INDUSTRY // METAL COMPONENTS

Metal parts inspection: machined, stamped, cast and welded components

Camera checks for machined, stamped, cast and assembled metal parts, including error-proofing and traceability on automotive component lines.

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// SHORT ANSWER

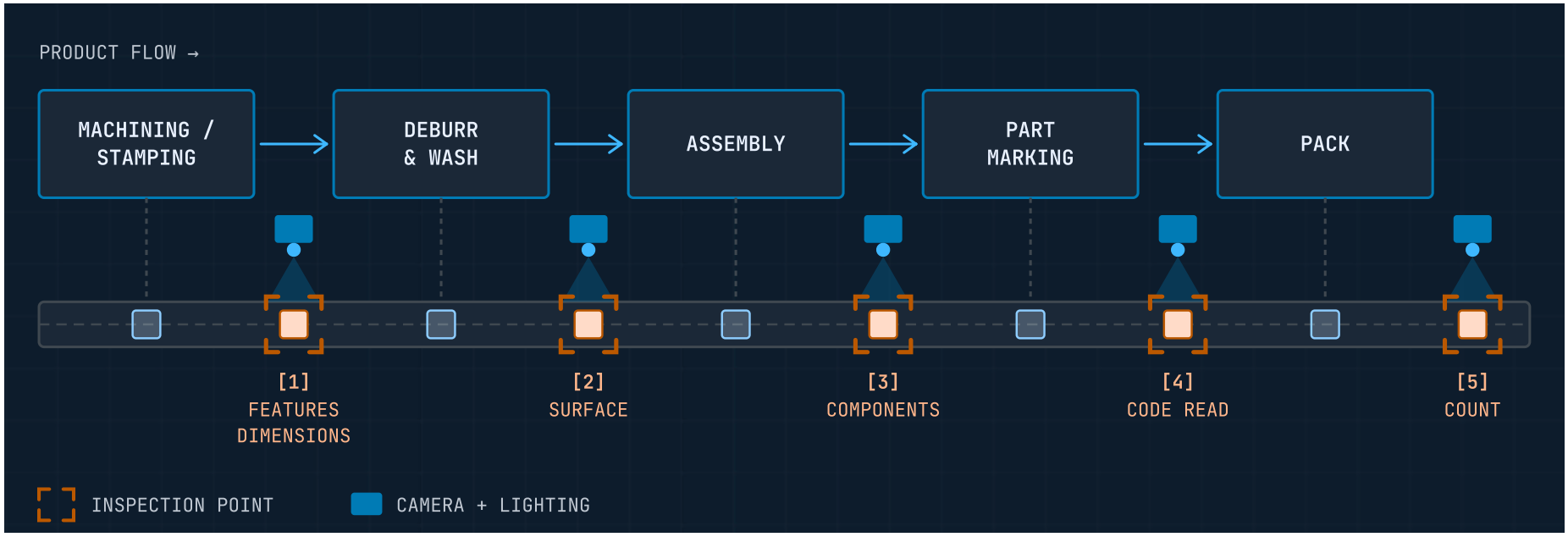
Metal parts inspection with machine vision checks parts for missing holes, slots and other features, key dimensions, visible scratches and dents, missing components in an assembly, and part codes. On metal, the result depends mostly on glare, oil films and how the part is held: a fixture that presents every part the same way, and lighting chosen for the surface finish, matter as much as the camera. Internal cracks, porosity and hardness are not visible.

// WHERE IT FITS

Inspection points from machining to packing

Parts may travel on a conveyor, in a fixture or by robot; the checks are the same.

[Schematic] PROCESS FLOW · NOT TO SCALE



[1] Features & dimensions: holes, slots and key sizes after machining or stamping.

[2] Surface: scratches, dents and marks on a clean surface.

[3] Components: fasteners, clips and seals present for the variant.

[4] Code: the part mark present, readable and correct.

[5] Count: the right number of parts per box or tray.

// DEFECT RISKS

What goes wrong at each step

Visible faults by step, and the application that checks for them.

PRODUCTION STEP	TYPICAL VISIBLE FAULTS	INSPECTION
Machining	Missing holes, slots or chamfers; features out of position; the wrong variant from a program mix-up	Dimensional measurement Presence & counting
Stamping and forming	Missing or partly punched holes, burrs, split edges, bent tabs	Dimensional measurement Surface defect detection
Handling and washing	Scratches, dents, handling marks, residue and stains	Surface defect detection
Assembly	Missing fasteners, clips, washers, O-rings or bushes; the wrong variant fitted	Presence & counting
Part marking	Missing, unreadable or wrong laser-marked or dot-peened codes	OCR/OCV & code inspection

// INSPECTIONS

Checks that apply to metal components

Feature, dimension and code checks can often share one fixtured station.

Dimensional measurement

Lengths, diameters, hole positions and gaps, with the part held at a known position.

`At: after machining or stamping`

Dimensional measurement →

Presence & counting

Holes, features and fitted components present for the variant being run.

`At: machining and assembly`

Presence & counting →

Surface defect detection

Scratches, dents and marks, with lighting chosen for the surface finish.

`At: after washing`

Surface defect detection →

OCR/OCV & code inspection

Part codes and text marked on the part, read and checked against the job.

`At: after marking`

OCR/OCV & code inspection →

// APPLICATION MAP

Metal component inspection scenarios by part

Typical parts from South African machine shops, press shops, foundries and automotive component suppliers, what a camera checks on each, and the application page with the detail. The method in each row is a starting point, confirmed on your own parts. Internal flaws, hardness and thread gauging need other methods.

PRODUCT / LINE POSITION	WHAT IS INSPECTED	TYPICAL FAULT CAUGHT	INSPECTION METHOD	RELATED APPLICATION
Turned and ground shafts after the lathe or grinder	Diameters, lengths, grooves and chamfers in silhouette	Missing groove or chamfer, wrong length, the wrong variant	Backlight with a telecentric lens, the shaft held in V-blocks	**Dimensional measurement**

PRODUCT / LINE POSITION	WHAT IS INSPECTED	TYPICAL FAULT CAUGHT	INSPECTION METHOD	RELATED APPLICATION
Stamped brackets at the press exit or in a nest	Holes and slots present and in position; tabs formed	Missing or partly punched hole, slug left in a hole, unformed tab	Backlight under the part in a nest	**Dimensional measurement**
Bolts, screws and nuts on a sorting feeder before packing	Head shape, length, visible thread and nylon lock insert	Mixed lengths, missing thread, missing nylon ring	Backlit profile as parts pass on a rail or glass disc; top view for nuts	**Dimensional measurement**
Aluminium and iron castings after fettling and shot blasting	Visible surface, cored holes and fettled edges	Cold shuts, surface blowholes, blocked cored holes, fins left on. Internal porosity needs X-ray	Low-angle or dome light; a height-profile sensor for relief	**Surface defect detection**
Welded assemblies after the welding cell	Weld beads present, in position and of the expected visible length; weld nuts fitted	Missing or misplaced weld, missing projection-weld nut, heavy spatter. Penetration is not visible	Diffuse light, or a laser profile sensor for bead shape	**Presence & counting**
Laser and dot-peen marked parts after the marking station	Data Matrix code readable and matching the job	Unreadable, missing or duplicated serial number	Low-angle or dome light with a reader set up for DPM	**DPM code reading**

PRODUCT / LINE POSITION	WHAT IS INSPECTED	TYPICAL FAULT CAUGHT	INSPECTION METHOD	RELATED APPLICATION
Ball and roller bearings after assembly and sealing	Balls or rollers present, seal or shield fitted, snap ring	Missing ball, missing or damaged seal	Camera facing the bearing with a ring light	**Presence & counting**
Coil springs after coiling and end grinding	Free length, ground ends and coil profile	Wrong length, unground end, uneven pitch	Backlit silhouette	**Dimensional measurement**
Brake pads after bonding and grinding	Friction material edges, backing plate, shim and wear-indicator clip	Chipped friction edge, missing shim or clip	Camera from above with low-angle light	**Surface defect detection**
Powder-coated, zinc-plated and galvanised parts after the curing oven or plating line	Coating coverage on visible faces and edges	Runs, drips, bare patches, craters and scratches	Colour camera with diffuse or dome light; large panels in several views	**Surface defect detection**
Machined housings and manifolds after the machining centre	Holes, ports and O-ring grooves present for the variant; tapped holes seen at the entry	Missing hole or groove, untapped hole. Thread quality needs a gauge	Ring light on each face, or a robot presenting faces in turn	**Presence & counting**

PRODUCT / LINE POSITION	WHAT IS INSPECTED	TYPICAL FAULT CAUGHT	INSPECTION METHOD	RELATED APPLICATION
Fastener and fitting kits at kitting, before sealing	Every compartment filled with the right part	Empty compartment, wrong part in a compartment	Overhead camera with diffuse light over the open tray	**Presence & counting**

// INTEGRATION

Conditions specific to metal parts

On metal, lighting and presentation usually decide the result before the software does.

GLARE

Reflective surfaces

Polished metal reflects like a mirror; hot spots hide or imitate defects. Dome or low-angle lighting, sometimes with polarising filters, is chosen for the finish.

WE ASK

Surface finishes on the line

OIL FILMS

Coolant, oil and mist

Cutting fluid and oil change how a surface reflects and can look like stains; mist and chips foul optics. Checks sit where the surface is consistent.

WE ASK

Surface condition at the check

FIXTURING

Part presentation

Measurement needs the part at a known position and distance. A fixture or nest often decides whether a measurement repeats.

WE ASK

How parts are held and loaded

TOLERANCE

Tolerance against optics

Resolution is shared across the field of view, so tolerance, part size and optics are weighed together; precise edges may need telecentric optics.

WE ASK

Drawing with the critical tolerances

VARIANTS

Similar parts, different jobs

Variants can differ by one hole or chamfer. Each needs a recipe, and the station can confirm the part matches the job being run.

WE ASK

Variant list and job selection

PART MARKS

Direct part marks (DPM)

Laser and dot-peen codes have less contrast than print and vary with the surface; they need suitable lighting and a reader set up for DPM.

WE ASK

Marking method and surface

// AUTOMOTIVE SUPPLIERS

Error-proofing and traceability evidence for automotive component suppliers

Where vision fits in the checks that vehicle manufacturers expect from their suppliers.

Error-proofing (poka-yoke) at an assembly or machining cell uses a camera to confirm, before the next step, that the right variant is loaded, the right way round, with every fastener, weld nut, washer, clip or O-ring present. The result is interlocked with the cell PLC, so a wrong part stops the cell instead of travelling on. It is often the first automotive inspection a component supplier automates, because a missed feature found at the customer is far more expensive than one found at the cell.

Traceability evidence. Vehicle and equipment manufacturers audit their suppliers on whether each part can be traced to its batch, machine and test result. A DPM code reading station reads the

serial marked on the part and stores it with the inspection results and image, so the evidence exists per part rather than per shift sheet.

Metal surface defect detection on machined, ground or plated faces depends mostly on lighting: low-angle light for scratches, dome light for shiny curved parts, and fixtures that present every part the same way. Casting porosity and cracks below the surface stay with X-ray or ultrasonic testing.

// LIMITS

What a camera cannot tell you about a metal part

We agree these boundaries before a project starts.

× Needs another method

- **Internal cracks and porosity.** Sub-surface cracks, casting porosity and weld penetration need methods such as X-ray, ultrasonic or eddy-current testing.
- **Hardness and material.** Heat treatment, hardness and alloy are not visible.
- **Thread quality.** Vision may show that a hole is threaded, not that the thread passes a gauge.
- **Hidden features.** Features inside bores or on faces the camera cannot see need another view or method.

✓ Works reliably when

- **Parts are fixtured.** Same position and distance for every part.
- **Lighting suits the finish.** Tested on each finish that runs on the line.
- **Tolerance fits the optics.** Checked on samples before a measurement is agreed.

- **Full geometry to CMM accuracy.** A line station checks selected dimensions on every part; full 3D geometry and first-article inspection stay on the CMM.

// SAMPLES & ACCEPTANCE

What to send for a sample test

We test your own parts before proposing a station; quantities and shipping are agreed first. The same samples later define acceptance.

Sample preparation guide

Good parts
Parts across the normal range of finish, and each variant that runs.

Defect parts
Missing features, out-of-size parts, scratches and missing components, each marked.

Drawings
Drawings with the dimensions and tolerances that decide acceptance, and how you measure them today.

Acceptance
Measurements compared with your reference method, plus false rejects and missed defects on marked samples; levels agreed per project.

// MANUAL INSPECTION

Why manual inspection struggles on these lines

Conditions on metal component lines that make checking by eye unreliable over a full shift.

- **Glare.** On machined and polished surfaces, scratches and dents appear and disappear as the angle of view changes.
- **Oil, coolant and chips.** Films and residue look like stains, so an inspector has to judge each mark rather than simply see it.
- **Similar variants.** Parts that differ by one hole or chamfer are easy to mix on a busy cell, and hard to tell apart at a glance.

- **Measurement by sampling.** Gauges are used on samples, so drift between two checks is not seen until the next one.
- **Shift fatigue.** Repetitive handling of heavy or sharp parts over a long shift makes the rare fault easier to miss.

These are reasons to automate the checks that are defined and visible, and to keep people for judgement and for fixing causes. The guide to manual or camera inspection compares the two.

// LINE SOLUTIONS

Line solutions for metal components

Complete stations for lines in this industry, each with the HIKROBOT hardware, installation and an indicative installed budget for a typical application in rand, excluding VAT. **All line solutions →**

LINE SOLUTION	FAULTS IT CATCHES	HIKROBOT CONFIGURATION	INDICATIVE BUDGET (EXCL. VAT)
Rebar counting	Short or over-counted bar, tube and pipe bundles; hand counts with no record	20 MP camera + VisionMaster deep-learning count, operator screen	R 430 000 – R 1 190 000
Assembly verification	Missing screws and clips, O-rings, wrong variant, connector not latched	SC vision sensor, or smart cameras + ID5000 with PLC interlock	R 100 000 – R 960 000
Tyre barcode reading	Tyres with no read, unreadable labels, wrong code for the lane	Two to six HIKROBOT ID5000 readers in a frame, MES check, divert	R 260 000 – R 1 390 000

LINE SOLUTION	FAULTS IT CATCHES	HIKROBOT CONFIGURATION	INDICATIVE BUDGET (EXCL. VAT)
Fastener inspection	Wrong length or diameter, thread missing, mixed parts, profile burrs	Telecentric camera + backlight, VisionMaster, air-jet reject	R 270 000 – R 930 000
Glue bead inspection	Gaps, thin or wide sections and off-path beads; low bead height in 3D	2D camera + ring light, or DP 3D profiler on an axis or robot	R 230 000 – R 1 590 000
Anode plate inspection	Copper anode flatness, lugs, fins, blisters; carbon anode cracks, chips, stub holes	DP-series 3D profiler + 20 MP camera with deep learning, cooled	R 1 190 000 – R 2 760 000

// FAQ

Metal component inspection questions

Can machine vision detect scratches on metal parts?

Often, when lighting makes the scratch stand out from the normal machining pattern; low-angle and dome lighting are the usual starting points. Fine scratches on oily or textured surfaces are harder, so we test your parts and agree which marks count.

How accurate is camera measurement of metal parts?

There is no single figure. It depends on field of view, resolution, lens, lighting, edge quality and presentation. We compare your drawing tolerance with what the optics resolve, and check repeatability on your parts, before agreeing a measurement.

How are missing components detected in an assembly?

The station checks each position where a fastener, clip or O-ring should be, against the recipe for that variant. Hidden components need another view.

Can the station read laser-marked or dot-peened codes?

Often, with lighting and a reader set up for direct part marks. Reading confirms the code is present and decodes; it is not the same as grading mark quality to a standard. Marks on curved, rough or oily surfaces are tested on samples first.

Can machine vision sort mixed bolts, screws and nuts?

Often, when the difference is visible: length, head shape, thread present or a missing nylon insert. Parts are usually fed one at a time past the camera on a rail or glass disc and blown off when rejected. Thread gauging, hardness and plating thickness need other checks.

Can a camera check welds on fabricated parts?

It can check what is visible: that each weld is present, in the right place and of the expected visible length, and that weld nuts are fitted. A laser profile sensor adds bead shape. Penetration, internal porosity and cracks below the surface need X-ray, ultrasonic or other test methods.

RELATED: Dimensional measurement → Presence & counting → Surface defect detection → How we deliver a project → All industries →

// METAL COMPONENTS

Request an assessment for your parts

Request a Vision Assessment

Tell us the parts, finishes, variants and what you need to check. We will say which checks apply and what a sample test needs.