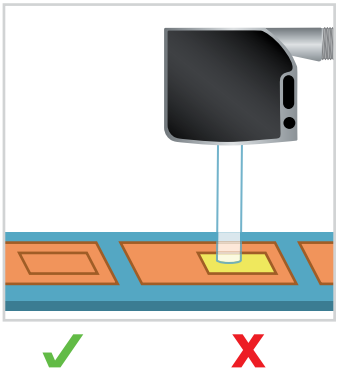


Specialty sensors

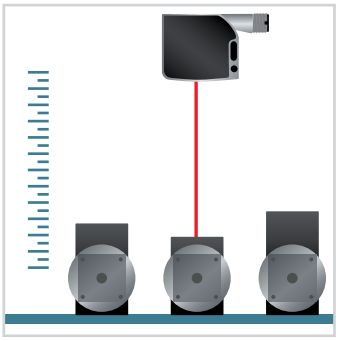
Sealant/grease detection
When UV tracers are present in the sealant or grease, detection of proper material and amount is easily accomplished.



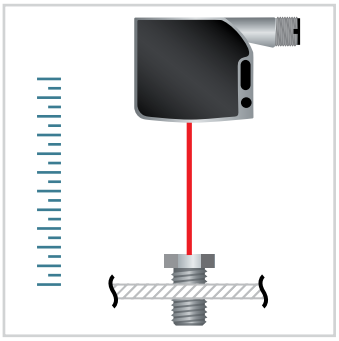
Color matching
The color sensor is taught a known good color and is then ready to detect that color based on a tolerance factor.



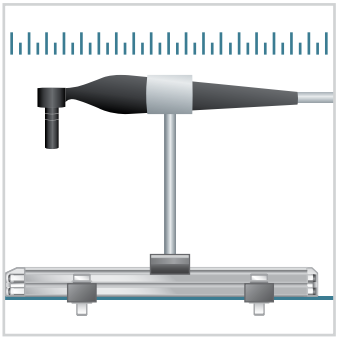
Measurement sensors
By using a measurement sensor, the correct part or component can be verified. This also aids in flexible manufacturing.



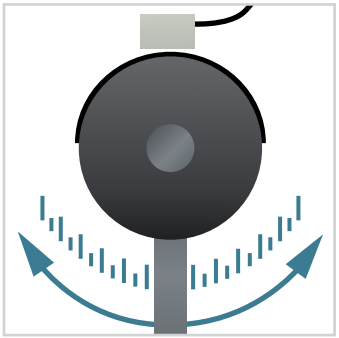
Size verification – Part seated
With multiple fasteners and possible depths, a measurement sensor can provide all the details needed for verification.



Tool position – Linear
Spacial position applications with linear movement are reliably and economically solved by linear position traducers.



Tool position – Rotary
Spacial position applications with rotary movement are reliably and economically solved by magnetic tape encoders.



The Perfect Error Proofing Tool

Vision simplifies complex sensing applications

In most production situations, vision systems can be overkill – too expensive, too much functionality, and just too complex. Instead, Balluff vision sensors are easy to set up, simple to use, and quicker to return your initial investment.

The Balluff vision sensor is a powerful error proofing tool that can be used in almost any area of your manufacturing process. It provides reliable part or feature presence/absence and position detection, plus dimension verification and accurate barcode reading with crisp and reliable resolution. The Balluff vision sensor has far more functionality than any discrete sensor, sensor array, or vision product in its class.

Increases Product Quality

- Eliminates unreliable manual inspection
- Allows 100% quality checking instead of audit checking
- Provides the resolution needed for reliable quality inspection
- Enables automated barcode reading

Reduces Costs

- Single-unit operation replaces expensive, cumbersome multi-sensor solutions
- Three models with multiple performance levels to choose from provide multiple price points based on functionality
- An easy to use software package minimizes setup time and cuts startup costs
- Provides vision performance at smart sensor pricing

Increases Productivity

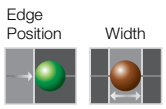
- Improves line speed and error proofing by eliminating the need for manual inspection
- Minimizes false code reads with very high code resolution for greater reliability
- Catches errors sooner to reduce unplanned downtime and scrap
- Reduces planned downtime with greater functionality and flexibility

Balluff Vision Sensor Series Application Examples

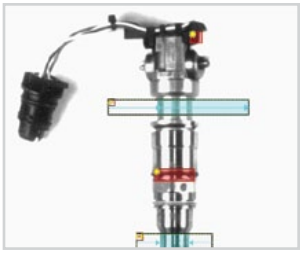
The Balluff Vision Sensor can replace many different discrete and analog sensor functions along with entire sensor arrays in a single error proofing device.

Automotive – Standard Version

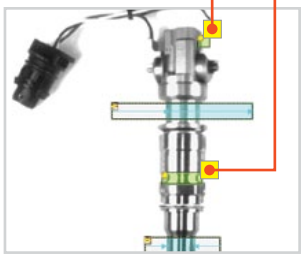
Dimensional gauging/component inspection
Inspect fuel injector for verification/presence of electrical cap, injector nozzle, o-ring, and gauging for the proper injector width.



✓ Verify presence of components and proper injector width

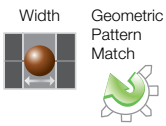


X Missing o-ring
Missing cap

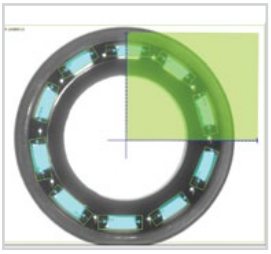


Automotive – Advanced Version

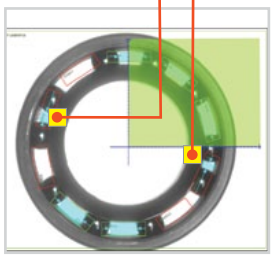
Geometric pattern matching – searches X, Y, and 360° rotation for geometric features
Verify presence of bearings and size of gaps.



✓ Bearings present; gaps correct



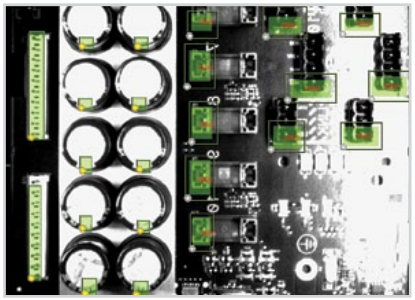
X Incorrect gap



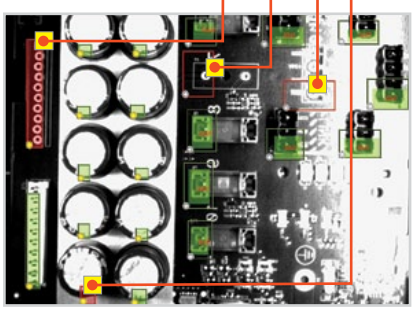
Electronics – Standard Version

Assembly verification
Inspect a circuit board to ensure that all connectors are present and verify the correct orientation of all the capacitors.

✓ All connectors are present and capacitors are in correct orientation



X Bad orientation
Missing connector



Packaging – ID Version

Verify barcodes
- Codes are read irrespective of slight changes in position
- High detection rate

- Part identification
- Process monitoring
- Print monitoring

Packaging – ID Version

Verify data matrix codes
- Codes are read irrespective of the position
- High detection rate
- ECC 200 compliant

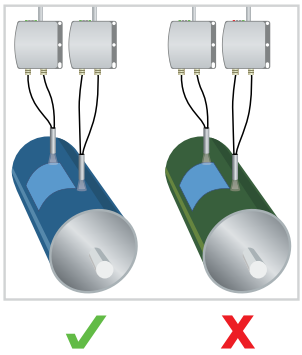
- Part identification
- Process monitoring
- Print monitoring

Color Sequencing

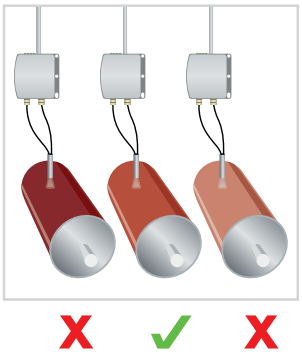
With flexible manufacturing, product color is constantly changing on the same production line. Over time, humans have difficulty identifying color. This fact has driven true color sensors to become vital Poka-Yoke devices. These devices are simple and effective… just teach all possible colors and then the sensor will signal if your intended specific color is present.

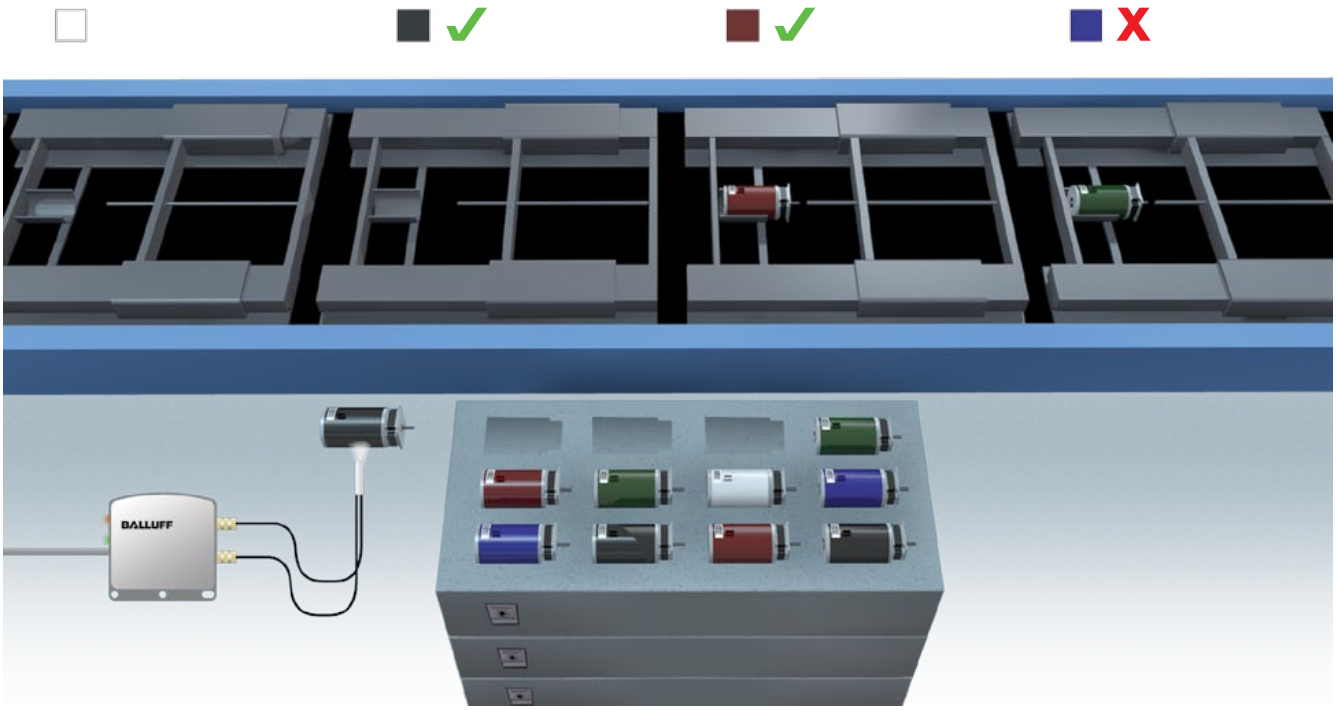
To address sequencing challenges, true color sensors verify the components when preparing the shipment as well as verifying the shipment once it has arrived. When multiple color combinations are required, true color sensors match the sub-component color to the main component color signaling a match.

Color matching



Color shade verification

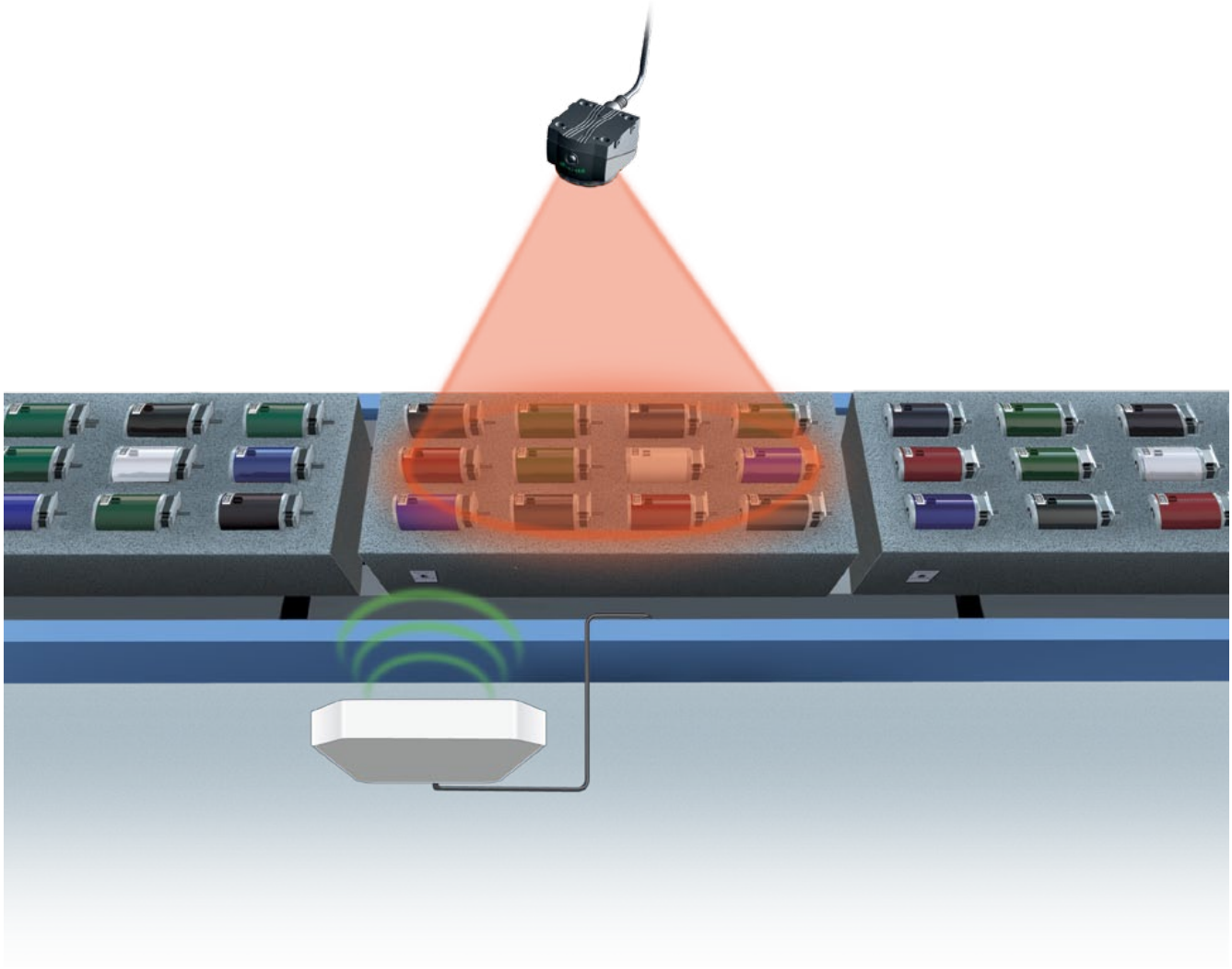




Traceability for Just-in-Sequence

Just-in-Sequence (JIS) is a subset of Just-in-Time (JIT) material flow. Common in flexible manufacturing assembly lines, JIS not only brings sub-components to the line at the right time, but also in the correct sequence. By sequencing the sub-components to match the assembly sequence, critical automation equipment always pull the correct parts.

Traceability is the method by which multiple vendors can ensure delivery of sequenced products. By using Ultra High Frequency (UHF) Radio Frequency Identification (RFID) in combination with a multi-barcode scanner, part shipping pallets and containers can be tracked with exact pocket location. The specific build data on the part from the 2D barcode can be combined with other parts into a database logged with the RFID tag. By using RFID, vendors' systems do not have to be highly integrated to achieve error proof sequencing.



3: Contain Product Discrepancies

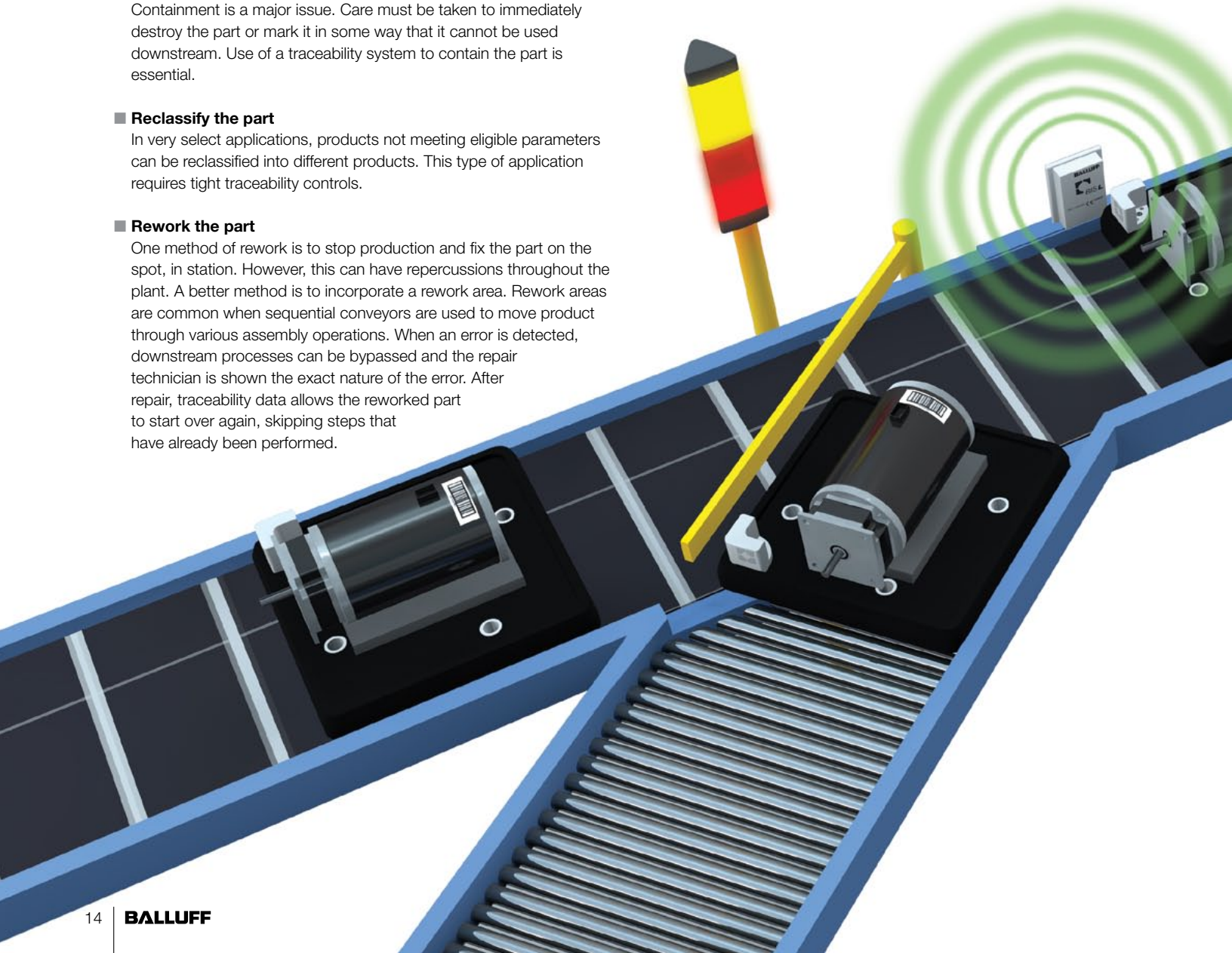
Traceability is an integral part of containment. In flexible manufacturing environments, traceability data identifies and tracks the specific version to be manufactured. This is accomplished with build data, which is a complete description of the intended part. For example, if the build data calls out a dark blue part, the color sensor must confirm this. Thus, the Poka-Yoke devices verify what the build data is asking for.

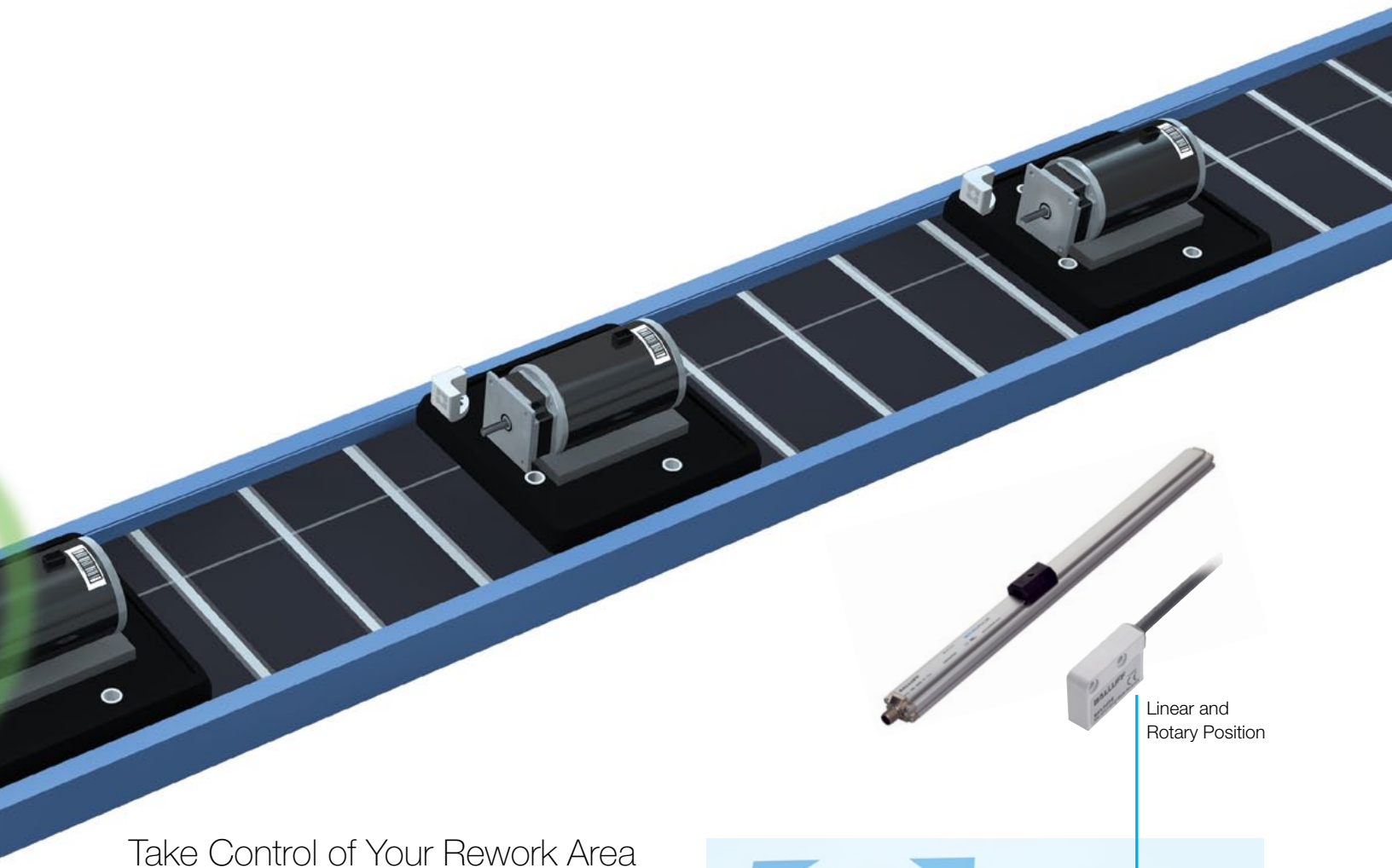
Discrepancies occur when build data and Poka-Yoke device data does not match. There are 3 main ways to deal with discrepancies:

- **Scrap the part**
  Containment is a major issue. Care must be taken to immediately destroy the part or mark it in some way that it cannot be used downstream. Use of a traceability system to contain the part is essential.

- **Reclassify the part**
  In very select applications, products not meeting eligible parameters can be reclassified into different products. This type of application requires tight traceability controls.

- **Rework the part**
  One method of rework is to stop production and fix the part on the spot, in station. However, this can have repercussions throughout the plant. A better method is to incorporate a rework area. Rework areas are common when sequential conveyors are used to move product through various assembly operations. When an error is detected, downstream processes can be bypassed and the repair technician is shown the exact nature of the error. After repair, traceability data allows the reworked part to start over again, skipping steps that have already been performed.





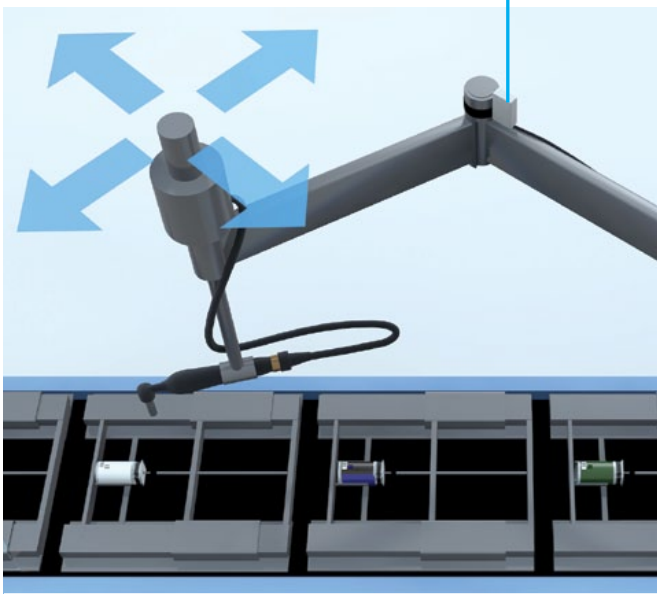
Linear and
Rotary Position

Take Control of Your Rework Area

Reworking a nonconforming part is challenging. Rework areas often have limited controls making it possible for a part to enter with one problem and leave with a new one. Fortunately, traceability enables tighter controls.

Based on the actual problem with the part, constraints are placed over the rework area to limit the access of rework technicians. This can be done by locking out certain tools using spacial positioning to constrain tools to the affected areas. Spacial positioning monitors the tool's actual position using linear or rotary position sensors to ensure the correct area is being worked. More common are electric tools that are simply disabled if in the wrong position.

When rework is complete, traceability information will guide the part back through existing in-process inspections as deemed appropriate by the process. These records are also maintained for future training and process improvements.



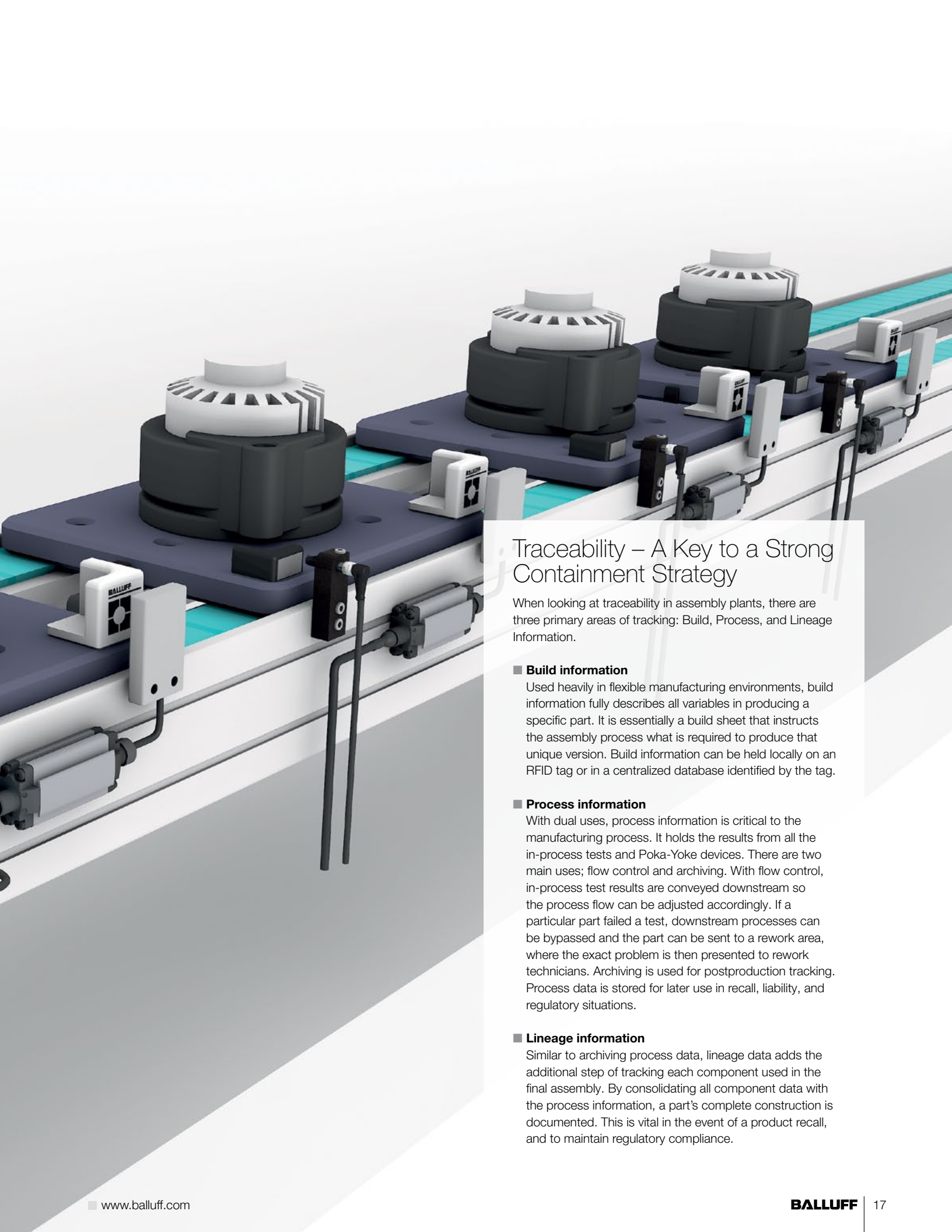
Spacial positioning of a torque wrench

Add Complete Visibility to your Assembly Systems

RFID enables complete traceability in flexible manufacturing systems

Manufacturing plants utilizing automated assembly have unique requirements when it comes to tracking their Work-in-Process (WIP). Accurate, real-time tracking brings complete visibility to processes. Tracking can also include all the lineage information from all the components used in the final assembly. Most automated manufacturing lines also utilize flexible manufacturing where multiple product versions are made on one line. When looking at automated assembly in total, there are three primary areas of tracking: Build, Process, and Lineage Information.

Identification
BIS V



Traceability – A Key to a Strong Containment Strategy

When looking at traceability in assembly plants, there are three primary areas of tracking: Build, Process, and Lineage Information.

Build information

Used heavily in flexible manufacturing environments, build information fully describes all variables in producing a specific part. It is essentially a build sheet that instructs the assembly process what is required to produce that unique version. Build information can be held locally on an RFID tag or in a centralized database identified by the tag.

Process information

With dual uses, process information is critical to the manufacturing process. It holds the results from all the in-process tests and Poka-Yoke devices. There are two main uses; flow control and archiving. With flow control, in-process test results are conveyed downstream so the process flow can be adjusted accordingly. If a particular part failed a test, downstream processes can be bypassed and the part can be sent to a rework area, where the exact problem is then presented to rework technicians. Archiving is used for postproduction tracking. Process data is stored for later use in recall, liability, and regulatory situations.

Lineage information

Similar to archiving process data, lineage data adds the additional step of tracking each component used in the final assembly. By consolidating all component data with the process information, a part's complete construction is documented. This is vital in the event of a product recall, and to maintain regulatory compliance.

Supporting Systems Architecture

Control architectures have significant impact on how a total error proofing and traceability program is implemented. Having a system that works well initially is somewhat easy. The real test is how well it works as time goes on. In an error proofing environment, easy expandability is a unique requirement.

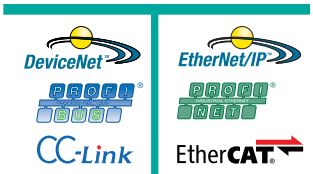
It is important to specify the appropriate control architecture during the initial design and build phase. This requires an architecture that easily integrates Poka-Yoke devices and traceability devices, such as Radio Frequency Identification (RFID), into one seamless system that allows easy and low cost expansion for the future.

Balluff has developed expandable architecture built around the open standard of IO-Link. This architecture seamlessly integrates Poka-Yoke devices and industrial identification devices. By keeping a few IO-Link ports open, future expansion is easy and cost effective. And the best part is the ability to implement the expandable architecture on popular control platforms from Allen-Bradley, Siemens, Mitsubishi and others.

Endless Error Proofing Possibilities – With Just One Network Connection

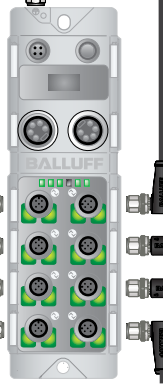
Continuous process improvement often means adding to your existing control system. Fortunately, Balluff's IO-Link technology is the perfect balance between plant engineering and continuous improvement groups.

IO-Link Masters
- 4 port and 8 port versions
- Parameter server functionality
- Fully programmable display



Smart Light
- Stack light Mode: 1-5 zones
- Level Mode: high/low level
- Configure: colors, brightness, levels, etc.

Discrete Sensors
- Up to 16 laser sensors
- IP67 metal or plastic, M8 or M12
- Inputs, outputs, configurable

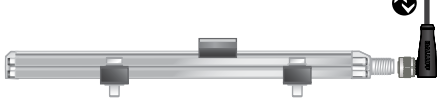


Smart Sensors
- Photoeye, Prox, Ultrasonic, Pressure Sensors
- Software storable and programmable parameters
- Diagnostics and digital measurements

Laser Measurement Sensors
- Take measurements up to 6m away
- Ideal for flexible manufacturing
- Laser light is visible for targeting

RFID Traceability
- Simple to implement, easy to use
- 8 byte or 30 byte read/write versions
- Enables flexibility and visibility in the machine

True Color Sensors
- For color sequencing and matching
- Teach up to 3 colors
- Ideal for flexible manufacturing



Linear Transducers
- No shielded cable runs and 32 bit signed integer
- Programmable stroke and set points
- Available from 2" to 180"

Consult factory for connection options

Vision Sensor
- Simple and effective error proofing tool
- Poka-Yoke checks and ID in one
- Simple 1, 2, 3 programming

Economical connection of sensors/actuators to the controller

IO-Link

Fieldbus modules

Type	IO-Link Master EtherNet/IP		IO-Link Master PROFINET		IO-Link Master ETHERCAT		IO-Link Master CC-Link		IO-Link Master DEVICENET		IO-Link Master PROFIBUS		Commisioning Tool			
Ordering code Part number	**BNI006A** BNI EIP-508-105-Z015		**BNI005H** BNI PNT-508-105-Z015		**BNI0077** BNI ECT-508-105-Z015		**BNI0040** BNI CCL-502-100-Z001		**BNI005A** BNI DNT-502-100-Z001		**BNI005R** BNI PBS-502-101-Z001	**BNI003P** BNI PBS-507-001-Z011	**BNI0073** BNI USB-901-013-A501			
No. of ports	8		8		8		8		8		8	4	1			
Inputs	16		16		16		16		16		16	8				
Outputs	16		16		16		16		16		16	8				
Config. I/O	16		16		16		16		16		16	8				
Analog input I																
Analog input U																
IO-Link ports	8		8		8		4		4		4	4	1			

Tracking and tracing streams of goods

Model	BIS V RFID processor unit				HF read/write head BIS VM, M30×1.5	HF read/write head BIS VM 80×80×40 mm, standard	Metal mount	Data bolts	HF read/write head BIS VM, 25×50×10 mm			HF read/write head BIS VM, M12×1			HF read/write head BIS VM, M18×1			HF read/write head BIS VM, 25×50×10 mm, Metal mount		
Ordering code Part number	**BIS0012** BIS V-6106-034-L004	**BIS00T3** BIS V-6102-019-C001	**BIS00U9** BIS V-6110-063-C002	**BIS010P** BIS V-6111-073-C003	**BIS00RF** BIS VM-300-001-S4	**BIS00T0** BIS VM-301-001-S4	**BIS00T2** BIS VM-351-001-S4	**BIS00TA** BIS VM-341-001-S4	**BIS00T9** BIS VM-305-001-S4			**BIS00T7** BIS VM-306-001-S4			**BIS00T8** BIS VM-307-001-S4			**BIS00T6** BIS VM-352-001-S4		
Ethernet/IP	■																			
Profibus		■																		
EtherCAT			■																	
CC-Link				■																
Degree of protection as per IEC 60529	IP 65	IP 65	IP 65	IP 65	IP 67	IP 67	IP 67	P 67	IP 67			IP 67			IP 67			IP 67		

Sensor hubs | **Analog adapters** | **LED signal tower light** | **Inductive couplers**








	M8 sensor hub			M12 sensor plastic hub		M12 config. plastic hub		M12 sensor metal hub		M12 config. metal hub		Analog adapter		Universal config. I/O		SmartLight 3 position		SmartLight 5 position		Inductive coupler base		Inductive coupler remote	
	BNI001W BNI IOL-101-S01-K018	**BNI001Y** BNI IOL-102-S01-K019	**BNI0022** BNI IOL-104-S01-K021	**BNI0006** BNI IOL-104-000-K006		**BNI005T** BNI IOL-302-S01-K006		**BNI0039** BNI IOL-104-S01-Z012		**BNI003C** BNI IOL-302-S01-Z012		**BNI0041** BNI IOL-712-000-K023	**BNI0042** BNI IOL-714-000-K023	**BNI005M** BNI IOL-771-000-K027		**BNI007F** BNI IOL-801-000-Z036		**BNI0072** BNI IOL-802-000-Z036		**BIC0070** BIC 1B0-ITA50-Q40KFU-SM4A4A		**BIC0071** BIC 2B0-ITA50-Q40KFU-SM4A5A	
	4	8	8	8		8		8		8										1		1	
	4	8	16	16		16		16		16				16									
						16				16				16		3		5					
						16				16				16									
												1											
													1										
																				1		1	





Model	HF High Frequency BIS M -410 Reading/writing compact processors 56×40×24 mm					HF High Frequency BIS M -411 Reading/writing compact processors 105×73×24 mm					UHF Ultra High Frequency BIS U-62_ processors 164×112×45 mm				UHF Antenna Mid range			UHF Antenna Long range			
Ordering code Part number	**BIS00W1** BIS M-410-067-001-04-S92	**BIS00W2** BIS M-410-068-001-00-S115	**BIS00W3** BIS M-410-068-001-02-S115	**BIS00W4** BIS M-410-068-001-09-S72		**BIS00W5** BIS M-411-067-001-04-S92	**BIS00W6** BIS M-411-068-001-00-S115	**BIS00W7** BIS M-411-068-001-02-S115	**BIS00W8** BIS M-411-068-001-09-S72		**BIS00Z4** BIS U-620-068-111-00-ST29	**BIS00Z8** BIS U-620-067-111-04-ST30	**BIS00Z0** BIS U-626-069-111-06-ST32		**BIS00TY** BIS U-301-C1-TNCB			**BIS00U0** BIS U-302-C1-TNCB			
Subnet 16	■					■															
RS232		■					■														
RS485			■					■													
USB				■					■												
Degree of protection as per IEC 60529	IP 67	IP 67	IP 67	IP 67		IP 67	IP 67	IP 67	IP 67		IP 65	IP 65	IP 65		IP 65			IP 65			

Field components

IO-Link

Industrial RFID

Type	IO-Link Industrial RFID systems read/write units																	
Ordering code Part number	**BIS00LW** BIS M-402-045-002-07-S4	**BIS0105** BIS M-402-072-002-07-S4	**BIS00M1** BIS M-402-045-004-07-S4	**BIS0106** BIS M-402-072-004-07-S4	**BIS00UY** BIS M-402-045-005-07-S4-SA1	**BIS00LK** BIS M-401-045-001-07-S4	**BIS00LM** BIS M-451-045-001-07-S4	**BIS0102** BIS M-401-072-001-07-S4	**BIS0103** BIS M-451-072-001-07-S4	**BIS00LH** BIS M-400-045-001-07-S4	**BIS0108** BIS M-400-072-001-07-S4	**BIS00LJ** BIS M-400-045-002-07-S4	**BIS0104** BIS M-400-072-002-07-S4					
IO-Link version	1.1 only																	

Model	BVS Sensors BVS Identification								Vision Sensors BVS Standard									
Ordering code Part number	**BVS001R** BVS ID-3-005-E	**BVS0001** BVS ID-3-001-E	**BVS000T** BVS ID-3-003-E	**BVS001C** BVS ID-3-105-E	**BVS0019** BVS ID-3-101-E	**BVS001A** BVS ID-3-103-E			**BVS000E** BVS OI-3-005-E	**BVS0003** BVS OI-3-001-E	**BVS0005** BVS OI-3-003-E	**BVS0013** BVS OI-3-105-E	**BVS0014** BVS OI-3-101-E	**BVS0012** BVS OI-3-103-E				
Light type: red, LED	■	■	■						■	■	■							
Light type: infrared, LED				■	■	■						■	■	■				
Lens	6 mm	8 mm	12 mm	6 mm	8 mm	12 mm			6 mm	8 mm	12 mm	6 mm	8 mm	12 mm				
Working distance: Reading the barcode and data matrix code	■	■	■	■	■	■												
Verifying manufacture and expiration dates (OCV)	■	■	■	■	■	■												
Checking brightness and contrast									■	■	■	■	■	■				
Checking part position, diameter and width									■	■	■	■	■	■				
Detect patterns									■	■	■	■	■	■				
Detect 360 °C **patterns**																		
Detect 360 °C **contour**																		
Ethernet interface	■	■	■	■	■	■												
RS232 port	■	■	■	■	■	■												
Degree of protection as per IEC 60529	IP 54	IP 54	IP 54	IP 54	IP 54	IP 54			IP 54	IP 54	IP 54	IP 54	IP 54	IP 54				

BIS M tags

BIS00UC	BIS M-116-03/A	Ø6x1.0 112 Bytes
BIS00UE	BIS M-116-08/A	Ø6x1.0 160 Bytes
BIS00YC	BIS M-132-10/L	Ø25x5 736 Bytes
BIS00YF	BIS M-132-03/L	Ø25x5 112 Bytes
BIS0046	BIS M-112-02/L	50x3mm 2000 Bytes
BIS0045	BIS M-111-02/L	30x2.5mm 2000 Bytes
BIS00Y5	BIS M-135-03/L	51x51mm 112 Bytes
BIS00Y6	BIS M-135-02/L	51x51mm 2000 Bytes
BIS00Y2	BIS M-135-07/L-HT	51x51mm 992 Bytes
BIS00NZ	BIS M-191-02/A	24x24x21 2000 Bytes
BIS00NW	BIS M-143-02/A-M8	M8 2000 Bytes
BIS00NU	BIS M-143-02/A-M6	M6 2000 Bytes
BIS004F	BIS M-150-02/A	40x22mm 2000 Bytes
BIS004H	BIS M-151-02/A	40x22mm **Metal Mount**
BIS00LC	BIS M-107-03/L-H200	40x22mm **High Temp**
BIS00NL	BIS U-100-02-CA	127x37mm 12 Byte EPC

Model					
	Vision Sensors BVS Universal	True-Color-Sensor	Plastic fiber	Adapter lens	M8 to 9 pin Dsub interface cable
Ordering code Part number		**BFS000L** BFS 33M-GSS-F01-PU-02	**BFO00C4** BFO D22-XB-LB-EAK-15-SA1-02	**BAM020P** BAM LS-FO-003-M6-L	**BCC0ARP** BCC M313-D259-B0-688-PS0334-020
	BVS001M BVS UR-3-001-E	■			
	BVS001N BVS UR-3-003-E	■			
	BVS001L BVS UR-3-005-E	■			
	BVS001H BVS UR-3-101-E		■		
	BVS001J BVS UR-3-103-E		■		
	BVS001F BVS UR-3-105-E		■		
	BVS001K BVS UR-3-107-E		■		
		7			
		3 bit output Push/Pull NO/NC			
	8 mm	n/a	130 mm	400 mm	
	12 mm	2 m	2 m		2 m
	6 mm				
	8 mm				
	12 mm				
	6 mm				
	16 mm				
	IP 54				
	IP 54				
	IP 54				
	IP 54				
	IP 54				
	IP 54				
	IP 54				

Photoelectric sensors with discrete and analog outputs

Discrete

Type	BOS 08M	BOS 12M laser	BOS 18M red light	BOS 18M laser	BOS 18M laser with angle head	BOS 18KF	BOS 18KW with angle head	BOS Q08M laser	BOS 2K	
Supply voltage	10...30 V DC	10...30 V DC	10...30 V DC	10...30 V DC	10...30 V DC	10...30 V DC	10...30 V DC	10...30 V DC	10...30 V DC	
Output function	PNP NO/NC	PNP NO/NC	PNP NO/NC	PNP NO/NC	PNP NO/NC	PNP NO/NC	PNP NO/NC	PNP NO/NC	PNP NO/NC	
Connection	Connectors/ cables	Connectors/ cables	Connectors	Connectors/ cables	Connectors/ cables	Connectors/ cables	Connectors/ cables	Connectors/ cables	Connectors/ cables	
Ambient temperature	–10...+60 °C	–10...+50 °C	–5...+55 °C	–5...+55 °C, –10...+55 °C, –15...+55 °C	-5...+55 °C	–10...+50 °C –25...+55 °C	–10...+50 °C –25...+55 °C	0...+50 °C	–20...+50 °C	
Degree of protection as per IEC 60529	IP 67	IP 67	IP 67	IP 65/IP 67	IP 67	IP 67	IP 67	IP 67	IP 67	
Light type	Red light	Laser, red light	Infrared light, red light	Laser	Laser	Infrared light, red light, laser	Infrared light, red light, laser	Laser, red light, pin point red light	Red light	
Special features										
Housing material	Metal	Metal	Metal	Metal	Metal	Plastic	Plastic	Metal	Plastic	

Many other products are included in our complete object detection product line.

Analog

Type Working range	BOD 6K 20...80 mm		BOD 21M 20...200 mm		BOD 26K 30...100 mm		BOD 26K 80...300 mm		BOD 63M 200...2000 mm		BOD 63M 200...6000 mm		BOD 63M 200...6000 mm	
Ordering code Part number	**BOD000H** BOD 6K-RA01-S75-C	**BOD000F** BOD 6K-RA01-C-02	**BOD000M** BOD 21M-LA02-S92	**BOD000R** BOD 21M-LB02-S92	**BOD0005** BOD 26K-LB04-S115-C	**BOD000C** BOD 26K-LBR04-S115-C	**BOD0006** BOD 26K-LB05-S115-C	**BOD000E** BOD 26K-LBR05-S115-C	**BOD000U** BOD 63M-LA02-S115	**BOD0010** BOD 63M-LB02-S115	**BOD0012** BOD 63M-LI06-S4		**BOD000W** BOD 63M-LA04-S115	**BOD0011** BOD 63M-LB04-S115
Light type														
Red light	■	■									■			
Laser light			■	■	■	■	■	■	■	■	■		■	■
Output														
RS485 interface						■		■						
PNP transistor	■	■												
IO-Link											■			
2× PNP transistor			■	■	■	■	■	■	■	■			■	■
Alarm output									■	■			■	■

Type	
Ordering code Part number	
Output signal	0...10 V
	IO-Link
	4...20 mA
Degree of protection as per IEC 60529	
Red light	
Switching output PNP	

	BOS 5K laser	BOS 6K laser	BOS 21M laser	BOS 23K laser	BOS 26K	BOS 50K	BKT 67M UV contrast sensor	BFS 26K color sensor	Through-beam fork sensor BGL	Angle sensor BWL
	10...30 V DC	10...30 V DC	10...30 V DC	10...30 V DC, 12...30 V DC	10...30 V DC	10...30 V DC	10...30 V DC	12...28 V DC	10...30 V DC	10...30 V DC
	PNP/NPN NO/NC	PNP NO/NC	PNP/NPN NO/NC	PNP NO/NC	PNP/NPN NO/NC	PNP/NPN I/O Link	PNP/NPN/ Analog NO/NC	3x PNP	PNP/NPN NO/NC	PNP/NPN NO/NC
	Connectors/ cables	Connectors/ cables	Connectors	Connectors	Connectors	Connectors	Connectors	Connectors	Connectors	Connectors
	–10...+55 °C	–20...+60 °C	–10...+50 °C	–20...+60 °C	–20...+60 °C	–10...+60 °C	–10...+55 °C	–10...+55 °C	–10...+60 °C	–10...+60 °C
	IP 67	IP 67	IP 67	IP 67/IP 69K	IP 67	IP 67	IP 67	IP 67	IP 67	IP 67
	Laser, red light	Laser, red light	Laser	Laser	Red light, infrared laser	Red light	Red, green and blue light	Pulsed white light	Red light, PinPoint, infrared, laser	Red light, PinPoint, infrared, laser
		Teach-in					Interchange-able optics		Fluid detection Transparent detection	
	Plastic	Plastic	Metal	Plastic	Plastic	Plastic	Metal	ABS	Metal	Metal

	Inductive displacement sensors BIP IO-Link			Magneto-inductive displacement sensors BIL 160 voltage 0...10 V or current 4...20 mA			Inductive distance sensors Block designs, 10×30×6 mm R03, M8, flush		Analog Fork sensor 1 analog with 1 switching/ error output		Magnetic displacement sensors Working range 256 mm, absolute, resolution 1 µm, read distance 0.35 mm, output signal SSI		Magnetic displacement sensors, Working range infinite or rotary, incremental, resolution 0.1 mm, read distance 2 mm, output signal HTL		Profile PF BTL6 Measuring length 50...4570 mm				
	BIP0002 BIP AD2-B040-02-S4	**BIP0004** BIP LD2-T040-02-S4	**BIP0005** BIP CD2-B040-02-S4	**BIL0004** BIL ED0-P160A-01-S75			**BAW0031** BAW R03KC-UAE40B-BP00,3-GS49		**BGL0033** BGL 30C-005-S4	**BGL003C** BGL 50C-005-S4	**BML-S1H...** BML-S1H_-_6_C-M3_A-DO-KA00,3-S284		**BML-S1C0-...** BML-S1C0-Q53_-M400-_0-KA_ _		BTL6-**U**110-M____-PF-S4____	BTL6-**A**500-M____-PF-S115	BTL6-**E**500-M____-PF-S115 (4...20 mA)	BTL6-**C**500-M____-PF-S115 (0...20 mA)	BTL6-**G**500-M____-PF-S115 (-10...+10 V)
	■			■			■		■	■						■			
		■													■				
			■	■													■	■	■
				IP 67			IP 67				IP 67		IP 67		IP 67	IP 67	IP 67	IP 67	IP 67
									■	■									
									■	■									

Service

Customized to your specifications

Next Steps

Few process improvements can impact your bottom line like a well-executed error proofing strategy. By utilizing an infrastructure of modular expandable I/O for Poka-Yoke devices and an effective traceability program, you will be far ahead of the game. The rest is as easy as 1, 2, 3 – Identify, Detect, and Contain.

Rely on Balluff's in-plant assistants when trouble spots are identified. There are often a few different methods to detect errors and Balluff has experts that can suggest the best method for almost every situation. Also, plant-wide audits are a valuable means to address multiple issues at one time.

As your error proofing partner, Balluff is uniquely positioned to assist you in all phases of your error proofing strategy. Balluff's modular expandable I/O systems establish a strong architectural foundation for years to come. This I/O system perfectly integrates our traceability products as well as our wide line of Poka-Yoke devices. No single supplier is more capable of supplying a complete and more integrated error proofing strategy.

Contact Balluff to take the next step in your continuous improvement.

A successful error proofing project requires a competent partner for the life of the system. This includes conception, planning, testing, and training.

Balluff has experience in assisting customers develop the architecture for their unique needs. Additionally, Balluff works with partners, such as qualified systems integrators and machine builders, that can provide complete error-proofing solutions or simply help with integration or more advanced automation.

Application advice through our Tech Support
Discuss your technical requirements and take advantage of our expertise.

More information can be found in our services brochure.

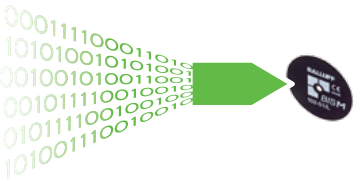
Real-world examples
- Assist in defining data maps and data locations – central vs. decentralized
- Review tracking technologies – bar code and LF, HF and UHF RFID
- Architecture layout to ensure the most cost-effective system
- Component selection assistance

Customized software for handhelds
Balluff can custom-configure the software for handhelds for your mobile tracking needs.

As a user of industrial RFID or barcode, you need a handheld that speaks your language. Balluff engineers can program the handheld screens to convey the tracking information in your terms. That means a data field will appear in real language, such as “Tool Usage Counter”, and not an obscured address reference within an RFID data tag.

The advantages
- Access to all tracking information
- Intuitive interface drastically reduces learning curve
- Maintain process and corporate names throughout the plant floor
- No additional resources required

Individually programmed RFID tags
Balluff can pre-program your data tags to get you up and running faster.



For centralized data systems utilizing read-only functionality, the data tags only require a serial number or a special code. Balluff offers a service to pre-program your data tags at the factory with exactly what you need. They are ready to install and require no writing hardware or user intervention. Just leave the programming to us!

The advantages
- Cost-effective – no need for separate hardware
- Time-saving – programming of write routines can be eliminated completely
- Easy to place a repeat order – data tags with the same specifications can always be obtained again

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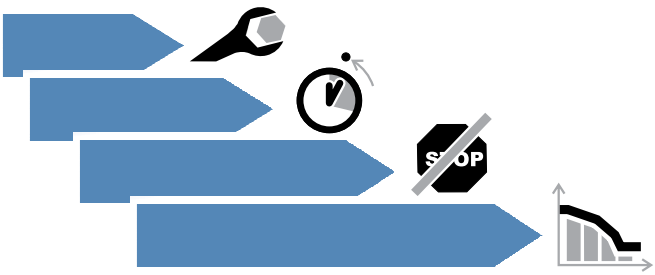
Workshops
Make use of Balluff’s vast knowledge in error-proofing solutions.



Have one of our regional tech engineers meet with your project team to discuss your error-proofing project.

Target learning areas
- Vision systems
- Sensor fundamentals
- Modular expandable architectures
- Dedicated RFID systems
- RFID based traceability solution
- Vision sensor based bar code
- Mobile handheld solutions

BALLUFF

sensors worldwide

- Systems and Services
- Industrial Networking and Connectivity
- Industrial Identification
- Object Detection
- Linear Position Sensing and Measurement
- Fluid Sensors
- Accessories

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