

*Standards and
Assessment Guide*

Renewable Energy

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 62 – Renewable Energy

World Skills Occupational Standards

Section	WSOS section	Relative importance (%)
1	Work organization and management	5
2	Communication and interpersonal skills	5
3	Problem solving, innovation, and creativity	10
4	Planning and design	15
5	Installation	20
6	Operation, testing, commissioning, and reporting	25
7	Maintenance, fault-finding, and repair	20
	Total	100

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.

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 and formats of resources, such as a link to a video, a website link, an illustration, a photo, or a reference to a book. It needs to be as detailed as possible to show the differentiation between 0, 1, 2, and 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.

Score	Descriptor
0	Not acceptable
1	Optimisation / rework
2	Professional
3	Excellent

Assessment Aspects

The following aspects illustrate the range of Measurement (M) and Judgement (J) criteria applied across the Test Project. Each aspect is assessed against the WSOS section indicated, using the benchmarks and resources agreed by the marking team.

WSOS section

Sub-criteria

Resource

5

Installation of Equipment

0 - Poor Distribution

- Boxes too close to each other (< 0.5 m)
- Lack of organization and alignment
- Irregular heights
- Difficult access and ventilation
- Does not meet minimum clearances

Height Guidelines (recommendation)

- Top row: 1.6 – 1.8 m
- Bottom row: 0.8 – 1.0 m
- Vertical spacing between rows: ≥ 0.5 m



✗ Does not meet recommended height distribution.

1 - Fair Distribution

- Some distances meet the minimum, others do not
- Visual misalignment
- Heights not consistent
- Restricted access and ventilation
- Improvements needed

Height Guidelines (recommendation)

- Top row: 1.6 – 1.8 m
- Bottom row: 0.8 – 1.0 m
- Vertical spacing between rows: ≥ 0.5 m



⚠ Partially meets the recommendations. Adjust spacing and heights.

2 - Good Distribution

- All minimum distances met (≥ 0.5 m)
- Good alignment and organization
- Heights close to recommended
- Good access and ventilation
- Minor improvements possible

Height Guidelines (recommendation)

- Top row: 1.6 – 1.8 m
- Bottom row: 0.8 – 1.0 m
- Vertical spacing between rows: ≥ 0.5 m



✓ Meets the minimum requirements with good overall distribution.

3 - Excellent Distribution

- All distances well above the minimum (≥ 0.5 m)
- Perfect alignment and organization
- Heights within recommended range
- Excellent access and ventilation
- Standardized and professional installation

Height Guidelines (recommendation)

- Top row: 1.6 – 1.8 m
- Bottom row: 0.8 – 1.0 m
- Vertical spacing between rows: ≥ 0.5 m



✓ Excellent distribution. Fully compliant and ready for operation.

WSOS section	Sub-criteria	Resource
5	PV Module Installation	0 0 – All modules misaligned, unlevel and missing fixing components  1 1 – Modules slightly misaligned, level and missing two or more fixing components  2 2 – All modules aligned, level and fixing components unaligned, no standard  3 3 – All modules aligned, level and fixing components aligned with standard 

WSOS section

Sub-criteria

Resource

5

Installation Equipment

HOW TO MANUALLY CHECK IF PV PANELS ARE WELL SECURED

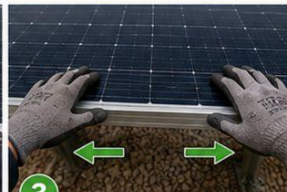
 **OK – CORRECT METHOD**



1 VISUAL CHECK FIRST
Check that all clamps, bolts and supports are in place and properly tightened.



2 GENTLY PUSH DOWN
Place both hands on the panel and apply gentle downward pressure.



3 PUSH SIDE TO SIDE
Apply gentle horizontal pressure left and right. The panel should not move.



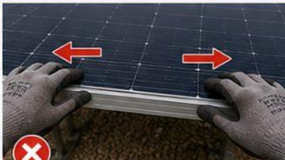
4 PULL UP GENTLY
Try to lift the panel slightly upwards. It should not lift or loosen.

 If the panel does not move, make noises or show any signs of looseness, it is well secured.

 **NOT OK – SIGNS OF LOOSE OR POORLY FIXED PANELS**



MOVES DOWNWARD
If the panel moves or shifts when pushed down, the fixation is not secure.



MOVES SIDE TO SIDE
If the panel moves when pushed horizontally, clamps may be loose or mispositioned.



LIFTS UP
If the panel lifts or separates from the structure, the fixation is insufficient.



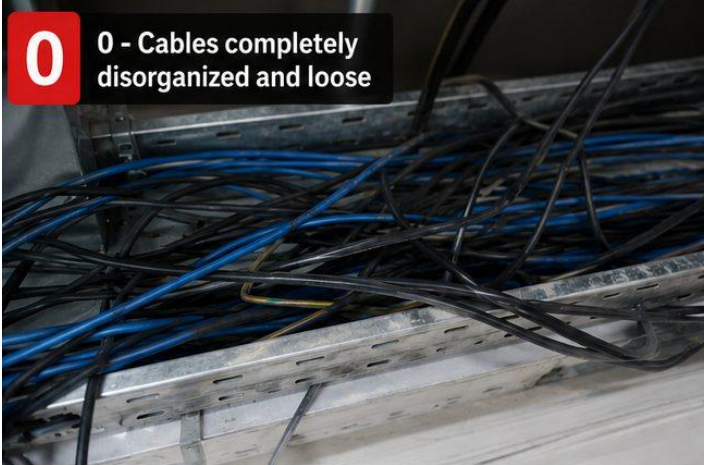
NOISES OR RATTLES
Any noise, rattling or vibration indicates loose components or improper installation.

 **BEST PRACTICES**

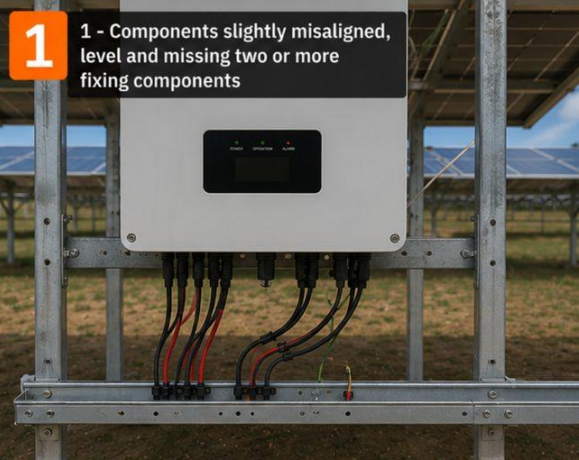
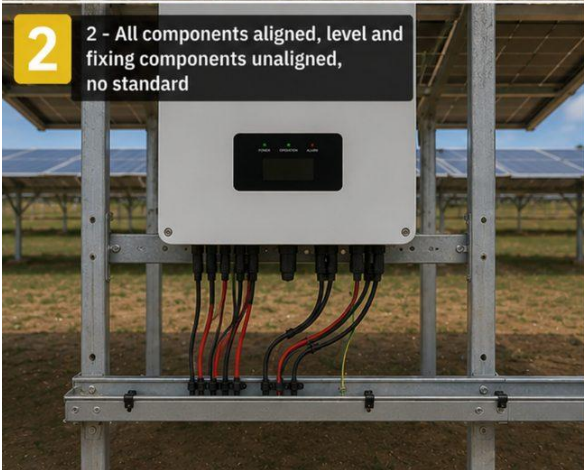
- ✓ Use clean gloves to avoid damaging the panels.
- ✓ Apply gentle pressure – do not use excessive force.
- ✓ Test all panels in different directions.
- ✓ If movement or noise is detected, tighten and recheck.

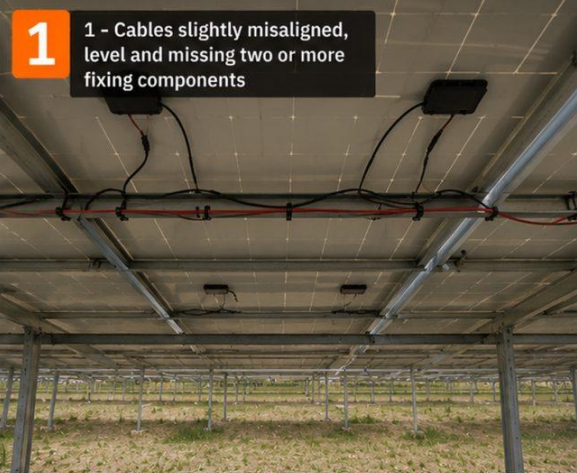
 **WHY IT MATTERS**

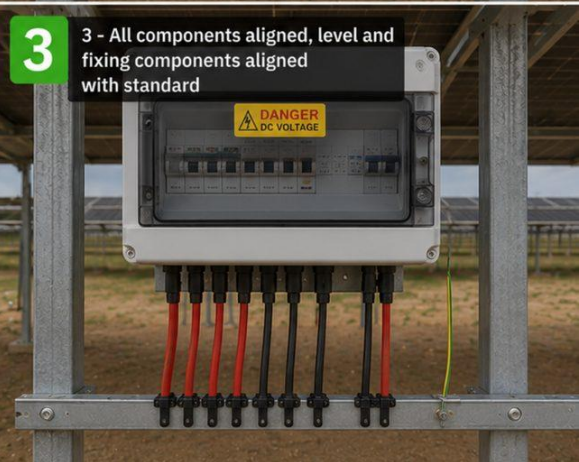
- ✓ Ensures structural safety and system reliability.
- ✓ Prevents damage from wind, vibration and environmental loads.
- ✓ Guarantees long-term performance and warranty compliance.
- ✓ Protects people, assets and the investment.

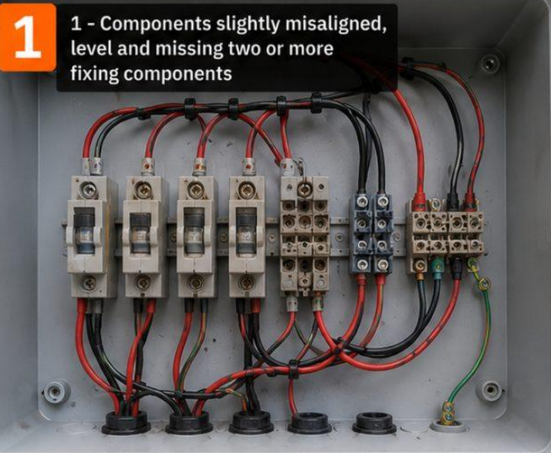
WSOS section	Sub-criteria	Resource
5	Wire Installation	0 0 - Cables completely disorganized and loose  1 1 - Cables partially fixed but still disorganized  2 2 - All cables fixed and aligned  3 3 - All cables fixed, aligned and organized by standard 

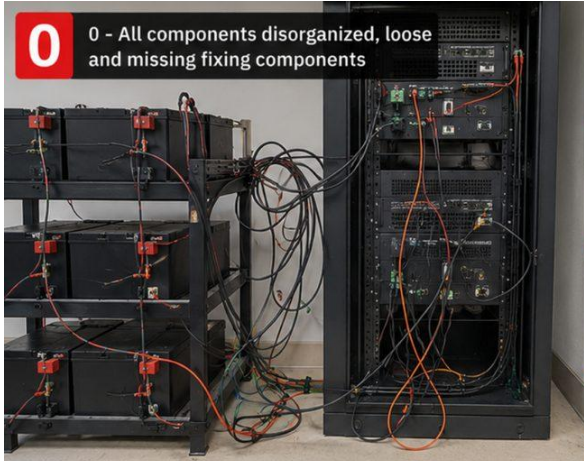
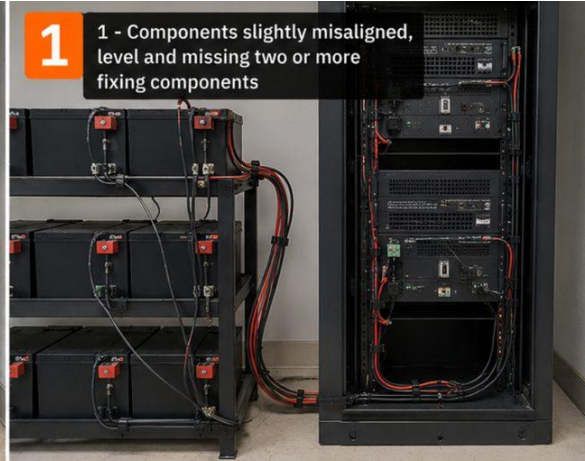
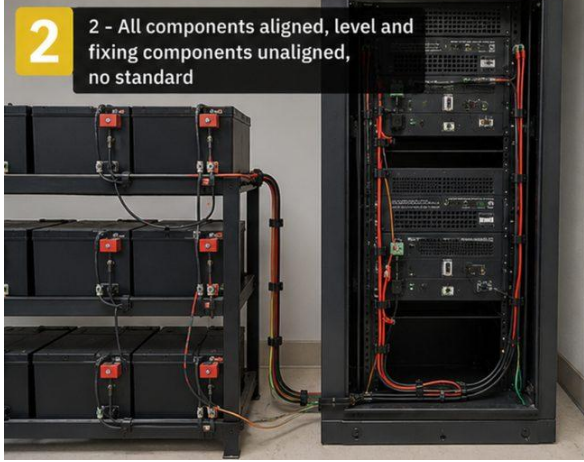
WSOS section	Sub-criteria	Resource
5	Wire Installation	0 0 - All cables disorganized, loose and missing fixing components  1 1 - Cables slightly misaligned, level and missing two or more fixing components  2 2 - All cables aligned, level and fixing components unaligned, no standard  3 3 - All cables aligned, level and fixing components aligned with standard 

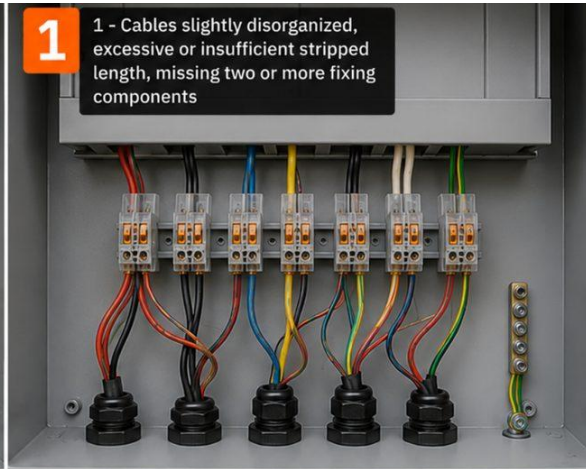
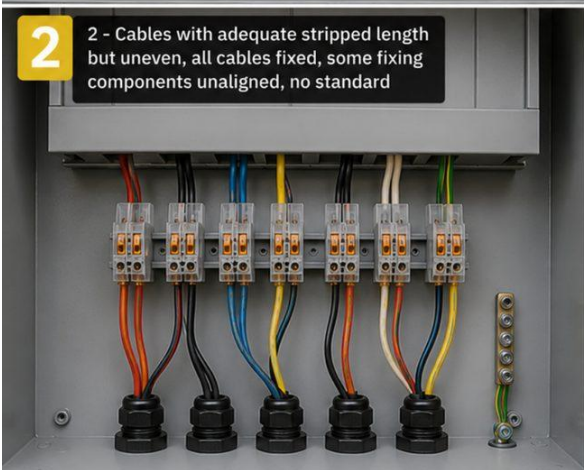
WSOS section	Sub-criteria	Resource
5	Wire Installation	0 0 - All components disorganized, loose and missing fixing components  1 1 - Components slightly misaligned, level and missing two or more fixing components  2 2 - All components aligned, level and fixing components unaligned, no standard  3 3 - All components aligned, level and fixing components aligned with standard 

WSOS section	Sub-criteria	Resource
5	Wire Installation	0 0 - All cables disorganized, loose and missing fixing components  1 1 - Cables slightly misaligned, level and missing two or more fixing components  2 2 - All cables aligned, level and fixing components unaligned, no standard  3 3 - All cables aligned, level and fixing components aligned with standard 

WSOS section	Sub-criteria	Resource
5	Wire Installation	0 0 - All components disorganized, loose and missing fixing components  1 1 - Components slightly misaligned, level and missing two or more fixing components  2 2 - All components aligned, level and fixing components unaligned, no standard  3 3 - All components aligned, level and fixing components aligned with standard 

WSOS section	Sub-criteria	Resource
5	Wire Installation	0 0 - All components disorganized, loose and missing fixing components  1 1 - Components slightly misaligned, level and missing two or more fixing components  2 2 - All components aligned, level and fixing components unaligned, no standard  3 3 - All components aligned, level and fixing components aligned with standard 

WSOS section	Sub-criteria	Resource
5	Wire Installation	0 0 - All components disorganized, loose and missing fixing components  1 1 - Components slightly misaligned, level and missing two or more fixing components  2 2 - All components aligned, level and fixing components unaligned, no standard  3 3 - All components aligned, level and fixing components aligned with standard 

WSOS section	Sub-criteria	Resource
5	Wire Installation	0 0 - All cables disorganized, excessive stripped length, loose and missing fixing components  1 1 - Cables slightly disorganized, excessive or insufficient stripped length, missing two or more fixing components  2 2 - Cables with adequate stripped length but uneven, all cables fixed, some fixing components unaligned, no standard  3 3 - Cables with adequate and uniform stripped length, all components aligned and fixed, with standard 

WSOS section

Sub-criteria

Resource

5

Wire Installation

HOW TO CHECK BY PULLING THE CABLES TO VERIFY IF THE ELECTRICAL CONNECTIONS ARE WELL SECURED IN PANELS, JUNCTION BOXES AND INVERTERS

✓ OK – CORRECT METHOD



1 VISUAL CHECK FIRST
Check that the cable is fully inserted in the terminal and that the connection is tightened.



2 GENTLY PULL STRAIGHT
Grip the cable close to the terminal and pull gently in a straight line. Do not use tools.



3 CHECK FOR MOVEMENT
The cable should not move or come out. The connection must be firm and stable.



4 CHECK SIDE TO SIDE
Move the cable slightly to the left and right. It should not loosen or feel loose.



5 CHECK DOWNWARD
Pull the cable gently downward. It should not move or slip.



6 RECHECK ALL CONNECTIONS
Repeat the process for all cables. All connections must be secure and stable.

✓ If the cable does not move, come out or loosen in any direction, the connection is secure.

✗ NOT OK – CONNECTIONS NOT SECURE



✗ CABLE COMES OUT
The cable comes out when pulled. The connection is not tight or properly made.



✗ MOVES EASILY
The cable moves or shifts easily. Screws or clamps are not tightened enough.



✗ EXPOSED COPPER
Copper is exposed outside the terminal. Risk of short circuit and overheating.



✗ SIGNS OF OVERHEATING
Discoloration, melting or burnt marks. Indicates high resistance or poor contact.



✗ POOR ORGANIZATION
Cables not secured or organized. Risk of damage and loose connections.



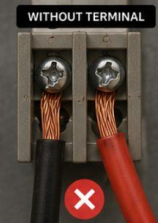
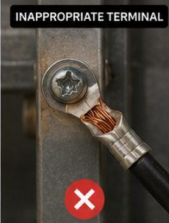
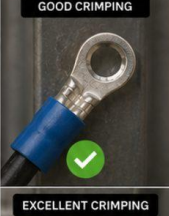
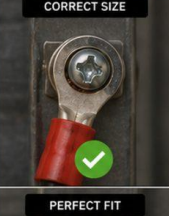
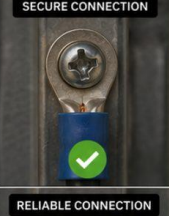
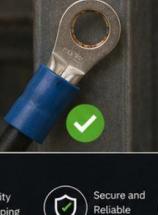
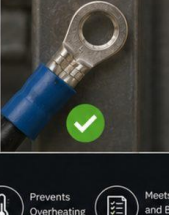
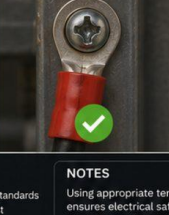
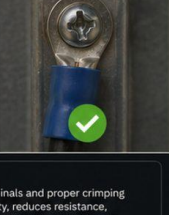
✗ NOT FULLY INSERTED
The cable is not fully inserted in the terminal. Risk of poor contact and overheating.

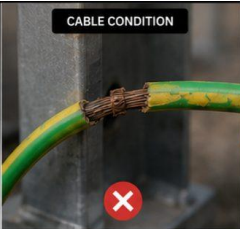
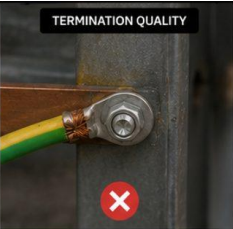
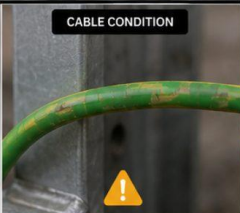
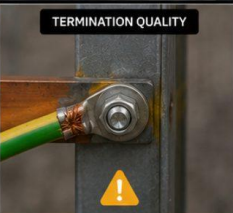
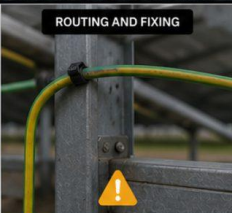
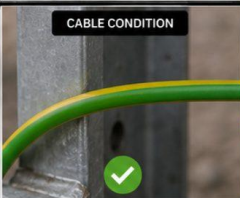
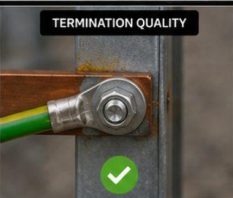
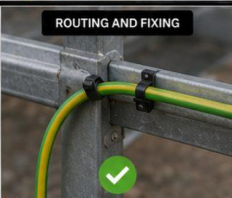
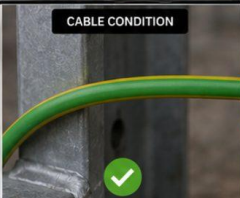
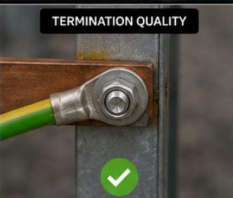
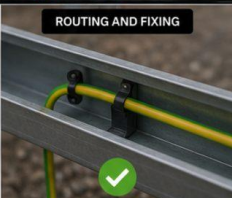
BEST PRACTICES

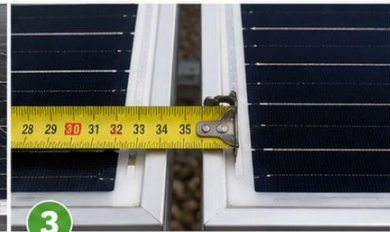
- ✓ Always tighten connections to the manufacturer's recommended torque.
- ✓ Use appropriate terminals and tools.
- ✓ Inspect and test connections periodically.
- ✓ Keep cables organized, identified and secured.

WHY IT MATTERS

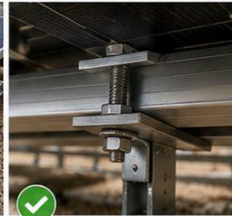
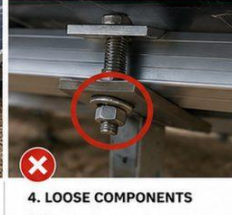
- ✓ Ensures electrical safety and system reliability.
- ✓ Prevents overheating, outages and equipment damage.
- ✓ Extends the lifespan of the system.
- ✓ Protects people, assets and the investment.

WSOS section	Sub-criteria	Resource
5	Wire Installation	0 0 - Poor - Terminals not used where required - Stranded wires inserted directly under screws - Risk of loose connection, overheating and failure - Does not meet standard requirements 1 1 - Fair - Terminals used but with some issues - Inconsistent crimping quality - Incorrect terminal type or size in some points - Connection may work but not ideal - Improvement needed 2 2 - Good - Proper terminals used - Correct terminal type and size - Good crimping quality - Secure connection - Meets standard requirements - Minor improvements possible 3 3 - Excellent - Proper terminals used in all connections - Correct type and size - Excellent crimping quality - Fully secure and reliable - Professional installation - Best practice WITHOUT TERMINAL  INAPPROPRIATE TERMINAL  POOR CRIMPING  WRONG SIZE  PARTIALLY STRANDED WIRES  MINOR CRIMPING ISSUES  INCORRECT TERMINAL TYPE  SUBOPTIMAL FIT  CORRECT TERMINAL  GOOD CRIMPING  CORRECT SIZE  SECURE CONNECTION  HIGH-QUALITY TERMINAL  EXCELLENT CRIMPING  PERFECT FIT  RELIABLE CONNECTION  KEY QUALITY ASPECTS  Correct Terminal Type and Size  Quality Crimping  Secure and Reliable Connection  Prevents Overheating  Meets Standards and Best Practices NOTES Using appropriate terminals and proper crimping ensures electrical safety, reduces resistance, prevents overheating and increases the reliability and lifetime of the PV system.

WSOS section	Sub-criteria	Resource
5	Wire Installation	0 - Poor - Incorrect cable size - Damaged or deteriorated insulation - Poor or incomplete termination - Loose connection - No protection against mechanical damage - Does not meet standard requirements CABLE CONDITION  TERMINATION QUALITY  ROUTING AND FIXING  1 - Fair - Correct cable size but with minor issues - Minor insulation damage - Acceptable termination but not optimal - Connection slightly loose or not fully tightened - Routing could be improved - Partially meets standard CABLE CONDITION  TERMINATION QUALITY  ROUTING AND FIXING  2 - Good - Correct cable size - Insulation in good condition - Proper termination - Connection properly tightened - Well routed and secured - Good mechanical protection - Meets standard requirements CABLE CONDITION  TERMINATION QUALITY  ROUTING AND FIXING  3 - Excellent - Correct cable size with high-quality insulation - Professional termination with suitable lug - Connection fully tightened and secure - Optimized routing with proper fixing - Excellent mechanical protection - Exceeds standard requirements CABLE CONDITION  TERMINATION QUALITY  ROUTING AND FIXING  BEST PRACTICES FOR GROUNDING CABLES  Use correct cable size according to the project  Ensure firm and secure connections  Protect cables against mechanical damage and corrosion  Keep routing organized and properly fixed  Follow standards (IEC 60364-5-54, NBR 5410, ABNT NBR 16690, among others) NOTES Good grounding ensures the safety of people and equipment, protects against overvoltages and guarantees the proper operation of the PV plant.

WSOS section	Sub-criteria	Resource
5	PV Panel Measurements	CORRECT USE OF TAPE MEASURE – PV MODULE DISTANCE  1 Hook positioned at the module edge Place the tape hook at the outer edge of the module frame.  2 Tape measure straight and aligned Keep the tape straight, not angled or tilted.  3 Read at the module edge Read the measurement at the outer edge of the opposite module. ✗ NOT OK – INCORRECT METHODS  ✗ Angled measurement Tape is not straight. This gives inaccurate results.  ✗ Hook not at the edge Hook placed inside the frame or not at the outer edge. This shortens the distance.  ✗ Tape not tight / sagging Tape must be tight and straight. Sagging causes incorrect measurement.  ✗ Incorrect reading angle Reading the tape from an angle can lead to parallax error and wrong measurements. 💡 BEST PRACTICE Always measure from outer edge to outer edge of the modules. Keep the tape straight, tight and parallel to the modules for accurate results.

WSOS section	Sub-criteria	Resource
5	PV Panel Level	CORRECT USE OF LEVEL – PV PANELS  OK – CORRECT METHOD  1 Place the level on the frame Position the level flat on the top edge of the PV panel frame.  2 Check the bubble Ensure the bubble is centered between the lines.  3 Panel is level The centered bubble indicates the panel is level.  NOT OK – INCORRECT METHODS  Level not flat The level is tilted or not resting flat on the frame. This gives an inaccurate reading.  Level on the glass Placing the level on the glass surface can give false readings. Always use the frame.  Bubble not centered The bubble is not between the lines. Panel is not level.  Obstructed surface Debris or objects under the level can affect accuracy. Ensure a clean, flat surface.  BEST PRACTICE • Use a high-quality level. • Check level both across the short edge and along the long edge of the panel. • Ensure the mounting structure is stable before checking the level.  A level panel ensures proper performance, drainage and structural reliability.

WSOS section	Sub-criteria	Resource
5	Installation Equipment	PV PANELS – CORRECT FIXING VERIFICATION  OK – CORRECT INSTALLATION  1. END CLAMPS CORRECTLY POSITIONED End clamps are in full contact with the panel frame and fully tightened. No gap between clamp and frame.  2. MID CLAMPS CORRECTLY POSITIONED Mid clamps are centered between panels and fully tightened. Equal clearance on both sides.  3. PANELS ALIGNED AND FLUSH Panels are aligned, level and flush with each other. No height difference.  4. STRUCTURE FIXED AND TIGHTENED All bolts, nuts and screws are tightened to the specified torque. No loose components.  5. GROUNDING CONNECTED AND SECURED Grounding wire is properly connected, tight and protected against corrosion.  NOT OK – INCORRECT INSTALLATION EXAMPLES  1. END CLAMP INCORRECT Gap between clamp and frame. Clamp not fully tightened or incorrectly positioned.  2. MID CLAMP INCORRECT Mid clamp not centered. Unequal clearance can cause mechanical stress and damage.  3. PANELS MISALIGNED Panels are not level or not flush. Height difference between panels can cause stress.  4. LOOSE COMPONENTS Bolts, nuts or screws not tightened properly. Risk of loosening or failure.  5. GROUNDING INCORRECT Grounding wire loose, not properly connected or showing signs of corrosion.  WHY IT MATTERS - Ensures structural safety and system reliability - Prevents damage from wind, vibration and environmental loads - Guarantees long-term performance and warranty compliance - Protects people, assets and the investment  BEST PRACTICE - Use the correct clamps for end and mid positions - Tighten all components to the recommended torque - Verify alignment and level before final tightening - Inspect and document all fixing points and grounding

WSOS section	Sub-criteria	Resource
5	Equipment Measurements	CORRECT USE OF LEVEL – ELECTRICAL PANELS AND INVERTERS  1 Place the level on the top edge Position the level flat on the top edge of the panel or inverter.  2 Check the bubble Ensure the bubble is centered between the lines.  3 Panel / inverter is level A centered bubble indicates the panel or inverter is level. ✗ NOT OK – INCORRECT METHODS  ✗ Level not flat The level is tilted or not resting flat on the top edge. This gives an inaccurate reading.  ✗ Level on handle / protrusion Placing the level on handles, cable glands or other protrusions can give false readings. Always use the flat top edge.  ✗ Bubble not centered The bubble is not between the lines. Panel or inverter is not level.  ✗ Dirty or obstructed surface Dirt, dust or objects on the surface can affect accuracy. Ensure a clean, flat surface. 💡 BEST PRACTICE ✓ Use a high-quality level with clear visibility. ✓ Check level in both directions (front-to-back and side-to-side) if critical. ✓ Ensure the mounting surface is stable before checking the level. ✓ A level and properly installed panel/inverter ensures safety, performance and reliability. 📋 A level installation ensures: • Proper door alignment and sealing • Efficient heat dissipation • Mechanical stability • Compliance with standards

WSOS
section

Sub-criteria

Resource

6

Reports and
Commissioning

HOW TO DETERMINE IF A HANDWRITTEN INSPECTION REPORT IS ACCEPTABLE

✓ OK – ACCEPTABLE REPORT


LEGIBILITY

- All handwriting is readable.
- No ambiguous characters.


COMPLETENESS

- All mandatory fields completed.
- No missing measurements or observations.


CORRECTIONS

- Corrections clearly identified.
- Original information remains readable.


CONSISTENCY

- Values recorded in the correct fields.
- Dates, signatures and references completed.


EVIDENCE QUALITY

- Photos attached when required.
- Traceable and auditable information.

PV PLANT INSPECTION REPORT

Date: 22/05/2024 Inspector: João Silva

Location: Solar Farm - Area 01 Equipment ID: INV-01

Item	Description	Measurement / Observation	Result	Comments
1	PV Panels Condition	No cracks, clean	OK	—
2	Structure Fixing	All bolts tight	OK	—
3	DC Cables	Connections tight	OK	—
4	Combiner Box	No overheating	OK	—
5	Inverter	Operating normally	OK	—
6	Earthing	Continuity OK	OK	—
7	Labels & ID	All labels in place	OK	—

General Comments:
System operating normally.
No issues found.

Signature: João Silva Date: 22/05/2024

1 Handwriting is clear

2 All fields completed

3 Signature and date completed

4 Values clearly recorded

5 Corrections with single line and initials

BEST PRACTICES

- ✓ Write clearly using durable ink (blue or black).
- ✓ Fill all mandatory fields completely.
- ✓ Use a single line to correct errors and add initials.
- ✓ Review the report before submission.
- ✓ Ensure photos and attachments are identified and referenced.



✗ NOT OK – UNACCEPTABLE REPORT


ILLEGIBLE HANDWRITING

- Information cannot be interpreted reliably.


MISSING INFORMATION

- Mandatory fields left blank.


UNCONTROLLED CORRECTIONS

- Erasures, scribbles or overwritten values.


INCONSISTENT RECORDS

- Values recorded in wrong fields.
- Missing units.


LACK OF TRACEABILITY

- Missing date, signature or identification.

PV PLANT INSPECTION REPORT

Date: 11/05 Inspector: João Silva

Location: Equipment ID:

Item	Description	Measurement / Observation	Result	Comments
1	PV Panels Condition	2 worst locs	OK	high
2	Structure Fixing	Bag sole	OK	—
3	DC Cables	2 cables	OK	—
4	Combiner Box	1 cable	OK	—
5	Inverter	2 cables	OK	hot
6	Earthing	1 cable	OK	—
7	Labels & ID	1 cable	OK	—

General Comments:
System operating normally.
No issues found.

Signature: Date: 11

1 Illegible handwriting

2 Missing information

3 Uncontrolled corrections

4 Inconsistent records

5 Missing signature

6 Incomplete date

WHY IT MATTERS

- ✓ Ensures data quality and reliability.
- ✓ Supports traceability and regulatory compliance.
- ✓ Reduces rework and delays.
- ✓ Protects people, assets and the investment.


**QUALITY
SAFETY
RELIABILITY**

WSOS section

Sub-criteria

Resource

6

Reports and Commissioning

HOW TO DETERMINE IF A HANDWRITTEN INSPECTION REPORT IS OK

CRITERIA – THE REPORT IS OK WHEN:



LEGIBILITY

- All handwriting is readable.
- No ambiguous characters.



COMPLETENESS

- All mandatory fields completed.
- No missing measurements or observations.



CORRECTIONS

- Corrections clearly identified.
- Original information remains readable.



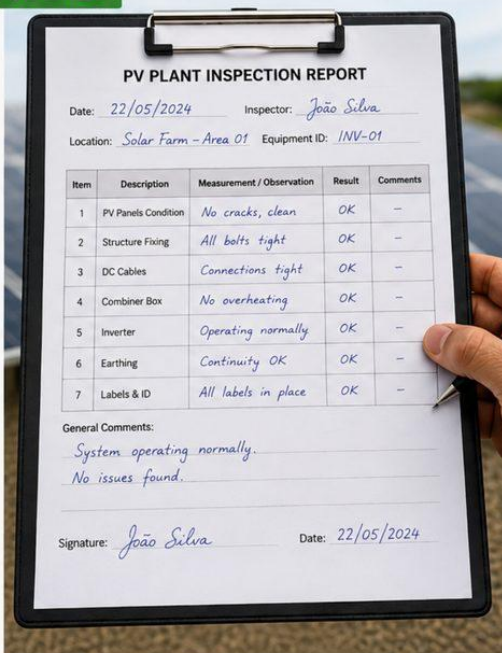
CONSISTENCY

- Values recorded in the correct fields.
- Dates, signatures and references completed.



EVIDENCE QUALITY

- Photos attached when required.
- Traceable and auditable information.



PV PLANT INSPECTION REPORT

Date: 22/05/2024 Inspector: João Silva

Location: Solar Farm - Area 01 Equipment ID: INV-01

Item	Description	Measurement / Observation	Result	Comments
1	PV Panels Condition	No cracks, clean	OK	-
2	Structure Fixing	All bolts tight	OK	-
3	DC Cables	Connections tight	OK	-
4	Combiner Box	No overheating	OK	-
5	Inverter	Operating normally	OK	-
6	Earthing	Continuity OK	OK	-
7	Labels & ID	All labels in place	OK	-

General Comments:
System operating normally.
No issues found.

Signature: João Silva Date: 22/05/2024

EXAMPLES – WHAT TO CHECK

1

Inspector: João Silva

Location: Solar Farm - Area 01

Item	Description	Measurement / Observation
1	PV Panels Condition	No cracks, clean
2	Structure Fixing	All bolts tight
3	DC Cables	Connections tight

LEGIBLE HANDWRITING

All information is readable and unambiguous.

2

Date: 22/05/2024

Inspector: João Silva

Location: Solar Farm - Area 01

Equipment ID: INV-01

Item	Description	Measurement / Observation	Result
1	PV Panels Condition	No cracks, clean	OK
2	Structure Fixing	All bolts tight	OK

COMPLETE FIELDS

All mandatory fields are completed.

3

Signature: João Silva

Date: 22/05/2024

SIGNATURE AND DATE

Signature and date are present.

4

Measurement / Observation	Result
No cracks, clean	OK
All bolts tight	OK
Connections tight	OK

VALUES CLEARLY RECORDED

Measurements and results are clearly registered.

5

General Comments:
System operating normally.
No issues found.

Signature: ~~overwritten~~ J.S.
João Silva Date: 22/05/2024

CORRECTIONS DONE CORRECTLY

Corrections have a single line, with initials, and original information remains readable.

BEST PRACTICES

- ✓ Write clearly using durable ink (blue or black).
- ✓ Fill all mandatory fields completely.
- ✓ Use a single line to correct errors and add initials.
- ✓ Review the report before submission.
- ✓ Ensure photos and attachments are identified and referenced.



WHY IT MATTERS

- ✓ Ensures data quality and reliability.
- ✓ Supports traceability and regulatory compliance.
- ✓ Reduces rework and delays.
- ✓ Protects people, assets and the investment.



**QUALITY
SAFETY
RELIABILITY**

A clear, complete and well-documented report is evidence of a safe and reliable installation.

WSOS
section

Sub-criteria

Resource

6
Reports and
Commissioning

EXAMPLES OF HANDWRITTEN REPORTS – NOT OK

1. ILLEGIBLE HANDWRITING

PV PLANT INSPECTION REPORT

Date: 22/05/2024 Inspector: João Silva
Location: Solar Farm - Area 01 Equipment ID: INV-01

Item	Description	Measurement / Observation	Result	Comments
1	PV Panels Condition	no cracks	OK	+
2	Structure Fixing	All bolts tight	OK	OK
3	DC Cables	Connections tight	OK	OK
4	Inverter	Operating normally	OK	OK
5	Earthing	Continuity	OK	OK

General Comments:

Signature: João Silva Date: 22/05/2024

REASON: Information cannot be read or understood.
Impact: Cannot be verified or trusted.

2. MISSING INFORMATION

PV PLANT INSPECTION REPORT

Date: Inspector:
Location: Equipment ID:

Item	Description	Measurement / Observation	Result	Comments
1	PV Panels Condition			
2	Structure Fixing			
3	DC Cables			
4	Inverter			
5	Earthing			

General Comments:

Signature: Date:

REASON: Mandatory fields are left blank.
Impact: Incomplete report, not acceptable.

3. UNCONTROLLED CORRECTIONS

PV PLANT INSPECTION REPORT

Date: 22/05/2024 Inspector: João Silva
Location: Solar Farm - Area 01 Equipment ID: INV-01

Item	Description	Measurement / Observation	Result	Comments
1	PV Panels Condition	no cracks	OK	OK
2	Structure Fixing	All bolts tight	OK	OK
3	DC Cables	Connections tight	OK	OK
4	Inverter	Operating normally	OK	OK
5	Earthing	Continuity	OK	OK

General Comments:

Signature: João Silva Date: 22/05/2024

REASON: Erasures, multiple cross-outs or overwritten values.
Impact: Information may be altered or unclear.

4. INCONSISTENT RECORDS

PV PLANT INSPECTION REPORT

Date: 22/05/2024 Inspector: João Silva
Location: Solar Farm - Area 01 Equipment ID: INV-01

Item	Description	Measurement / Observation	Result	Comments
1	PV Panels Condition	No cracks	OK	
2	Structure Fixing	All bolts tight	OK	
3	DC Cables	Connections tight	OK	
4	Inverter	Operating normally	OK	
5	Earthing	Continuity	OK	yes

General Comments:

Signature: João Silva Date: 22/05/2024

REASON: Values in wrong fields, missing units or inconsistent data.
Impact: Data cannot be validated or compared.

5. LACK OF TRACEABILITY

PV PLANT INSPECTION REPORT

Date: Inspector:
Location: Equipment ID:

Item	Description	Measurement / Observation	Result	Comments
1	PV Panels Condition		OK	
2	Structure Fixing		OK	
3	DC Cables		OK	
4	Inverter		OK	
5	Earthing		OK	

General Comments:

Signature: Date:

REASON: Missing date, signature or identification.
Impact: Cannot be traced or attributed.

6. DISORGANIZED AND CLUTTERED

PV PLANT INSPECTION REPORT

Date: 22/05/2024 Inspector: João Silva
Location: Solar Farm - Area 01 Equipment ID: INV-01

Item	Description	Measurement / Observation	Result	Comments
1	PV Panels Condition	no cracks	OK	
2	Structure Fixing	All bolts tight	OK	
3	DC Cables	Connections tight	OK	
4	Inverter	Operating normally	OK	
5	Earthing	Continuity	OK	

General Comments:

Signature: João Silva Date: 22/05/2024

REASON: Disorganized layout and excessive notes.
Impact: Difficult to interpret and increases risk of error.

WSOS section	Sub-criteria	Resource
1	Workstation Organization	0 0 - Poor - Extremely disorganized workstation - Tools, cables and materials scattered - Safety risks and obstruction - No defined storage or organization - Does not meet standard requirements   1 1 - Fair - Some organization but with evident issues - Tools and materials not in proper places - Cables and components partially organized - Limited workspace and movement - Improvement needed   2 2 - Good - Well organized workstation - Tools, cables and materials in proper places - Clear workspace and good accessibility - Components and documents organized - Meets standard requirements   3 3 - Excellent - Fully organized and standardized workstation - Tools in dedicated and labeled locations - Cables, components and documents neatly stored and identified - Clean, safe and efficient workspace - Exceeds standard and best practices   WORKSTATION QUALITY ASPECTS  Organization and order  Tools in proper place  Cables properly stored  Components organized  Documents protected and accessible  Clear workspace and safe access  Cleanliness and maintenance NOTES A well-organized workstation increases safety, productivity and quality of work, and reduces the risk of errors and accidents.

WSOS
section

Sub-criteria

Resource

1

Personal Safety

USE OF PERSONAL PROTECTIVE EQUIPMENT (PPE) VISUAL INSPECTION – CORRECT USE OF PPE				
CRITERIA	0 - NON-COMPLIANT Not used or used incorrectly	1 - PARTIALLY COMPLIANT Used, but incorrectly or incompletely	2 - COMPLIANT Used correctly, with minor opportunities for improvement	3 - FULLY COMPLIANT Used correctly and appropriately
 SAFETY HELMET (HARD HAT) Protects against impacts and electrical shocks	 - Not wearing a safety helmet - Inappropriate use (e.g., worn backwards)	 - Helmet present, but with incorrect adjustment - Chin strap loose or not used	 - Helmet used correctly - Adjusted, but with minor adjustments needed	 - Helmet used correctly - Properly adjusted and in perfect condition
 SAFETY GLASSES Protects against impacts and particles	 - Not wearing safety glasses - Inappropriate use (e.g., on head or hanging)	 - Glasses present, but with incorrect adjustment - Does not fully protect the eyes	 - Glasses used correctly - Minor opportunities for improvement (fit or cleaning)	 - Glasses used correctly - Proper fit and clean lenses
 SAFETY GLOVES Protects against electrical shocks, cuts and abrasions	 - Not wearing gloves - Inappropriate use (damaged gloves or not suitable for the task)	 - Gloves present, but not suitable for the risk - Damaged or poorly adjusted	 - Gloves adequate for the task - Minor signs of wear	 - Gloves adequate and in perfect condition - Full protection for the task
 SAFETY FOOTWEAR Protects against impacts, punctures and slips	 - Not wearing safety footwear - Inappropriate use (e.g., sneakers, sandals, etc.)	 - Footwear present, but inadequate - Damaged or without adequate protection	 - Appropriate safety footwear - Minor signs of wear	 - Appropriate safety footwear - In perfect condition and suitable for the task
 HIGH-VISIBILITY VEST Increases worker visibility	 - Not wearing a high-visibility vest - Inappropriate use (covered or not visible)	 - Vest present, but not visible - Incorrectly closed or covered	 - Vest used correctly - Minor opportunities for improvement	 - Vest used correctly - In perfect condition and highly visible
 SAFETY HARNESS Protects against falls from height	 - Not wearing a safety harness - Inappropriate use (not connected to anchorage point)	 - Harness present, but with incorrect adjustment - Incorrect or incomplete connection	 - Harness used correctly - Minor adjustments needed	 - Harness used correctly - Connected to the proper anchorage point
 GENERAL GUIDELINES - Verify the correct use of all required PPE for the activity - PPE must be in good condition and within its validity period - Inadequate PPE must be considered a risk to the activity - In case of non-compliance, guide and correct immediately MANDATORY MINIMUM PPE  Hard Hat  Safety Glasses  Gloves  Safety Footwear  High-Visibility Vest  Safety Harness  NOTE This verification must be performed daily and recorded as part of the commissioning process and workplace safety routines.				

WSOS section

Sub-criteria

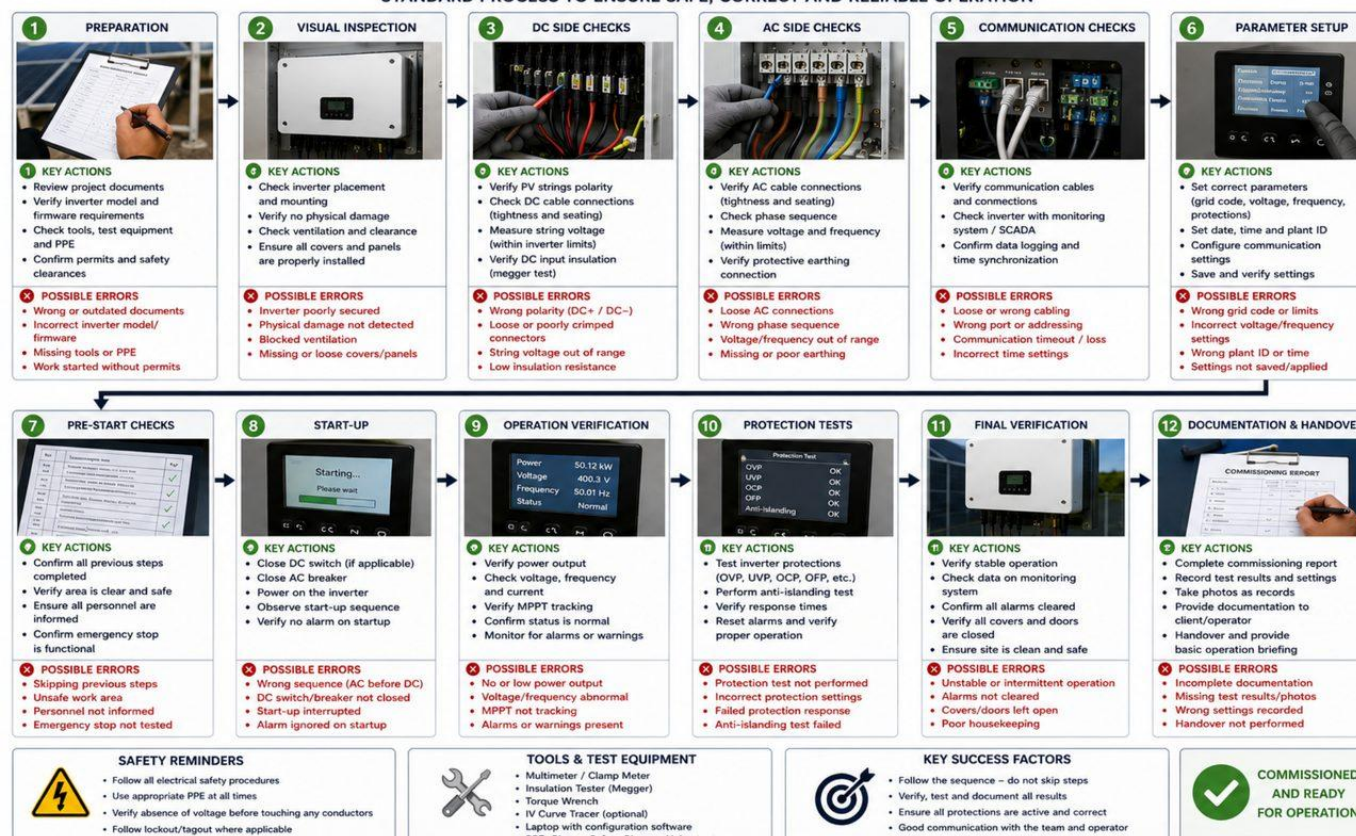
Resource

6

Reports and Commissioning

PV INVERTER COMMISSIONING PROCEDURE – FLOW & POSSIBLE ERRORS

STANDARD PROCESS TO ENSURE SAFE, CORRECT AND RELIABLE OPERATION



Summary Table with Standards (IEC Reference)

The following reference values apply to Reports and Commissioning, and are drawn from the relevant IEC standards.

- Continuity of frames: $< 0.1 \Omega$ — IEC 62446-1:2016, 5.3.1
- Insulation resistance: $\geq 1 \text{ M}\Omega/\text{kV}$ — IEC 62446-1:2016, 5.3.2
- Polarity: positive voltage — IEC 62446-1:2016, 5.3.3
- Open circuit voltage (Voc): $\pm 5\%$ of the corrected value — IEC 62446-1:2016, 5.3.4
- Short circuit current (Isc): $\pm 10\%$ of the corrected value — IEC 62446-1:2016, 5.3.4
- Rapid shutdown: $\leq 30 \text{ V}$ within 30 s — IEC 62446-1:2016, 5.3.5 / NEC 690.12
- Thermography (optional): $\Delta T \leq 10^\circ\text{C}$ — IEC TS 62446-3:2017
- I-V curve (optional): $P_{\text{max}} \geq 90\%$, $\text{FF} \geq 0.70$ — IEC 60891:2021
- Anti-islanding: $\leq 100 \text{ ms}$ — IEC 62109-2:2011, 7.7
- Power factor: $0.92\text{--}0.99$ — IEC 61727:2004, 5.4
- Performance ratio (72 h): $\geq 75\%$ — IEC 61724-2:2025