Guideway straightness inspection plan

guideway-straightness

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Application template; not a claim of a completed customer project.

Scope

For guideway assembly, adjustment and verification. Agree on the line, span, datum and evaluation method before reconstructing a profile from angular readings.

Equipment and configuration guidance

• Autocollimator selected for the required range and optical path

• Reflector base with a known support span

• Stable support, station markers and temperature recording

Principle and calculation

If step equals effective base span and each reading represents one interval, $\Delta h = L \tan(\theta)$. Accumulate height and apply the agreed reference. Least-squares residual peak-to-valley is not minimum-zone straightness.

On-site checklist

• Step and base span agree

• Direction information was not lost through re-zeroing

• Reverse-run differences and reference drift are recorded

Suggested records

• Raw angles and environment

• Profile and evaluation method

• Adjustment comparison and verification

Limitations

Geometric checks do not replace thermal, dynamic or machining acceptance. Specify tolerance and uncertainty in the confirmed inspection plan.

Detailed teaching example

Teaching plan: measure, evaluate and verify a 600 mm guideway

Scenario and task

Teaching demonstration, not a real customer project. A 600 mm line and 150 mm reflector-base span define four angular intervals, illustrating the route from agreed requirements to raw records, endpoint-reference evaluation and verification deliverables. All angles are synthetic and no instrument accuracy is specified.

Workflow overview

Agree requirements → Nodes and span → Acquire angles → Reconstruct and evaluate → Reverse verification → Deliver records

Preparation and measurement steps

01. Agree on line direction, the 600 mm useful range, support state and endpoint-line evaluation in the requirements record. Without a specified tolerance, report data without a pass/fail decision.

02. Clean support contacts, verify the effective 150 mm span and mark five nodes at 0, 150, 300, 450 and 600 mm. Each angular reading represents one interval between nodes.

03. Align the autocollimation path and check return-beam range throughout travel. Fix the sign convention, acquire stable interval readings and do not re-zero partway through.

04. Convert angles to radians and calculate four height increments using $\Delta h = L \tan\theta$. Accumulate node heights and subtract the line through the endpoints.

05. Repeat in reverse at the same nodes, retaining a separate data column. Compare return-to-start, station differences and environmental changes instead of keeping only a final peak-to-valley number.

06. Deliver the station diagram, raw angles, endpoint-residual plot, algorithm, environment and uncertainty statement. Following mechanical adjustment, acquire a complete new series and preserve both versions.

Teaching example readings

- Useful line 600 mm; support span=sampling step=150 mm.
- Four synthetic interval angles: +0.50″, −0.50″, −0.50″, +0.50″.
- Initial height is defined as 0 μm; the integrated final height is also zero, so the endpoint reference is zero.

Calculation procedure

Each 0.50″ interval gives $|\Delta h| = 150000 \times \tan(0.5\pi/648000) = 0.363610261$ μm. Cumulative heights are $[0, +0.363610261, 0, -0.363610261, 0]$ μm. Endpoint residual peak-to-valley $= 0.363610261 - (-0.363610261) = 0.727220522$ μm.

Example result and interpretation

The teaching endpoint-residual peak-to-valley is approximately 0.727221 μm. It applies only to this sampling model and endpoint reference. Least-squares or minimum-zone evaluation must be recalculated and named explicitly.

Example verification checklist

- Check the interval/span association; five nodes do not mean five increments.
- No reverse-run data are provided, so reverse agreement must not be invented.
- Formal acceptance needs a tolerance, calibration corrections, complete uncertainty and referenced standard.

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