

Standards and Assessment Guide

Rail Vehicle Technology

Introduction

Welcome to the Standards and Assessment Guide (SAG), a comprehensive resource designed to support excellence in assessment practices for all skills competitions hosted at the WorldSkills Competition. A key component of the SAG is the commitment to continuous improvement through ongoing review, ensuring that these guides consistently reflect the latest industry innovations and high standards of assessment in an open and transparent manner.

Purpose

The primary purpose of this guide is to provide a structured framework for the consistent and fair assessment of each skill competition. It aims to ensure that all assessments are conducted with a high degree of accuracy, reliability, validity, and reflect global industry standards. By adhering to these guidelines, assessors can maintain the integrity of the competition and uphold the high standards associated with WorldSkills.

Note: this guide is not a replacement for the Marking Scheme and should only be used as a reference when required during the assessment process. Competitors are not allowed to have a copy of this SAG in the workshop in either digital or paper form.

Scope

This document covers general assessment practices applicable to a diverse range of industry sectors including:

- Manufacturing and Engineering Technology
- Information and Communication Technology
- Construction and Building Technology
- Transportation and Logistics
- Social and Personal Services
- Creative Arts and Fashion

Each skill competition has its unique requirements and benchmarks, which are detailed within sections of this guide. The consistency of assessment across each skill is the overarching principle, ensuring a unified approach to evaluating Competitor performance to the highest standards.

Key Components

The guide is structured into several key components, each addressing critical aspects of the assessment process:

Assessment Principles and Objectives

- Emphasis on fairness, transparency, and objectivity in assessments.
- Alignment with global industry standards and best practices.

Assessment Methods and Tools

- Description of various assessment methods in Measurement and Judgement.
- Guidance on the application of appropriate assessment tools and equipment (if applicable).

Criteria and Benchmarks

- Examples of assessment criteria and aspects for each skill, outlining the expected competencies and performance standards.
- Benchmarks for different levels of proficiency i.e. Judgement award range 0, 1, 2, 3 or Yes/No criteria alongside clear measurable descriptors.

Expert assessment requirements

- Completion of the Access Programme.
- Approved Curriculum Vitae (CV).
- Reaching 100% Expert preparedness.
- Full participation of online and in-person Mandatory Assessment Training (MAT).
- Completion of practical assessment testing at the Competition.

Quality Assurance and Improvement

- Monitoring and evaluation: Ensuring assessments are carried out correctly and produce reliable results.
- Continuous improvement: Using feedback from Experts and Skill Competition Managers to enhance future assessments.
- Periodic review: Regularly updating processes to reflect current industry and WorldSkills standards.

Implementation

For effective implementation, this guide should be used for guidance purposes only and in parallel with the Technical Description for each skill. Experts are encouraged to familiarize themselves thoroughly with both the general guidelines and the particular requirements of their respective skill areas. Collaborative efforts between the Skill Management Team, Experts, and Competitors are vital for achieving the ultimate goal of global skills development.

Conclusion

The Standards and Assessment Guide embodies the commitment of the WorldSkills movement to nurturing talent and promoting the highest standards of vocational education and training worldwide. By providing clear and comprehensive guidance, we aim to empower Experts to conduct marking and assessment practices that are not only rigorous and equitable but also inspiring and transformative for all participants.

Thank you for your dedication to upholding these standards and contributing to the success of the WorldSkills Competition. Together, we can continue to champion skills excellence and celebrate the achievements of talented individuals from around the globe.

Skill 61 – Rail Vehicle Technology

Measurement

Measurement is used to assess accuracy, precision, and other performance that can be measured objectively. It is used where ambiguity must be avoided.

The total marks allocated to measurement marking may vary from competition to competition depending on the Test Project.

Aspect	Sub Criterion name	Descriptor	Requirement
Preparations	Checking equipment, tools and materials	The Competitor is required to find defective or missing equipment, tools and materials.	(Y/N) Marks are awarded for correctly finding the defective or missing items, and are deducted if otherwise.
Safe operations	Operation safety and conformity	The TP and Work Manual specify the requirements for operation safety, including the wearing of personal protective equipment, the correct use of tools, electrical safety, work reporting and other aspects. The Competitor must comply with these operational requirements during work.	(Y/N) Corresponding marks for failure to comply with operation requirements
Mechanical parts maintenance	Mechanical parts appearance inspection and maintenance	The Competitor is required to find equipment faults such as loose fastener, stain or foreign object, and fix these faults as per the standards set out in the Work Manual.	(Y/N) Marks are awarded if the faults are found and fixed correctly and are deducted otherwise. Notes: 1. After a Competitor has completed a task and submitted the record sheet (if applicable), the verification may be conducted at any time provided that it does not affect the Competitor's current and subsequent operations (it is not necessary to wait until the end of the Competition session).

			2. Missing or loose fasteners: randomly check three (3) fasteners (with defective ones selected first).
	Parameter adjustment and measurement	The Competitor is required to adjust and measure various parameters of the pantograph, passenger compartment door and bogie, such as dimensions, time, tolerance, etc.; examples are carbon contact strip thickness, dimensional parameters of the door, pantograph lifting and lowering durations, door opening and closing durations, bogie wheelset measurements, etc.	(Y/N) Marks are awarded if the measurement values are within the tolerances, and deducted if otherwise.
Pipe Maintenance	Pressure maintaining test	Pressure maintaining test is required for both the pantograph and bogie, where the leaked air within the specified time should be within the specified range.	(Y/N) Marks are awarded if the leak is within the specified value, and deducted if otherwise.
Electrical maintenance	Electrical installation and wiring	The Competitor is required to complete the installation of electrical components and circuit wiring in accordance with the Electrical Circuit Schematic Diagrams and Wiring Tables, ensure the correctness and integrity of the wiring, and conduct step-by-step verification through standardized test procedures.	(Y/N) Marks are awarded if the test results are correct, and deducted if otherwise.
	Fault finding and repair	The Competitor is required to find the specific electrical faults and fix the faults.	(Y/N) Marks are awarded if the faults are found and fixed correctly, and deducted if otherwise.

Judgement

Judgement is used to assess the quality of performance about which there may be small differences of view when applying the external benchmarks.

The Resources column in the table below may include all kinds/formats of resources such as: a link to a YouTube video, a website link, an illustration, a photo, a reference to a book, and so on. It needs to be as detailed as possible to show the differentiation between 0, 1, 2, 3.

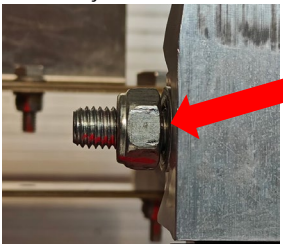
Generic rules:

The assessment group comprises three Experts plus one Expert who acts as the supervisor. The supervising Expert will replace an Expert in the marking group to prevent compatriot marking.

The difference of the three Experts' scores may not exceed 1. If this is the situation the Experts must re-score until there is a maximum difference of 1. As long as the three Experts judge within 1, the result can be entered into the CIS.

The total marks allocated to judgement marking may vary from competition to competition depending on the Test Project.

Aspect – Mechanical Parts Replacement

WSOS section as per TD	Score	Descriptor	Resource
4. Vehicle mechanical part repair, maintenance, and commissioning	0	Fail to replace the part or replace the wrong part, or six (6) or more process defects exist	Process defects description for Module A Pantograph – Carbon contact strip replacement - Fastener defects: randomly check three (3) fasteners (with defective ones selected first) for missing or loose fasteners and missing or non-standard anti-loose marks; randomly check one (1) fastener (tightened, with standard anti-loose mark) for improper torque application. A maximum of three (3) defects can be counted. - Missing or loose fasteners: check by visual and manual inspection. <i>Fault example (loose bolt):</i>  - Missing or non-standard anti-loose marks (refer to the standards defined in the Work Manual): check by visual inspection. <i>Example (misaligned anti-loose mark):</i>  - Improper torque application: check through fastener torque inspection (the standard torque for M8 thread is 16N·m).
	1	Replace the correct part, with three (3) to five (5) process defects	
	2	Replace the correct part, with one (1) to two (2) process defects	
	3	Replace the correct part, without process defects	

2. Conducting wire defects: only one (1) defect can be counted for one (1) conducting wire and a maximum of two (2) defects can be counted.

- Unconnected conducting wire: check by visual inspection.
- Defects such as loose strands, interfere with other parts, crossing, stretching or bending caused by conducting wire connection: check by visual inspection.

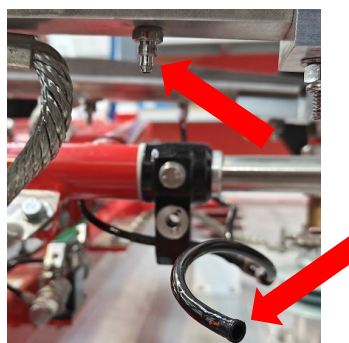
Example (loose strands caused by conducting wire connection):



3. Pneumatic hose defect: only one (1) defect can be counted for one (1) hose, and a maximum of one (1) defect can be counted.

- Unconnected pneumatic hose: check by visual inspection.

Example (unconnected pneumatic hose):



- Missing or loose fastener of a pneumatic hose fitting: check by visual and manual inspection.
- Missing or non-standard anti-loose mark (refer to the standards defined in the Work Manual) of a pneumatic hose fitting fastener: check by visual inspection.

Example (missing pneumatic hose fitting fastener):



4. Non-standard gaps between pantograph horns and carbon contact strips; use a feeler gauge to check whether the gaps are within the standard range of 0.5mm-2.5mm; only one (1) defect can be counted for one (1) gap, and a maximum of two (2) defects can be counted.

Example (gap not within the standard range: the feeler gauge of the correct dimension can't fit in the gap):



5. Other defects agreed by majority of marking Experts (over half of Experts in the marking team): check by visual and manual inspection. A maximum of two (2) defects can be counted.

Process defects description for Module B Passenger compartment door – Installation and adjustment of the isolating lock mechanism

1. Fastener defects: randomly check two (2) fasteners (with defective ones selected first) for missing or loose fasteners and missing or non-standard anti-loose marks; randomly check one (1) fastener (tightened, with standard anti-loose mark) for improper torque application. A maximum of two (2) defects can be counted.
- Missing or loose fasteners: check by visual and manual inspection.
- Missing or non-standard anti-loose marks (refer to the standards defined in the Work Manual): check by visual inspection.

Example (non-standard anti-loose marks):

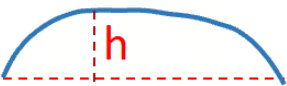


- Improper torque application: check through fastener torque inspection (the standard torque for hexagon nut is 16N-m).
2. Washers improperly installed: check by visual inspection for washer protrusion, which causes interference with other parts or serious deformation. A maximum of one (1) defect can be counted.
 3. Cable ties bonded improperly (direction, cut end, spacing, etc.): check by visual inspection; only one (1) defect can be counted for one (1) wire harness, and a maximum of one (1) defect can be counted.
 4. Other defects agreed by majority of marking Experts (over half of Experts in the marking team): check by visual and manual inspection. A maximum of two (2) defects can be counted.

		Process defects description for Module B Passenger compartment door – Installation and adjustment of catch hook 1. Fastener defects: randomly check two (2) fasteners (with defective ones selected first) for missing or loose fasteners and missing or non-standard anti-loose marks; randomly check one (1) fastener (tightened, with standard anti-loose mark) for improper torque application. A maximum of two (2) defects can be counted. • Missing or loose fasteners: check by visual and manual inspection. • Missing or non-standard anti-loose marks (refer to the standards defined in the Work Manual): check by visual inspection. • Improper torque application: check through fastener torque inspection (the standard torque for the hexagon nut is 42N·m). 2. Washers improperly installed: check by visual inspection for washer protrusion, which causes interference with other parts or serious deformation. A maximum of one (1) defect can be counted. 3. Non-standard dimensions of e and f after installation: check by measurement; reference values: $e=13.5\pm 1\text{mm}$; $f=0\sim 1\text{mm}$. Only one (1) defect can be counted for the same catch hook, and a maximum of two (2) defects can be counted. 4. Other process defects agreed by majority of marking Experts (over half of Experts in the marking team): check by visual and manual inspection. A maximum of two (2) defects can be counted. Process defects description for Module C Bogie – Motor wires replacement 1. Fastener defects: randomly check three (3) fasteners (with defective ones selected first) for missing or loose fasteners and missing or non-standard anti-loose marks; randomly check one (1) fastener (tightened, with standard anti-loose mark) for improper torque application. A maximum of three (3) defects can be counted. • Missing or loose fasteners: check by visual and manual inspection. • Missing or non-standard anti-loose marks (refer to the standards defined in the Work Manual): check by visual inspection. • Improper torque application: check through fastener torque inspection (the standard torque for M10 thread is 18N·m). 2. Terminals that are not properly crimped or loose: check by visual and manual inspection, and a maximum of three (3) defects can be counted.
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			3. Insulated heat-shrinkable tubes not fully heated or at the wrong position: check by visual inspection; reference value for the distance between the tube and the terminal top is $35\pm 3\text{mm}$. A maximum of three (3) defects can be counted. 4. Heat shrinkable tubes with a three-phase mark not fully heated or at the wrong position: check by visual inspection; reference value for the distance between the tube and the terminal top is $150\pm 5\text{mm}$. A maximum of three (3) defects can be counted. 5. Wire sealing joints not installed, loose or with non-standard anti-loose marks: check by visual and manual inspection; a maximum of three (3) defects can be counted. 6. Other defects agreed by majority of marking Experts (over half of Experts in the marking team): check by visual and manual inspection. A maximum of two (2) defects can be counted.
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Aspect – Pipe Installation or Replacement

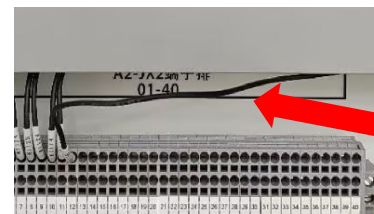
WSOS section as per TD	Score	Descriptor	Resource
4. Vehicle mechanical part repair, maintenance, and commissioning	0	Completion rate is below 50%, with seven (7) or more process defects	Process defects description for Module A Pantograph – Pneumatic circuit installation *The completion rate is evaluated by comparing the number of installed components and pipes with the required quantity. 1. Disordered layout, components interfering with operation, or horizontal and vertical alignment (using joints as reference points) not followed: randomly check two (2) locations (with defective ones selected first) by visual and manual inspection. A maximum of two (2) defects can be counted. 2. Pipe crossing or significant bending of a straight pipe (maximum bending height $h > 15$ mm): randomly check two (2) locations (with defective ones selected first) by visual and manual inspection. A maximum of two (2) defects can be counted. <i>Example (maximum bending height $h > 15$ mm):</i>  3. Air leakage at pipe joints detected during air tightness test (checked by hand touch): randomly check two (2) locations (with defective ones selected first) by visual inspection. A maximum of two (2) defects can be counted. 4. Uneven pipe end or the cutting angle clearly greater than 30°: randomly inspect two (2) locations (with defective ones selected first) by visual inspection. A maximum of two (2) defects can be counted. 5. More than two abandoned pipes, each longer than 30 mm: check by visual inspection. A maximum of one (1) defect can be counted. 6. Other process defects agreed by majority of marking Experts (over half of Experts in the marking team): check by visual and manual inspection. A maximum of two (2) defects can be counted.
	1	Completion rate is above 50%, with three (3) to six (6) process defects	
	2	Completion rate is above 80%, with one (1) to two (2) process defects	
	3	Completion rate is below 50%, with seven (7) or more process defects	

Aspect – Pipe Installation or Replacement

WSOS section as per TD	Sector	Descriptor	Resource
5. Vehicle electrical systems care, maintenance, and testing	0	Completion rate is below 50%, with seven (7) or more process defects	Process Defects Description for Module A Pantograph – Electrical Installation, Layout and Appearance Process *The completion rate is evaluated by comparing the number of completed wire terminations with the total required number. 1. Cabinet doors or panel doors not properly closed or not locked: check by visual and manual inspection. A maximum of two (2) defects can be counted. <i>Example (cabinet doors and panel doors not properly closed):</i>  2. Wire duct covers not installed or not properly installed (not fully fastened, clips exposed, wires exposed, etc.): check by visual and manual inspection. A maximum of two (2) defects can be counted. <i>Example (wire duct cover not installed):</i> 
	1	Completion rate is above 50%, with three (3) to six (6) process defects	
	2	Completion rate is above 80%, with one (1) to two (2) process defects	
	3	Completion rate is 100%, without process defects	

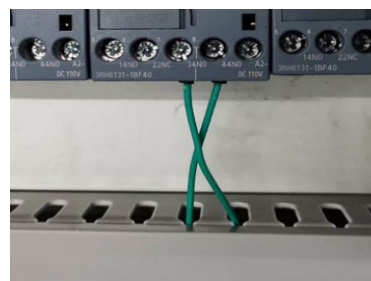
3. Non-standard wire routing (refer to the standards defined in the Work Manual): check by visual inspection. A maximum of two (2) defects can be counted.

Example (non-standard wire routing):



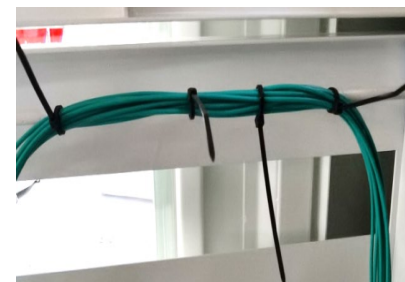
4. Dangling wires: check by visual inspection. A maximum of two (2) defects can be counted.
5. Crossed wires or wiring spanning components: check by visual inspection. A maximum of two (2) defects can be counted.

Example (wires cross over):



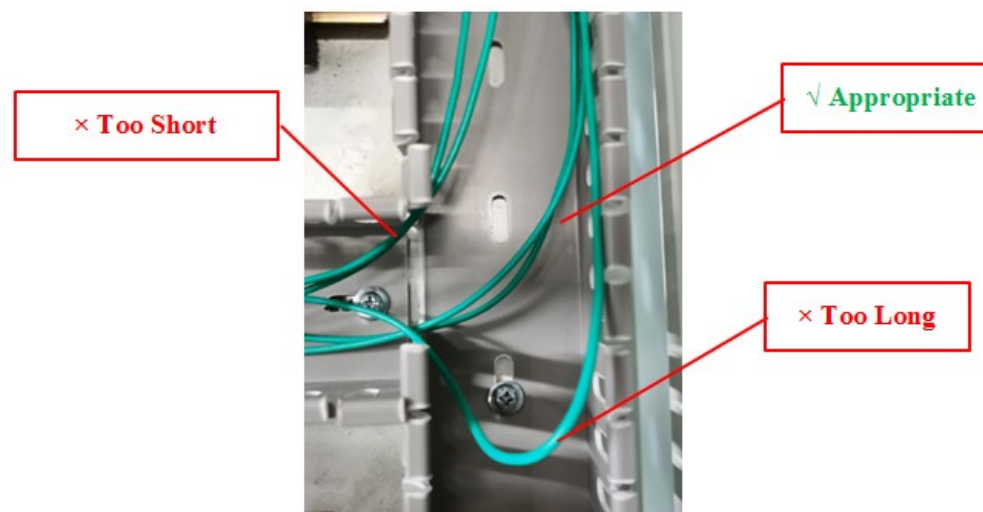
6. Improper cable tie bundling (orientation, cutting, spacing, etc.): check by visual inspection. Only one (1) defect can be counted for each wire harness. A maximum of two (2) defects can be counted.

Example (improper cable tie bundling):



7. Improper wire length allowance at corners: check by visual inspection. Only one (1) defect can be counted for each wire harness. A maximum of two (2) defects can be counted.

Example (improper wire length allowance at corners):



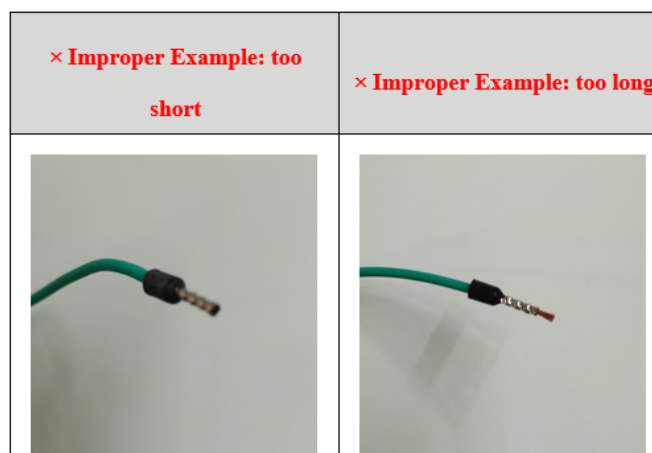
8. Other appearance defects agreed by majority of marking Experts (over half of Experts in the marking team): check by visual inspection. A maximum of two (2) defects can be counted.

Process defects description for Module A Pantograph – Wire processing and wiring process

*The completion rate is evaluated by comparing the number of completed wire terminations with the total required number.

1. Improper crimping or incorrect terminal type (refer to the standards defined in the Work Manual): randomly check one (1) terminal for each type of component (with defective ones selected first) by visual and manual inspection. A maximum of four (4) defects can be counted.

Example (improper crimping):



2. Wire length allowance too long (over 200 mm) or too short (less than 20 mm): randomly check four (4) wires (with defective ones selected first) by measurement. A maximum of four (4) defects can be counted.

Example (wire length allowance too short):



3. Missing wire marking tube or incorrect tube orientation (refer to the standards defined in the Work Manual): randomly check four (4) wires (with defective ones selected first) by visual inspection. A maximum of 4 defects can be counted.

Example (incorrect tube orientation):



1. Loose connections, or the number of wires at a connection point exceeds the specification (refer to the standards defined in the Work Manual): randomly check four (4) connection points (with defective ones selected first) by visual inspection. A maximum of four (4) defects can be counted.
2. More than three abandoned wires, each longer than 200 mm: check by visual inspection. A maximum of one (1) defect can be counted.
3. More than three abandoned terminals: check by visual inspection. A maximum of one (1) defect can be counted.

		4. Other defects agreed by majority of marking Experts (over half of Experts in the marking team): check by visual inspection. A maximum of two (2) defects can be counted. Process defects description for Module B Passenger compartment door – Connector assembly *The completion rate is evaluated by comparing the number of completed wires with the total required number. 1. Connector housing/hood not installed or not securely installed: check by visual and manual inspection. A maximum of two (2) defects can be counted. 2. Insufficient wire harness protection (no braided sleeve installed, or more than 20 mm of wire harness exposed): check by visual inspection and measurement. A maximum of one (1) defect can be counted. 3. Incorrect module combination or incorrect installation position: check by visual inspection. A maximum of two (2) defects can be counted. 4. Missing wire marking tube or inconsistent tube orientation: randomly check two (2) wires (with defective ones selected first) by visual inspection. A maximum of two (2) defects can be counted. 5. Improper terminal crimping (e.g. exposed wire core) or improper terminal installation: randomly check two (2) connection points (with defective ones selected first) by visual inspection. A maximum of two (2) defects can be counted. 6. More than two abandoned crimp terminals: check by visual inspection. A maximum of one (1) defect can be counted. 7. Other defects agreed by majority of marking Experts (over half of Experts in the marking team): check by visual inspection. A maximum of two (2) defects can be counted. Process defects description for Module B Passenger compartment door – Local control box assembly *The completion rate is evaluated by comparing the number of completed wire terminations with the total required number. 1. Improper crimping or incorrect terminal type (refer to the standards defined in the Work Manual): randomly inspect one (1) terminal for each type of component (with defective ones selected first). A maximum of four (4) defects can be counted. 2. Excessive wire length allowance (over 60 mm): randomly check two (2) wires (with defective ones selected first) by measurement. A maximum of two (2) defects can be counted.
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		3. Loose electrical connections: randomly check two (2) connection points (with defective ones selected first) by visual inspection. A maximum of two (2) defects can be counted. 4. Loose button installation: check by manual inspection. A maximum of two (2) defects can be counted. 5. Missing or loose cover plate fasteners: check by visual and manual inspection. A maximum of two (2) defects can be counted. 6. Other defects agreed by majority of marking Experts (over half of Experts in the marking team): check by visual inspection. A maximum of two (2) defects can be counted. Process defects description for Module D vehicle – Connector assembly *The completion rate is evaluated by comparing the number of completed wires with the total required number. 1. Connector housing/hood not installed or not securely installed: check by visual and manual inspection. A maximum of two (2) defects can be counted. 2. Insufficient wire harness protection (no braided sleeve installed, or more than 20 mm of wire harness exposed): check by visual inspection and measurement. A maximum of one (1) defect can be counted. 3. Incorrect wire cross-section selection: randomly check two (2) wires (with defective ones selected first) by visual inspection. A maximum of two (2) defects can be counted. 4. Missing wire marking tubes or inconsistent tube orientation: randomly check two (2) wires (with defective ones selected first) by visual inspection. A maximum of two (2) defects can be counted. 5. Improper terminal crimping (e.g. exposed wire core) or improper terminal installation: randomly check two (2) connection points (with defective ones selected first) by visual inspection. A maximum of two (2) defects can be counted. 6. More than two abandoned crimp terminals: check by visual inspection. A maximum of one (1) defect can be counted. 7. Protective earthing wire not using yellow and green wire: check by visual inspection. A maximum of one (1) defect can be counted. 8. Other defects agreed by majority of marking Experts (over half of Experts in the marking team): check by visual inspection. A maximum of two (2) defects can be counted.
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