RESOURCES // GLOSSARY

Machine vision and industrial inspection glossary

Plain definitions of the terms used when planning, buying and accepting an inspection station, with what each one means on a production line.

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Ask about your line

// WHAT THIS GLOSSARY COVERS

This glossary explains the terms used when planning, buying and accepting a machine vision inspection station, from lenses and lighting to PLC signals and acceptance tests. Each entry gives a one-sentence definition, what the term means on a production line, including its usual pitfalls, and a link to the guide or application page that covers it. The terms are grouped into optics and lighting, cameras, inspection methods, codes, PLC and reject integration, acceptance metrics, packaging and line equipment, and industry terms with the South African rules behind them.

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// TERMS A–Z

1 100 % inspection

A Air knife, Anode plate, Anomaly detection, Area-scan camera, Automated

Optics and lighting

How the lens and the light decide what the camera can see. Most inspection problems are solved, or lost, here.

Field of view (FOV)

Field of view (FOV) is the area of the scene that a camera and lens capture in one image, usually stated as its width and height at the product.

The field of view is chosen together with the smallest detail to be found: the camera's pixels are spread across it, so a larger view means each pixel covers more of the part. It must also leave a margin for variation in product position, or parts drift out of the image. A large product with small defects may need several cameras, a line-scan camera or several images rather than one wide view.

SEE: Inspection technology · Dimensional measurement

RELATED TERMS: Spatial resolution, Working distance

Working distance (WD)

Working distance (WD) is the distance from the front of the lens to the surface being inspected.

Together with the lens focal length, it sets the field of view, and it decides how much space the station needs above or beside the conveyor. A short distance can leave too little room for lighting, guards or product changeovers; a long one needs a longer lens and more light. Dome and low-angle lights often have to sit close to the part, so working distance and lighting are planned together at the site survey.

SEE: Inspection technology · Machine vision lighting guide

RELATED TERMS: Field of view, Depth of field

Depth of field (DOF)

Depth of field (DOF) is the range of distances from the lens over which the image stays acceptably sharp.

It matters when products vary in height, sit at different positions on the conveyor or have features at several levels. Closing the lens aperture increases depth of field but lets in less light, which calls for a brighter light or a longer exposure, and a longer exposure blurs moving products. Parts that move outside the depth of field give soft edges, which can look like defects or hide them.

SEE: Reducing false rejects · Inspection technology

RELATED TERMS: Exposure time and motion blur, Working distance

Spatial resolution (smallest detectable feature, pixel resolution)

Spatial resolution is the size of the area on the part that one camera pixel covers, and it sets the smallest feature a station can detect or measure.

It follows from the field of view divided by the number of pixels across the sensor. A defect or character detail must cover several pixels to be found reliably, not just one, so the camera is chosen from the smallest detail that matters rather than from its pixel count alone. Focus, optics, lighting contrast and motion blur also limit what is resolved in practice, which is why the result is confirmed on your own samples.

SEE: Dimensional measurement · Web & line-scan inspection

RELATED TERMS: Field of view, Exposure time and motion blur

Telecentric lens

A telecentric lens is a lens that keeps the magnification of an object constant when its distance from the lens changes, within the lens's working range.

It matters for measurement: with a standard lens, nearer features look larger, so a part that sits higher or tilts reads as a different size. Presence, label and code checks rarely need one. The limits are practical: the field of view is no larger than the front of the lens, so the lens must be at least as large as the part; it is longer and heavier and needs more mounting space; and it works best with lighting matched to it, typically a backlight for silhouette measurement.

SEE: Dimensional measurement · Inspection technology

RELATED TERMS: Backlight, Edge and caliper measurement

Backlight (backlighting, transmitted light)

Backlighting is a lighting method in which the light sits behind the part, facing the camera, so that opaque parts appear as dark silhouettes.

It gives sharp outlines for measuring edges, holes and gaps, for finding flash and short shots, and for checking presence and position. On clear containers the light passes through, showing fill level, particles and bubbles. It shows nothing of the top surface. It needs access behind the part, which not every conveyor allows, and dust on the light shows up as a false defect. Labels block the view of the fill level, and foam or condensation can confuse it.

SEE: Machine vision lighting guide · Fill level, cap & seal · Dimensional measurement

RELATED TERMS: Telecentric lens

Bright-field lighting (ring light, bar light)

Bright-field lighting is a lighting geometry in which light reflected from a flat surface enters the lens, so the surface looks bright and features that scatter light look darker.

Ring lights around the lens and bar lights above the part are the usual forms. It is the simplest and brightest option and suits matte parts: printed cartons, paper labels, presence and colour checks. On glossy parts it creates hot spots, reflections of the light itself, which can hide print or cause false rejects; moving the light off the camera axis often moves them out of view.

SEE: Machine vision lighting guide · Label & print inspection

RELATED TERMS: Dark-field lighting, Dome lighting

Dark-field lighting (low-angle lighting)

Dark-field lighting is a lighting geometry in which light arrives at a low angle so that its reflection from a flat surface misses the lens, leaving the surface dark while scratches, edges and raised features glow.

It is the usual first choice for scratches, dents, burrs, embossed or engraved text and dot-peen codes. Part height and tilt must be consistent, because the effect depends on the angle. Dust and fibres glow as well, and a single bar light shows features running across its light better than those running along it. On clear glass and plastic it shows cracks and chips, which bend light towards the camera.

SEE: Machine vision lighting guide · Surface defect detection · DPM code reading

RELATED TERMS: Bright-field lighting, Direct part marking

Dome lighting (diffuse lighting)

Dome lighting is a diffuse lighting method that surrounds the part with even light from nearly every direction, so reflections from shiny, curved or crinkled surfaces merge into an even background.

It is used to read print and codes on cans, foil, blister packs, bottles and other shiny curved packs, and for laser marks on curved metal. The dome must sit close to the part, the camera hole can show as a dark spot on flat mirror-like parts, and because diffuse light hides relief it also hides shallow scratches and dents. Where both print and surface relief matter, two lighting set-ups or two images may be needed.

SEE: Machine vision lighting guide · OCR/OCV & code inspection · DPM code reading

RELATED TERMS: Coaxial lighting, Dark-field lighting

Coaxial lighting (on-axis lighting)

Coaxial lighting is a lighting method in which a half-mirror, called a beam splitter, sends light down along the camera's own axis, so that flat surfaces square to the camera reflect it straight back into the lens.

A flat, polished face looks bright, while scratches, pits and stains scatter the light and look dark. It suits polished metal, glass, laminated labels, flat foil and laser marks on flat, polished faces. Curved or tilted areas turn dark, so it only works on faces square to the camera, and the beam splitter wastes much of the light, which calls for a brighter source or a longer exposure.

SEE: Machine vision lighting guide · DPM code reading

RELATED TERMS: Dome lighting

Line light

A line light is a light that produces a narrow, bright and even line of illumination along the scan line of a line-scan camera.

A line-scan camera exposes each line only briefly, so it needs concentrated light, and the light must be even along its whole length or the image shows bright and dark bands along the material. Light and scan line must stay aligned; a knock to either mounting shows as darker images. Depending on the defect, it is set up as a backlight through the web, as reflected light, or at a low angle.

SEE: Web & line-scan inspection · Machine vision lighting guide

RELATED TERMS: Line-scan camera, Encoder

Strobe lighting (strobing, strobed light)

Strobe lighting is a lighting method in which the light switches on only for the camera exposure, triggered together with the camera.

With a short exposure it freezes moving products and can outshine ambient light, because during that moment the station light is far brighter than the room. Light and exposure timing must match: if the flash starts late or ends early, images vary in brightness from product to product. Pulse limits come from the datasheets of the light and its controller and differ between lights.

SEE: Machine vision lighting guide · Reducing false rejects

RELATED TERMS: Exposure time and motion blur, Shroud and ambient light

Polarising filter (polariser, cross-polarisation)

A polarising filter is an optical filter that passes light polarised in one direction, so that a polariser on the light and a crossed polariser on the lens can suppress glare while keeping surface detail.

It works because light reflected from many surfaces is partly polarised. It helps with glare on film, glossy print and wet or coated surfaces. Filters cost light, so the light must be brighter or the exposure longer. Changing the lighting geometry, for example to a dome or an off-axis light, often works better, so polarisers are tried on the samples rather than fitted by default.

SEE: Machine vision lighting guide · Label & print inspection

RELATED TERMS: Dome lighting, Bright-field lighting

Shroud and ambient light (enclosure, light shield)

A shroud is an enclosure or shield around the inspection area that keeps ambient light, such as daylight, overhead lights and light from neighbouring stations, out of the camera's view.

Ambient light changes through the day, and a recipe set up in the morning can start rejecting good products when the afternoon sun comes in. A shroud, strobing the station light and a lens filter that passes only the station light are the usual remedies, often combined. A shroud also shields operators from flashing light. It needs to be designed with cleaning and changeover access, or it tends to be left open.

SEE: Machine vision lighting guide · Reducing false rejects

RELATED TERMS: Strobe lighting, Drift

Machine vision lens (industrial lens, FA lens, fixed focal length lens)

A machine vision lens is a fixed focal length lens made for industrial cameras, chosen so that the field of view, working distance and sharpness suit the inspection.

Its focal length sets the field of view at a given working distance, and its resolution must match the camera's pixels, or small defects blur away. Industrial lenses have lockable focus and aperture so settings cannot drift. Measurement tasks may need a telecentric lens instead.

SEE: Inspection technology · Dimensional measurement

RELATED TERMS: Field of view, C-mount

C-mount (lens mount, CS-mount, S-mount)

C-mount is the most common screw-thread lens mount on industrial area-scan cameras, defining both the thread and the distance from the mount to the sensor.

Lens and camera must share the mount and cover the same sensor size, or the image corners darken. Long line-scan sensors and large-format cameras often need larger mounts than C-mount. CS-mount and small S-mount (M12) lenses use different distances and are not interchangeable without adapters.

SEE: Inspection technology

RELATED TERMS: Machine vision lens, Area-scan camera

UV lighting (ultraviolet light, UV illumination)

UV lighting uses ultraviolet light to make fluorescent materials, such as some inks, glues, sealants and security marks, glow for the camera.

It is used to check that a glue bead or sealant is present, or to read marks invisible in normal light. The material must fluoresce, the camera usually needs a filter that blocks the UV itself, and operators must be shielded from the light.

SEE: Machine vision lighting guide

RELATED TERMS: Shroud and ambient light, Strobe lighting

Collimated backlight (parallel backlight, collimated light, telecentric backlight)

A collimated backlight is a backlight whose rays leave it almost parallel to one another, so that the outline of a part seen against it in silhouette stays sharp.

A diffuse backlight lights the part from many angles, so on round parts such as bolts and pins light wraps around the edge and the silhouette looks slightly smaller or soft; parallel rays reduce that effect. It is usually paired with a telecentric lens for measurement, as on a fastener station, and the two are aligned with each other. Dust on the light or a light knocked out of line moves the measured edge, so cleaning and alignment are part of the maintenance routine.

SEE: Fastener inspection · Dimensional measurement · Machine vision lighting guide

RELATED TERMS: Backlight, Telecentric lens, Edge and caliper measurement

Liquid lens (electrically focused lens, liquid lens autofocus)

A liquid lens is a lens element whose focus is changed electrically, by changing the shape of a liquid surface inside it, instead of by moving glass.

It lets one camera or code reader refocus for products of different heights or sizes without anyone touching the lens, which suits code reading on mixed carton sizes and lines with frequent changeovers. The focus position can be stored per recipe or found by an autofocus routine; autofocus takes time, so on a fast line a fixed position per product is more predictable. It does not add depth of field within one product, and the focus setting becomes part of the recipe that is checked at changeover.

SEE: Camera and lens selection · Inspection technology

RELATED TERMS: Machine vision lens, Depth of field, Inspection recipe

Fluorescent tracer (UV tracer, UV glue, fluorescent adhesive, UV-traceable adhesive)

A fluorescent tracer is an additive in a glue, sealant or coating that glows under ultraviolet light, so that a camera can see material that is clear or the same colour as the surface.

Under UV lighting, with a filter on the camera that blocks the UV itself, the bead glows and the part stays dark, which makes clear glue on a carton flap or a sealant bead on a metal part checkable in 2D. Whether the adhesive contains a tracer is a question for its supplier, and the result is proven on samples. Without a tracer, a bead that does not contrast with the surface can sometimes be found by its height with a 3D profiler, and sometimes not at all.

SEE: Glue bead inspection · Folder gluer inspection · Machine vision lighting guide

RELATED TERMS: UV lighting, 3D vision

Cameras and imaging

The camera types, where the processing runs, and the settings that decide whether a moving product gives a sharp, repeatable image.

Area-scan camera (matrix camera)

An area-scan camera is an industrial camera that captures a whole two-dimensional frame at once, like a photograph.

It is the usual choice for separate products such as bottles, cartons, labels and machined parts: one trigger gives one image per product or view. The frame must cover the product with a margin for position variation, and the product must stay sharp during the exposure. For long or continuous material, or round products imaged while they rotate, a line-scan camera is often a better fit. Several area-scan cameras may be needed to see every face that matters.

SEE: Inspection technology · Web & line-scan inspection

RELATED TERMS: Line-scan camera, Field of view

Line-scan camera

A line-scan camera is an industrial camera that images one thin line at a time and builds a continuous image by stacking the lines as the material or product moves past.

It suits webs of film, foil, paper, board, nonwovens, coil and sheet, and rotating cylinders. Each line is usually triggered by an encoder so that the image keeps its scale when speed changes; without one the image stretches or squashes and defect positions along the roll

are lost. It needs a bright line light, a stable material path without flutter, and a line rate that keeps up at top speed. Wide webs use several cameras side by side.

SEE: Web & line-scan inspection · Machine vision lighting guide

RELATED TERMS: Encoder, Line light, Area-scan camera

Smart camera

A smart camera is an industrial camera with the processor, inspection software and lighting control built into the same housing.

It suits one or two checks from a single view and keeps a station compact, with less hardware in the cabinet. The limit is processing headroom: many tools on one image, deep learning or several views of one product usually point to a PC or vision controller instead. HIKROBOT states that a build of VisionMaster runs on some of its smart cameras; whether a recipe moves between a smart camera and a PC station depends on the model, software version, modules and licence.

SEE: Inspection technology · HIKROBOT VisionMaster integration

RELATED TERMS: Vision controller and PC-based vision

Vision controller and PC-based vision (PC-based vision, vision PC)

A vision controller is a purpose-built industrial computer with camera ports and digital I/O that runs the inspection software for one or more separate industrial cameras, and PC-based vision is the same arrangement on an industrial PC.

This architecture suits several cameras, heavier processing such as deep learning, an operator screen and image storage. The trade-offs are more hardware, hardening of the PC

for dust, heat and vibration in the plant, and its lifecycle: operating system updates and replacement hardware have to be planned. Camera ports and I/O should leave room for later extensions. The inspection software can be the same as on a smart camera; only where it runs changes.

SEE: Inspection technology · HIKROBOT VisionMaster integration

RELATED TERMS: Smart camera, Digital I/O

Exposure time and motion blur (shutter time, motion blur)

Exposure time is the length of time the camera sensor collects light for one image, and motion blur is the smearing that appears when the product moves during that time.

On a moving line a short exposure keeps edges sharp; how short depends on line speed and the smallest detail to be seen, and it is set during the sample test. A shorter exposure collects less light, so it is paired with a brighter or strobed light. Blur softens edges and characters, which can look like a defect, hide one or shift a measurement. An exposure that was right at one speed can be too long after the line is speeded up.

SEE: PLC & reject integration · Reducing false rejects

RELATED TERMS: Strobe lighting, Depth of field

GigE Vision and GenICam (GigE Vision, GenICam)

GigE Vision is a camera interface standard for sending images and camera control over Gigabit Ethernet, and GenICam is a standard hosted by the EMVA that gives cameras a generic programming interface whatever interface they use.

Together they let vision software acquire images from compliant cameras of different makes. HIKROBOT states that its GigE area-scan and line-scan cameras are compatible with GigE Vision and GenICam, and that VisionMaster is compatible with the GigE Vision standard. Compliance makes image acquisition possible; it does not mean every camera feature can be controlled from every software, so a mixed combination is confirmed before quoting. Cabling, switches and network load for several cameras are part of the design.

SEE: Inspection technology · HIKROBOT VisionMaster integration · Web & line-scan inspection

RELATED TERMS: Industrial Ethernet

3D vision (laser profiling, laser triangulation, structured light, 3D laser profiler, laser triangulation sensor)

3D vision is imaging that measures the height or shape of a surface, for example by laser profiling, where a camera views a laser line projected across the part, or by structured light, where a camera views a projected pattern.

It is needed for flatness, warp, thickness, step height, weld bead shape and dents that do not show in a flat image; a standard 2D camera looking straight down sees one plane. 3D sensors have their own limits: shiny or dark surfaces can return a weak or noisy profile, parts of the shape can be hidden from the sensor, and laser profiling needs the part to move past at a known speed or with an encoder. It is a different station design and costs more.

SEE: Dimensional measurement · Surface defect detection · Glue bead inspection · Cost & budget guide

RELATED TERMS: Encoder, Fluorescent tracer

Machine vision camera (industrial camera, inspection camera)

A machine vision camera is an industrial camera made to be triggered by a machine and read by inspection software, not viewed by a person.

It is chosen by resolution, frame rate, sensor type, colour or monochrome, and interface such as GigE Vision or USB3 Vision. It has no screen or controls of its own; the lens, lighting and software decide what it can inspect. It is sold separately from the processing, unlike a smart camera.

SEE: Inspection technology · HIKROBOT VisionMaster integration

RELATED TERMS: Area-scan camera, Smart camera

Vision sensor (image sensor (vendor usage))

A vision sensor is a compact camera-based device with built-in lighting and a small set of fixed tools, such as presence, pattern match or count, that outputs a pass or fail.

It is simpler to set up than a smart camera and suits one simple check from one view. It has fewer tools and usually cannot handle many product variants or several views. HIKROBOT lists its SC1000, SC2000 and SC3000 series as vision sensors and only the SC5000X and SC6000 as smart cameras.

SEE: Presence & counting · Inspection technology

RELATED TERMS: Smart camera, Photoelectric sensor

Global shutter and rolling shutter (global shutter camera, rolling shutter)

A global shutter exposes every pixel of the sensor at the same moment, while a rolling shutter exposes the sensor row by row.

On a moving line a rolling shutter distorts fast products, because the top and bottom of the image are taken at slightly different times. Industrial inspection cameras for moving products therefore normally use global shutter sensors; rolling shutter sensors suit stationary scenes.

SEE: Inspection technology

RELATED TERMS: Exposure time and motion blur, Machine vision camera

Frame rate (fps, frames per second, acquisition rate)

Frame rate is the number of complete images a camera can capture per second.

It must cover the products per second times the images per product, with a margin. Processing time and the network or cable often limit the real rate before the sensor does. For line-scan cameras the equivalent figure is the line rate.

SEE: Inspection technology

RELATED TERMS: Throughput and cycle time, Line-scan camera

IP rating (ingress protection, IP65, IP67, washdown rating)

An IP (ingress protection) rating states how well an enclosure keeps out dust and water; IP65 is dust-tight and protected against water jets, IP67 also against temporary immersion.

Cameras, lights and cable glands in washdown areas of food lines, or near spray and dust, need a suitable rating or a protective housing. The rating of the weakest part, often a connector or cable gland, sets the rating of the whole station.

SEE: Inspection technology

RELATED TERMS: Shroud and ambient light, Machine vision camera

Inspection methods and software

How an image becomes a pass, a fail or a value: the two families of methods and the tools a recipe is built from.

Machine vision (vision inspection, camera inspection)

Machine vision is the use of industrial cameras, optics, lighting and software to capture images of products on a production line and turn them into decisions or data, such as pass or fail, a measurement or a code read.

In a working station the camera is only one link: a trigger, lighting designed around the defect, a link to the PLC and a reject mechanism matter as much. Vision sees surfaces, outlines, print and marks; it cannot see inside opaque material or behind other parts, and a visible seal check is not a leak test. In electronics the same kind of camera-based check is often called automated optical inspection (AOI).

SEE: Inspection technology · All applications

RELATED TERMS: Rule-based inspection, Deep-learning inspection

Rule-based inspection (traditional machine vision)

Rule-based inspection is a machine vision method in which an engineer builds and tunes a chain of tools, such as locate, measure, count and read, and compares each result with a set limit.

Every decision can be traced to a measured value and the limit it was compared with, which makes it predictable and easy to explain in an audit. It fits faults that can be defined as a measurement or a rule: presence, position, dimensions, counts, codes and print in a consistent font. It struggles when good product varies naturally in appearance, because fixed rules then need many exceptions. It depends on stable imaging; when the image changes, the limits no longer fit.

SEE: Rule-based vs deep learning · Inspection technology

RELATED TERMS: Deep-learning inspection, Pattern matching

Deep-learning inspection (AI inspection)

Deep-learning inspection is a machine vision method that uses a model trained on labelled images to classify an image, locate objects or mark defect regions, instead of rules written by an engineer.

It suits defects that vary in shape and appearance on naturally variable surfaces: scratches, marks, moulding faults and difficult print. It moves effort from writing rules to collecting and consistently labelling images, validation, and retraining when products or materials change. The model returns a score or a region; people still set the threshold that turns it into pass or fail. It cannot find a defect the image does not show, so lighting and optics come first. HIKROBOT supplies VisionMaster's deep-learning modules as a separate package.

SEE: Rule-based vs deep learning · Surface defect detection

RELATED TERMS: Anomaly detection, Rule-based inspection, Borderline sample library

Anomaly detection

Anomaly detection is a deep-learning method trained on images of good products only, which flags image regions that differ from what it learned as normal.

It helps when defects are rare or too varied to collect many examples of each type. It reduces the need for defect images during training, but not during validation: defect samples are still needed to prove the model catches what matters. Because it flags anything unusual, normal variation that was missing from the training images, such as a new print shade or supplier, is flagged too. HIKROBOT's VisionMaster page lists anomaly detection trained on normal samples only, with abnormal areas shown as a heat map (vendor-stated); the V4.3.0 deep-learning package lists it, while the V4.4.0 package listing does not, so availability is confirmed for the version used on each project.

SEE: Rule-based vs deep learning

RELATED TERMS: Deep-learning inspection, Reference sample set

Region of interest (ROI, inspection window)

A region of interest (ROI) is the part of the image that an inspection tool examines, set so that the tool ignores everything outside it.

A tight region keeps backgrounds, guides and neighbouring products out of the decision and shortens processing; narrowing the inspected region is one way to cut false rejects. When products move, the region must follow the part, which is why a locate step usually comes first. A region set too tight lets a shifted label or code fall outside it; one set too wide picks up background variation. In costing, ROI also means return on investment, a different term.

SEE: Reducing false rejects · Label & print inspection

RELATED TERMS: Pattern matching

Pattern matching (part location, template matching)

Pattern matching is a machine vision tool that finds a taught reference pattern in the image and reports its position and angle, so that other tools can be placed relative to the part.

It is usually the first step in a recipe. Products do not arrive in exactly the same place, so regions of interest and measurements are positioned from the part, not from fixed image coordinates. The reference must be taught from a representative part: a pattern taught on one unusual part, or on a feature that varies between batches, gives failed locates, which show up as rejects of good product.

SEE: Rule-based vs deep learning · Presence & counting

RELATED TERMS: Region of interest, Inspection recipe

Blob analysis (connected-component analysis)

Blob analysis is a machine vision tool that groups neighbouring pixels of similar brightness or colour into regions, called blobs, and measures their number, area, position and shape.

It is used to count objects, check presence and absence, and find spots, holes or contamination that stand out clearly from the background. It depends on a clean threshold between object and background, so uneven lighting and shadows cause miscounts. Where objects touch or overlap in the image, a count can be wrong even with good lighting, so product presentation and spacing matter as much as the tool.

SEE: Presence & counting · Rule-based vs deep learning

RELATED TERMS: Region of interest, Backlight

Edge and caliper measurement (edge detection, caliper tool)

Edge and caliper measurement is a machine vision tool that finds edges, where brightness changes sharply, along a line or band in the image and measures the distance between them.

It is the basis of most dimensional checks: lengths, widths, diameters, gaps and positions. The result is only as good as the edge the software finds, so a backlit silhouette gives the most repeatable edges; burrs, chamfers and shadows are agreed in advance, because they change where the edge sits. Converting pixels to units needs calibration with a target, and tilt or movement of the part looks like a change in dimension.

SEE: Dimensional measurement

RELATED TERMS: Telecentric lens, Backlight, Repeatability and gauge R&R

Inspection recipe (job file)

An inspection recipe is the stored set of settings for one product, covering camera and lighting settings, references, tools, limits and expected codes, that a station loads to inspect that product.

Each product or SKU usually has its own recipe. At changeover the PLC or HMI selects it, the station reports back which recipe it is running, and the PLC checks they match before production restarts; a wrong recipe is a common cause of rejects after a changeover. Recipes should be named, versioned, backed up and changed under an agreed approval, with operator access to limits restricted. Recipe files and backups are part of the handover.

SEE: PLC & reject integration · How we deliver a project · Support & changes

RELATED TERMS: Pattern matching, Drift

Reference sample set (golden samples, master samples)

A reference sample set is a small, controlled set of known good and known defective products used to check that a station still gives the same results and images as when it was accepted.

It is run at agreed moments, such as shift start, after cleaning and after changeover, and result and image are compared with the stored reference. It catches drift early: ageing lights, a film on the optics, a camera that moved. The samples must be stored so that they do not wear, fade or get mixed into production. A golden sample should be representative rather than the best part on the bench, because references taught on a perfect part cause good products to be rejected.

SEE: Reducing false rejects · Dimensional measurement

RELATED TERMS: Drift, Borderline sample library

Computer vision vs machine vision (computer vision quality control)

Computer vision is the broad field of software that interprets images; machine vision is its industrial use for inspecting, measuring or guiding products on a production line under controlled conditions.

Search results for computer vision quality control often lead to research and software libraries. A machine vision station adds what a line needs: fixed lighting and positions,

triggers, a PLC link, a reject and a validation that the same decision is made on every product.

SEE: Inspection technology

RELATED TERMS: Machine vision, Deep-learning inspection

VisionMaster (HIKROBOT VisionMaster, VM)

VisionMaster is HIKROBOT's machine vision software, which provides algorithm tools for positioning, measurement, defect detection, code reading and OCR, including deep-learning modules.

addaScan builds inspection stations on VisionMaster, running on HIKROBOT smart cameras or on a PC or vision controller with separate cameras. The version and licence are fixed per project. This website does not claim any official HIKROBOT partnership or distributor status.

SEE: HIKROBOT VisionMaster integration · Rule-based vs deep learning

RELATED TERMS: Deep-learning inspection, Inspection recipe

Colour inspection (color inspection, colour check, colour verification)

Colour inspection compares the colour of a product, cap, print or label with a reference under controlled light to find wrong colours or missing colour.

Clear colour differences are reliable with a colour camera and stable white light. Small shade differences between batches depend on light, angle and finish, and may need colour measurement rather than an inspection camera.

SEE: Surface defect detection · Machine vision lighting guide

RELATED TERMS: Bright-field lighting, Drift

Presence and absence detection (presence/absence, presence detection, missing part detection)

Presence and absence detection checks that every item that should be in a product, pack or assembly is there, and nothing that should not be.

It is one of the most common vision checks: caps, labels, inserts, leaflets, screws, seals. A photoelectric sensor can confirm one item at one point; a vision sensor or camera checks many positions at once and can also judge orientation.

SEE: Presence & counting

RELATED TERMS: Blob analysis, Vision sensor

Foreign matter detection (visual) (foreign object detection, foreign body detection)

Visual foreign matter detection finds objects that differ in colour, shape or brightness from the product on the surface a camera can see.

It works on an open product belt, in empty containers and on visible surfaces. It cannot see inside a closed pack or under opaque material; metal detection and X-ray inspection cover those. Which method is needed is decided in the site's foreign-matter risk assessment.

SEE: Empty containers & preforms · Food & beverage lines

RELATED TERMS: Blob analysis, Anomaly detection

Optical sorter (colour sorter, optical sorting machine, fruit grader)

An optical sorter is a dedicated machine that inspects loose product, such as grain, nuts or fruit, piece by piece and ejects rejects from the stream with air jets or mechanical ejectors.

It is bought as a complete machine from sorter manufacturers for bulk throughput. An inspection station built by an integrator works on packed or single products instead: labels, codes, seals, counts and single-unit grading.

SEE: Agro-processing

RELATED TERMS: Reject mechanism, Colour inspection

Automated optical inspection (AOI) (AOI, AOI machine)

Automated optical inspection (AOI) usually refers to camera-based inspection of printed circuit boards and electronic assemblies for solder, placement and component faults.

AOI machines are specialised equipment for electronics production lines. addaScan does not build PCB AOI; the term is sometimes used loosely for any automated visual inspection, which is what our stations do on packaging and parts lines.

SEE: All applications

RELATED TERMS: Machine vision, Computer vision vs machine vision

Poka-yoke (error-proofing, error proofing, mistake-proofing)

Poka-yoke, or error-proofing, is designing a process so that a mistake either cannot be made or is caught where it happens, before the part moves on.

Fixtures, keyed parts and simple sensors are the first tools; a camera is used when the check is visual, such as a missing screw, clip or O-ring, a wrong variant or a connector that is not seated. On the line it works as an interlock: the station PLC holds the part, or does not release the fixture, until the check passes, and any bypass is logged and access-controlled. A camera confirms what it can see; it cannot confirm torque or that a hidden clip has latched.

SEE: Assembly verification · Metal components · PLC & reject integration

RELATED TERMS: Presence and absence detection, PLC, Fault behaviour and fail-safe design

Rebar bundle counting (rebar counting, reinforcing bar counting, bar counting, bundle counting)

Rebar bundle counting is counting the reinforcing bars, tubes or pipes in a bundle from an image of their cut ends, so that each bundle leaves with a known count.

The camera faces the bundle ends before the bundle is tied. Ends that touch, overlap, sit at different depths or are cut unevenly make it harder than counting separate items, which is why deep-learning counting is used and doubtful counts are shown to an operator to confirm. An image kept per bundle answers later queries about short counts. Only visible ends are counted: a bar hidden behind others is not seen, and how the bundle is presented is settled at the sample test.

SEE: Rebar counting · Presence & counting · Rule-based vs deep learning

RELATED TERMS: Deep-learning inspection, Blob analysis, Presence and absence detection

Codes and marking

Printed and marked codes: reading text, reading symbols, and why reading a code is not the same as grading it.

OCR (optical character recognition)

OCR (optical character recognition) is a machine vision function that reads printed or marked characters and returns them as text.

On a line it is used when the text must be logged, passed to a traceability system or compared with a value held elsewhere. It needs the characters in a predictable area with consistent contrast; inkjet dot characters, white lines from worn thermal print heads and low-contrast laser marks make reading harder. For date and batch codes whose expected text is known, OCV is usually the better check. HIKROBOT describes VisionMaster's OCR as deep-learning based (vendor-stated).

SEE: OCR/OCV & code inspection · Label & print inspection

RELATED TERMS: OCV

OCV (optical character verification)

OCV (optical character verification) is a machine vision check that starts from the text that should be printed and confirms that it is present, complete and legible.

For best-before dates and batch codes the line already knows what the code should say, so OCV answers the useful question: is the expected text there and readable? It needs the expected string for every run, ideally sent automatically from the recipe, coder or PLC rather than typed in at each changeover. Its limit is the source: if the recipe and the coder both hold the wrong date, they agree and the error passes.

SEE: OCR/OCV & code inspection

RELATED TERMS: OCR, Inspection recipe

1D barcode (linear barcode)

A 1D barcode is a code that stores data in the widths of parallel bars and spaces, read across one direction.

Retail product codes and logistics labels are the common examples on a line. A reader or camera station decodes the code and checks that its content matches the product or the order. Reading fails when bars are smeared or cut off, when the code sits on a curved or crinkled surface at an unfavourable angle, or when glare covers it. A code that decodes has not thereby been graded; print quality against a formal standard needs a verifier.

SEE: OCR/OCV & code inspection · Carton & pallet verification

RELATED TERMS: Code reading and code verification, 2D code and Data Matrix

2D code and Data Matrix (2D code, Data Matrix, matrix code)

A 2D code is a code that stores data in a pattern of cells in two directions, and Data Matrix is a square or rectangular 2D code widely used to mark products and parts.

2D codes hold more data in less space than a 1D barcode and include error correction, so a partly damaged code can often still be read. Data Matrix is common for part serials and direct part marking; QR codes appear more often on packaging. Reading depends on enough pixels per cell, even contrast and a mark that faces the reader. The content is usually checked against the expected product or serial, and duplicates can be flagged by the PLC or MES.

SEE: DPM code reading · OCR/OCV & code inspection

RELATED TERMS: Direct part marking, Code reading and code verification

Direct part marking (DPM)

Direct part marking (DPM) is the marking of a code or text directly onto the surface of a part, by dot-peen, laser or ink-jet, instead of on a label.

It gives a part a permanent identity for traceability. Contrast comes from the mark itself: dot-peen from the shape of the dots, so it usually reads best under low-angle light; laser marks from a change in colour or texture, often read under dome or coaxial light. Marks drift as a stylus wears or laser settings change, and later processes such as heat treatment, blasting or coating can reduce contrast or fill the mark. A read straight after marking gives early warning.

SEE: DPM code reading · Metal components

RELATED TERMS: Dark-field lighting, 2D code and Data Matrix

Code reading and code verification (barcode grading, barcode verification, code grading)

Code reading is decoding a barcode or 2D code to obtain its data, whereas code verification, also called grading, measures the print quality of the code against a formal standard with a dedicated, calibrated verifier.

A reader shows that a code decodes and holds the right content; it does not give a formal quality grade, and a code that reads on one reader can still fail a customer's grading. For direct part marks the quality guideline is ISO/IEC 29158. Production camera stations are set up for reading and matching content; if a customer or retailer requires graded codes, that

needs a verifier and its own procedure. addaScan stations read codes; formal grading is not offered.

SEE: OCR/OCV & code inspection · DPM code reading

RELATED TERMS: 1D barcode, 2D code and Data Matrix

SSCC (Serial Shipping Container Code)

The SSCC (Serial Shipping Container Code) is the GS1 identification key for a logistic unit such as a case or pallet.

It is usually carried as a barcode on the logistic label. On a line, a reader decodes the SSCC at a defined point and the station or the warehouse management system compares it with the unit expected there, so a pallet is released only on a match. Reading confirms that the label decodes and matches; the GS1 Logistic Label Guideline gives placement and verification recommendations, and formal grading of the label is a separate check.

SEE: Carton & pallet verification

RELATED TERMS: Code reading and code verification, 1D barcode

Barcode scanner, code reader and verifier (barcode reader, fixed-mount scanner, code reader, barcode verifier)

A barcode scanner or code reader decodes a barcode or 2D code and returns its content, while a barcode verifier grades the code's print quality against a standard.

Fixed-mount code readers sit on the line and read every pack; handheld scanners suit goods-in and rework. A read at a scanner only shows that the code decodes; a verifier is needed to prove print quality for listing or a customer specification.

SEE: OCR/OCV & code inspection · Carton & pallet verification

RELATED TERMS: Code reading and code verification, Barcode quality standards (ISO/IEC 15416, 15415, 29158)

QR code (Quick Response code)

A QR code is a square 2D code with three finder patterns in its corners, able to hold text, numbers or a web address in a small area.

On packaging it often carries a web link or, as a GS1 QR code, product data. Industrial traceability marks more often use Data Matrix. A code reader or camera reads both, provided the code is printed at a size and quality the reader can resolve.

SEE: OCR/OCV & code inspection

RELATED TERMS: 2D code and Data Matrix, GS1 DataMatrix

GS1 DataMatrix (GS1 Data Matrix)

GS1 DataMatrix is a Data Matrix code that carries GS1 data, such as the GTIN, batch or lot number, expiry date and serial number, in a standard structure.

It is used in healthcare and increasingly on retail products; GS1 aims for retailers to scan 2D codes at the till by the end of 2027. Because it carries the batch and expiry date, the line can check that the code content matches the printed date and the batch running.

SEE: OCR/OCV & code inspection

RELATED TERMS: 2D code and Data Matrix, GTIN

GTIN (Global Trade Item Number, barcode number)

A GTIN (Global Trade Item Number) is the GS1 number that identifies a product, carried in EAN/UPC barcodes, ITF-14 on cases and GS1 DataMatrix codes.

A label or code check can confirm that the GTIN read from the pack belongs to the product being run, which catches a wrong label after a changeover. Allocating GTINs is done through GS1, not by the inspection station.

SEE: Label & print inspection · OCR/OCV & code inspection

RELATED TERMS: EAN and UPC barcodes, GS1 DataMatrix

EAN and UPC barcodes (EAN-13, UPC-A, retail barcode)

EAN-13 and UPC-A are the linear barcodes scanned at retail tills, each carrying a product's GTIN.

Their print quality for point-of-sale use is set in the GS1 General Specifications, and GS1 South Africa tests them to ISO/IEC 15416 for retailers that require a test report at listing. An in-line reader confirms every pack decodes with the right GTIN.

SEE: OCR/OCV & code inspection

RELATED TERMS: GTIN, Barcode quality standards (ISO/IEC 15416, 15415, 29158)

GS1-128 (UCC/EAN-128)

GS1-128 is the linear barcode used on cases and pallets to carry GS1 data such as the SSCC, GTIN, batch and dates.

The GS1 General Specifications make it the carrier for the SSCC on logistic labels, with a minimum print quality of 1.5/10/660 for general distribution. A pallet label station reads it

and matches the SSCC with the warehouse system.

SEE: Carton & pallet verification

RELATED TERMS: SSCC, Barcode quality standards (ISO/IEC 15416, 15415, 29158)

Barcode quality standards (ISO/IEC 15416, 15415, 29158) (barcode grade, barcode grading standards, ISO 15416, ISO 15415)

ISO/IEC 15416 grades the print quality of linear barcodes, ISO/IEC 15415 of 2D codes such as Data Matrix and QR, and ISO/IEC 29158 of direct part marks.

They define the parameters, such as contrast, decodability and modulation, and the grade scale. Application standards such as the GS1 General Specifications then set the minimum grade needed. Grading needs a calibrated verifier; an in-line reader does not produce a formal grade.

SEE: OCR/OCV & code inspection · DPM code reading

RELATED TERMS: Code reading and code verification, Barcode scanner, code reader and verifier

Read rate and no-read (read rate, no read, mis-read)

Read rate is the share of codes a reader decodes successfully; a no-read is a code that could not be decoded, and a mis-read is one decoded with the wrong content.

On a line, every no-read must be treated as a fail, not a pass, and routed to a reject or an operator. Read rate is agreed and measured on your own coded products at line speed, at FAT and SAT.

SEE: DPM code reading · Carton & pallet verification

RELATED TERMS: Code reading and code verification, Reject mechanism

Inkjet, thermal transfer and laser coding (inkjet coding, CIJ, TIJ, thermal transfer overprinting, TTO, laser coding)

Inkjet, thermal transfer and laser coders are the machines that print or mark date codes, batch codes and barcodes on packs during production.

Each fails differently: inkjet codes fade, break into dots or smear; thermal transfer shows white lines from worn print heads; laser contrast depends on the material. An OCR/OCV station checks the result of whichever coder you run; it does not service the coder.

SEE: OCR/OCV & code inspection

RELATED TERMS: OCV, OCR

Date code and lot code (date code, lot code, batch code, lot number, best-before date, use-by date)

A date code is the date printed on a pack, such as a best-before or use-by date, and a lot or batch code identifies the production run the pack came from, so that it can be traced and, if needed, recalled.

Both are printed on the line, usually by an inkjet, thermal transfer or laser coder, and change with every run or day, so they are checked by OCR or OCV against the value the line expects rather than against a fixed image. Typical faults are a missing, smudged, partial or wrong code, often after a changeover or a coder fault. A camera confirms that the code is there, legible and right; it does not grade print quality to a standard.

SEE: OCR/OCV & code inspection · Label & print inspection · Product recalls in South Africa

RELATED TERMS: OCV, OCR, Inkjet, thermal transfer and laser coding

PUC code (PUC, production unit code, PHC, packhouse code)

A PUC, or production unit code, is the code marked on fresh produce cartons that identifies the unit where the fruit was produced, and it is used together with the packhouse code (PHC) to trace a carton back to its source.

For citrus sold in South Africa, regulation R963 lists the producer or packhouse code among the particulars to be marked on the carton, with the class, size code, count and a date code, marked clearly and legibly. For export, PPECB inspection covers marking requirements, and what each market needs comes from the export standards. A code reader or camera at the carton end can check that the codes are present, legible and right for the run; it does not replace PPECB inspection.

SEE: Fruit carton marking inspection · Agro-processing

RELATED TERMS: PPECB, Date code and lot code, OCV

DOT code (tyres) (DOT code, tyre identification number, TIN, tyre date code)

A DOT code is the identification marking moulded into a tyre sidewall, named after the US Department of Transportation, whose last group gives the week and year the tyre was made.

Passenger tyres sold in South Africa must comply with SANS 20030, with UNECE R30 accepted as equivalent, and R30 requires the date of manufacture as a week-and-year group, which may be on one sidewall only. Because the characters are moulded rubber on rubber, black on black, they are read by OCR on a 3D height image or under low-angle

light, a separate station from reading a barcode label, and the station has to find the code wherever the tyre's rotation puts it. Reading the date is not tyre defect inspection.

SEE: Tyre barcode reading & DOT codes · OCR/OCV & code inspection · DPM code reading

RELATED TERMS: OCR, 3D vision, Dark-field lighting, Green tyre

Scan tunnel (barcode scan tunnel, scanning tunnel, multi-side scanning)

A scan tunnel is a frame of fixed code readers mounted around a conveyor so that the barcode on a carton, tote or parcel is read in motion, whichever face it is on.

Readers cover each face a label can be on, the top, the sides and sometimes the bottom through a gap in the conveyor, and the code is passed to the warehouse system or sorter, tied to the item by tracking. Items with no read, or with two different codes, go to a manual lane instead of being guessed. The fewer faces a label can be on, the fewer readers are needed; with a dimensioner and a scale the tunnel becomes a DWS station.

SEE: Scan tunnel & dimensioning · Carton & pallet verification

RELATED TERMS: Dimensioning system (DWS), Read rate and no-read, SSCC, Barcode scanner, code reader and verifier

PLC and reject integration

What happens after the decision: signals to the line, tracking the product and making sure the failed one really leaves.

Trigger, latency and jitter (photo-sensor trigger, hardware trigger, trigger jitter)

A trigger is the signal that tells the camera or vision controller that a product is in position and an image should be taken, usually from a photo-sensor that the product breaks as it arrives.

The sensor must see every product once and only once: small gaps between products, transparent containers and wobbling products cause missed or double triggers, which give images of half a product or no result at all. Timing also varies. Latency is the delay from trigger to result; jitter is how much that delay, or the product's position at the moment of exposure, varies from one product to the next. Reject tracking must allow for the full variation, not only the average, and counting triggers against results shows when one goes missing.

SEE: PLC & reject integration · Reducing false rejects

RELATED TERMS: Encoder, Shift-register tracking

Encoder (rotary encoder, shaft encoder)

An encoder is a sensor on a conveyor or roller shaft that sends pulses as it turns, so that the line's movement is measured by distance rather than by time.

It is used when line speed varies, when the line stops and restarts, or when products are close together. The PLC can then track a failed product to the reject by distance, and a line-scan camera uses the pulses to trigger each image line so the image keeps its scale. The encoder measures the belt or roller, not the product: where products slip, accumulate or are pushed together, a sensor at the reject point re-identifies the product. The encoder itself must not slip on its shaft or wheel.

SEE: PLC & reject integration · Web & line-scan inspection

RELATED TERMS: Shift-register tracking, Line-scan camera

Shift-register tracking (reject tracking)

Shift-register tracking is a PLC method that stores the position and result of each inspected product in a queue and fires the reject when that product reaches the reject point.

With encoder counts, tracking follows distance, so it stays correct through speed changes and stops, provided each product moves with the belt. A simple time delay does the same job on constant-speed lines where products do not slip, but goes wrong when the line slows, stops or restarts. Two checks keep tracking honest: count triggers against results, and keep products from changing order between camera and reject. If the saved image of a rejected product shows a pass, tracking removed the wrong product.

SEE: PLC & reject integration

RELATED TERMS: Encoder, Reject confirmation, Trigger, latency and jitter

Digital I/O (discrete I/O, hard-wired I/O)

Digital I/O is the set of on/off input and output signals, wired directly between a vision station and the PLC, used for the trigger, pass/fail, result valid, ready and alarm.

It is the simplest route: fast, easy to test with a meter and independent of network settings. A 'result valid' pulse tells the PLC when to read the pass/fail output. The output type, NPN or PNP, must match the PLC input card. Digital I/O carries only a few on/off states, so codes read, measurements and recipe numbers need an industrial network. Where a network protocol does not match the PLC, hard-wired I/O is the usual fallback.

SEE: PLC & reject integration · Inspection technology

RELATED TERMS: Industrial Ethernet

Industrial Ethernet (PROFINET, EtherNet/IP, Modbus TCP)

Industrial Ethernet is the family of Ethernet-based protocols, such as PROFINET, EtherNet/IP and Modbus TCP, that PLCs and devices use to exchange data on a production line.

Over a network a vision station can send more than pass/fail: the codes read, measurements, the active recipe, counters and a sequence number per product. Protocol support depends on the camera, code reader or controller model, not on the software brand. HIKROBOT's catalogue lists TCP/IP, Modbus, serial, UDP and EtherNet/IP for VisionMaster, and PROFINET on specific smart code reader models. The exact model is checked against your PLC before quoting; a gateway or hard-wired I/O covers a mismatch.

SEE: PLC & reject integration · HIKROBOT VisionMaster integration · Inspection technology

RELATED TERMS: Digital I/O, GigE Vision and GenICam

Reject mechanism (rejector, air jet, pusher, diverter)

A reject mechanism is the actuator that removes a failed product from the line, such as an air jet, a pusher or a diverter that switches products into another lane.

The choice depends on product weight and stability, spacing between products, available compressed air and space on the conveyor. The mechanism must remove the failed product without knocking over its neighbours or taking a good product with it. An air-pressure switch shows when the supply is low and the reject may not work. The reject is only finished when a sensor confirms that the product left the line.

SEE: PLC & reject integration · Inspection technology

RELATED TERMS: Reject confirmation, Shift-register tracking

Reject confirmation (reject verification, reject confirmation sensor, confirm sensor)

Reject confirmation is a check, made by a sensor at the chute, in the bin or just after the reject point, that a failed product actually left the line within an agreed window.

Firing the reject is not proof that the product left. If the product is still on the line, or a good product was removed, the PLC raises an alarm or stops the line, as agreed in the design; a bin-full sensor completes the picture. Without confirmation, a reject that sometimes misses looks like a working station, and a defect that was detected still reaches the customer. Confirmation is tested at SAT on the real line.

SEE: PLC & reject integration · How we deliver a project

RELATED TERMS: Reject mechanism, Fault behaviour and fail-safe design, Site acceptance test

Fault behaviour and fail-safe design (fault handling, fail-safe design)

Fault behaviour is the agreed, documented response of a line when part of the inspection chain fails, such as no result in time, a camera offline, low air pressure, a failed reject confirmation or a full reject bin.

Each case needs a decision with production and quality: reject the product, stop the line or raise an alarm. A fail-safe design chooses them so that a fault does not silently let uninspected product through, for example with a heartbeat that lets the PLC notice a silent station, and a logged, access-controlled inspection bypass. This is general control practice,

tested at FAT and SAT; it is not a certified machine-safety function, and hazards to people are handled by the machine's safety system.

SEE: PLC & reject integration · How we deliver a project

RELATED TERMS: Reject confirmation, Factory acceptance test

PLC (programmable logic controller)

A PLC (programmable logic controller) is the industrial computer that runs a production line: it reads sensors, controls motors and actuators, and in an inspection station receives the camera's result and fires the reject.

The station passes its result to the PLC over digital I/O or an industrial network, and the PLC tracks the failed product to the reject. Who changes the PLC program, the plant's controls team or the integrator, is agreed in the scope.

SEE: PLC & reject integration

RELATED TERMS: Digital I/O, Shift-register tracking

Photoelectric sensor (photo eye, photocell, through-beam sensor, retro-reflective sensor)

A photoelectric sensor, or photo eye, detects that an object is present by the interruption or reflection of a light beam.

In a vision station it usually triggers the camera when a product arrives and confirms that a rejected product left. On its own it can count products that pass with a gap, but it cannot tell a right product from a wrong one.

SEE: PLC & reject integration · Presence & counting

RELATED TERMS: Trigger, latency and jitter, Reject confirmation

Air knife (air blade, air knife reject)

An air knife is a long, narrow nozzle that blows a thin, even sheet of compressed air across a conveyor or a surface.

On inspection lines it is used in two ways: switched by a fast valve as a reject, blowing a light failed product such as a can, carton or pouch into a reject guide, and as a steady blow-off that clears water, dust or loose debris from a product or a camera window before the image is taken. As a reject it needs exact timing from tracking, a stable air supply and a product light and steady enough to move cleanly; heavy or tall, unstable products need a pusher or diverter. A confirmation sensor checks that the product actually left.

SEE: Can inspection · PLC & reject integration

RELATED TERMS: Reject mechanism, Reject confirmation, Shift-register tracking

Metrics and acceptance

How a station is proved and kept working: the two error rates, measurement studies, samples and the two acceptance tests.

False reject and false reject rate (false rejection rate, FRR, false call, overkill, overdetection, false positive)

A false reject is a good product that an inspection station rejects, and the false reject rate is the number of good products rejected divided by the number of good products inspected.

It is measured by running a known number of good products at production speed and counting the rejects, with the sample set, speed and duration recorded. It is reported together with the missed defect rate, because either can be lowered by raising the other. False rejects cost more than the product in the bin: operators stop trusting the station, and sooner or later someone loosens a limit or switches it off. Fix the imaging before touching the limit.

SEE: Reducing false rejects · How we deliver a project

RELATED TERMS: Missed defect and missed defect rate, Drift

Missed defect and missed defect rate (escape, false accept, false negative)

A missed defect, also called an escape, is a defective product that an inspection station passes, and the missed defect rate is the number of defective products passed divided by the number of defective products fed.

It is measured by feeding known defective products at known positions and counting how many pass. A small run with no misses shows that detection works on those samples; it does not prove the station misses nothing in long-term production. For critical faults the target and the test method are agreed in writing before FAT. Loosening a limit to cut false rejects raises this rate, which is why limits are changed together with the quality team.

SEE: Reducing false rejects · How we deliver a project

RELATED TERMS: False reject and false reject rate, Borderline sample library

Throughput and cycle time (line speed)

Throughput is the number of products a line or station handles in a given time, and cycle time is the time available for, or taken by, one product or machine cycle.

For a vision station the cycle time is the budget for trigger, exposure, processing, result handover and reject. Heavier processing, such as deep learning or many tools per image, needs faster hardware or more time per product. Line speed and product spacing are gathered at the site survey; where parts must stop to be measured, cycle time decides whether that is possible. Throughput can be written into the acceptance criteria and checked at FAT, as in the envelope line case.

SEE: PLC & reject integration · Dimensional measurement · Case: envelope verification line

RELATED TERMS: Exposure time and motion blur, Factory acceptance test

Repeatability and gauge R&R (gauge R&R, gauge repeatability and reproducibility)

Repeatability is the variation in a station's results when the same part is inspected or measured several times under the same conditions, and a gauge R&R study adds reproducibility, the variation from reloading, operators or set-ups.

For measuring stations it is the basis of acceptance: the same parts are measured repeatedly, with reloading, and the spread is compared with your tolerance, which must be wide compared with the station's own variation. For pass/fail checks, a part that passes once and fails the next time shows poor repeatability, often a borderline part or unstable imaging. Agreement with your CMM or gauges is a separate check that finds systematic differences.

SEE: Dimensional measurement · Reducing false rejects

RELATED TERMS: Edge and caliper measurement, Borderline sample library

Drift

Drift is a slow change in a station's images or results over time, caused by changes in the station or the product rather than by real defects.

Common causes are light output falling with age, a film of dust or oil mist on the lens or cover glass, a camera or guide moved during cleaning or changeover, and a new label stock, resin, ink or supplier. The usual symptom is false rejects creeping back after months of stable running. Reference samples run at agreed intervals, and a chart of good products rejected per shift or batch, show drift early. Fix the cause and re-verify rather than retuning limits on the line.

SEE: Reducing false rejects · Support & changes

RELATED TERMS: Reference sample set, False reject and false reject rate

Sample test (feasibility test, sample testing)

A sample test, or feasibility test, is the imaging of a customer's own good and defective products under candidate cameras, lenses and lighting to find out whether the defects that matter can be seen and separated, before a station is designed or quoted.

It asks "can this be seen and separated?", not "does the station perform on the line?". The samples must represent real production: the normal variation of good product, every defect type and borderline cases, each labelled. The result is a written feasibility conclusion: what was visible, under which conditions, and what still has to be verified on the line. There is no fixed sample quantity; it depends on how much the product and the defects vary.

SEE: Preparing inspection samples · How we deliver a project

RELATED TERMS: Borderline sample library, Factory acceptance test

Borderline sample library (borderline samples, limit samples)

A borderline sample library is a collection of parts that are just acceptable and just rejectable, each recorded with the quality team's decision, a photo and the reason.

It settles arguments on the line, trains operators, and keeps limits and deep-learning labels consistent: if two inspectors disagree about a borderline part, a model learns the disagreement. It is used to set limits during the sample test and to check limit changes later. The library is kept apart from production stock and extended when new materials or suppliers bring new kinds of borderline part.

SEE: Reducing false rejects · Preparing inspection samples

RELATED TERMS: Reference sample set, Missed defect and missed defect rate

Factory acceptance test (FAT)

A factory acceptance test (FAT) is the test of a built inspection station against agreed samples and criteria before it is delivered to site.

At FAT the station is checked for detection of each agreed defect on the FAT samples, false rejects on good samples, recipe changeovers and its outputs; the customer may witness it. The result is a FAT record, with any open points agreed in writing. FAT shows that the imaging, the decisions and the signals work on the built station; it does not prove that the reject works on the line, which is why a site acceptance test follows.

SEE: How we deliver a project · Case: envelope verification line

RELATED TERMS: Site acceptance test, False reject and false reject rate

Site acceptance test (SAT)

A site acceptance test (SAT) is the test of an installed inspection station on the customer's line, with real production and seeded defect samples, against criteria agreed before the build.

SAT repeats the FAT checks at line speed and adds the reject mechanism, reject confirmation, PLC signals, fault behaviour and the operator workflow, with production, quality and maintenance staff taking part. The SAT report is the basis for handover, training and the support plan. Criteria that were not written down before the build are hard to test fairly at SAT, so they are agreed in the proposal.

SEE: How we deliver a project

RELATED TERMS: Factory acceptance test, Reject confirmation, Fault behaviour and fail-safe design

Defect detection rate (detection rate, catch rate)

The defect detection rate is the share of defective products that a station catches, equal to one minus the missed defect rate.

It is measured by feeding a known number of marked defective products at known positions at line speed. It is always reported together with the false reject rate, because tightening a limit raises both.

SEE: Reducing false rejects

RELATED TERMS: Missed defect and missed defect rate, False reject and false reject rate

100 % inspection (100% inspection, full inspection, inline inspection)

100 % inspection means every product on the line is checked, rather than a sample taken at intervals.

Manual checks at set intervals can miss a fault that starts and stops between two checks; a camera station checks every unit at line speed. It does not make a process perfect: the check is only as good as its detection rate on the faults it was designed for.

SEE: All applications · Label & print inspection

RELATED TERMS: Defect detection rate, Sample test

OEE (overall equipment effectiveness)

OEE (overall equipment effectiveness) is a production measure that combines availability, performance and quality into one figure for a machine or line.

A vision station affects the quality part by stopping bad product, and can hurt availability and performance if false rejects or stops are frequent. Its counts and reject data can feed an OEE calculation.

SEE: Reducing false rejects

RELATED TERMS: False reject and false reject rate, Throughput and cycle time

Cost of poor quality (COPQ) (COPQ, quality cost)

Cost of poor quality is what defective product costs a plant, from internal failures such as scrap, rework and sorting to external failures such as returns, claims and recalls.

It is the figure a vision station is set against in a business case. Count only the part the station would actually prevent, and weigh rare recalls separately rather than as a yearly

saving.

SEE: Cost & budget guide · Payback calculator

RELATED TERMS: False reject and false reject rate, Sample test

Challenge test (challenge samples, challenge packs, test packs, challenge testing)

A challenge test is a routine check in which marked, deliberately faulty test samples are run through an inspection station to prove that it still detects them, rejects them and raises its alarms.

The set covers each fault the station is meant to catch, such as a missing code, a wrong label or a missing cap, plus a no-read case and good samples that must pass; it is run at FAT and SAT and then routinely at line speed, at a frequency set by the site's own risk assessment, and each result is recorded. BRCGS guidance on clause 6.2.4 (Issue 8 FAQ) describes challenging online label and code verification equipment with incorrect packs and testing detection, the reject or line stop, the authorised restart and the mis-read or no-read alarm. Challenge samples are kept marked and controlled so that none leaves in a shipment.

SEE: Challenge tests for audits · Preparing inspection samples · Label & print inspection

RELATED TERMS: Borderline sample library, Reject confirmation, Factory acceptance test, Site acceptance test

Packaging and line equipment

The machines, packs and pack features that inspection stations sit beside, and what each one means for where the camera goes and what it can check.

Vertical form fill seal (VFFS) (VFFS, form fill seal machine, sachet packing machine)

A vertical form fill seal (VFFS) machine forms a tube from a reel of flat film, fills it from above with product, and seals and cuts it into individual bags, pouches or sachets.

The faults a camera can see are product trapped in the seal, pleats or folds across it, an open or cut-off edge, and a missing or unreadable date and batch code printed on the film. Powders and granules are the usual cause of product in the seal. The station sits after the machine's discharge, where packs are separated and spaced. A seal that looks right can still leak, so leak-tightness is a separate test.

SEE: Pouch, sachet & flow wrap inspection · Maize meal bag inspection

RELATED TERMS: Flow wrap, Sachet, Date code and lot code

Flow wrap (flow wrapper, flow pack, horizontal form fill seal, HFFS, pillow pack)

A flow wrap is a pack made on a horizontal machine that wraps film around a product carried along a conveyor, seals it lengthwise and then seals and cuts the ends.

It is common for bars, biscuits, confectionery and bakery items. A camera after the wrapper can check the printed date and batch code, the visible end seals for trapped product and folds, and that each pack holds a product; on printed or metallised film the contrast at the seal decides what can be seen. As with VFFS packs, leak-tightness needs a separate test.

SEE: Pouch, sachet & flow wrap inspection

RELATED TERMS: Vertical form fill seal (VFFS), Sachet, Date code and lot code

Sachet (stick pack, portion pack)

A sachet is a small, flat, sealed pack, usually sealed on three or four sides, that holds a single portion or dose of a powder, liquid or granules.

Sachets are often made on multi-lane machines, several side by side at once, so a station either inspects every lane and rejects the right sachet or checks them later as a count per carton. The checks are the printed code, the visible seal area and the count; the small print area and reflective film drive the choice of lighting.

SEE: Pouch, sachet & flow wrap inspection · Food & beverage lines

RELATED TERMS: Vertical form fill seal (VFFS), Flow wrap, Date code and lot code

Multipack (shrink pack, shrink-wrapped pack, tray pack)

A multipack is a group of individual containers, such as bottles or cans, handled and sold as one unit and held together by shrink film, a tray, a carton or a sleeve.

The usual faults are a missing container, a missing cap and the wrong product after a changeover. A camera above the pack counts positions and checks caps and product type, ideally before shrink film or a closed carton hides them, because film adds reflections and distortion. Fill level and pack weight are the filler inspector's and the checkweigher's job, not the camera's.

SEE: Multipack inspection · Presence & counting · Carton & pallet verification

RELATED TERMS: Checkweigher, Presence and absence detection

Returnable crate (bottle crate, beverage crate, returnable bottle crate)

A returnable crate is a reusable plastic crate in which returnable glass or PET bottles are delivered, collected, washed and refilled, so it comes back from the market holding whatever customers left in it.

Returned crates can hold foreign bottles of another brand or shape, bottles with caps still on, broken glass and debris, so inspection points sit before the uncaser, after the crate washer and after the caser. A camera above the crate sees the bottle tops and the crate floor; it does not look inside the bottles, which is the empty bottle inspector's job after the washer.

SEE: Crate inspection · Empty containers & preforms · Food & beverage lines

RELATED TERMS: Presence and absence detection, Foreign matter detection (visual)

Tamper-evident band (tamper band, tamper-evident ring, TE band)

A tamper-evident band is a ring at the bottom of a screw cap that stays on the container neck and breaks away from the cap at small bridges when the cap is first opened, showing that the pack has been opened.

South African hygiene regulation R638 requires prepacked food to be packed so that it cannot be removed without the stopper, lid or seal being removed or visibly damaged, and a tamper band is one common way to show that. Cameras check it in two places: on the closure line for broken bridges or a missing band after moulding, and after capping for a broken, missing or ridden-up band, usually from two or more side views on a round bottle. A band hidden by a sleeve or label cannot be seen.

SEE: Fill level, cap & seal · Closure inspection

RELATED TERMS: Induction seal, Closure liner, Short shot and flash

Induction seal (induction liner, induction heat seal, foil seal)

An induction seal is a foil-laminated liner, usually fitted in the cap, that an induction coil heats after capping so that it bonds to the container rim and seals it under the cap.

A camera checks the part that can be seen: that the foil is present before capping. Once the cap is on, the seal is hidden, and whether the foil bonded to the rim and holds is a matter for a leak test or a dedicated seal tester, not a camera. The inspection is appearance only.

SEE: Fill level, cap & seal

RELATED TERMS: Closure liner, Tamper-evident band

Closure liner (cap liner, liner, wad)

A closure liner is a disc or ring of softer material inside a cap that seals against the container rim when the cap is tightened.

A missing, misplaced or tilted liner leaves the container unsealed although the cap looks right from outside. A camera looking into each cap on the closure line checks that the liner is there and seated, with lighting chosen so the liner stands out from the cap; a liner the same colour as the cap is harder and is tested on samples first. Some liners are induction seals.

SEE: Closure inspection · Plastics & packaging

RELATED TERMS: Induction seal, Tamper-evident band, Short shot and flash

Folder gluer (folder-gluer, carton folder gluer, folding carton gluer)

A folder gluer is a machine that takes flat, printed and die-cut carton blanks, applies glue to the glue flap, folds them and presses the joint to make flat-folded cartons or boxes.

An inspection station on the folder gluer checks that each blank has glue on the flap, the right print and a readable barcode before it is folded. Glue can only be checked where it fluoresces under UV light or contrasts visibly with the board, which is proven on samples first, and the camera sees glue, not bond strength. Blanks run fast and close together, so the camera position, trigger and reject are planned with the machine.

SEE: Folder gluer inspection · Label & print inspection

RELATED TERMS: Fluorescent tracer, UV lighting, 1D barcode

Weigh price labeller (weigh-price labeller, weigh price labeler, price labeller)

A weigh price labeller is a packing machine that weighs each variable-weight pack, such as a tray of meat or poultry, calculates its price, and prints and applies a label with the weight, price, barcode and dates.

Because each label is printed from the labeller's data, the risks are a missing, crooked or unreadable label, or a label for the wrong product after a changeover. A code reader and camera after the labeller check that the label is there, readable and agrees with the labeller's data and with the product in the tray. The station does not weigh; that stays with the labeller's scale, and the data link to the labeller comes from its supplier.

SEE: Weigh price label verification · Label & print inspection

RELATED TERMS: Checkweigher, Legal metrology, OCV

Checkweigher (check weigher, dynamic checkweigher, in-motion scale)

A checkweigher is an automatic scale built into a conveyor that weighs every pack in motion and rejects those outside set weight limits.

It answers a question a camera cannot: how much is in the pack, including opaque containers, cans and sealed bags. On many lines the two sit side by side, the checkweigher for quantity and the camera for code, label, cap and count, and a count from a camera and a weight from a checkweigher answer different questions. Where it controls prepack quantity, the legal metrology rules apply.

SEE: Fill level, cap & seal · Multipack inspection · Maize meal bag inspection

RELATED TERMS: Legal metrology, Multipack, Weigh price labeller

Dimensioning system (DWS) (DWS, dimension-weight-scan, dimensioner, parcel dimensioning system, freight dimensioning system)

A dimensioning system measures the length, width and height of a carton or parcel on a conveyor, and a DWS (dimension-weight-scan) station combines it with a scale and code readers so that each item's size, weight and code are recorded together.

Distribution centres use it to check carton sizes, plan loads, catch wrong items and feed the sorter. The size comes from a 3D sensor above the conveyor, the weight from an in-line scale and the code from a scan tunnel, all matched to the same item by tracking. Where measured weight or volume is used to charge a customer, legal metrology may require approved, legal-for-trade equipment, so that is confirmed before the data is used for billing.

SEE: Scan tunnel & dimensioning · Dimensional measurement

RELATED TERMS: Scan tunnel, Legal metrology, 3D vision

Industry terms and South African rules

Products, defects and regulators that come up on specific South African lines. Regulatory entries state only what the cited source says; they are not legal advice.

PPECB (Perishable Products Export Control Board)

The PPECB (Perishable Products Export Control Board) is the South African body that carries out end-point export inspection of perishable products, covering quality, phytosanitary aspects and marking requirements, and approved product is stamped as passed for export.

For a packhouse it means the carton marking has to be right before the pallet reaches the inspector, and what each market needs on the carton comes from the export standards. A code reader or camera at the carton end can check that the marking is present, legible and right for the run while the run is still on the line. It supports the packhouse's own checks; it does not replace PPECB inspection.

SEE: Fruit carton marking inspection · Agro-processing

RELATED TERMS: PUC code, Date code and lot code

Legal metrology (Legal Metrology Regulations, legal for trade, prepackage quantity control)

Legal metrology is the body of law that governs measurement used in trade, including the quantity in prepackages and the instruments used to weigh or measure goods for sale.

In South Africa the Legal Metrology Regulations (2018) require prepackages to comply with SANS 289, take the tolerances between marked and actual quantity from SANS 458, and

require users of automatic filling or weighing instruments outside the voluntary “e” mark scheme to take steps to detect incorrect quantities and keep records of the checks; according to the NRCS, non-conforming product must be brought into compliance, or it is confiscated, destroyed or returned. The regulations do not prescribe a method: quantity is proved by weighing, and a camera fill-level check on clear containers supports that but does not replace it. Where measured weight or volume is used to charge a customer, approved, legal-for-trade equipment may be required.

SEE: Fill level, cap & seal · Food & beverage lines · Scan tunnel & dimensioning

RELATED TERMS: Checkweigher, Dimensioning system (DWS), Weigh price labeller

Short shot and flash (short shot, flash, incomplete fill, moulding defects)

A short shot is a moulded part that is incomplete because the plastic did not fill the mould cavity, and flash is a thin film of excess plastic that escapes along the mould's parting line or around ejector pins.

Both change the part's outline, so on caps and small parts they are usually found against a backlight in silhouette, or by edge checks in a top view; a short shot on a cap can leave a gap in the thread or the tamper band. They often come from one cavity of a multi-cavity mould, so reading the cavity number, where one is moulded in, helps the moulding team find the cause. Very thin flash that hardly changes the outline is harder to see and is tested on samples.

SEE: Closure inspection · Plastics & packaging · Surface defect detection

RELATED TERMS: Backlight, Edge and caliper measurement, Closure liner, Tamper-evident band

Green tyre (uncured tyre, green tire)

A green tyre is a tyre that has been built up from its rubber components on the building machine but not yet cured, or vulcanised, in the press.

Where a plant labels the green tyre at the building machine, a fixed code reader can read the label at a transfer point before the curing press, so that each tyre is tracked through curing. Uncured rubber, the label material and the handling differ from finished tyres, so that reading position is part of the sample test. Tyre defect inspection is a separate field.

SEE: Tyre barcode reading & DOT codes

RELATED TERMS: DOT code (tyres), Read rate and no-read, Barcode scanner, code reader and verifier

Anode plate (copper anode, carbon anode, refinery anode, smelter anode)

An anode plate is the positive electrode in an electrolytic process: in a copper refinery a cast copper plate that dissolves as pure copper is deposited on the cathodes, and in an aluminium smelter a baked carbon block that is consumed in the reduction cell.

Inspection looks at shape and surface before the anode goes into the cell: on copper anodes uneven thickness, bent lugs and casting fins that disturb spacing in the cell, and on carbon anodes cracks, chipped edges and damage around the stub holes. The surfaces are dark and rough and the area is often hot and dusty, so 3D profilers are used where 2D contrast is poor, in housings suited to the plant.

SEE: Anode plate inspection · Surface defect detection

RELATED TERMS: 3D vision, IP rating

// FAQ

Questions about the terms

What is the difference between OCR and OCV?

OCR reads the characters and reports what is printed. OCV starts from the text that should be printed and checks that it is there, complete and legible. For best-before dates and batch codes, OCV is usually the right check, because the line already knows what the code should say.

When do you need a telecentric lens?

Mainly for measurement, when features sit at different heights or the distance to the part varies, because a standard lens makes nearer features look larger. A telecentric lens keeps the magnification constant over its working range, but it must be at least as large as the part, needs more mounting space and works best with matched lighting such as a backlight. Presence, label and code checks rarely need one.

What is the difference between a false reject and a missed defect?

A false reject is a good product the station rejects; a missed defect is a defective product it passes. The false reject rate is counted against the good products inspected, the missed defect rate against the defective products fed. They are reported together, because loosening a limit lowers one and raises the other.

Is reading a barcode the same as grading it?

No. Reading shows that a code decodes and holds the right content. Grading, or verification, measures its print quality against a formal standard with a dedicated verifier; for direct part marks the guideline is ISO/IEC 29158. A production camera station reads codes; it does not replace a verifier.

RELATED: Machine vision lighting guide → Reducing false rejects → PLC & reject integration → Rule-based vs deep learning → Preparing inspection samples → OCR/OCV & code inspection → DPM code reading → Dimensional measurement → Web & line-scan inspection → Inspection technology → How we deliver a project →

// NEXT STEP

Talk through your inspection with an engineer

Start an assessment

Describe the product, the defect and the line. We will tell you which of these points matter for your station and what the sample test needs to show.