APPLICATION // 10

DPM code reading and traceability

Direct part marking (DPM) codes on parts: dot-peen, laser marking and ink-jet DataMatrix codes, read and passed to your PLC or MES, for component suppliers in South Africa.

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Request an assessment for this application

// SHORT ANSWER

DPM code reading means reading codes marked directly on a part, usually a DataMatrix code made by dot-peen, laser or ink-jet, with a fixed DPM code reader, and sending the serial and result to the PLC or MES for the part's traceability record. Whether it reads reliably depends mainly on the mark and the lighting: dot-peen usually needs low-angle light, laser marks on shiny metal often need dome or coaxial light. Reading a code is not grading it to the DPM quality standard. We test your marked parts first.

// WHAT IT DOES

What a DPM reading station does

Three functions. Which you need depends on how your traceability records are kept.

01 // READ

Decode the mark

Reads Data Matrix and other 2D codes marked on the part, at a fixed point in the process.

NEEDS

The mark facing the reader in a known position

02 // MATCH

Check the content

Compares the decoded serial or part number with what the line expects, and flags duplicates already on record.

NEEDS

Expected data or a duplicate check in the PLC or MES

03 // RECORD

Write the traceability record

Sends the result to the PLC or MES, linking the serial to the station, time and outcome.

NEEDS

An agreed record format

How the marking method affects reading

METHOD	HOW THE MARK IS MADE	LIGHTING TRIED FIRST	COMMON READING PROBLEMS
Dot-peen	A stylus punches small dots into the surface; contrast comes from their shape, not colour.	Low-angle (dark-field)	Worn stylus tip, uneven dot spacing, rough or oily surface.
Laser	The beam changes the colour or texture of the surface, or removes material.	Diffuse (dome) or coaxial	Low contrast on some alloys, glare, fading after coating or heat treatment.
Ink-jet	Ink dots printed on the surface, closer to a code on a label.	Diffuse or bright-field	Smearing, ink spread on oily parts, abrasion in handling.

A consistent mark matters more than the reader. Marks drift as a stylus wears or laser settings change, so a read straight after marking gives early warning. We do not sell or service markers. Printed date and batch codes are covered under **OCR/OCV and code inspection**.

// IMAGING

Lighting angles for direct part marks

Lighting creates the contrast the reader needs from a direct part mark; low-angle light is also called dark-field light. The geometry is confirmed on your parts.

Low-angle (dark-field)

Light skims the surface, so dot edges light up against a dark background. Usually first choice for dot-peen.

Diffuse (dome)

Even light from all directions hides tooling marks and curvature. Common for laser marks on curved or shiny parts.

Coaxial

Light along the camera axis: flat, shiny areas look bright, marked cells dark. Suits laser marks on flat, polished faces.

// LIMITS

Where DPM reading stops

We agree these boundaries before a project starts, so nobody expects the reader to do what it cannot.

Not covered by this station

- **Formal DPM grading.** Grading to ISO/IEC 29158 needs a calibrated verifier.

Works reliably when

- **The mark is presented the same way.** A fixture, stop or robot places the mark at a known angle.

- **Destroyed or covered marks.** Lighting cannot recover a mark filled by paint or scale, or worn away.
- **Wrong data at source.** If the marker and the MES both hold the wrong serial, they agree and the error passes.

- **The marking process is controlled.** Stylus, laser settings and part cleanliness stay consistent.
- **No-reads have a defined path.** Every failed read ends at a NOK station with a record.

// 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.

How to prepare inspection samples →

BUDGET MODEL

Installed budgets of line solutions that use this check

Assembly error-proofing
R 100 000 – R 960 000

Tyre codes
R 260 000 – R 1 390 000

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.

All line solutions with budgets →

// READER CHOICE

Fixed DPM code reader or handheld scanner?

Where each one fits, and what a line reader adds for traceability.

Handheld DPM scanners suit rework, goods-in and low volumes: the operator tilts the part until the code reads. **Fixed DPM code readers** suit the line: the part arrives at a defined angle, the reader and its lighting are set for that mark, and every read, no-read and serial is recorded without an operator. Many plants use both, a fixed reader on the line and a handheld scanner at the NOK station.

Traceability evidence for OEM audits

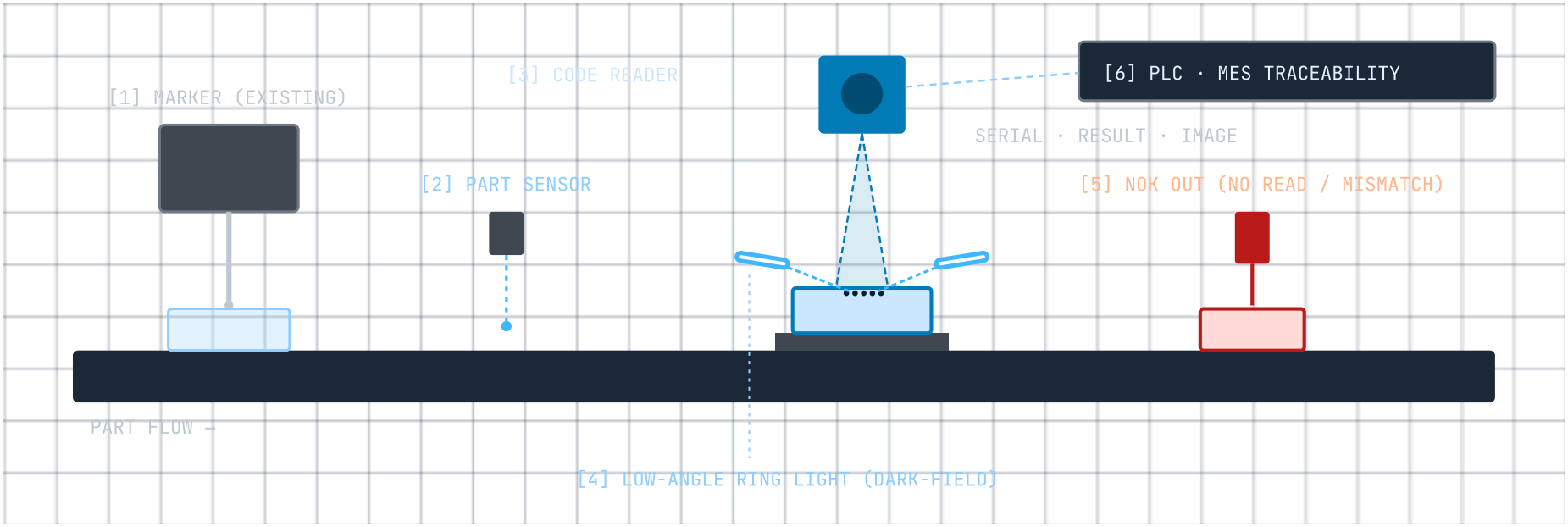
Component suppliers to vehicle and equipment manufacturers are often audited on whether they can trace each part to its batch, machine and test results. A fixed reader gives that evidence in the form auditors ask for: each serial read at a defined step, with time, station, result and image stored against it, and every no-read resolved through a documented path. Which fields are recorded, and where, is agreed with your quality and IT teams at design review.

// STATION LAYOUT

How a DPM reading station is laid out

Side view of a typical station after the marker. The real layout follows the site survey.

[Schematic] SIDE VIEW · NOT TO SCALE



[1] Marker: your existing dot-peen, laser or ink-jet marker.

[2] Part sensor: tells the reader a part is in position.

[3] Code reader: resolution chosen from the mark's cell size.

[4] Low-angle light: or a dome or coaxial light for some laser marks.

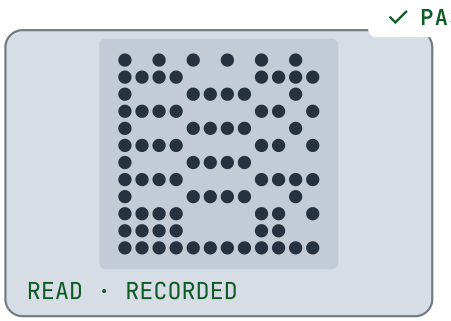
[5] NOK outlet: receives parts that fail to read or match.

[6] PLC and MES: receive serial, result and images.

// PASS AND REJECT [Illustrative examples]

What a pass and a reject look like

Illustrations, not images of real parts or codes. How much the lighting can recover from a weak mark is found on your own parts.

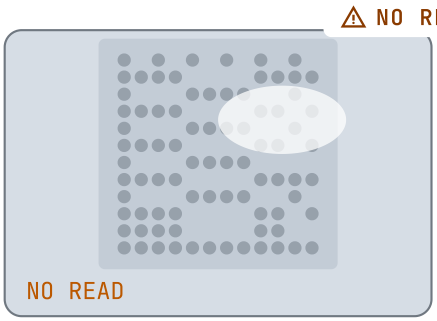


EXAMPLE // DOT-PEEN ON STEEL

Code read and recorded

Dots are clear under low-angle light; the serial is written to the part's record.

READ: OK ACTION: PASS

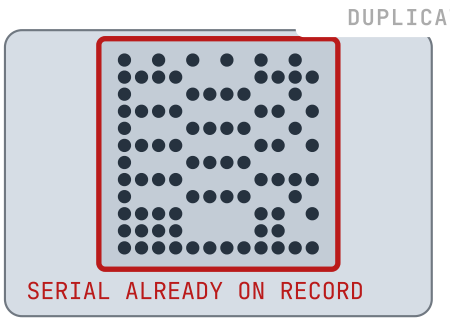


EXAMPLE // DOT-PEEN, OILY PART

Mark not readable

Faint dots and glare from an oil film. The part goes to NOK for cleaning and a re-read.

READ: ✗ NO READ ACTION: NOK



EXAMPLE // LASER ON ALUMINIUM

Serial already on record

The code reads, but the MES already holds this serial, so the part is stopped.

DATA: ✗ DUPLICATE ACTION: NOK / ALARM

// RESULT INTERFACE

What the station sends, and where

Who builds each side of the link is agreed at design review.

RESULT	GOES TO	USED FOR
Pass, fail or no-read	Line PLC	Part continues, or goes to NOK.

RESULT	GOES TO	USED FOR
Decoded string	PLC or MES	Starts or updates the serial's record.
Duplicate or unexpected serial	MES or station	Stops repeated or out-of-sequence serials.
Image of a failed read	Station storage	Shows whether mark, position or lighting failed.

Protocol support depends on the reader model: HIKROBOT's catalogue lists protocols such as PROFINET, EtherNet/IP and Modbus on specific code reader models (vendor-stated: HIKROBOT catalogue). MES-side changes are made by your MES team or supplier.

// ACCEPTANCE

How the station is accepted

We define what is measured, and on which parts, before FAT and SAT.

01

Read rate on your parts

The share of good marks read at line conditions, measured on agreed production parts.

02

No-read handling

A test that every failed read reaches the NOK station and is logged with its image.

03

Record integrity

A check that each serial read lands in the right record, including duplicates and link failures.

// EVIDENCE

Marking rules, mark size and read rate: the numbers behind a DPM station

GS1's direct part marking rules, a sizing example and how read rates are proven.

What GS1 says about the mark itself. GS1's technical considerations for direct part marking ask for at least a 20 % difference in reflectance between the mark and the surface, warn against finishes that cause heavy shadowing or glare, and keep marks off sealing surfaces, wear surfaces and surfaces in direct air or water streams. Marks should go on surfaces no rougher than 250 and no smoother than 8 micro-inches; rougher surfaces need larger cells (GS1 General Specifications, 5.12.4.3).

AVERAGE SURFACE ROUGHNESS	MINIMUM CELL SIZE (GS1 TABLE 5-61)	TYPICAL SURFACE
0.51 µm (20 µin)	0.19 mm	Ground or fine-machined faces
1.52 µm (60 µin)	0.23 mm	Typical turned or milled faces
3.05 µm (120 µin)	0.38 mm	Rougher machined or blasted faces
5.08 µm (200 µin)	0.51 mm	Near the GS1 upper roughness limit

MARKING METHOD	MINIMUM MATERIAL THICKNESS	MAXIMUM MARKING DEPTH
Dot peen	1.016 mm	0.102 mm

MARKING METHOD	MINIMUM MATERIAL THICKNESS	MAXIMUM MARKING DEPTH
Laser etch	0.762 mm	0.076 mm
Laser engraving	1.27 mm	0.127 mm
Electro-chemical etch	2.54 mm	0.254 mm
Laser bonding (additive)	0.025 mm	Surface mark

For GS1 DataMatrix marked directly on items other than medical devices, GS1 symbol specification table 7 sets a cell size of 0.254 to 0.615 mm with a target of 0.300 mm, a one-cell quiet zone and a minimum quality of 1.5/06/660 (GS1 General Specifications, table 7). Internal part marks that do not use GS1 data follow the customer's own specification, but the same physics apply.

Worked example: how big is the mark, and can the reader resolve it? In Data Matrix, two digits or one letter take one codeword; our **GS1 DataMatrix guide** gives the capacity table. The rows below are arithmetic on the stated data and cell sizes.

DATA	CODEWORDS	SMALLEST SQUARE SYMBOL	CELL SIZE	MARK SIZE
Serial AB12345678901234 (2 letters, 14 digits)	9 codewords	16 × 16 (holds 12)	0.30 mm (GS1 target)	about 4.8 mm, 5.4 mm with quiet zone

DATA	CODEWORDS	SMALLEST SQUARE SYMBOL	CELL SIZE	MARK SIZE
Same serial on a cast face, Ra about 3 µm	9 codewords	16 × 16	0.38 mm (GS1 minimum for that roughness)	about 6.1 mm, 6.9 mm with quiet zone
GS1 element string: FNC1, (01) GTIN, (21) 8-digit serial	about 14 codewords	18 × 18 (holds 18)	0.30 mm	about 5.4 mm, 6.0 mm with quiet zone

On the reader side, assume a 30 mm field of view on a sensor 1,280 pixels wide: each pixel covers about 0.023 mm, so a 0.30 mm cell spans about 13 pixels and a 0.38 mm cell about 16. A wider field of view to cope with loose part positioning lowers that quickly, which is why DPM stations locate the part first.

Light for marks

HIKROBOT's glossary explains why dot-peen and laser marks need different light: below 45°, flat areas look dark and rough or raised areas bright, which lights up peened dots; coaxial light turns a flat polished face into a mirror on which marked cells show dark; shadowless light weakens grain and tooling marks (HIKROBOT light catalogue, glossary).

How a DPM station is accepted

- **Read rate:** good decodes divided by read attempts, on parts from every marking machine, material and surface condition that reaches the station.
- **No-read rate and its bound:** a trial of 1,000 parts with no no-reads bounds the no-read rate at about 0.27 % with 95 % confidence, using the Wilson method in NIST's handbook (NIST e-Handbook, 7.2.4.1); it does not prove zero.

- **Content and duplicates:** every decoded serial checked against the expected format and the record, with duplicates flagged.
- **Mark quality trend:** where the reader reports a quality value, its trend shows a worn stylus or a drifting laser before reads fail. A formal grade to ISO/IEC 29158 needs a verifier.

SOURCES FOR THIS SECTION

1. GS1 General Specifications, Release 26.0: 5.12.4.3 technical considerations for direct part marking, Tables 5-61 and 5-62, symbol specification table 7 (https://gs1za.org/wp-content/uploads/2026/05/GS1-General-Specifications-2026.pdf) `(standard, read 2026-10-27)`
2. HIKROBOT Light Source Catalogue 2025 Q3, glossary pp.76–79 (low-angle, coaxial and shadowless light) (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. NIST/SEMATECH e-Handbook, 7.2.4.1 Confidence intervals for a proportion (https://www.itl.nist.gov/div898/handbook/prc/section2/prc241.htm) `(NIST, read 2026-10-27)`

// BEFORE WE START

What to prepare for the sample test

We test marks from your own marker before proposing a station, and confirm quantities and shipping with you first.

Sample preparation guide

Marked parts
Production parts, after marking and after later processes.

Difficult marks
Faint, uneven or damaged marks, and parts that fail today.

Mark specification
Marking method, symbol type, data format and mark location drawing.

Line information
Marker, PLC and MES details, and how parts are presented at the read point.

// FAQ

DPM code reading questions

Why read a direct part mark instead of a label?

A direct part mark stays on the part through machining, heat treatment, washing and assembly, where a label would fall off, burn or be removed. That makes it the usual choice when every part must be traceable to its batch, machine or test result for its whole life, as automotive and component supply chains often require.

What is ISO/IEC 29158?

ISO/IEC 29158 is the test specification for grading direct part marks (current edition 2025; earlier editions were titled the DPM Quality Guideline), adapting 2D barcode grading to marks on metal and plastic. A formal grade needs a calibrated verifier; an in-line DPM code reader shows whether each mark reads with the right content.

Why does a dot-peen code read on the bench but fail on the line?

On the bench the operator tilts the part until it reads. On the line the angle and lighting are fixed, and oil, coolant or swarf change the image. The mark must be presented the same way each time.

What is a DPM reader?

A fixed or handheld code reader whose lighting and decoding suit direct part marks, such as dot-peen and laser-marked Data Matrix codes on metal and plastic. On a line it is usually a fixed DPM reader with dome or low-angle light, chosen at the sample test on your parts.

How do automotive suppliers verify DPM code readability on parts?

By reading every mark at the point where it must later be read, under the same light and angle, and logging the result per part; a mark that does not read goes to a NOK station before the part leaves. A formal grade needs samples measured on a verifier to ISO/IEC 29158.

Which lighting works best for direct part marks?

It depends on mark and surface. Dot-peen usually reads best under low-angle light, laser marks on shiny or curved parts under dome or coaxial light. We compare options on your parts.

Is reading a DPM code the same as verifying it?

No. Reading confirms the code decodes with the right content. Verification grades the mark against the DPM quality standard ISO/IEC 29158 with a dedicated verifier. We read codes; we do not supply formal grading.

Can marks be read after heat treatment, blasting or coating?

Sometimes. Later processes can reduce contrast or fill the mark, so we test parts straight after marking and after those processes before choosing the read point.

What happens when a code cannot be read?

A no-read is a fail. The part goes to a NOK station, the image is saved, and an authorised person decides whether to re-read, re-mark or scrap it.

Which hardware do you use?

HIKROBOT's range includes fixed and handheld code readers, and VisionMaster reads linear and 2D codes (vendor-stated). The reader is chosen at the sample test. This website does not claim any official HIKROBOT partnership or distributor status.

RELATED: Choosing a HIKROBOT code reader → · Barcode verification and grading → · OCR/OCV & code inspection → · Metal components → · Machine vision lighting guide → · PLC & reject integration → · HIKROBOT VisionMaster integration → · Inspection technology →

LINE SOLUTIONS USING THIS: Assembly error-proofing → · Tyre codes → · Machined part mix-up inspection →

COMMON IN THESE INDUSTRIES: Metal components → · Machining →

TYPICALLY BUILT WITH: Vision sensor (HIKROBOT SC1000–SC3000) → · Fixed code reader (HIKROBOT ID series) → · Smart camera (HIKROBOT SC5000X, SC6000) →

SOURCES

1. ISO/IEC 29158:2025, bar code symbol quality test specification, direct part mark (https://www.iso.org/standard/87123.html) (standards body page, checked 2026-10-04; replaces the 2020 edition (DPM Quality Guideline))
2. HIKROBOT VisionMaster product page (code reading) (https://www.hikrobotics.com/en/machinevision/visionmaster/) (vendor page, checked 2026-09-24)
3. HIKROBOT machine vision product navigation (fixed and handheld code readers) (https://www.hikrobotics.com/en/machinevision/visionproduct/?typeId=78) (vendor page, checked 2026-09-24)

4. HIKROBOT Machine Vision Smart Product Catalog, 2025 Q4 (PDF) (https://www.hikrobotics.com/en2/source/vision/video/2026/1/20/Machine%20Vision%20Smart%20Product%20Catalog_2025Q4.pdf) (vendor catalogue, checked 2026-09-24; code reader protocol rows)

// PRODUCTION CHECKS

Keep part identity through machining, washing and dispatch

Test the mark in the condition in which it will be read: an oil-covered machined face, a washed part and a reflective finished part are different optical conditions. Select the reading position where the mark is accessible and the physical part can still be tracked.

DECISION OR EVENT	CHECK OR ACTION	ACCEPTANCE BOUN
Expected record	Supply work order, part family and required identifier from trusted data	Do not derive the unverified incom
Read	Validate syntax and decode the identifier	A successful dec grade.
Compare	Check identity, duplicates and the required process state	A readable code wrong part.
Exception	Hold no-read, unknown and conflicting identities	Provide an autho route with a new

Agree field ownership and retention with the production-system owner. Use the cycle or tray position to link an identifier to the

physical component; a database record alone does not prove that the correct part was quarantined.

Visible variant and identity checks · Machining industry

// DPM CODE READING

Request an assessment for this application

Tell us how parts are marked and where the record is kept, and send marked parts, including ones that fail today. We will tell you what a station can read.

Start application assessment