CONBYTH Quality Inspection Procedure for Galvanized Steel

1. Purpose and Scope

This procedure defines the quality inspection and control requirements for continuously hot-dip galvanized steel sheet and strip from incoming raw materials to finished products. It ensures that appearance, dimensional accuracy, mechanical properties and coating performance comply with GB/T 2518 and customer specifications. The procedure applies to continuously hot-dip zinc coated steel sheet and strip in the thickness range 0.20 mm – 6.0 mm, mainly used in automotive, building, household appliance and electrical industries.

2. Applicable Standards

Standard No.	Title	Description
GB/T 2518-2019	Continuously hot-dip zinc and zinc alloy coated steel sheet and strip	Product standard for hot-dip galvanized and zinc alloy coated steel
GB/T 1839-2025	Test method for gravimetric determination of the mass per unit area of galvanized coatings on steel products	Coating weight test method (effective 2026-03-01)
GB/T 228.1-2021	Metallic materials – Tensile testing – Part 1: Method of test at room temperature	Mechanical properties test
GB/T 232-2024	Metallic materials – Bend testing method	Bend test for coating adhesion
GB/T 10125-2021	Corrosion tests in artificial atmospheres – Salt spray tests	Salt spray test method
GB/T 13912-2020	Metallic coatings – Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods	Technical requirements for hot-dip galvanized coatings
GB/T 15675-2020	Continuously electrolytic zinc/zinc‑ nickel alloy coated steel sheet and strip	Standard for electro-galvanized steel (reference)
GB/T 41746-2022	Continuously hot-dip zinc coated twin-roll cast steel sheet and strip for commercial grade	Standard for twin-roll cast products

Special note: GB/T 2518-2019 is currently under revision (plan No. 20260882-T-605, issued

2026-03-02, revision period 16 months). GB/T 1839-2025 will become effective on 2026-03-01, replacing GB/T 1839-2008. Quality inspectors shall monitor the release of new editions and update the inspection basis accordingly.

3. Quality Inspection Procedure (Five-Stage Control)

Stage 1 – Incoming Raw Material Inspection

- **Substrate (hot-rolled / cold-rolled steel coil) inspection**: Check surface quality (no severe rust, scale residue, scratches, oil, inclusions). Measure thickness and width. Re-test mechanical properties per batch (yield strength, tensile strength, elongation).
- **Zinc ingot inspection**: Verify chemical composition (Zn ≥ 99.995% for high-grade products). Appearance clean, free of inclusions, oil and dross. Each batch shall be accompanied by a supplier certificate of analysis.
- **Post-treatment chemicals**: Verify type, batch number, concentration/viscosity of passivation solution (chromate or Cr-free), anti-fingerprint solution and rust preventive oil. Appearance free of sedimentation.
- **Environmental compliance**: Passivation solution shall meet RoHS and REACH requirements for Cr(VI) content.
- **Non-conforming materials:** shall be rejected and a non-conformance notice issued.

Stage 2 – Pre-production Process Check

- **Annealing furnace**: Verify furnace temperature profile, protective atmosphere (H_2 content, dew point, oxygen content), strip centering. Ensure adequate reduction of surface oxides.
- **Zinc pot and coating control**: Check molten zinc bath temperature (typically 450℃–470℃), bath chemistry (Al content control for spangle regulation, Fe content monitoring for dross formation), air knife parameters (pressure, gap, distance from strip).
- **Skin pass and tension leveler**: Confirm skin pass mill elongation, work roll roughness; tension leveler elongation for flatness improvement.
- **Post-treatment line**: Check roll coater parameters for passivation/AFP application, curing oven temperature (for organic coatings), oil application rate and uniformity.

Stage 3 – In-process Inspection (Online)

Inspection Item	Frequency	Method
Coating weight	At least once per shift	XRF or gravimetric method (GB/T 1839)
Coating thickness	3–5 points per coil	Magnetic thickness gauge
Spangle pattern	Continuous visual	Visual + reference spangle panel
Flatness	Head & tail of each coil	Feeler gauge / shape meter
Surface defects	Continuous visual	Visual + auxiliary light
Mechanical properties	At least once per batch	Tensile testing machine GB/T228.1
Surface roughness	Once per shift	Roughness tester
Coating adhesion (bend)	At least once per shift	180° bend test (GB/T 232)

Any non‑conformity found online shall be immediately marked, recorded and fed back; stop production if necessary.

Stage 4 – Finished Product (Off-line) Inspection

- **Appearance**: Uniform spangle (if specified); no skip plating (bare spots), scratches, zinc droplets, black spots, white rust, dross adherence, staining or oil stains.
- **Dimensional accuracy**: Thickness tolerance (point-to-point variation within specified limits), width tolerance (typically 0 to +5 mm), crescent (sickle) shape (≤4 mm/2 m), flatness (≤3 mm/m or as specified).
- **Coating performance**: Coating weight (e.g. Z60, Z100, Z120, Z140, Z180, Z200, Z275 – g/m² both sides), coating thickness, 180° bend adhesion (no flaking, no peeling).
- **Mechanical properties**: Yield strength, tensile strength, elongation (as per grade).
- **Corrosion resistance**: Neutral salt spray test (NSS) according to GB/T 10125 – white rust resistance typically ≥72–96 h for passivated products; red rust resistance as agreed.
- **Post-treatment performance**: Passivation corrosion resistance, anti-fingerprint property (if applicable), oil film weight, chromate film weight for chromate-passivated products.

Stage 5 – Packaging, Marking and Warehouse Inspection

- **Packaging**: Inner moisture-proof paper/plastic film intact; outer steel strapping tight; edge protectors correctly installed; no loosening or damage.
- **Marking verification**: Label information (product name, grade, dimensions, coating weight, surface treatment, batch number, net weight, production date) matches coil and quality certificate.
- **Warehouse re-inspection**: Random re‑inspection per batch; non-conforming product

handled according to non-conformance procedure.

4. Key Inspection Items and Acceptance Criteria

4.1 Appearance

Item	Acceptance Criteria	Method
Spangle (if specified)	Uniform size and distribution; matches reference panel	Visual comparison
Surface defects	No skip plating (bare spots), scratches, zinc droplets, black spots, white rust, dross, staining	Visual + auxiliary light
Passivation film	Uniform, no yellowing or streaks (for chromate-passivated products)	Visual inspection

4.2 Dimensions and Shape

Item	Acceptance Criteria	Method
Thickness	Nominal thickness ± tolerance per GB/T 2518; point-to-point variation ≤ specified limit	Micrometer / thickness gauge
Width	0 to +5 mm (or as per contract)	Steel tape / width gauge
Crescent (sickle)	≤4 mm per 2 m	Straight edge + feeler gauge
Flatness	≤3 mm per metre (or as per agreement)	Feeler gauge

4.3 Coating Performance

Item	Acceptance Criteria	Method	Standard
Coating weight	Meets order requirement (e.g. Z100 → 100 g/m² both sides for double-side coating)	Gravimetric / XRF	GB/T 1839
Coating thickness	Meets order requirement; uniform across strip width	Magnetic thickness gauge	GB/T 2518
Coating adhesion (bend)	180° bend test (or specified bend angle), no flaking, no peeling	Bend test	GB/T 232

4.4 Mechanical Properties (Typical Grades)

Grade	Yield strength ReL (MPa)	Tensile strength Rm (MPa)	Elongation A80mm (%)
DX51D+Z	≤ 360	≤ 440	≥ 20
DX52D+Z	≤ 260	300 – 390	≥ 28
DX53D+Z	≤ 200	270 – 320	≥ 38
DX54D+Z	≤ 180	270 – 310	≥ 40
S250GD+Z	≥ 250	≥ 330	≥ 19
S350GD+Z	≥ 350	≥ 420	≥ 16
S450GD+Z	≥ 450	≥ 510	≥ 14
S550GD+Z	≥ 550	≥ 560	–

Note: Mechanical properties shall be tested in accordance with GB/T 228.1-2021. Values shown are typical; refer to product standard or contract for specific requirements.

4.5 Corrosion Resistance (Neutral Salt Spray Test – NSS)

Product Type	Acceptance Criteria	Method
Chromate-passivated (regular)	≥72–96 h, no white rust	Salt spray chamber, GB/T 10125
Anti-fingerprint (AFP) treated	≥96–120 h, no white rust	Salt spray chamber, GB/T 10125
Oiled only (no passivation)	≥24–48 h, no white rust	Salt spray chamber, GB/T 10125
High corrosion resistance grade	As agreed (e.g. ≥240–500 h, no red rust)	Salt spray chamber, GB/T 10125

Note: NSS test conditions per GB/T 10125-2021: 5% NaCl solution, pH 6.5–7.2, chamber temperature 35°C ± 2°C, continuous spray. White rust is the primary failure mode for galvanized coatings; red rust indicates substrate corrosion.

4.6 Post-treatment Performance

Treatment Type	Inspection Item	Acceptance Criteria
Chromate passivation	Corrosion resistance (NSS)	As per corrosion resistance table above
Cr-free passivation	Corrosion resistance (NSS)	As agreed; may be lower than chromate
Anti-fingerprint (AFP)	Anti-fingerprint property	No permanent mark after sweat/oleic acid wipe
Anti-fingerprint	Anti-blackening	No darkening after humidity test

Treatment Type	Inspection Item	Acceptance Criteria
(AFP)		
Oiling	Oil film weight	Meets process requirement (typically 0.5–2.0 g/m²)
All treatments	Environmental compliance	Cr(VI) content ≤ 0.1% (RoHS); REACH compliance for EU market

5. Common Defects – Identification and Disposition

Defect	Description	Probable Cause	Disposition
Skip plating / bare spot	Local area without zinc coating, exposing base steel	Poor surface pretreatment, residual scale/oil, inadequate pickling, low H_2 content in annealing furnace	Scrap or downgrade; check cleaning and pickling section
Zinc spangle uneven	Non-uniform spangle size and distribution	Bath temperature fluctuation, uneven cooling rate, inconsistent Al content	Adjust process parameters
Zinc droplet / zinc lump	Local protrusion, irregular shape	Zinc dross adhered to strip, air knife not functioning properly, bath temperature too high	Light: remove by grinding; severe: scrap; clean dross, adjust air knife
White rust (wet storage stain)	White powdery corrosion product on surface	Moisture ingress during storage/transportation, inadequate passivation	Downgrade or reject (if severe); improve packaging and storage conditions
Black spot	Dark spot on surface	Impurities in zinc bath (Cu, Fe, As), poor passivation, residual pickling salts	Scrap or downgrade; check bath chemistry and post-treatment
Scratch	Continuous or intermittent line mark	Foreign matter or damage on line roller, misaligned strip	Light: repair; severe: scrap; inspect rolls
Flaking / peeling	Zinc layer separates from substrate during forming	Poor annealing, inadequate surface reduction, excessive bath temperature, high Si content in substrate	Scrap; adjust annealing and bath conditions
Edge overcoating (thick edge)	Edge coating thickness significantly higher than middle	Air knife edge effect, poor strip shape (edge wave), edge rust on substrate	Downgrade or adjust air knife parameters
Passivation stain (yellowing)	Yellowish streaks or patches on surface	Residual chromate solution, uneven drying, poor squeeze roll performance	Re- passivate or downgrade; adjust roll coater
Poor flatness (wavy edge / center buckle)	Wavy edge or center buckle exceeding tolerance	Improper skin pass / leveler parameters, uneven cooling, poor incoming substrate flatness	Downgrade or scrap; adjust process

6. Quality Records and Reports

The quality inspector shall maintain the following records:

1. **Raw material inspection records**: Substrate batch number, thickness, surface quality, mechanical properties certificate; zinc ingot chemical composition and certificate; post‑treatment chemical batch numbers and concentration.
2. **In-process inspection records**: Coating weight, coating thickness, spangle pattern, flatness, surface defects per coil/shift.
3. **Mechanical properties test records**: Yield strength, tensile strength, elongation per batch, including test curves.
4. **Corrosion resistance test records**: Salt spray test results (NSS), white rust/red rust occurrence time, test conditions.
5. **Bend test records**: Bend angle, presence/absence of flaking or peeling.
6. **Finished product test report**: Final inspection data per batch, including quality certificate.
7. **Non-conformance handling records**: Non-conforming item, quantity, disposition, corrective action and verification.
8. **Instrument calibration records**: Regular calibration and maintenance of all testing equipment (magnetic thickness gauge, XRF, tensile tester, salt spray chamber, etc.).

7. Inspection Equipment and Calibration

7.1 Main Inspection Equipment

Equipment	Purpose	Recommended Specification
Magnetic coating thickness gauge	Coating thickness measurement	Measuring range 0–3000 μm, accuracy ±1%
X-ray fluorescence spectrometer (XRF)	Coating weight determination, bath chemistry analysis	Element analysis accuracy ≤0.01%
Universal tensile testing machine	Mechanical properties test (tensile)	Load range 0.5–50 kN, accuracy ±0.5%
Salt spray chamber	Corrosion resistance test (NSS)	Temperature range 15–60°C, meets GB/T 10125
Glossmeter (60°)	Surface gloss measurement	Measuring range 0–2000 GU
Surface roughness tester	Surface roughness measurement	Accuracy ±0.01 μm
Bend tester	Coating adhesion (bend test)	Bend angle 0–180° controllable
Flatness/shape meter	Online flatness detection	Real-time detection

Equipment	Purpose	Recommended Specification
Straight edge + feeler gauge	Crescent shape measurement	Accuracy 0.02 mm
Analytical balance (gravimetric method)	Coating weight determination	Accuracy 0.0001 g

7.2 Calibration Management

Equipment Type	Calibration Frequency	Calibration Method	Record Requirement
Magnetic thickness gauge	Before each shift	Calibration with standard shims	Fill calibration record
XRF spectrometer	Before each batch	Calibration with certified reference material	Fill calibration record
Universal tensile tester	Every 6 months	Third-party calibration	Obtain calibration certificate
Salt spray chamber	Every quarter	Internal comparison + third-party calibration	Fill calibration record
Other measuring instruments	Annually	Third-party calibration	Obtain calibration certificate

Calibration deviation shall be within the specified tolerance. Equipment exceeding tolerance shall be taken out of service for maintenance and recalibrated before re-use. Calibration records shall be retained for at least 3 years.

8. Non-conformance Control

8.1 Identification and Segregation

- **Identification**: Non-conforming product shall be clearly marked with a red label or marking.
- **Segregation**: Non-conforming product shall be stored separately in a designated area to prevent mixing with conforming product.
- **Recording**: Fill out a Non-conformance Handling Record Form with details of the non-conforming product.

8.2 Disposition Methods

Disposition	Applicable Condition	Approval Authority
Rework	Can be brought to specification after rework	Quality Department Head
Downgrade	Does not meet specified grade but meets a lower grade requirement	Quality Department Head
Concession	Minor defect does not affect usability, subject to customer agreement	Sales + Technical + Quality (joint signature)
Scrap	Cannot be repaired or downgraded	Quality Department Head

8.3 Root Cause Analysis and Corrective Action

- **Root cause analysis**: Quality department shall organize technical and production departments to analyse the cause of non-conformance.
- **Corrective action**: Develop corrective and preventive measures, assign responsible person and completion deadline.
- **Effectiveness verification**: Quality department shall verify the effectiveness of corrective actions; non‑conformance shall only be closed after confirmation of effectiveness.

9. Safety and Environmental Requirements

9.1 Testing Operation Safety

- Wear protective gloves and safety goggles when handling chemical reagents (e.g. salt spray test solution, pickling acids).
- Exercise caution when operating high-temperature equipment such as salt spray chambers and ovens to prevent burns.
- Follow mechanical safety procedures when operating tensile testing machines and other mechanical equipment.
- Use appropriate cut‑resistant gloves when handling steel coil edges during on-line sampling.

9.2 Environmental Requirements

- Preference shall be given to Cr-free (chromium-free) passivation solutions that comply with RoHS Directive requirements.
- Waste liquids generated during testing (e.g. salt spray test waste, chemical analysis waste) shall be collected separately as hazardous waste and disposed of by qualified waste treatment facilities.
- Wastewater from passivation and AFP treatment lines shall be treated before discharge.
- Products exported to the EU market shall be accompanied by REACH compliance declarations and test reports.

10. Quality Commitment

- Quality certificate issued per batch
- Non-conforming products never released
- Full traceability records archived
- Continuous update with latest standard revisions
- All inspection personnel shall be trained and qualified before assuming inspection duties

Note: This procedure is based on GB/T 2518-2019, which is currently under revision $planNo.20260882 - T - 605$. Quality inspectors shall monitor the release of the revised standard and update the inspection basis accordingly. GB/T 1839-2025 will become effective on 2026-03-01, replacing GB/T 1839-2008; ensure that the new test method is adopted in a timely manner.