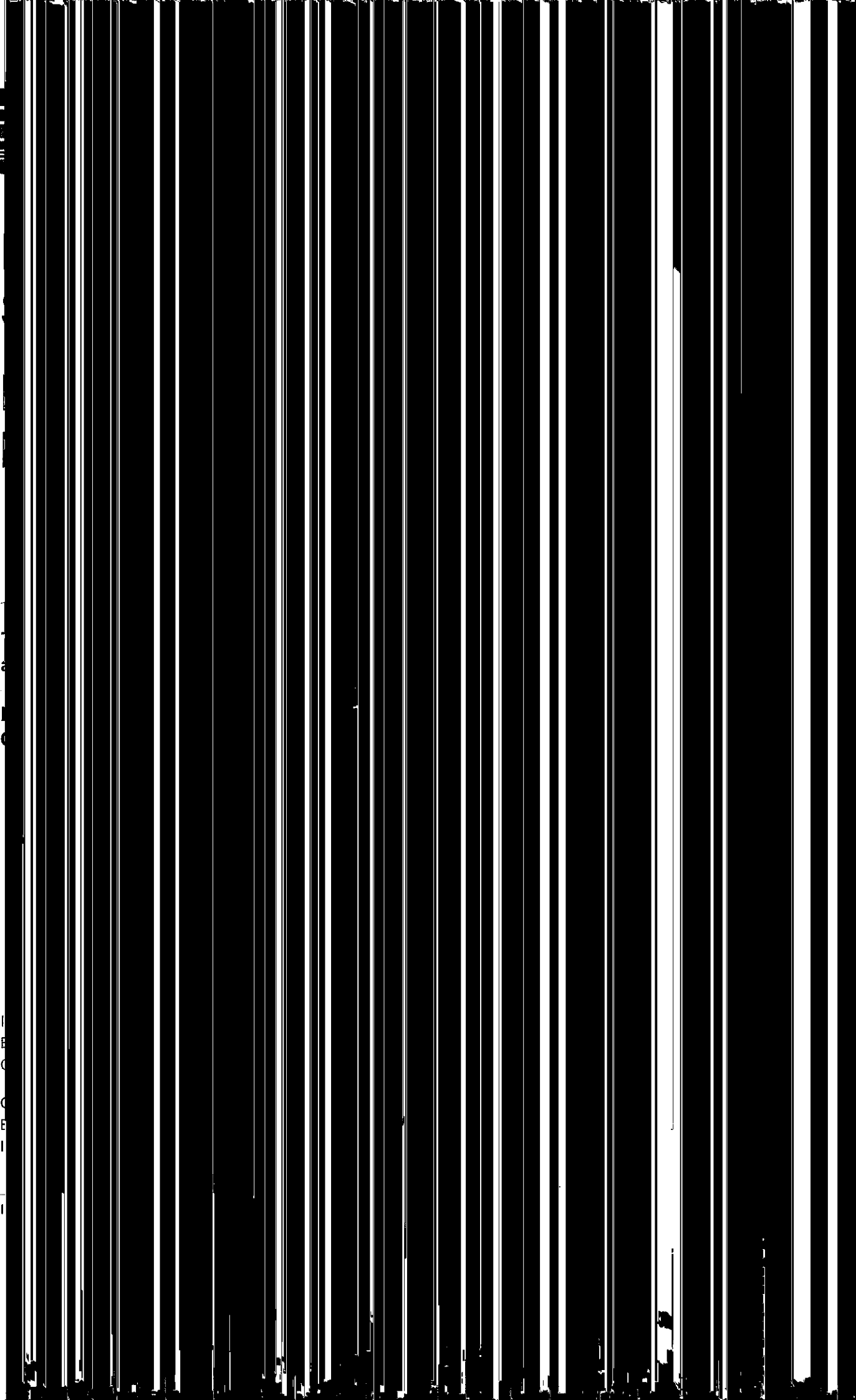


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FOREWORD

- 1 Scope
- 2 Normative references
- 3 Sampling
- 4 Marking
- 5 Testin
- 6 Pass c
- 7 Major
- 8 Report
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- 10 Test p

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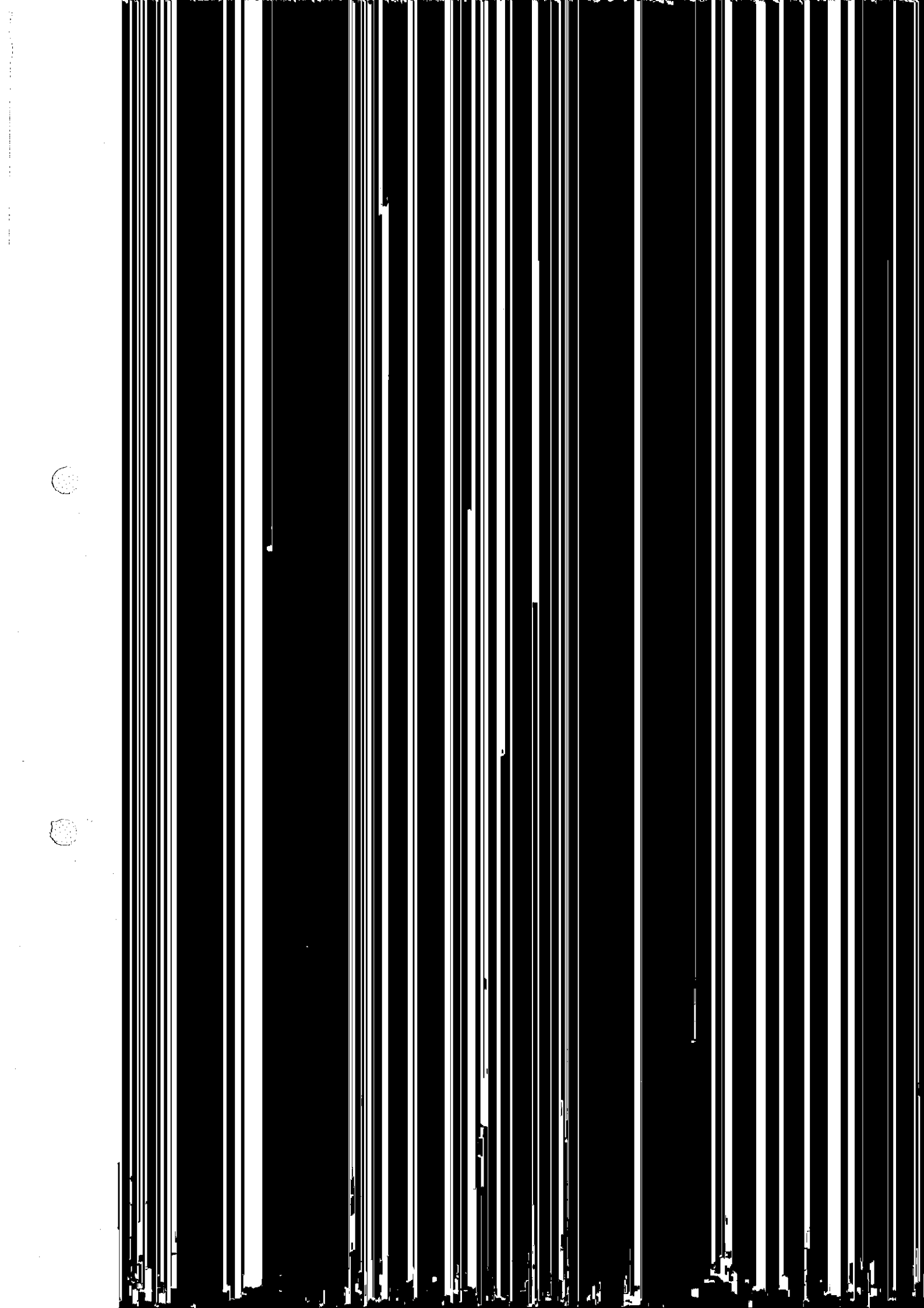
- 10.8.1 Purpose
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 - 10.19.2 Ap
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 - 10.19.5 Re

Bibliography.....

- Figure 1 – Qualification
- Figure 2 – NOCT corre
- Figure 3 – Hot-spot effe
case shading condition
- Figure 4 – Thermal cyc
- Figure 5 – Humidity-fre
- Figure 6 – Hail test equ
- Figure 7 – Impact locat
- Figure 8 – Bypass Dioc

- Table 1 – Summary of t
- Table 2 – Ice ball mass
- Table 3 – Impact locati



- Modified the wording without failure.
- Added requirements
- Removed the "Twist test."
- Made the pass/fail on the module area.
- Added the temperature
- Modified temperature or a solar simulator.
- Deleted reference pla
- Added apparatus section 1.
- Rewrote the hot-spot
- Eliminated edge dip r
- Changed mechanical
- Added bypass diode

The text of this standard

Full information on the voting indicated in the ab

This publication has been

The committee has decided the maintenance result of the data related to the sp

- reconfirmed,
- withdrawn,
- replaced by a revised
- amended.

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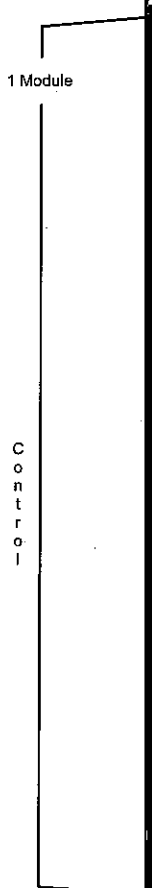
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- o) A statement that the certificate or report shall not be reproduced without the written approval of the laboratory.

A copy of this report shall be kept by the laboratory and manufacturer.

9 Modifications

Any change in the design, materials, components or processing requires the repetition of some or all of the qualification tests to maintain type approval.



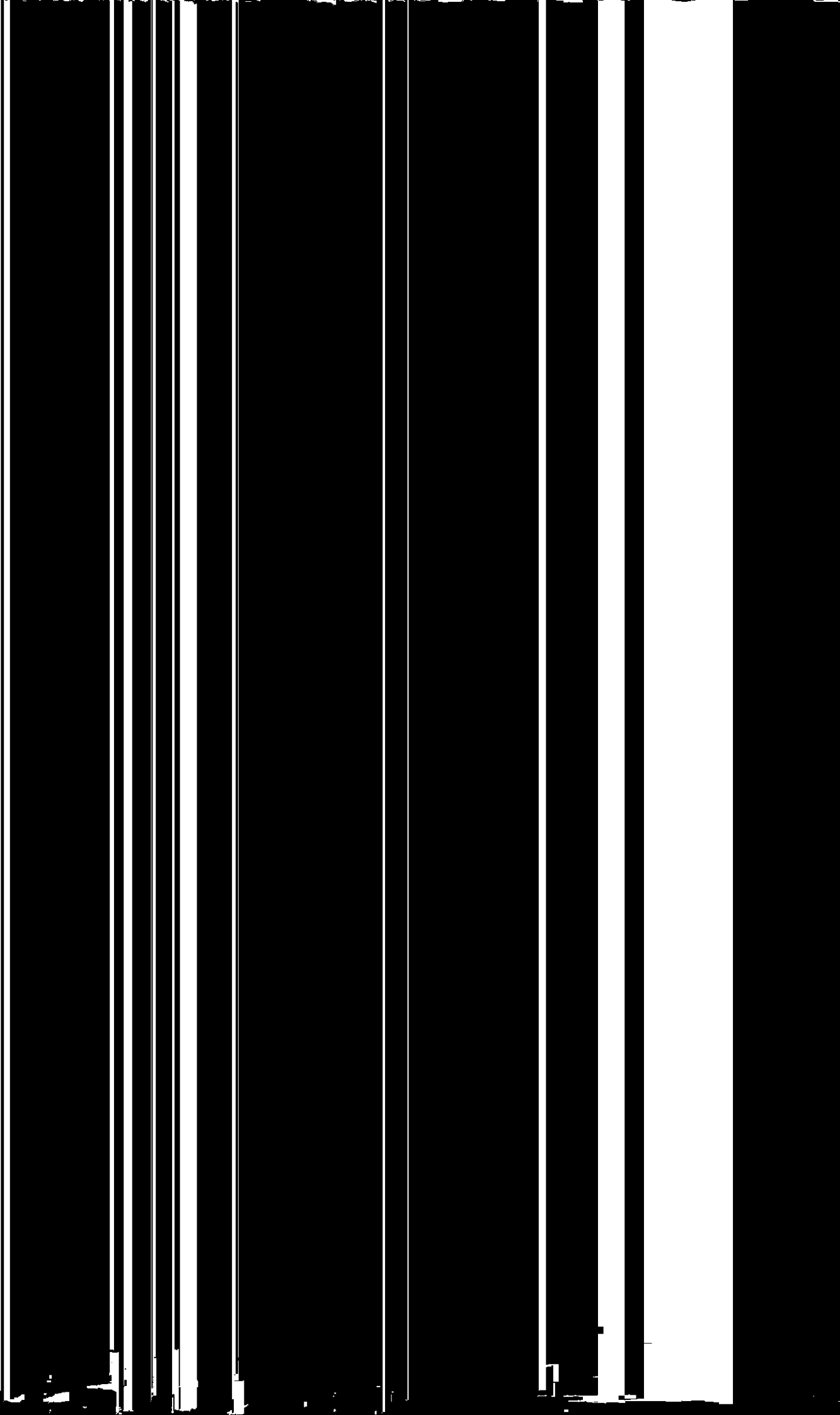
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10 Test procedure

10.1 Visual inspection

10.1.1 Purpose

To detect any

10.1.2 Procedure

Carefully inspect the following conditions:

- cracked, delaminated or damaged;
- faulty interconnections;
- voids in, or between, the cells;
- visible corrosion;
- failure of the encapsulation;
- bubbles or air trapped in the module;
- tacky surfaces;
- faulty terminations;
- any other defects.

Make note of any delamination, subsequent to the test.

10.1.3 Requirements

Visual conditions for the purpose of type testing.

10.2 Maximum power point tracking

10.2.1 Purpose

To determine the maximum power point tracking (MPPT) efficiency of the PV module. Repeat the test for each cell.

10.2.2 Apparatus

- a) A radiant flux source with IEC 60904-9 compliance;
- b) A PV reference cell of the reference technology;
- c) A suitable load resistor, normal to the test;
- d) Apparatus for measuring the current and voltage of the PV module.

10.2.3 Procedure

Determine the maximum power point for a specific set of conditions.

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using natural sur
IEC 60904-9. In
different range of
temperature and
modules tempera
For nonlinear mo
irradiance and w
assure that peak
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particular module

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10.3 Insulation

10.3.1 Purpose

To determine whe
parts and the fram

10.3.2 Apparatu

- a) A d.c. voltage
twice the max
4) according to
- b) An instrument

10.3.3 Test con

The test shall be
(see IEC 60068-1)

10.3.4 Procedu

- a) Connect the
insulation test
- b) Connect the e
If the module f
foil around the
glass superstr
negative termi
- c) Increase the
maximum equ
system voltage
maximum syst
Maintain the v
- d) Reduce the ap
to discharge th
- e) Remove the st
- f) Increase the v
500 V or the m
voltage at this
- g) Reduce the ap
to discharge th
- h) Remove the st

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- b) Mour
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- c) If the
contr
- d) If ten
the s
temp

the test specimen
warm up naturally
equilibrium temperature

- e) Record the current with recording device at the desired temperature in the shade.
- f) The irradiance current (I_{sc}) of the test specimen should be approximately the same as specified temperature.

Where α_{TC} is the temperature coefficient

- g) Adjust the temperature of the test module as specified in item d) performed.
- h) Ensure that the current is constant with temperature. The measurement should be taken at 1 m distance from the test module as defined in item d).
- i) Repeat steps g) and h) until the current is at least 30 measurements. A minimum of 30 measurements should be taken.

10.4.3.2 Procedure

- a) Determine the ambient temperature.
- b) Mount the test specimen and instrumentation.
- c) Set the irradiance as specified in item a).
- d) Heat or cool the test specimen to the desired temperature. The steps of approximately 1°C should be used for measurement.

NOTE 1 The compensation temperature change should be taken into account.

NOTE 2 Care should be taken during measurement.

10.4.3.3 Calculation

- a) Plot the values of I_{sc} versus T_c and a squares-fit curve should be drawn.
- b) From the slope of the curve, calculate α_{TC} .

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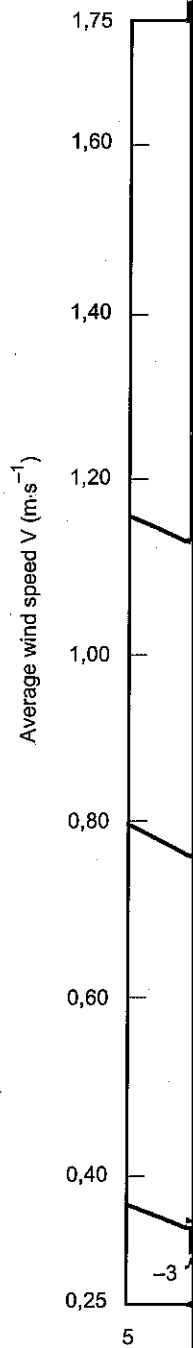
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- d) From a
300 W
 $(T_J - T_a$
- e) Determ
value of
- f) Calcula
associa
from Fig
- g) Add the
sum is
- h) Repeat
they are
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10.6 Performance

10.6.1 Purpose

To determine how
(1 000 $\text{W}\cdot\text{m}^{-2}$, 25
irradiance distribu
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NOTE 2
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are clearly

NOTE 3
conditions

Figure 3
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the shaded
developed
dissipate
generate
This is the
power curve

Module current

Fig

10.9.3

Solar cell

Case S:

Case PS:

Case SP:

Each con

10.9.4 Appar

- a) Radiant sou
- conforming
- b) Module I-V e
- c) Equipment f
- d) Opaque cov
- e) An appropri

10.9.5 Proce

The hot-spot te
spot protective
module is teste

10.9.5.1 Cas

- a) Expose the
stabilization
maximum po
precondition
- b) Short-circuit
- c) Starting from
Move the ce
shaded cells
of the non-s
the selected
- d) Move an op
monitor the
falls outside
size of the
attained aga
- e) The final wi
worst case s
- f) Remove the

NOTE Revers
irregularly spre

- g) Re-measure
- h) Place the co
- i) Expose the r
temperature
condition of
the I_{sc} within
- j) Maintain the
- k) At the end o
appropriate t

10.9.5.2 Cas

- a) Expose the
attained, me

- b) Short
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- c) Re-n
- d) Appl
of 1
- e) At th
appr

10.9.5.3

- a) Expc
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- j) Main
- k) At th
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10.9.6

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- Insul

NOTE 1

NOTE 2
film layers

10.10 UV

10.10.1 Pr

To precondition
freeze test
degradation

10.10.2 A

- a) Equipm
equipm
- b) Means
 ± 2 °C.
module
to moni
- c) Instrum
light so
320 nm
- d) A UV I
 ± 15 %
below 2
regions
- e) A load s

10.10.3 Pr

- a) Using th
and en
250 W·m
 ± 15 % d
- b) Attach
selecte
tempera
- c) Subject
between
band be
prescrib

10.10.4 Fi

Repeat test

10.10.5 Re

- no evid
- insulatic

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10.11.1 Pu

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- a) A d
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- d) Thr
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After a

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a)

b)

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d)

Module temperature (°C)

10.12.3 Pr

- a) Attach a middle.
- b) Install the
- c) Connect
- d) After closing Figure 5 levels at the maximum
- e) Through module

10.12.4 Fin

Repeat test

10.12.5 Re

- No evidence
- Insulation
- No operation

10.13 Dam

10.13.1 Pu

To determine humidity.

10.13.2 Pr

The test shall

- a) Precondition The most precondition
- b) Severity The following Test temperature Relative Test duration

10.13.3 Fir

After a record

10.13.4 Re

- No evidence
- Insulation
- Wet leakage

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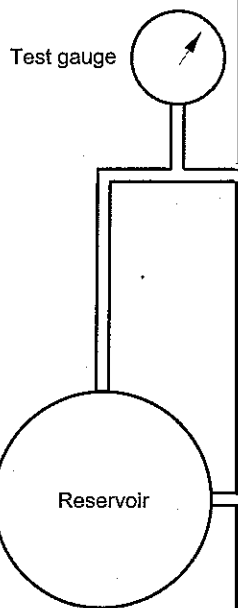
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- b) A freezer, controlled
- c) A storage container
- d) A launcher capable
hit the module with
launcher to the mod
the test requirement
- e) Rigid mount for supp
with the impact surfa
- f) A balance for determ
- g) An instrument for n
velocity sensor shall

As an example, Figure
horizontal pneumatic
electronically measures
beams.

Diameter mm	Mass g
12,5	0,9
15	1,6
25	7,5
35	20,



10.17.3 Procedure

- a) Using the method including so
- b) Examine each requirement
 - no crack
 - diameter
 - mass with
- c) Place the ball
- d) Ensure that room temper
- e) Fire a number adjust the la in the presc Table 2.
- f) Install the n normal to the
- g) Take an ice first impact I ball from the

- h) Inspect the module in the impact area for signs of damage and make effects of the shot. Errors of up to 10 mm from the specified location are allowed.
- i) If the module is undamaged, repeat steps g) and h) for all the other locations shown in Table 3, as illustrated in Figure 7.

Table 3 – Impact locations

Shot Number	Location
1	A corner of the module window, not more than 50 mm from the top edge.
2	An edge of the module, not more than 12 mm from the frame.
3,4	Over the edge of the circuit.
5,6	Over the circuit near cell interconnects.
7,8	Near the point of mounting on the circuit.
9,10	In the center of the circuit, farthest from the mounting points.
11	Any point which may prove especially vulnerable to hail impact.

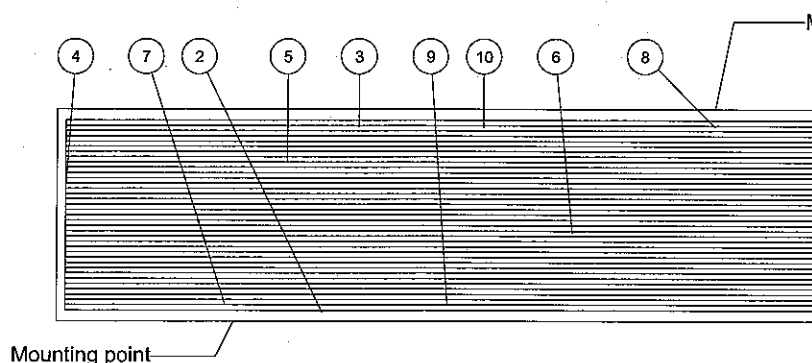


Figure 7 – Impact locations

10.17.4 Final measurements

Repeat tests 10.1 and 10.3.

10.17.5 Requirements

- No evidence of major visual defects, as defined in Clause 7.
- Insulation resistance shall meet the same requirements as for the initial test.

10.18 Bypass diode thermal test

10.18.1 Purpose

To assess the adequacy of the thermal design and relative long-term reliability of the bypass diodes used to limit the detrimental effects of module hot-spot susceptibility.

If the bypass diodes are not accessible in the module type under test, a test sample shall be prepared for this test. This sample shall be fabricated to provide a test environment for the diode as a standard production modules under test and shall be representative of the module type under test.

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10.18.2 Appa

- a) Means for
- b) Means for $\pm 1\text{ }^\circ\text{C}$.
- c) Means for Measurement or by mea should be transfer pa
- d) Means for
- e) Means for module up throughout

10.18.3 Proce

- a) Electrically
- b) Determine sheet.
- c) Measure th
- d) Connect w terminals c the wiring (

NOTE 1 Sor jumper cable

- e) Heat the n current of voltage of
- f) Using the temperatur using the f

where

$T_j =$
 $T_{\text{case}} =$
 $R_{\text{THjc}} =$
 $V_D =$
 $I_D =$

NOTE 2 If th diode, this te $43\text{ }^\circ\text{C} \pm 3\text{ }^\circ\text{C}$

- g) Increase th measured current flow
- h) Verify that

NOTE 3 Diode opera

10.18.4 Procedu

- a) Electrically sho
- b) Determine the sheet.
- c) Connect the le
- d) It is recommen

NOTE The lead wire

- e) Put the modul reaches satur
- f) Apply the puls module, measu
- g) As the same pr
- h) As the same pr
- i) As the same pr
- j) Then, obtain th and V_{D4} .

NOTE This V_D certification.

- k) Heat the modu current of the voltage of the e
- l) Using the V_D v test in k).
- m) Increase the a measured at ST
- n) Maintain the cu
- o) Verify that the

10.18.5 Final Mea

Repeat tests 10.1

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- e) Re

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¹ Under consideration.