APPLICATION // 08

Web inspection system: line scan cameras for film, foil, paper, board and fabric

Film inspection and web inspection for foil, paper and board, nonwovens, fabric, coil and sheet, plus print inspection on the press, for converters and mills in South Africa.

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Request an assessment for this application

// SHORT ANSWER

A web inspection system uses line scan cameras to image continuous material, such as film, foil, paper, board, nonwovens, coil and sheet, across its width as it moves. An encoder on a roller triggers each image line, so the image keeps its scale when speed changes. Line lights make holes, spots, streaks and coating faults visible. There is no single part to reject, so defects go to a defect map and are marked, or the line is slowed or stopped. We confirm feasibility on your material first.

// WHAT IT CHECKS

Which defects a web inspection system can find

Whether a defect shows depends on the light and its size compared with the pixel.

01 // HOLES

Holes and tears

Openings in the web, which let light through.

USUALLY NEEDS

Transmitted light (backlight)

02 // SPOTS

Spots, gels and inclusions

Dark or bright spots, gels in film, dirt and foreign particles.

USUALLY NEEDS

Transmitted or diffuse light

03 // STREAKS

Streaks and coating faults

Lines along the web, scratches, coating skips and uneven coating.

USUALLY NEEDS

Reflected light at a chosen angle

04 // EDGES

Wrinkles and edge faults

Creases, folds, edge cracks and edge position.

USUALLY NEEDS

Low-angle light or an edge view

Lighting decides what is visible

LIGHTING	HOW IT WORKS	MAKES VISIBLE
Transmitted (backlight)	Light shines through the web.	Holes, gels, thin spots, inclusions.
Reflected (bright-field)	The surface mirrors light to the camera.	Coating faults, streaks, stains on foil, coil and board.
Low-angle (dark-field)	Light skims the surface.	Scratches, creases, wrinkles.

// HOW IT WORKS

How a line scan camera works with the encoder and line light

The line-scan camera, encoder and line light are each chosen from your web width, speed and defects.

01

Line-scan camera

Images one thin line across the web at a time and stacks the lines into a continuous image. Wide webs use several cameras side by side.

02

Encoder triggering

An encoder on a roller sends a pulse per fixed length of travel; each pulse triggers one line, so scale holds when speed changes.

03

Line light

Exposure per line is very short, so light is concentrated into a bright, even line on the scan line.

How resolution and speed are set

DIRECTION	WHAT SETS IT	WHAT IT MEANS
Cross-web	Web width divided by the pixels across all cameras.	Wider webs or smaller defects need more pixels or cameras.
Along-web	Web travel per encoder pulse (per image line).	Usually matched to cross-web so defects are not stretched.
Speed	Lines per second needed at top web speed.	Faster webs need a higher line rate and brighter light.

DIRECTION	WHAT SETS IT	WHAT IT MEANS
Smallest defect	Must cover several pixels in both directions.	Decides both pixel sizes; confirmed on your material.

Line scan camera vs area scan camera

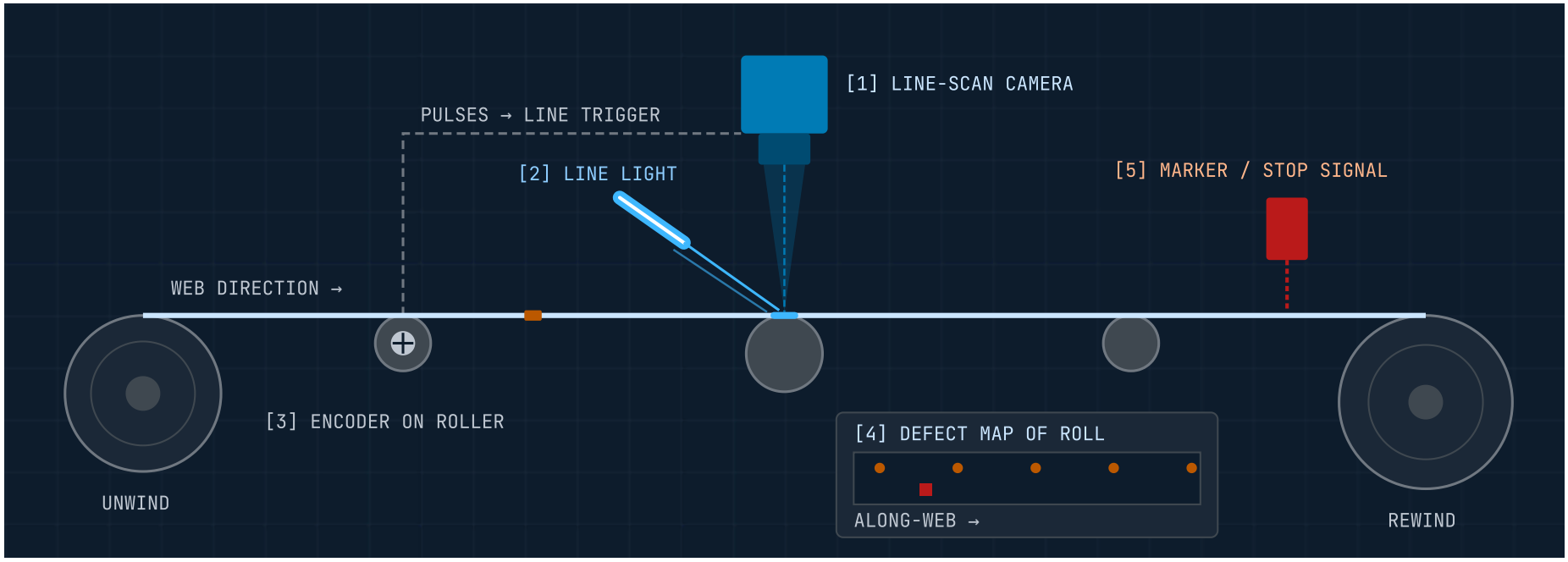
An area scan camera takes a whole rectangular frame at once, which suits separate products that stop or pass one at a time. A line scan camera has a sensor that is one or a few pixels high and very wide; it builds a continuous image line by line as the material moves, so it suits webs of any length and wide, fast material. Its long sensor often needs a lens with a larger image circle than the usual C-mount lenses on area scan cameras, so the line scan camera lens is chosen together with the camera. Fabric inspection on textile lines works on the same principle.

// STATION LAYOUT

How a web inspection station is laid out

Side view of a typical station; the real layout follows your web path.

[Schematic] SIDE VIEW · NOT TO SCALE



[1] Line-scan camera: images one line across the full web width at a time.

[2] Line light: a bright, even line of light on the scan line.

[3] Encoder: one pulse per length of travel triggers each line.

[4] Defect map: each defect logged by type and position on the roll.

[5] Marker / stop: flags the defect at the edge or signals the line.

// PASS AND FLAG [Illustrative examples]

What a clean web and a flagged defect look like

Illustrations, not images from a real line. Which defects count, and how small, is agreed on your material during the sample test.

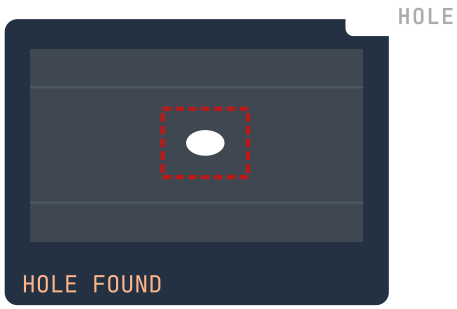


EXAMPLE // FILM, BACKLIT

Web within limit

Even texture under transmitted light, matching the good material.

SURFACE: IN LIMIT ACTION: NONE

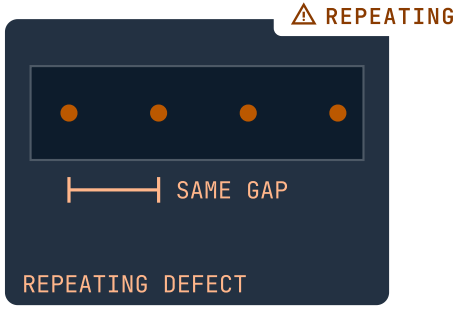


EXAMPLE // FILM, BACKLIT

Hole in the web

Light through the hole shows bright; it is logged and marked.

DEFECT: ✗ HOLE ACTION: MAP + MARK



EXAMPLE // DEFECT MAP

Repeating defect

An equal gap between defects usually points to a damaged roller.

PATTERN: ✗ REPEATS ACTION: ALARM / STOP

// AFTER DETECTION

Defect maps, marking and stopping instead of rejects

A continuous web has no single product to push off the line.

RESPONSE	WHAT HAPPENS	NEEDS
Defect map	Each defect logged with type, cross-web position and distance along the roll.	Encoder position and a roll reference.
Marking	A label, flag or ink mark at the web edge, found again at rewinding or slitting.	A marker downstream of the camera.

RESPONSE	WHAT HAPPENS	NEEDS
Alarm, slow or stop	Serious or repeating defects alert operators or stop the line.	Signals agreed with the PLC.
Roll report	Lets the slitter or next process cut out defects or grade the roll.	Agreed format.

// CONVERTERS

Print control on the press for packaging converters (FSSC 22000 2.5.2(d))

Print inspection for converters that supply food plants.

Packaging converters that print film, labels or cartons for food plants are often asked to prove print control. FSSC 22000 version 6 (Part 2, 2.5.2(d)) asks packaging manufacturers certified to the scheme for an artwork and print control procedure that includes approval of each print run against the agreed standard or master sample, a process to detect and identify printing errors during the run, and segregation of different print variants.

A web inspection system on the press or the rewinder is one way to meet the in-run part: it compares the printed web with the approved master continuously, logs missing print, colour and register faults, smears and wrong or mixed designs with their position on the roll, and marks them or stops the press. It does not approve artwork; that stays with the pre-press and customer sign-off. Typical questions from the press room are “how do we detect printing errors during the print run?”, “how do we check the run against the master sample?” and “how do we stop a wrapper being cut in the wrong place so the ingredient list is missing?”.

Source: FSSC 22000 Scheme Version 6, Part 2, 2.5.2(d) (https://www.fssc.com/wp-content/uploads/2023/03/FSSC-22000-Scheme-Version-6-.pdf) (read 2026-09-25). FSSC version 7 was published in 2026 and may renumber these clauses.

// LIMITS

Where web inspection stops

We agree these boundaries before a project starts.

× Not detectable with a camera

- **Thickness and coating weight.** These need gauging sensors, not a camera.
- **Faults inside opaque layers.** A fault buried in an opaque laminate, board or coil cannot be seen.
- **Strength and adhesion.** Tensile strength, bond and seal strength are not visible.

✓ Works reliably when

- **The web path is stable.** Imaging over a roller keeps the web in focus without flutter.
- **Defects are defined.** A defect catalogue with samples of each type that matters.

CONDITION	WHAT WE NEED TO KNOW	WHY IT MATTERS	CONFIRMED DURING
Material and width	Material, finish and width of every product.	Decides lighting and number of cameras.	Sample test
Speed range	Lowest and highest web speed.	Sets line rate and light power.	Site survey
Web path	Rollers, free spans and flutter.	The web must stay in focus.	Site survey

CONDITION	WHAT WE NEED TO KNOW	WHY IT MATTERS	CONFIRMED DURING
PLC and downstream	PLC, rewinder or slitter, existing marker.	Decides how maps, marks and stops are used.	Design review

// EVIDENCE

What you can check before you ask us

How feasibility is decided on your own samples, and the published budgets of complete line solutions that use this check.

ENGINEERING METHOD

How a sample test is judged

Samples
Good samples that show normal variation, and defective samples for each defect you need to catch, including borderline ones.

Imaging
Imaged under candidate lighting and optics; what is, and is not, visible is recorded.

Acceptance
False rejects and missed defects are agreed in writing and measured at FAT and SAT.

Outcome
A written feasibility conclusion with example images, before any proposal.

The method used on every project; not a measured result.

BUDGET MODEL

Installed budgets of line solutions that use this check

Sachets and pouches
R 80 000 – R 930 000

Pipe and cable print
R 110 000 – R 650 000

Folder gluers
R 170 000 – R 970 000

Aluminium extrusions
R 360 000 – R 1 340 000

Basis
Indicative budget for a typical application, in rand, excluding VAT, as at 2 October 2026, low to high configuration. A firm price follows the sample test.

Each figure is for a complete station on that line, not a price for this check on its own.

How to prepare inspection samples →

All line solutions with budgets →

// ACCEPTANCE

How the station is accepted

01

False rejects

Good material flagged as defective, measured on agreed good lengths.

02

Missed defects

Known defects that pass unflagged, measured with marked samples.

03

Position check

Map positions and marks compared with known defect positions.

// EVIDENCE

Sizing a web system: line rate, bandwidth, light and acceptance

A worked example against a real camera datasheet, lighting physics, interface standards and acceptance metrics.

Worked example: from web speed to line rate and bandwidth. A 1,300 mm web is inspected with 4K line-scan cameras such as the HIKROBOT MV-CL042-91GC, which the vendor lists with 4,096 pixels, a maximum line rate of 28 kHz at 8-bit in standard mode and 80 kHz in a high-bandwidth Bayer mode, on Gigabit Ethernet (HIKROBOT MV-CL042-91GC). Along-web pixels are matched to cross-web pixels, so the line rate is web speed divided by pixel size. The data rate is pixels × line rate × 8 bits. The figures are arithmetic for planning; the camera model, mode and count are chosen from your smallest defect and top speed.

CAMERAS ACROSS 1,300 MM	PIXEL SIZE	WEB SPEED	LINE RATE NEEDED	DATA PER CAMERA (8-BIT)	WHAT IT MEANS
1 camera (4,096 px)	0.32 mm	150 m/min	about 7.9 kHz	about 260 Mbit/s	Comfortable within the standard mode
1 camera (4,096 px)	0.32 mm	300 m/min	about 15.8 kHz	about 520 Mbit/s	Within the standard mode
2 cameras (about 8,000 px after overlap)	0.16 mm	150 m/min	about 15.4 kHz	about 500 Mbit/s each	Within the standard mode
2 cameras (about 8,000 px after overlap)	0.16 mm	300 m/min	about 30.8 kHz	about 1,000 Mbit/s each	Above the 28 kHz standard mode: needs the high-bandwidth mode, a third camera, or coarser along-web pixels

The last row shows the usual trade-off: halving the pixel size doubles both the cameras and the line rate, and the line rate runs into the camera's and the network's limits. Exposure time per line also shrinks as the line rate rises, so light power grows with speed.

Light for webs

HIKROBOT's glossary describes low-angle light, below 45°, as making flat areas dark and rough or raised areas bright, and coaxial light as turning a flat surface into a mirror on which roughness shows clearly; it lists line-scan lights among the sources for both (HIKROBOT light catalogue, glossary). On a web that becomes: transmitted light for

holes and gels, coaxial or bright-field reflection for coating faults on foil and film, and low-angle light for creases and scratches.

Interfaces and data

GigE Vision and GenICam are the machine-vision interface standards the camera above is listed against (HIKROBOT MV-CL042-91GC); EMVA hosts GenICam, the generic programming interface that lets software control cameras from different makers the same way (EMVA, GenICam). For a web system that means the software can address each camera's line rate, exposure and trigger mode, and the encoder input sets the line trigger.

How a web system is accepted

METRIC	HOW IT IS MEASURED	WHY IT MATTERS
Detection rate per defect class	Share of seeded or known defects of each class found in a trial roll	Holes and tears usually first, because they matter most downstream
False alarm rate	Alarms per 1,000 m (or per roll) that turn out to be no defect on review	Too many and operators stop trusting the system
Position accuracy	Difference between the logged position and where the defect is found at rewind or slitting	Decides whether the slitter can cut it out automatically
Classification agreement	Share of logged defects given the same class as the operator's review	Matters when rolls are graded by defect type

For printed packaging, FSSC 22000 version 6 expects packaging manufacturers to control printing, including approval of each run against the master sample and a process to detect and identify printing errors during the run (FSSC 22000 v6, 2.5.2(d)). A web or sheet inspection system with a defect map and a roll report is one way to show that process is in place.

SOURCES FOR THIS SECTION

1. HIKROBOT MV-CL042-91GC 4K GigE line-scan camera: 4096 pixels, 28 kHz standard / 80 kHz high-bandwidth line rate, Gigabit Ethernet, GigE Vision V2.0 and GenICam (https://www.hikrobotics.com/en/machinevision/productdetail?id=7236) `(vendor product data, read 2026-10-27)`
2. HIKROBOT Light Source Catalogue 2025 Q3, glossary pp.76–79 (low-angle, coaxial and line-scan lights; brightfield and darkfield) (https://www.hikrobotics.com/en2/source/vision/video/2025/7/21/Light%20Source%20Catalog_ENG_2025Q3_v2.pdf#page=77) `(vendor catalogue, read 2026-10-27)`
3. EMVA: GenICam standard (https://www.emva.org/standards-technology/genicam/) `(standards body page, read 2026-10-27)`
4. FSSC 22000 Scheme Version 6, Part 2, 2.5.2(d) print control for packaging manufacturers (https://www.fssc.com/wp-content/uploads/2023/03/FSSC-22000-Scheme-Version-6-.pdf) `(scheme document, read 2026-09-25)`

// BEFORE WE START

What to prepare for the sample test

We image your material under different lighting first.

Sample preparation guide

Good material
Lengths from different batches and finishes.

Defect samples
Lengths with each defect type marked.

Material details
Width, finish and your defect list.

Line information
Speed range, web path, PLC, rewinder or slitter.

// FAQ

Web and line-scan questions

What is a line scan camera?

A line scan camera is an industrial camera whose sensor captures one line of pixels at a time. As the material moves past, the lines are stacked into a continuous image, triggered by an encoder so that each line covers the same length of travel.

Line scan camera vs area scan camera: what is the difference?

An area-scan camera takes a whole frame at once and suits separate products. A line-scan camera takes one line at a time and builds a continuous image as material moves, so it suits webs of any length.

What is 100% print inspection?

Checking every printed item, or the full width and length of the web, instead of samples pulled from the run. Print defect detection compares what was printed with an approved master and finds missing print, streaks, spots and register shifts. Print inspection on a web uses a line-scan camera across the full width; carton print inspection on a folder gluer is covered on the folder gluer page.

Why does a line-scan camera need an encoder?

Each image line is triggered by an encoder pulse for a fixed length of travel, so lines cover the same length at any speed. Without it the image stretches or squashes as speed changes, and defect positions along the roll are lost.

How is the resolution of a web inspection system worked out?

From the smallest defect that matters, which must cover several pixels. Cross-web pixel size comes from web width and camera pixels; along-web from travel per encoder pulse. The camera must then reach the line rate needed at top speed.

What happens when a defect is found on a moving web?

It is logged on a defect map with its position, then marked at the web edge, passed to the slitter in a roll report, or used to stop the line.

Can a web inspection camera system measure thickness or coating weight?

No. Those need gauging sensors. A camera can show where coating is missing or visibly uneven.

Which cameras and software do you use?

We build stations on HIKROBOT VisionMaster. HIKROBOT GigE line-scan cameras (CL series) are stated compatible with GigE Vision and GenICam, with line, frame and combined line-and-frame trigger modes (vendor-stated). This website does not claim any official HIKROBOT partnership or distributor status.

RELATED: Camera and lens selection → Surface defect detection → Plastics & packaging → Building materials → Machine vision lighting → PLC & reject integration → Technology → How we deliver →

LINE SOLUTIONS USING THIS: Sachets and pouches → Folder gluers → Pipe and cable print → Aluminium extrusions → Food packaging version verification →

COMMON IN THESE INDUSTRIES: Food & beverage → Plastics & packaging → Building materials →

TYPICALLY BUILT WITH: Line scan imaging → Vision sensor (HIKROBOT SC1000–SC3000) → Area scan cameras with a vision controller →

SOURCES

1. HIKROBOT GigE line-scan camera datasheet (CL series): GigE Vision, GenICam, trigger modes (https://www.hikrobotics.com/en2/source/vision/document/2023/6/27/MV-CL024-91GC%20GigE%20Line%20Scan%20Camera_datasheet_20230506.pdf) (vendor datasheet, checked 2026-09-24)

// PRODUCTION CHECKS

Separate print defects from downstream packaging identity

A converter's print check and a food factory's packaging-version check solve different problems. Keep the print-job master, material identity and production-order mapping explicit at the handover.

DECISION OR EVENT	CHECK OR ACTION	ACCEPTANCE BOUNDAI
Print master	Compare the printed output with the approved print job	A correct printed jo the wrong food line

DECISION OR EVENT	CHECK OR ACTION	ACCEPTANCE BOUNDAI
Repeat or lane	Associate defects with web position and lane	A global alarm doe affected material.
Artwork change	Confirm master/version and allowed variable regions	Do not treat every a print defect.
Food-line handover	Supply approved version identifiers and reel/lot traceability	The downstream li expected product r

Agree how old revisions, mixed blanks, splices and changed reels are labelled and isolated. Only claim inspection of the areas visible at the defined conversion or packing step.

Downstream packaging-version verification · Changeover and reload challenge plan

// WEB & LINE-SCAN

Request an assessment for this application

Tell us your material, web width, speed range and the defects that matter. We will tell you what a line-scan station can find.

Start an assessment