Label Inspection Quality Standard (Template)

This standard sets out the requirements for a label inspection system, for use when selecting and assessing suppliers. The label inspection system shall check whether what the printer prints matches what the host computer sent to the printer, and shall judge each label by the zones, defect types, thresholds and duplicate-code requirements set out in this standard. “Shall” states a requirement on the inspection system; columns such as “This label” and “Used on site”, the ☐ boxes and the ___ blanks are filled in by the customer.

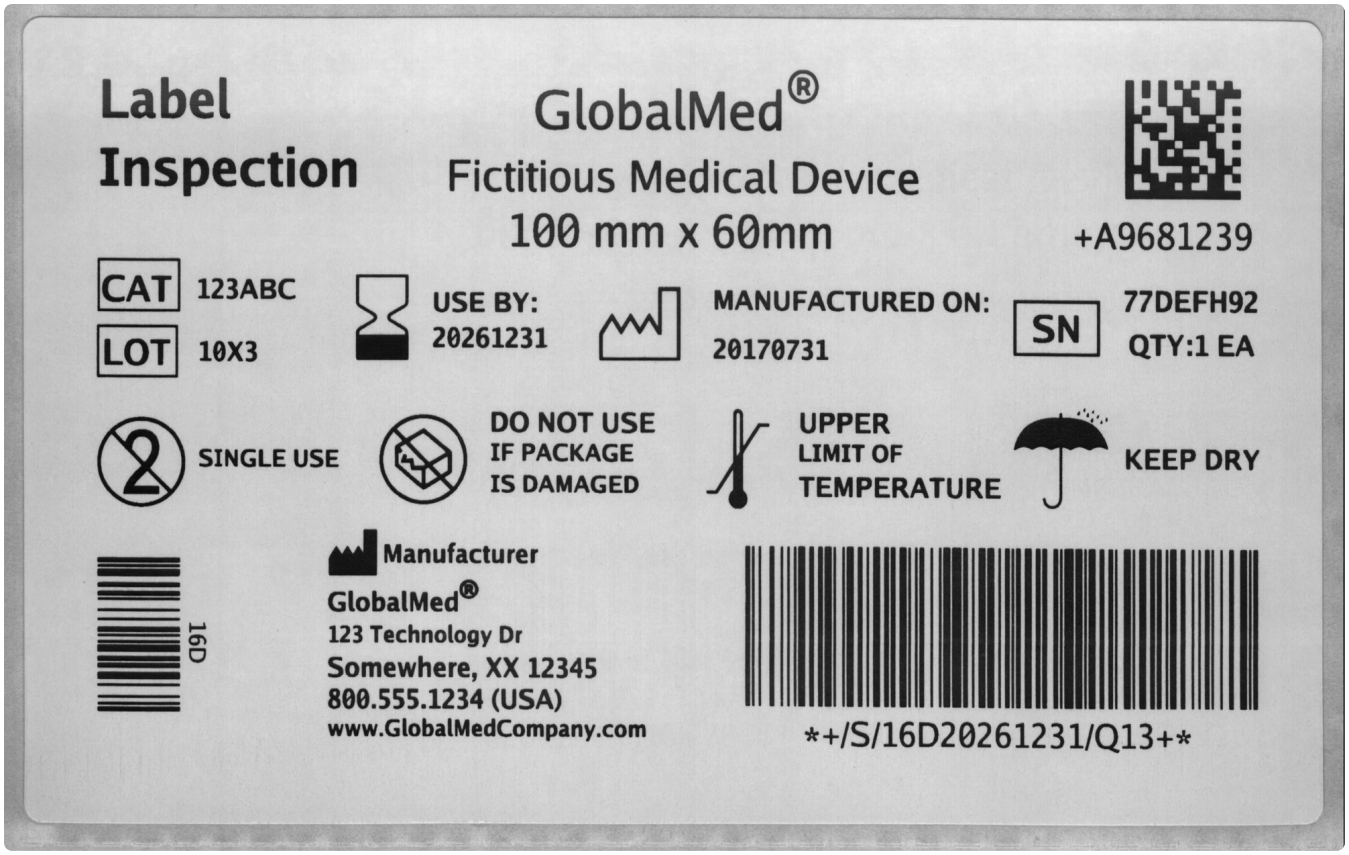
1 Basic requirement: consistency inspection

The label inspection system shall check the consistency between what the host computer sends to the printer and what the printer prints: every label is compared, one by one, with the content the host computer sent for that label. Inspection shall take place online, during printing.

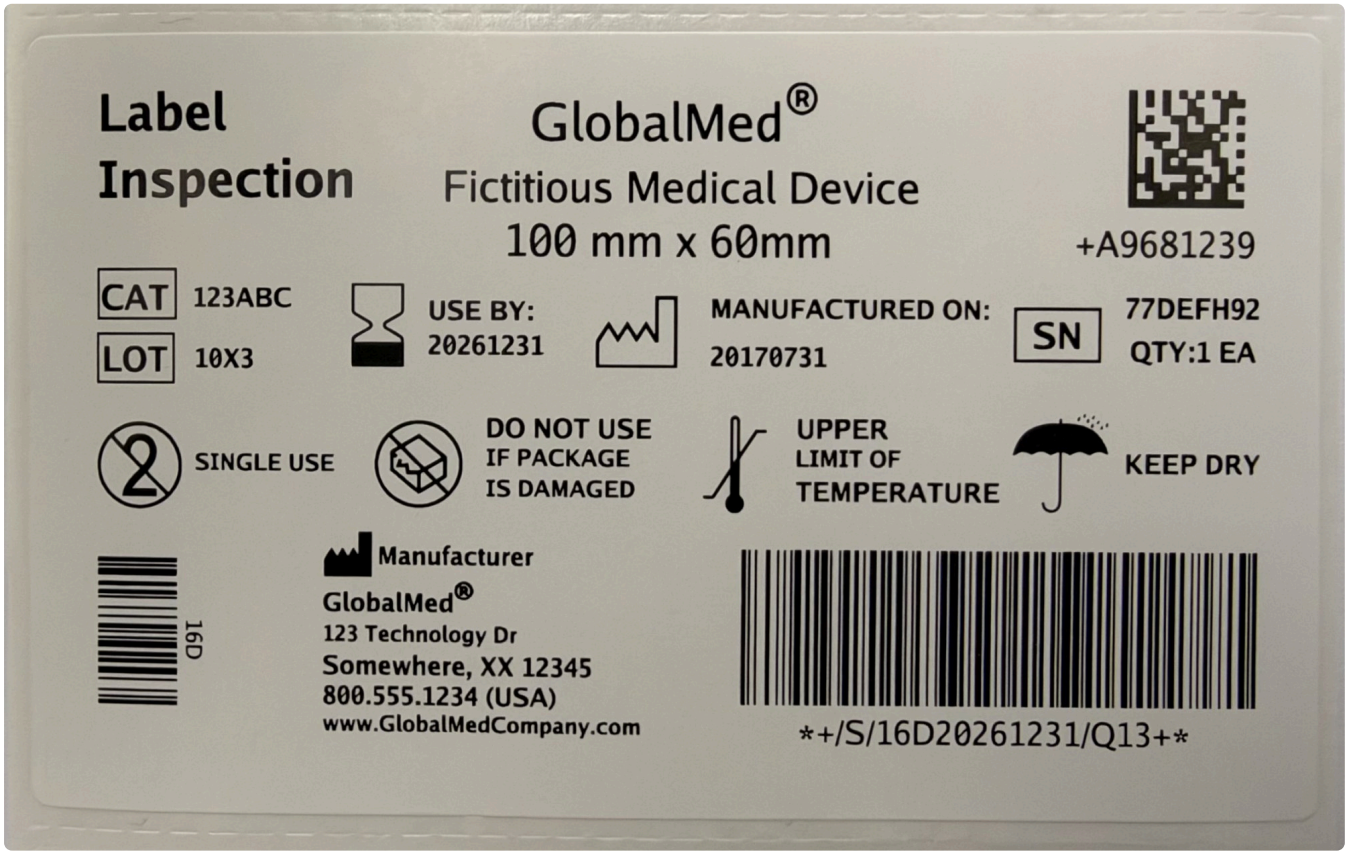
Below are the standard image and the camera image of a good product label; the two match in both data content and appearance.



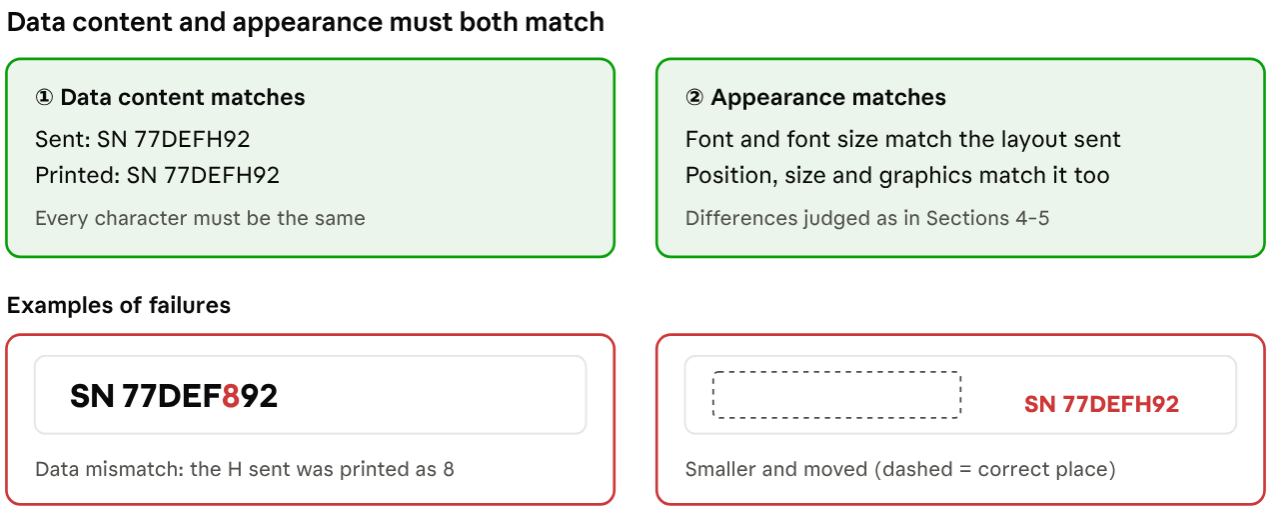
Standard image: what the content sent by the host computer to the printer should look like



Camera image: this label as captured by the camera (pass)



Phone photo: this label as taken with a phone



Two levels of consistency, and examples of failures

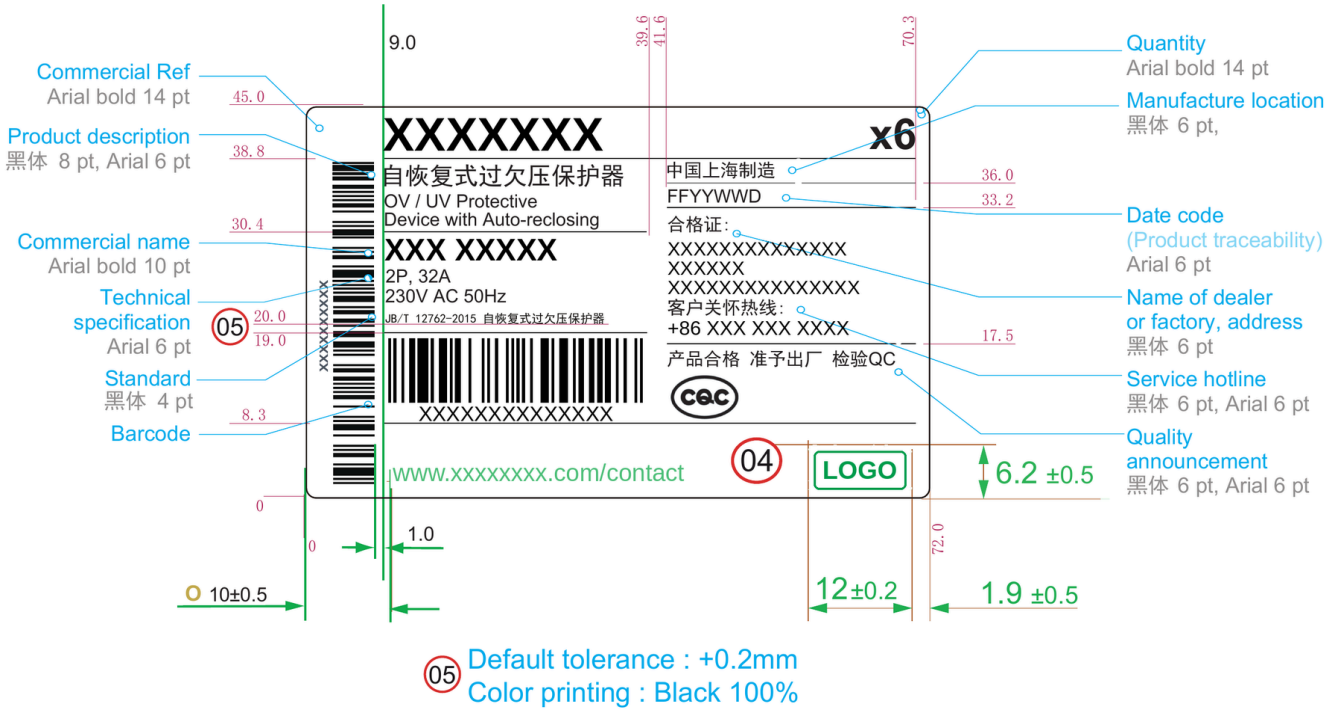
- **Data content matches**: whatever is sent must be printed, character for character. For example, if the serial number (SN) sent to the printer is 77DEFH92, the label must also read 77DEFH92.
- **Appearance matches**: the font, font size, position and size of the text match the layout sent, and graphics match the layout sent.

Each label is judged against the content sent for that label, so data such as model, batch number, date and serial number need not be listed item by item in this standard; wrong content, missing content or content printed as something else shall all be reported as defects (Section 4). The only data requirement that needs separate rules is duplicate codes (Section 6).

2 Layout reference

The customer provides any one of the following files as the reference for appearance (font, font size, position, size). On first use it is checked once against the layout sent by the host computer; after that every label is compared one by one as in Section 1.

Reference	Description	Used for this label
Label drawing	A drawing such as a PDF, marking font, font size, position, size and tolerance	☐
Label print template file	A template from label software such as BarTender (.btw)	☐
Printer commands	Commands written in a printer language such as ZPL	☐



Label drawing example: the drawing marks the font, font size, position, size and tolerance of every element (customer information replaced by XXXX and the logo by LOGO).

File name and version: _____

2.1 Inspection of appearance requirements

Customer requirement	How a mismatch shall be reported	Setting
Font, font size, size	Extra or missing parts of strokes are reported as missing ink, extra ink, broken stroke or bridge; a whole character or a whole bar missing is reported as missing element	Level in Section 5

Customer requirement	How a mismatch shall be reported	Setting
Position of a single element	Missing at the original position and extra at the new position, reported as missing ink and extra ink	Level in Section 5
Overall position and ± tolerance	The printed content as a whole has moved relative to the label edges, reported as offset	**Offset**: allowed left/right and up/down values
Tilt	The difference in distance from the two ends of the long side to the label edge is exceeded, reported as skew	**Skew**: allowed value

3 Inspection zones

The inspection system shall be able to divide a label into a **barcode zone** and a **non-barcode zone**, each with its own inspection criteria (Section 5). The zones are drawn in the inspection system's label inspection template.



Barcode zone
1D/2D codes and quiet zones (5.2)

Non-barcode zone
Everything else on the label (5.3)

Custom zone example
Serial number, stricter level (3.1)

Zone	Includes	Criteria
Barcode zone	Every barcode and 2D code on the label, together with the quiet zone around it	5.3
Non-barcode zone	Everything outside the barcode zone: text, graphics, the digits under barcodes, and blank areas	5.4

3.1 Custom zones (optional)

The inspection system shall be able to mark out further zones as needed, each with its own criteria. Common practice: key text such as model and serial number gets a stricter level; pre-printed trademarks and background patterns are not printed content and are set to not inspected.

Zone name	Includes	Criteria (level, or not inspected)
Example: serial number	SN with the serial number and quantity after it	Strict 0.2 mm

4 Defect detection capability

The label inspection system shall be able to detect the following 13 types of defects that printers produce, and report them as these 13 types; the defect names and settings in the inspection system shall correspond one to one with this section. In each illustration the left side is what the label should look like, the right side is what was printed, and a red box marks the defect.

Missing ink

Ink missing where there should be ink: white spots in strokes or solid areas, notches on stroke edges, a large area not printed.

Expected



Printed



Extra ink

Ink where there should be none: black dots on the paper, an extra bit on a stroke edge, blobs of ink; also includes smudges, such as debris covering printed content or smearing an edge.

Expected



Printed



Missing ink and extra ink each come as spots or lines: white or black dots, debris and small rings are spots; fine scratches, fibers and long thin gaps are lines. Spots and lines have separate thresholds (see 5.2).

Broken stroke

A stroke cut through, or a thin line with a section missing.

Expected



Printed



Bridge

Two strokes, two characters or a narrow gap that should be separate are joined by ink; a 1-dot white gap closing during normal printing does not count.

Expected



Printed



Snowflaking

Solid areas (barcode bars, bold text, filled blocks) are covered with scattered small white dots, so the area looks mottled and lighter. The whole area is reported as one defect.

Expected

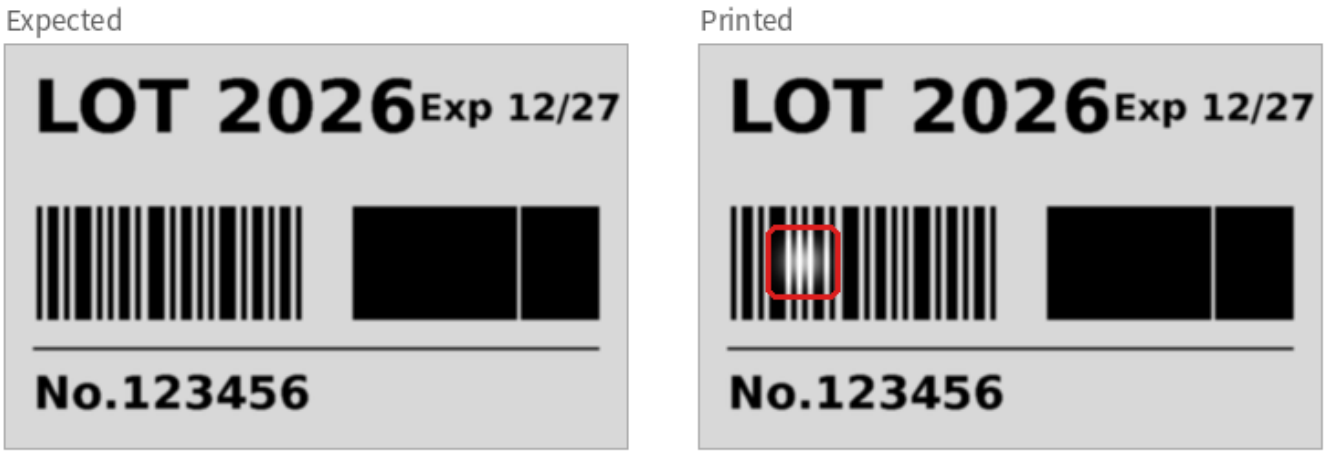


Printed



Film glare

Specular reflection on laminated or glossy face stock: a light spot brighter than the paper; the print quality underneath cannot be seen.



Printhead white line

A thin white line in the feed direction running through text, barcodes and graphics: a printhead dot has failed or is blocked by dirt. This is an equipment fault and is reported whenever detected.



Drag line

A broken line of grey or black dots in the feed direction on blank paper, usually from dirt on the printhead scraping the ribbon, or ink dragged by the ribbon.



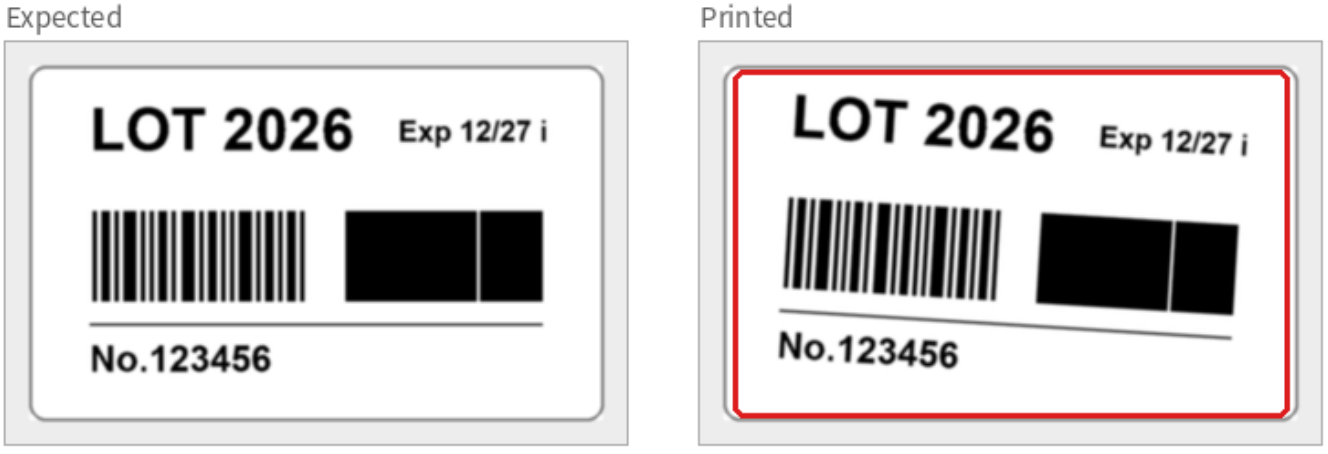
Offset

The printed content as a whole has moved relative to the label edges; left/right and up/down are judged separately.



Skew

The printed content is tilted relative to the label edges: the difference in distance from the two ends of the long side to the label edge exceeds the allowed value.



Content mismatch

The printed label does not match what should have been printed as a whole: the content is wrong, or the label was paired with the wrong standard image. The whole label fails.

Expected



Printed



Missing element

A whole character, bar or graphic is missing; this includes the dot on an i and a completely blank label.

Expected



Printed



Unreadable

A barcode cannot be read, or not a single character can be recognized in a character zone.



5 Threshold selection

The inspection system shall be able to set a threshold for each defect type separately. For defects judged by size, **a measured value ≥ the threshold of the selected level fails the label**. The customer selects the level in the “This label” column of each table; the recommended settings are pre-selected.

5.1 Definition of the levels

The label inspection system supports thresholds set at 3 levels, and also supports custom thresholds, for example:

Level	Threshold	Threshold for lines of missing or extra ink	Use when
Strict	0.2 mm	0.5 mm	No defect visible at close range (about 15 cm) is allowed
Medium	0.3 mm	1 mm	No defect visible at normal reading distance (about 25 cm) is allowed
Loose	0.6 mm	2 mm	No defect visible from a distance (about 50 cm) is allowed
Custom	Any value from 0.04 to 100 mm	Any value from 0.04 to 100 mm	The customer has specific requirements for a defect type

The “Threshold” column applies to spots of missing or extra ink and to broken stroke, bridge and the other defects judged by size. Lines of missing or extra ink are judged by their full length against the “Threshold for lines” column (how spots and lines are told apart: 5.2).

If other values are really needed, write them next to the table.

5.2 Telling spots from lines

The inspection system shall split missing ink and extra ink into spots and lines and judge each against its own threshold. A defect whose length is at least 3 times its width (this multiple is the “aspect ratio” and can be set) and which is longer than the “shortest length” is a line, measured along its full length. Everything else is a spot, such as dots, debris, small rings and very short pieces, measured by its equivalent diameter. When it cannot be told apart, it is judged as a spot.

The rule is set once for the whole label; the barcode zone, the non-barcode zone and custom zones all use it. The shortest length follows the distance at which the eye can just see that a mark has length:

Item	Range	Recommended	This label
Shortest length	Close (about 15 cm) 0.38 mm; normal (about 25 cm) 0.63 mm; far (about 50 cm) 1.25 mm; custom 0.12–1.25 mm	Normal 0.63 mm	Normal 0.63 mm
Aspect ratio	2–20	3	3

5.3 Barcode zone

The inspection system shall be able to set 1D codes and 2D codes in the barcode zone separately. Spots of missing or extra ink, broken stroke and bridge on each code type share one level, and lines of missing or extra ink have a level of their own (see 5.2); the customer may also add further requirements for defects on 1D or 2D codes, written next to the table.

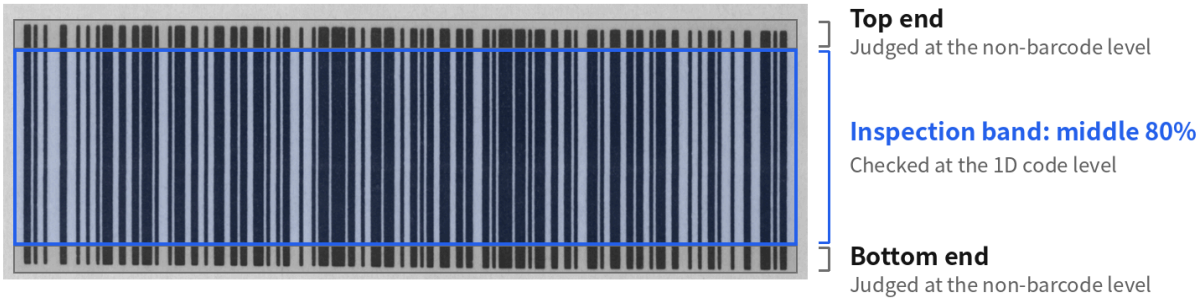
Code	Defects	Recommended	This label
1D code	Spots of missing or extra ink, broken stroke, bridge (shared)	Barcode default 0.1 mm	Barcode default 0.1 mm
1D code	Lines of missing or extra ink	Barcode default 0.1 mm	Barcode default 0.1 mm

Code	Defects	Recommended	This label
2D code (including quiet zone)	Spots of missing or extra ink, broken stroke, bridge (shared)	Same as non-barcode zone	Same as non-barcode zone
2D code (including quiet zone)	Lines of missing or extra ink	Same as non-barcode zone	Same as non-barcode zone
1D and 2D codes	Unreadable	On	On

1D codes can be given a stricter appearance standard of their own, because a defect on a 1D code may not affect reading but is very noticeable.

Uneven bar ends of one or two printer dots at the top and bottom of 1D code bars are inherent to thermal transfer printers and are not defects. The 1D code level applies only to the middle part of the bar height (the inspection band, 80% by default, freely adjustable); the two ends are not checked at the 1D code level but are judged at the non-barcode zone level.

1D code: middle checked at the 1D code level, ends at the non-barcode level



The band can be set from 10% to 100%, or the ends can be set as a few millimetres each (0.5 mm by default). Shown on the camera image of the sample medical device label.

5.4 Non-barcode zone

Defect	What is measured	Recommended	This label
Missing ink (spot)	Equivalent diameter of the missing area	Medium 0.3 mm	Medium 0.3 mm
Missing ink (line)	Full length of the missing line	Medium 1 mm	Medium 1 mm

Defect	What is measured	Recommended	This label
Extra ink (spot)	Equivalent diameter of the extra area	Medium 0.3 mm	Medium 0.3 mm
Extra ink (line)	Full length of the extra line	Medium 1 mm	Medium 1 mm
Broken stroke	Length of the break along the stroke	Medium 0.3 mm	Medium 0.3 mm
Bridge	Length of the bridge along the gap	Medium 0.3 mm	Medium 0.3 mm
Snowflaking	Judged at the missing ink level	On	On
Film glare	Equivalent diameter of the glare spot; turn on only for laminated or glossy labels	Off	Off

“Equivalent diameter” is defined as follows: take the area covered by the defect’s pixels, replace it with a circle of the same area, and measure that circle’s diameter. For custom zones (3.1), select a level for each type according to this table.

“Full length” is measured along a line from one end to the other, faint parts included.

5.5 Whole label

The following defects are judged on the whole label, regardless of zone.

Defect	Setting	Recommended	This label
Offset	Allowed shift left/right and up/down	Left/right 2 mm, up/down 3 mm	Left/right ___ mm, up/down ___ mm
Skew	Allowed difference in edge distance at the two ends of the long side (not less than 1.5 mm)	1.5 mm	___ mm
Printhead white line	Number of adjacent failed printer dots before it is reported (1–8)	1 dot	___ dots
Drag line	Sensitivity: Strict reports most easily, Loose least easily	Medium	Medium

Defect	Setting	Recommended	This label
Content mismatch	On/Off	On	On
Missing element	On/Off	On	On

6 Duplicate code requirements

The inspection system shall be able to detect duplicate codes: within a defined scope and time range, the same code may appear only the specified number of times. Codes whose content is fixed per product model and identical on every label (such as product barcodes) are not checked for duplicates.

Code	Check scope	Time range	Allowed occurrences
Example: serial number 2D code, bottom right	Duplicate check group: all cameras on lines 1 and 2	Permanent	1

- **Code**: state which code, e.g. “serial number 2D code, bottom right”. Codes not listed in the table are not checked for duplicates.
- **Check scope** (choose one): this camera; a duplicate check group, i.e. a set of cameras chosen by the customer, which may span production lines and plants; all inspections using the same label inspection template.
- **Time range**: permanent (default), or the last ___ days.
- **Allowed occurrences**: 1 by default; the second occurrence fails the label. Voided labels are not counted.
- **When checking is temporarily impossible**: if records from other cameras are temporarily unreachable during a cross-camera check, the label fails by default and the site decides whether to continue.

7 Printers, print modes and inspection speed

The inspection system shall work with the customer’s existing printers and computers, and keep up with printer speed.

7.1 Printers

The inspection system shall support the printers listed in the table below. If the printer brand or model is changed later, the inspection system software shall continue to work.

Brand	Model	Quantity
Example: Zebra	ZT610	6

Common printer models for reference: Zebra ZT411, ZT421, ZT510, ZT610, ZT620; SATO CL4NX Plus, CL6NX Plus, CL4-SXR, CL6-SXR; TSC MH and MX series; Honeywell PX940A; Brady i7500; Epson CW-C8030, CW-C6030A/P, CW-C6530A/P.

7.2 Computer

The inspection software shall run normally on a computer with the following configuration, and shall not require a dedicated graphics card (GPU).

Item	Configuration
Processor	Intel Core i5 12th generation or AMD Ryzen 5 5600
Memory	16 GB
Storage	256 GB SSD
Network ports	2 Gigabit Ethernet ports, or 1 Gigabit Ethernet port plus USB 3.0
Display	1920×1080
Operating system	Windows 10/11 64-bit, or Ubuntu 22.04/24.04

7.3 Print modes

The inspection system shall support the following print modes. The customer ticks the ones used on site.

Print mode	Description	Used on site
Tear-off	After printing, the label is torn off the printer by hand	☐

Print mode	Description	Used on site
Peel-off	The printer peels the label off the liner for manual application or an applicator	☐
Cutter	The printer cuts the label off with a cutter	☐
Rewind	Printed labels stay on the liner and are rewound into a roll	☐

7.4 RFID labels

RFID labels printed on site: ☐ Yes ☐ No.

If “Yes”, the inspection system shall be able to read the TID and EPC of every label, and support UHF ISO 18000-6B / 6C labels.

7.5 Inspection speed

The inspection system shall keep up with the printer's maximum print speed; inspection shall not slow the printer down.

Inspection speed not less than _____ labels/minute.

Estimate: labels/minute = print speed (mm/s) × 60 ÷ (label length + label gap, mm). For example, at 3 inches per second (76 mm/s) with a 100 mm label and a 2 mm gap, about 44 labels/minute.

8 Handling of failed labels

When the inspection system detects a failed label, it shall alert the site immediately and make the printer act according to the customer's settings.

- **Alarm**: raise an alarm immediately on a failed label or a camera fault (alarm light, buzzer or flashing screen), and keep it until someone resets it.
- **Pause printing**: pause the printer when a label fails, or when several labels in a row fail at the same position.
- **Reprint**: have the printer reprint the failed label.
- **Void** (optional, depending on the printer): retract the failed label into the printer and print VOID or XXX on it.
- **Combined-condition alarms**: besides single defects, the system shall be able to judge combinations according to the customer's acceptance clauses, e.g. “no more than 4 dot defects in blank areas”, and grade the result as fail, warning or record only.

- **Manual review**: an inspector can zoom into the camera image, compare it with the standard image and record a review conclusion; the conclusion and the reviewer are kept in the inspection record.

Printer action when this label fails: ☐ Alarm only ☐ Pause printing ☐ Reprint ☐ Void

9 Inspection reports

The inspection system shall be able to generate inspection reports by batch, by conditions (time period, camera, printer, verdict, etc.) or from selected inspection records, output as PDF in Chinese or English. A report shall include at least:

Content	Requirement
Inspection performance summary	Labels inspected, inspection coverage, defects detected, smallest defect detected, average inspection time, labels inspected per minute, read rate
Inspection criteria	The inspection settings actually in effect for each record: on/off and thresholds of each defect type (including the spot and line thresholds and the rule that tells spots from lines), barcode requirements, combined-condition alarm rules, and the recipe fingerprint of each set of settings (see Section 12)
Results	Pass rate; statistics by defect type (including smallest and largest size), zone, batch and time; defects recurring at the same position; comparison between cameras, printers or templates; blank labels that fed through without printing listed separately
Failed-label samples	A typical camera image for each defect type, with the defect marked by a red box, side by side with the standard image, stating the type and the number of records of that type
Manual review	How many were reviewed, and which verdicts were changed on review
Conclusion	The author's conclusion; the report shall show separately what is system statistics and what is a human-written conclusion, and state whether the conclusion has been changed

Content	Requirement
Appendix	Details of all inspection records
Tamper protection	The report carries a data fingerprint so its content can be verified as unchanged; the PDF is encrypted, with a separate password for each person who downloads it

The report header shall be able to show the customer's own company name and logo.

10 Data retention and automatic collection

The inspection system shall keep a complete inspection record for every label and store it centrally and automatically, without manual copying.

- **Inspection record**: one per label, including the camera image, standard image, verdict, the type, size and position of each defect, the inspection settings in effect at the time, the print command file sent by the host computer, and the log at the time of inspection.
- **Automatic collection**: inspection records from every production line are collected automatically on the plant server and the enterprise server (or cloud), with a copy kept at each location.
- **Keeps running when offline**: when the network is down, the site keeps inspecting and saves records locally; they are uploaded automatically once the network is back.
- **Retention period**: the customer sets a retention period, and all records within it can be found; original camera images can be kept for different lengths of time for passed and failed labels.
- **Search and traceability**: any label can be found by camera, printer, batch, verdict, time, job number or record number, together with its camera image and standard image from the time.

Item	Plant requirement
Retention period for inspection records	___ years
Original images of failed labels	Keep ___ days
Original images of passed labels	Keep ___ days, or do not keep ☐

11 Central monitoring

Managers shall be able to see inspection status for all production lines in one place, opened in a web browser.

- **Multi-camera live inspection**: one page shows live images, verdicts and counts (total inspected, failed) from several cameras at once, suitable for a large screen on the shop floor.
- **Live view of the site**: the printer exit can be watched remotely in real time.
- **Print content**: the content of every label actually received by each printer can be viewed.
- **Equipment status**: online status and fault alarms of printers, cameras and inspection computers are shown in one place.

12 Other requirements

- **Inspection recipe as an SOP**: the inspection system shall be able to export all inspection settings of a camera as an inspection recipe (PDF): it explains in plain language what raises an alarm and what does not, lists every setting, and carries a recipe fingerprint and a signature field for the approver. The inspection recipe can be issued as an SOP to plants and suppliers so the whole supply chain works to the same standard; every site can use the recipe fingerprint to check that the recipe in use is the approved one.
- **Permissions**: set by role (e.g. inspector, engineer, administrator) what each person can view, change and operate.
- **Operation log**: record who did what and when, and what was changed (including changes to inspection settings, templates and manual verdict changes); the log can be verified against tampering and can be exported.
- **External interface**: inspection results shall be sent automatically to external systems such as MES.
- **Interface languages**: Chinese and English.
- **Remote maintenance**: with the customer's consent, the supplier can diagnose and upgrade remotely.
- **Operating environment**: the operating temperature and humidity range of the inspection equipment shall be no narrower than that of the printers it is used with.