VDE SPEC

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Solar Module Quality Standard (SMQS)

Part 3: Production and Production-Related Quality Assurance of PV Modules

VDE SPEC 90038-3 V1.0 (en)

VDE

Foreword

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No draft has been published for the present VDE SPEC prior to publication.

This VDE SPEC resulted from the work of a project group between the authors as stated below.

This VDE SPEC was developed according to the VDE SPEC procedure. VDE SPEC 90038-1 (en) has been developed in a project group aiming for a Solar Module Quality Standard (SMQS) and it cannot be granted that all possibly interested parties could have been involved. However, a proposal for interaction for public interaction was made by means of according to the VDE procedure and all parties – possibly not involved at this point – were asked to participate in the process.

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In particular, this VDE SPEC is not a technical rule within the meaning of Section 49 EnWG.

The authors of this VDE SPEC are per alphabetic order of surname:

- Dr. Jürgen Arp, 8.2 Arp & Kleiss GmbH, Berlin
- Robin da Silva, Wattner Projektentwicklungsgesellschaft mbH, Köln
- Gero Deibert, BayWa r.e. Solar Projects GmbH, Freiburg
- Florian Furtlehner, ASG Anhalt Solar GmbH, Köthen
- Cyril Hinz, Deutsche Kreditbank AG, Berlin
- Dr. Gerhard Kleiss, 8.2 Arp & Kleiss GmbH, Berlin
- Alexandra Körner, Iqony Solar Energy Solutions GmbH, Würzburg
- Monika Leiner, Goldbeck Solar GmbH, Hirschberg
- Tobias Leschinsky, Iqony Solar Energy Solutions GmbH, Würzburg
- Erik Lohse, Enerparc AG, Hamburg
- Martin Lütgens, Abo Energy GmbH & Co. KG aA, Wiesbaden
- Hauke Nissen, Wattmanufactur GmbH & Co. KG, Galmsbüll
- Lars Petzold, Greentech GmbH, Hamburg
- Karl-Heinz Remmers, Remmers Solar GmbH, Berlin
- Volker Schöller, Schoenergie GmbH, Föhren
- Anne Sophie Selbach, Schoenergie GmbH, Föhren
- Dr. Ralf Siebert, Sonnedix Germany Solar GmbH & Co. KG, Frankfurt a.M.
- Fabian Wany, Greentech GmbH, Hamburg

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Executive Summary

Photovoltaics is a rapidly growing source for renewable electricity production worldwide. Solar modules are the central component for the direct generation of electrical energy from natural sunlight through the photovoltaic (PV) effect and a central component of solar PV systems.

Solar modules are manufactured as a mass product and are typically purchased in large quantities. In module supply contracts, requirements for the solar modules' quality are usually agreed, which are summarized in this specification.

As a generic text, this SMQS (Solar Module Quality Standard) series of specifications represents a way of simplifying the purchasing process: Requirements are described in general terms and a selection option for specifying the technical conditions to be agreed upon in the purchasing contract is defined. During contract negotiations the customer and seller/manufacturer can easily define the intended level.

Although the authors have made every effort to ensure that this specification is free of errors and inconsistencies, no guarantee can be given that this guide is absolutely free of errors. The same applies to the completeness of the topics listed.

Part 1 of this series of specifications provides definitions and technical requirements for the documentation and the production site and certain further requirements.

Part 2 of this series provides details for measurement and testing procedures.

Part 3 of this series provides a framework for production monitoring requirements.

The three parts contain checklists that can be agreed upon during module supply / purchasing negotiations.

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Introduction

Photovoltaic solar energy is a rapidly growing segment in electrical power supply worldwide. There are great opportunities for a further renewable expansion of this infrastructure in grid feed-in. In the segment of utility scale PV power plants addressed within this specification ground mounted PV systems have a major and rapid impact on further development.

Today, solar modules are sourced through a global supply chain. Therefore, this specification is published exclusively in English language.

The aim of this series of specifications is to standardize communication between manufacturers and customers to guarantee an elevated level of quality and at the same time speeding up the purchasing process.

After all, PV modules are the long-lasting key components of a PV system.

1 Scope

This specification aims to describe the quality level and framework conditions for solar modules made of crystalline silicon using today's technology (i.e. in the year of publication of the specification). The focus is on solar modules that are usually used in so-called ground mount PV systems.

Other technologies, such as thin-film modules or modules based on tandem solar cells, are not within the scope of this document. For products based on these technologies, the text can nevertheless be used as a guide. However, the applicability and completeness must then be checked with particular care by the user.

Not in the scope of this text are evaluation catalogs regarding electroluminescence (EL) or visual criteria (VI). Such catalogs are typically either agreed upon based on manufacturer's documentation or may be documented separately. Furthermore, this VDE SPEC does not specify any safety requirements. The corresponding safety standards for PV applications apply.

Although it is quite possible that different scenarios are conceivable, this specification uses the terminology „manufacturer" and „customer". No distinction is made between „manufacturer" and „seller" and „supplier". Moreover, the terms „customers" and „buyer" could also be used equivalent within this specification. Users of this specification are requested to adapt the terms to their corresponding actual situation if necessary.

Part 3 of this series presents quality assurance measures aimed at the production site and the PV module manufacturing process. Moreover, quality-relevant aspects of logistics are considered.

2 Normative References

The following documents are referred to in the text in such a way that their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies).

IEC 62941 Ed.1.0, *Terrestrial photovoltaic (PV) modules – Quality system for PV module manufacturing*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 2859-1, *Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot* inspection

ISO 9001, *Quality Systems – Requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO: Online browsing platform: available at https://www.iso.org/obp
- IEC: Electropedia: available at https://www.electropedia.org
- Batch: The definition of a batch can be found in VDE SPEC 90038-1
- Lot: The definition of a lot can be found in VDE SPEC 90038-1
- ISTA: International Safe Transit Association

3.1 Audit

systematic, independent, documented process for obtaining records, statements of fact or other relevant information and assessing them objectively to determine the extent to which specified requirements are fulfilled.

[SOURCE: ISO/IEC 17000:2004, 4.4, modified – The references to other terms within ISO/IEC 17000 have been replaced by hyperlinks to entries in the IEV.]

In the course this VDE SPEC refers to a process, where the quality management system is examined and evaluated by a person who is familiar with the production facilities and processes of solar modules. The scope is therefor much more technical as compared to a typical ISO 9001 audit, which refers

rather to the QM system. Audit as used in these specifications always refers to specific aspects relevant to the quality of the PV modules.

3.2
Production Monitoring

In the course of production monitoring, the implementation of the manufacturer's own QM system is supported. By agreement, additional QM measures can be supported or implemented.

Production monitoring mainly takes place in the production facilities.

3.3
Pre-shipment Inspection

As part of the pre-shipment inspection (PSI), a random sample is taken from the PV modules produced and checked by an inspector.

The pre-shipment inspection is usually carried out on the manufacturer's premises or at a logistics service provider.

Typical tests are:

- STC power measurement
- Electroluminescence (EL) images
- Visual inspection
- Insulation test

3.4
3rd Party Testing (Pre-Shipment Testing)

In this context, 3rd party testing refers to the testing of a sample in an external test laboratory before the lot is released for dispatch.

3.5
Loading Supervision

During loading supervision, inspectors monitor the loading of the pallets with PV modules and the accuracy of the transport documents.

4 Symbols and abbreviations

The following abbreviations are used in this text

AI	Artificial Intelligence
AQL	Acceptable Quality Level
B/S	back sheet (rear side plastic foil of GBM, not applicable for GGM
CB	Certifying Body, issuing the product certificate and accredited by a member body of IAF
Ce	Cerium (chemical element)
CDF	Constructional Data Form for Photovoltaic Modules
CID	Current Induced Degradation
CO_2	Carbon dioxide
EL	Electroluminescence
ESG	Environmental, Social and Governance
EVA	Ethylene-vinyl acetate
FIATA	International Federation of Freight Forwarders associations
GBM	Glass-backsheet module: PV module with glass at the front side and B/S at the rear side
GGM	Glass-glass modules: PV module with glass at the front side and rear side
GHG	Greenhouse gas
IAF	International Accreditation Forum (www.iaf.nu)
IEC	International Electrotechnical Commission (www.iec.ch)
ISO	International Organization for Standardization (www.iso.org)
IQC	Incoming quality control
IPQC	In-process quality control
LeTID	Light and elevated temperature induced degradation
LID	Light induced degradation
MPP	Maximum Power Point: operation condition providing peak output for a PV module
PA	Polyamide
PAN file	(from French. “panneau”): full dataset defining a specific PV module for PVsyst
PET	Polyethylene terephthalate
POE	Polyolefin Elastomer
PID	Potential Induced Degradation
PSI	Pre shipment inspection
PV	Photovoltaic
PVF	Polyvinyl fluoride
PVDF	Polyvinylidene fluoride
PVsyst	software made by PVSYST SA (Satigny, Switzerland) for yield calculation
Sb	Antinomy (chemical element)
SI	International System of Units
SoP	Start of Production
SOP	Standard Operation Procedures (e.g. work instructions)
STC	Standard Testing Conditions
SMQS	SOLAR MODULE QUALITY STANDARD

TPT	B/S consisting with a three-layer construction: PVF-PET-PVF
TS	Technical specification
UL	Underwriter Laboratories
UVID	Ultraviolet (light) induced degradation: possible degradation mechanism for solar cells
QA	Quality assurance

Table 1 – Symbols used

Symbol	Quantity referenced	SI Unit (if applicable)
V_{oc}	Open Circuit Voltage (of a PV module)	[V]
I_{sc}	Short Circuit Current (of a PV module)	[A]
P_{max}	Power at MPP	[W] (often noted as [Wp]) [MW] (often noted as [MWp])
RH	Relative humidity	[%] (not a SI Unit)
°C	Temperature	K

5 Quality Assurance Processus

5.1 Audits (pre-production)

5.1.1 Basics

In this document, an audit is understood to be a process in which the production facilities, processes and the associated quality management system are examined to determine their suitability for producing PV modules of consistently good quality.

The audits are generally based on the documents and processes of ISO 9001, but the audits for supplier and site qualification are usually carried out by auditors with a high level of technical qualification in relation to PV modules, so that the focus is less on the documentation and more on the product.

IEC 62941 can be understood as a PV-specific adaptation of ISO 9001 and can be used in a supplier qualification audit. However, this standard does not go into technology-specific detail either.

The providers of such audits each work with their own checklists, which have become very similar across providers.

A distinction must be made between technically orientated audits and ESG-orientated audits, the outcome of which are dealt with in Part 1.

Most suppliers have several production sites, some of which are divided into workshops and lines. The level of development of a manufacturer's workshops can vary greatly.

Due to the site-specific characteristics of the production technology, the QA documents are also at least partially site-specific.

A meaningful audit should cover the areas of the supplier that are relevant for subsequent production.

The time required for an average audit usually comprises 3-4 working days on site for the central departments and a production site.

One-day short audits can also be carried out for pre-qualification.

Annex B contains a table that makes suggestions for the minimum content depending on the scope of the audit.

Parts of an audit can also be conducted remotely, as a video meeting or as a hybrid meeting.

5.1.2 Implementation

The following specifications are required for the performance of an audit:

- Agreement on an audit including the scope (short audit or standard audit)
- Agreement of the lead time
- Audit mode (presence, video, hybrid)

5.2 Production monitoring

5.2.1 Fundamentals and delimitation

The term production audit is also frequently used for production monitoring, which in turn sometimes describes the monitoring of production in other cases a pre-shipment inspection in the factory. For reasons of conceptual clarity, a distinction is made here between these two tasks.

Production monitoring here refers exclusively to the continuous monitoring of the production processes and the implementation of the manufacturer's own quality assurance system.

This monitoring is carried out by the customer or by service providers appointed by the customer.

In most cases, production monitoring is preceded by at least a brief audit of the quality assurance system, as the quality assurance system to be monitored during the ongoing process is best known in advance.

In addition to the purely production-related tasks, the incoming goods inspection and the incoming and outgoing goods warehouse are normally also included.

For longer production runs, pre-shipment inspection can be integrated into ongoing production monitoring.

It can be agreed to carry out measurements and tests during production, such as peel-off tests, cross-linking degree determinations, PID or LeTID tests under the supervision of the inspectors in the manufacturer's in-house laboratories.

If continuous production monitoring is agreed, it makes sense to agree the boundary conditions for the production plan. For efficient monitoring, it is important that production takes place continuously and at a small number of locations. The customer requires an appropriate lead time for the organisation.

It is advisable to agree a maximum number of production runs, which are then carried out continuously with an agreed minimum daily capacity.

Continuous sampling of material samples may be necessary for further tests. The sampling of test specimens must be agreed in advance. One possible procedure is to agree on random sampling of raw and auxiliary materials, which do not exceed the material volume of one PV module per 10 MWp.

An agreement on how photographic documentation of deviations is to be carried out makes sense. Occasionally, manufacturers have reservations about allowing mobile phones into production. In such a case, it can be agreed that such images are made with a camera that cannot send images and that the images are agreed in detail.

It is common to cover around half of the production time. A decision must be made as to whether only the day shift or also the night shift is monitored. The implementation needs to consider:

- Lead time for the announcement of the production plan
- Number of production sites
- Number of production runs with minimum daily production and maximum duration per production run
- Exclusivity of capacities
- Time scope of monitoring
- Number of inspectors
- Sampling during ongoing production
- Capacity for production-related tests
- Access to the areas to be monitored
- Access to other factory facilities
- Authorisation for photographic documentation of facts that are the subject of a complaint

5.3 Pre-shipment inspection of the PV modules at the factory

5.3.1 Fundamentals and delimitation

A pre-shipment inspection (PSI) is an inspection of PV modules that have passed through the entire production process, including all quality assurance measures carried out by the manufacturer. The pre-shipment inspection is carried out by the customer or by a third party commissioned by the customer.

The STC performance test, a visual inspection, an insulation test and EL images of the test specimens are widely used. Usually, PV modules packed ready for dispatch are selected from the warehouse for PSI.

The pre-shipment inspection is usually carried out by a single inspector. The test specimen logistics and other support during the pre-shipment inspection must be provided and agreed by the manufacturer's employees.

The number of PV modules to be inspected during the pre-shipment inspection is specified in the purchase contract. It is common practice to either specify a number of pallets (e.g. one pallet per day selected from the ongoing process) or a number of test specimens that is determined on the basis of ISO 2859-1.

It is important to agree on the volume of the inspection in advance, as the manufacturer provides the helpers who unpack and pack the test specimens and provide the in-house logistics in the inspection area, at least for an inspection on its premises.

ISO 2859-1 contains both the sample size and the acceptance limits in tabular form. The following table contains the sample size according to General Inspection Level I for normal sampling as an example.

Table 1 – Sample size according to ISO 2859-1 – General Inspection Level I, exemplary for different PV module power classes

Total Power in MWp/PV module Power Wp	450 Wp	600 Wp	750 Wp
1 MWp	50	50	50
10 MWp	125	125	125
20 MWp	200	125	125
100 MWp	315	315	200

The General Inspection Level I and the Inspection Level S-4 which is shown in the table below are the most widespread sample sizes used in the PV industry for STC power measurements, EL and VI inspection.

The Acceptable Quality Level indicates which reject rate is accepted during these inspections. A distinction is made as to whether the defects are in the Minor, Major or Critical categories.

Some selected AQL levels are listed in the following table for the sample sizes specified in the table above. The table shows up to how many defective test specimens the tested batch is accepted and from how many defects the batch is rejected.

Table 2 – Acceptance Level according to ISO 2859-1 – General Inspection Level I, exemplary

Sample size/ AQL	AQL 0,065		AQL 0,4			AQL 1,0		AQL 2,5
	Accept	Reject	Accept	Reject	Accept	Reject	Accept	Reject
20	0	1	0	1	0	1	1	2
32	**0**	**1**	**0**	**1**	**1**	**2**	**2**	**3**
50	0	1	0	1	1	2	3	4
125	0	1	1	2	3	4	7	8
200	0	1	2	3	5	6	10	11
315	0	1	3	4	7	8	14	15

The AQL levels presented can be found in many contracts in the PV industry. As of 2024, the PV industry is not yet at the AQL level that is common in other industries and should be reduced in course of continuous development.

5.3.1.1 STC power measurements

The general technical definitions of an STC performance measurement can be found in VDE SPEC 90038-2, Chapter 5.0. Specific aspects must be defined for an STC performance measurement as part of a pre-shipment inspection.

- Definition of the solar simulator used for STC power measurement. The solar simulators from production can be used for this; in many production facilities, special solar simulators are only available for this purpose.
- Definition of the personnel provided by the manufacturer for support of the PSI.
- Definition of the degree of mechanisation/automation. Equipment available to ensure the correct temperature control of the DUT according to the requirements of IEC 61215, MQT06.
- Determine whether the sun simulator is operated by the manufacturer's employees or by the inspectors. Determining which reference module is used to calibrate the sun simulator. List of documents provided to the customer.

- Definition of the languages in which the sun simulator user interface must be available.

5.3.1.2 Visual Inspection (VI)Visual Inspection (VI)

Visual inspection usually takes place on test specimens that are removed from storage and unpacked again.

The basis is usually a catalogue of criteria agreed with the manufacturer.

In many modern production plants, high-resolution and technically good photographic images are required and produced. Manufacturers are increasingly transferring VI tasks to AI systems. As an alternative or in addition to VI in production, the high-resolution images from production can be checked by a customer AI system. In any event, it is necessary to agree on the transfer and quality of the images.

5.3.1.3 Electroluminescence imaging (EL)

The EL inspection is usually carried out on test specimens that are removed from the warehouse and unpacked again.

The basis is usually a catalogue of criteria agreed with the manufacturer. Further details for the basis of the imaging can be found in VDE SPEC 90038-2, Annex A.

High-resolution and technically good EL images are produced in all modern production systems. Manufacturers are increasingly transferring EL analyses to AI systems. As an alternative or in addition to EL analyses as part of pre-shipment inspection, the EL images from production can be checked by a customer AI system. In any event, it is necessary to agree on the transfer of the images.

A physical reinspection of the EL images is advisable if PV modules are already unpacked for an STC control measurement. In such case, the EL images can be taken without further effort.

5.3.1.4 Insulation test

Most pre-inspection lines that are provided include an insulation test. The test is therefore carried out with no additional effort.

5.3.1.5 Implementation

For the implementation of the mentioned test the following criteria are to be agreed:

- Lead time for the announcement of the production plan
- Definition of the data transmitted by the manufacturer
- Scope and type of inspection
- Number of inspectors
- Capacity (space and test equipment) for production-related tests
- Test-specific specifications, see chapter 5 of VDE SPEC 90038-2.

5.4 Inspection of PV modules prior to shipment at a third party facility / PST

Pre-shipment tests (PST) are usually carried out between production and dispatch. The PST is usually carried out in an ISO IEC 17025 accredited laboratory. The aim of the PST is to recognise fundamental technical problems with the products as early as possible.

Details on the organisation of the PST can be found below. The consequences resulting from the test results must be defined in the purchase contract.

5.4.1 Fundamentals and delimitation

PV modules that are randomly selected from production are often tested by independent third parties. As a rule, these are ISO IEC 17025 accredited test laboratories.

The scope of the test and the pass/fail criteria are defined in advance.

Part 2 of this specification can be used for this purpose. Widely used tests for PST and sample sizes are presented in Chapter 6 and Annex B of VDE SPEC 90038-2. The tests themselves and the possible PASS/FAIL criteria are presented in Chapter 5 and Annex A of the same specification.

The test specimens can be selected by a person authorised by the customer in production or in the warehouse. The test specimens can also be selected on the basis of the serial number lists.

Organisational measures such as packaging, transport and reintroduction into the logistics chain must also be prepared. In most cases, it makes sense to transfer responsibility for the process to the manufacturer until the modules arrive at the test laboratory; this reduces the number of interfaces.

For STC power measurements and EL imaging, it is usual to take the sample either according to ISO 2859-1, General Level I or Level S-4 or to define a round number of pallets.

The sample sizes according to General Level I are listed in Chapter 5.3.1. Level S-4 leads to the following sample size:

Table 3 – Sample size according to ISO 2859-1 – Inspection Level S-4, Exemplary

Total Power in MWp/PV module Power Wp	450 Wp	600 Wp	750 Wp
1 MWp	32	32	32
10 MWp	50	50	50
20 MWp	80	50	50
100 MWp	80	80	80

5.4.2 Implementation

- Test plan, requirements for the tests
- Procedure for selecting the sample
- Requirements for the test laboratory
- Packaging
- Transport
- Whereabouts of the examinees

5.5 Monitoring during loading of the PV modules

Loading is monitored in certain contractual constellations. During the loading process, pallets with specific numbers are loaded into a container, which is then sealed. The container and the seal have a unique number. The execution, the correct documentation and, if necessary, the leaving of the manufacturer's premises are monitored and confirmed by independent third parties.

The following definitions can be made for this process:

- Lead time for loading
- Dates
- Day/night shift
- Place of loading
- Loading capacity/number of ramps
- Spatial organisation

5.6 Transport, logistics, packaging incl. disposal capability, warehouse audit, shock watches

PV modules shall be packed so they are protected from the rigors of shipment, transshipment, and multiple handlings, loadings, and unloading according to applicable Incoterm and mode of transport in accordance with FIATA (International Federation of Freight Forwarders associations) member carrier requirements and best commercial practices.

The manufacturer shall take all necessary precautions to prevent damage from rain, moisture, humidity, condensation, mold, rust, corrosion, shock and vibration. The packaging system shall withstand transportation testing according to IEC 62759-1 or ISTA 3E. The individual modules are protected with cardboard corners. Cables and connectors shall be attached/taped to the back of the module in order to avoid their movement during transportation. All PV modules will be packed in first quality, seaworthy containers, or other packing when transported on land. No secondhand packing will be used.

Pallets shall be identified with the following information:

- Module type and description (including power class and cable length)
- Power and Current classification if applicable and if defined in the sales contract
- List of serial numbers of modules included in the package with Pmax & Imp values.
- Quantity of modules per package
- Package number
- Handling information (Fragile, UP/DOWN)

Shock watches can be used to determine external shocks during transportations that might have impacted the quality of PV modules. The recommended minimum specification of the Shockwatch is G=25.

Annex A: Check-List

Clause	Item	Characteristics	
5.1	Pre-Production Audit	Time and content scope	☐ Short audit 1 day ☐ **2-3 days** ☐ Supplier qualification, 1 week
		Minimum lead time	☐ 2 weeks ☐ 4 weeks ☐ 6 weeks
		Mode	☐ On-site audit ☐ Remote video audit ☐ Hybrid audit

Clause	Item	Characteristics	
5.2	Production Monitoring	Lead-time for the production plan	☐ Two weeks ☐ Three weeks ☐ Four weeks
		Maximum number of production sites	☐ one production site ☐ two production sites ☐ three production sites
		Maximum number of production runs	☐ **two production runs** ☐ three production runs ☐ four production runs ☐ Other:
		Daily minimum production	☐ 1,5 MWp ☐ 3,0 MWp ☐ 5,0 MWp ☐ Other:
		Coverage of the production monitoring	☐ > 30% ☐ > 50% ☐ > 75% ☐ Other:
		Definition of monitored shifts	☐ only day shift ☐ day- and night shift ☐ N/A
		Exclusive dedication of lines to the project	☐ Yes ☐ No
		Extent	☐ Continuous, access at any time ☐ Unannounced random checks ☐ Announced checks

Clause	Item	Characteristics	
5.2	Production Monitoring	Number of inspectors	☐ **not specified** ☐ one inspector ☐ two inspectors
		Lead time for the appointment of inspectors	☐ 1 week ☐ **2 weeks** ☐ 3 weeks
		Raw material sampling	☐ **Yes** ☐ No
		Test capacity provided by the manufacturer for testing parallel to production	☐ STC-power/EL, one pallet per day ☐ PID 3 PV modules per week ☐ LID 3 PV modules per week ☐ LeTID 3 PV modules per week
		Access to the production area	☐ **24/7 without prior announcement** ☐ access with one week lead-time ☐ Other:
		Access to production related areas, scheme according to the production area access	☐ IQC area ☐ IPQC area ☐ raw material warehouse ☐ PV module warehouse ☐ inspection area
		Continuous sampling of PV modules for external testing	☐ **Yes** ☐ No
		Photography in the production area	☐ Free authorisation for photography ☐ Free authorisation for photography limited to the documentation of raw materials and complaints ☐ Coordination with a representative of the manufacturer for each picture ☐ Mobile phone can be used for documentation purpose ☐ Camera without direct internet access can be used for documentation purpose

Clause	Item	Characteristics	
5.3	Pre-shipment inspection of the PV modules at the factory	Type of measurement/Inspection	☐ **STC-power** ☐ EL-imaging ☐ Visual Inspection ☐ Isolation test ☐ Other:

Clause	Item	Characteristics	
5.3	Pre-shipment inspection of the PV modules at the factory	Sample size	☐ One pallet per inspection day ☐ ISO 2859-1 Level S-4 per day ☐ ISO 2859-1 Level S-4 per production run ☐ ISO 2859-1 Level S-4 per production batch ☐ ISO 2859-1 General Level I per production batch
		AQL for Major Deviations	☐ 0,4 ☐ 1,0 ☐ 2,5 ☐ Other:
		AQL for Minor Deviations	☐ 0,4 ☐ 1,0 ☐ 2,5 ☐ Other:
		Sun simulator used for inspection	☐ sun simulator in production ☐ sun simulator in inspection area ☐ Other:
		Support by manufacturer	☐ handling of the samples by manufacturers staff ☐ operation of sun simulator and other equipment by manufacturers staff ☐ Other:
		A suitable environment is available to temper the test specimens to a measuring temperature of 25+-1°C	☐ Yes ☐ No
		Reference module for calibration of the inspection sun simulator	☐ No, specification ☐ see VDE SPEC 90038-2, Annex A, 6.1 ☐ Other:
		User-interface and manual of the sun simulator is available in	☐ Mandarin ☐ **English** ☐ Other:

Clause	Item	Characteristics	
5.4	Inspection of PV modules prior to shipment at a third-party facility		☐ **As defined in VDE SPEC 90038-2, Annex A** ☐ No
	Selection of test specimens		☐ By customer's authorised representative ☐ By the customer based on serial numbers ☐ Other:
	Responsibility for the packaging of the test specimens		☐ **Manufacturer** ☐ Customer ☐ Other:
	Responsibility for transporting the test specimens to the test laboratory		☐ **Manufacturer** ☐ Customer ☐ Other:
	Is there a deadline by which the results must be available after arrival at the test laboratory?		☐ Two weeks ☐ **Three weeks** ☐ Other:
	Whereabouts of the examinees		☐ Examinees stay with the manufacturer ☐ Examinees will be delivered to the customer

Clause	Item	Characteristics	
5.5	Monitoring during loading of the PV modules	The loading is monitored	☐ **Yes** ☐ No
		Lead time for the shipment schedule and information about the location of the loading.	☐ One week ☐ Two weeks ☐ Other:
		Loading during	☐ Day shift ☐ Night shift
		Lead time for information about loading capacity, number of loading bays	☐ One week ☐ Two weeks ☐ Other:

Clause	Item	Characteristics	
5.6	Specification of the packaging	IEC 62759-1	☐ **Yes** ☐ No
		ISTA 3E	☐ **Yes** ☐ No
	Protective caps for the connectors		☐ Yes ☐ No
	Minimum information on the pallet label		☐ **Pallet number** ☐ **Module type** ☐ **Power class** ☐ Current class (H, M, L or I1, I2, I3)) ☐ **Serial numbers of the PV modules** ☐ **Quantity of PV modules** ☐ Handling information ☐ **Weight** ☐ Other:
	Shockwatch		☐ **No** ☐ G = 25 ☐ G = 37 ☐ Other:

VDE Verband der Elektrotechnik
Elektronik Informationstechnik e.V.

Merianstraße 28
63069 Offenbach am Main
Germany
Phone +49 69 6308-0
service@vde.com
www.vde.com

VDE