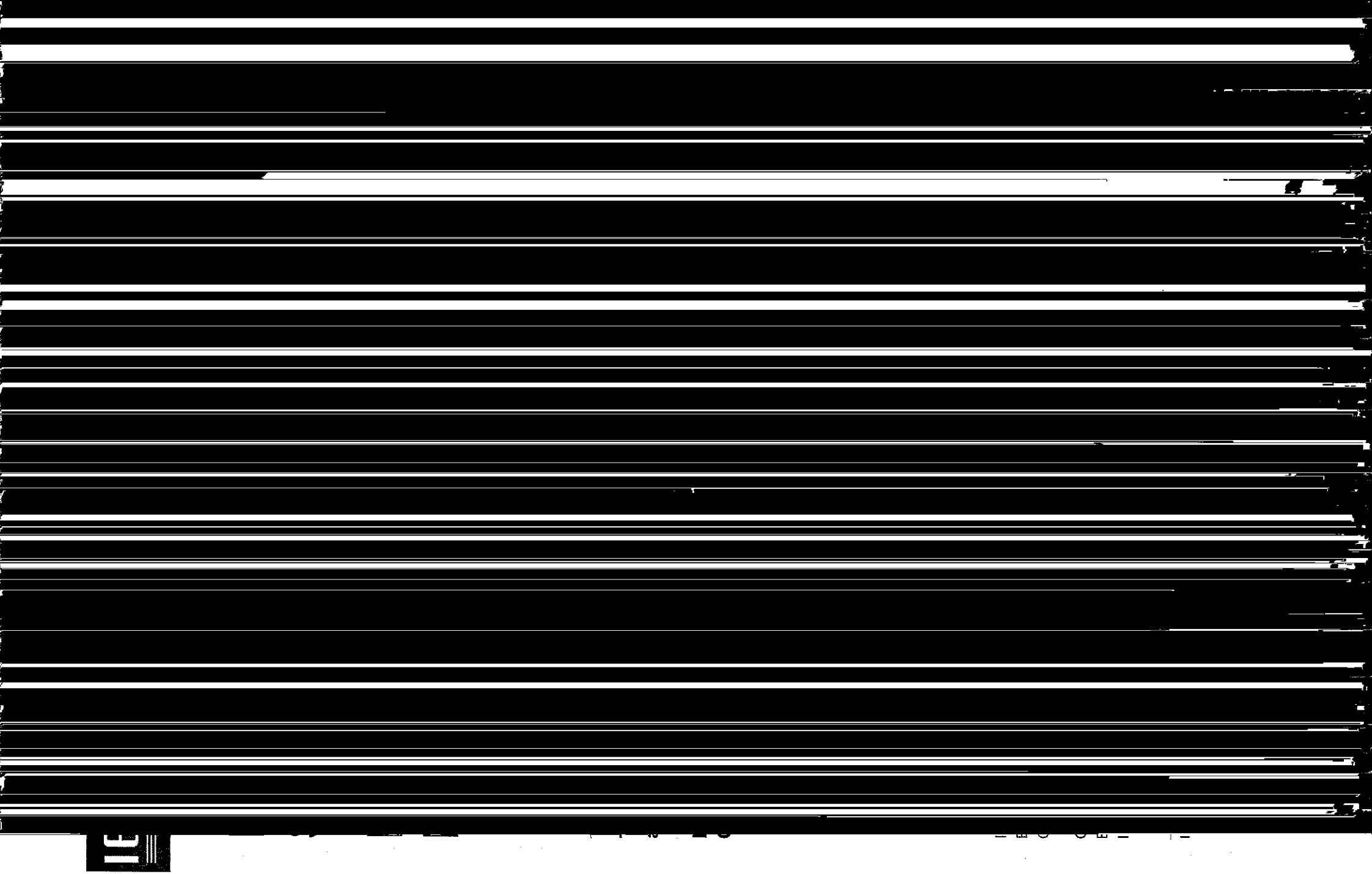

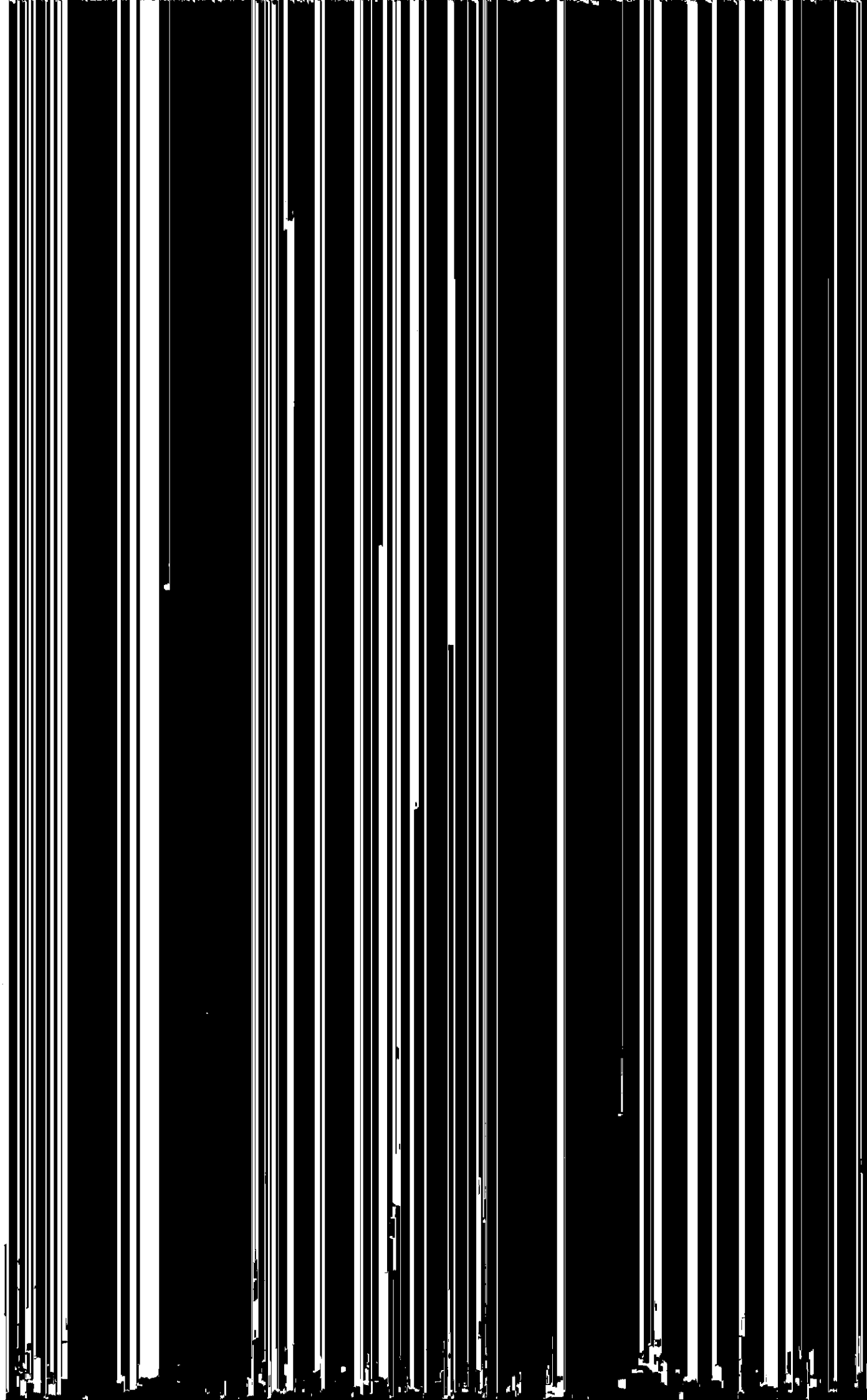

- Modified the wording without failure.
- Added requirements
- Removed the "Twist test.
- Made the pass/fail cr the module area.
- Added the temperatu
- Modified temperature or a solar simulator.
- Deleted reference pla
- Added apparatus sec edition 1.
- Rewrote the hot-spot
- Eliminated edge dip r
-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

The text of this standard

Full information on the v voting indicated in the ab

This publication has beer

The committee has deci the maintenance result c the data related to the sp

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- withdrawn,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

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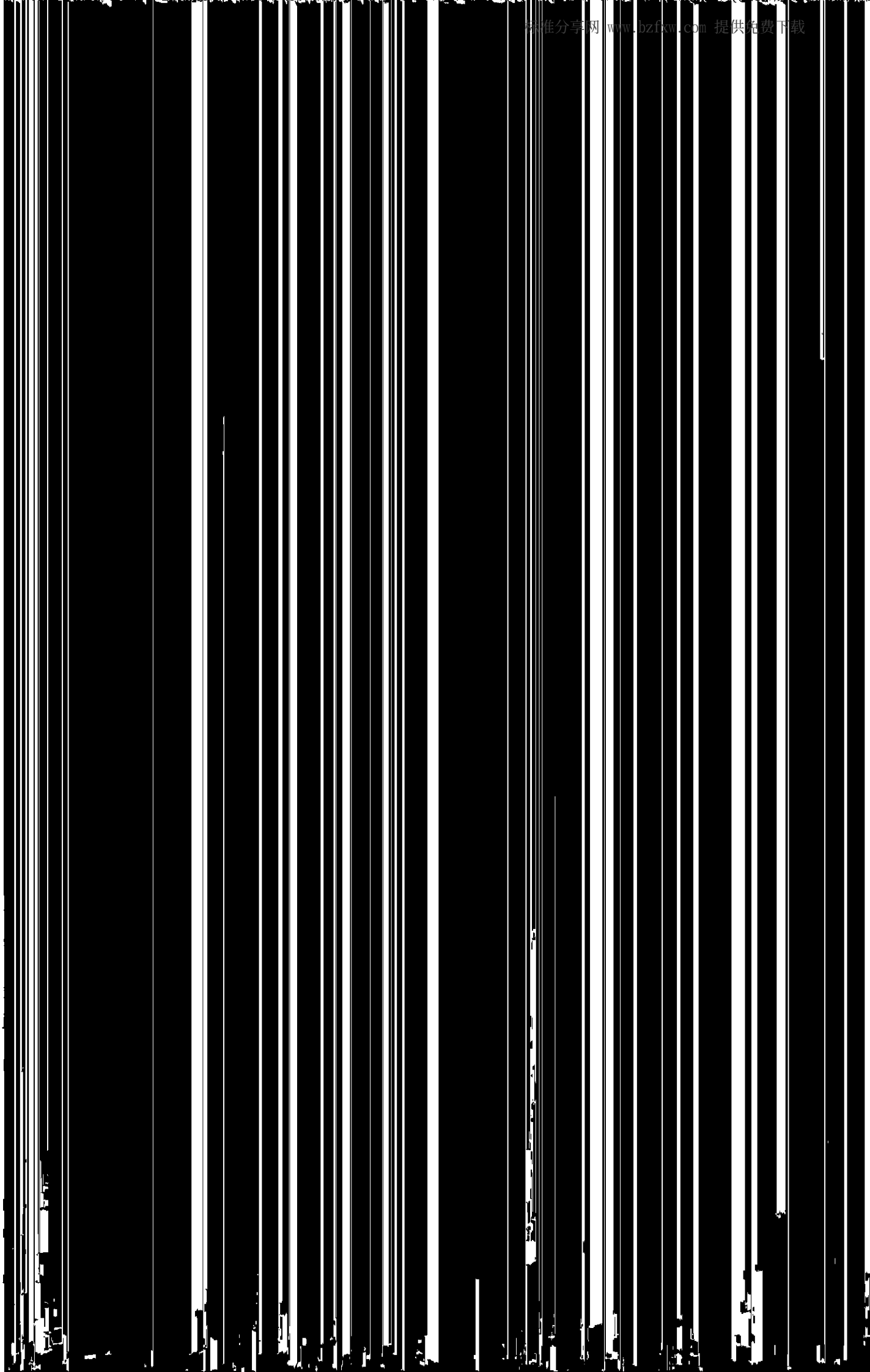
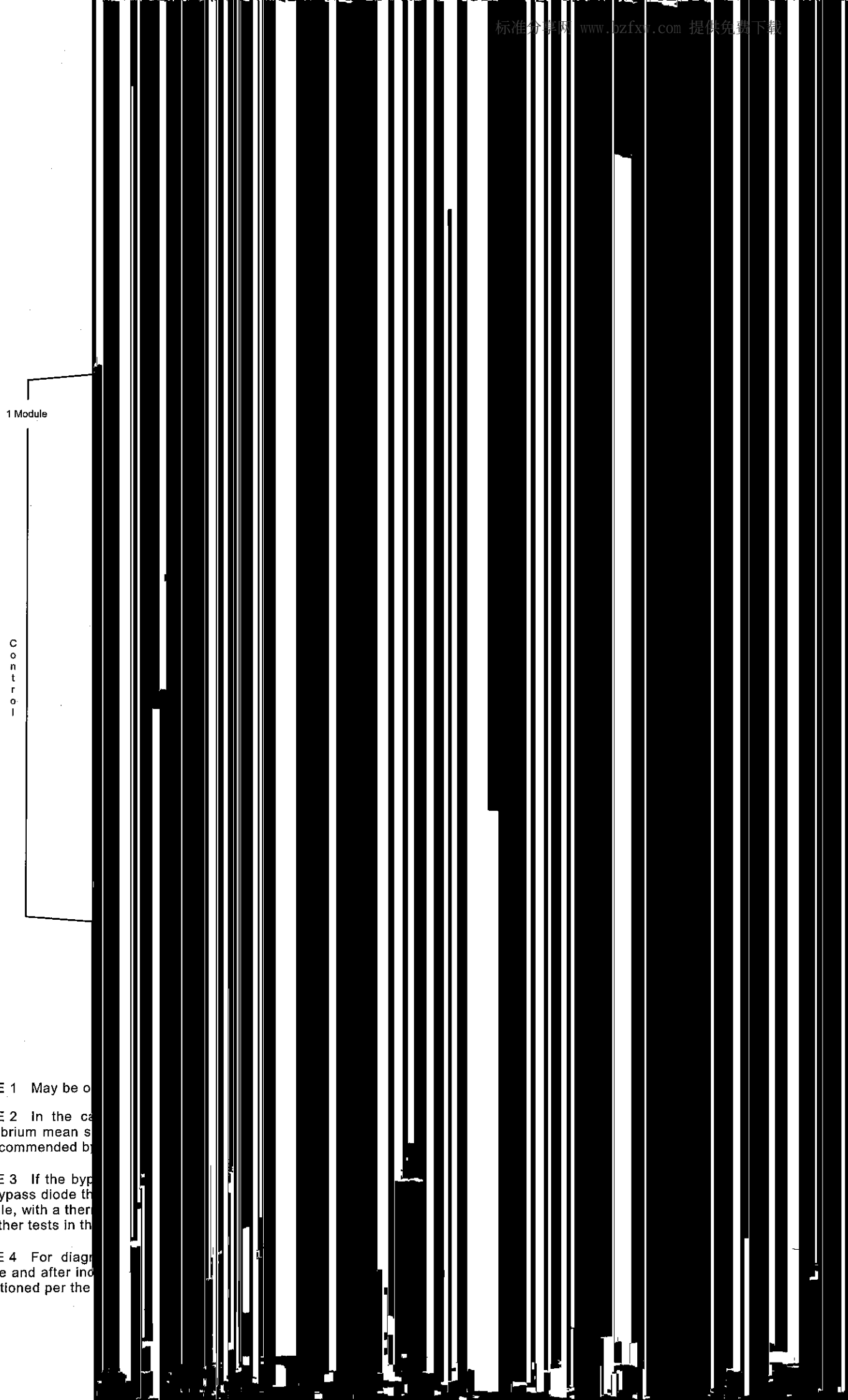


o) A statement that the certificate or report shall not be reproduced except in full without written approval of the laboratory.

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

9 Modifications

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

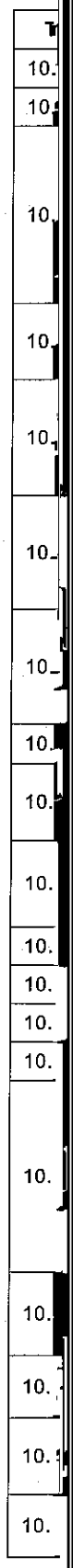


NOTE 1 May be o

NOTE 2 In the ca
equilibrium mean s
as recommended b

NOTE 3 If the byp
the bypass diode th
module, with a ther
the other tests in th

NOTE 4 For diagr
before and after ind
conditioned per the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10 Test pr

10.1 Visual

10.1.1 Pur

To detect any

10.1.2 Proc

Carefully ins
following con

- cracked,
- faulty inte
- voids in, a
- visible co
- failure of
- bubbles c
  module;
- tacky surf
- faulty terr
- any other

Make note
delamination,
subsequent t

10.1.3 Req

Visual conditi
purpose of ty

10.2 Maxim

10.2.1 Purp

To determine
tests. Repeat

10.2.2 App

a) A radiant
   with IEC 6
b) A PV refe
   the refere
   technolog
c) A suitable
   normal to
d) Apparatus

10.2.3 Proc

Determine the
a specific se

temperature betw
using natural sur
IEC 60904-9. In
different range c
temperature and
modules tempera
For nonlinear mc
irradiance and w
assure that peak
minimize the ma
particular module

NOTE The control m

10.3 Insulation

10.3.1 Purpose

To determine whe
parts and the fran

10.3.2 Apparat

a) A d.c. voltage
twice the max
4) according t

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 h
foil around the
glass superstr
negative termi

c) Increase the
maximum equ
system voltag
maximum sys
Maintain the v

d) Reduce the ap
to discharge th

e) Remove the sh

f) Increase the v
500 V or the m
voltage at this

g) Reduce the ap
to discharge th

h) Remove the sh

10.3.5

– no di

– for n
than

– for n
the a

10.4 M

10.4.1

To deter
from mo
which th
irradianc
measuri
coefficie
the mod
condition

10.4.2

The follo

a) a ra
with

b) a PV
deter

c) any
of int

d) a su
plane

e) appa

10.4.3

There ar

10.4.3.1

a) Meas
– th
– th
le
– th

b) Mour
direc

NOTE
within
correc

c) If the
contr

d) If ten
the s
temp

the test specim
warm up natu
equilibrium tem

e) Record the cu
with recording
desired temper
the shade.

f) The irradiance
current (I_{sc}) of
should be app
specified temp

Where α_{rc} is th

g) Adjust the tem
test module as
test module m
item d) perform

h) Ensure that th
constant withi
remains const
be taken at 1
translation car
as defined in

i) Repeat steps
is at least 30
A minimum of

10.4.3.2 Proce

a) Determine th
temperature,

b) Mount the tes
instrumentatio

c) Set the irradia
item a).

d) Heat or cool
desired tempe
steps of app
measurement

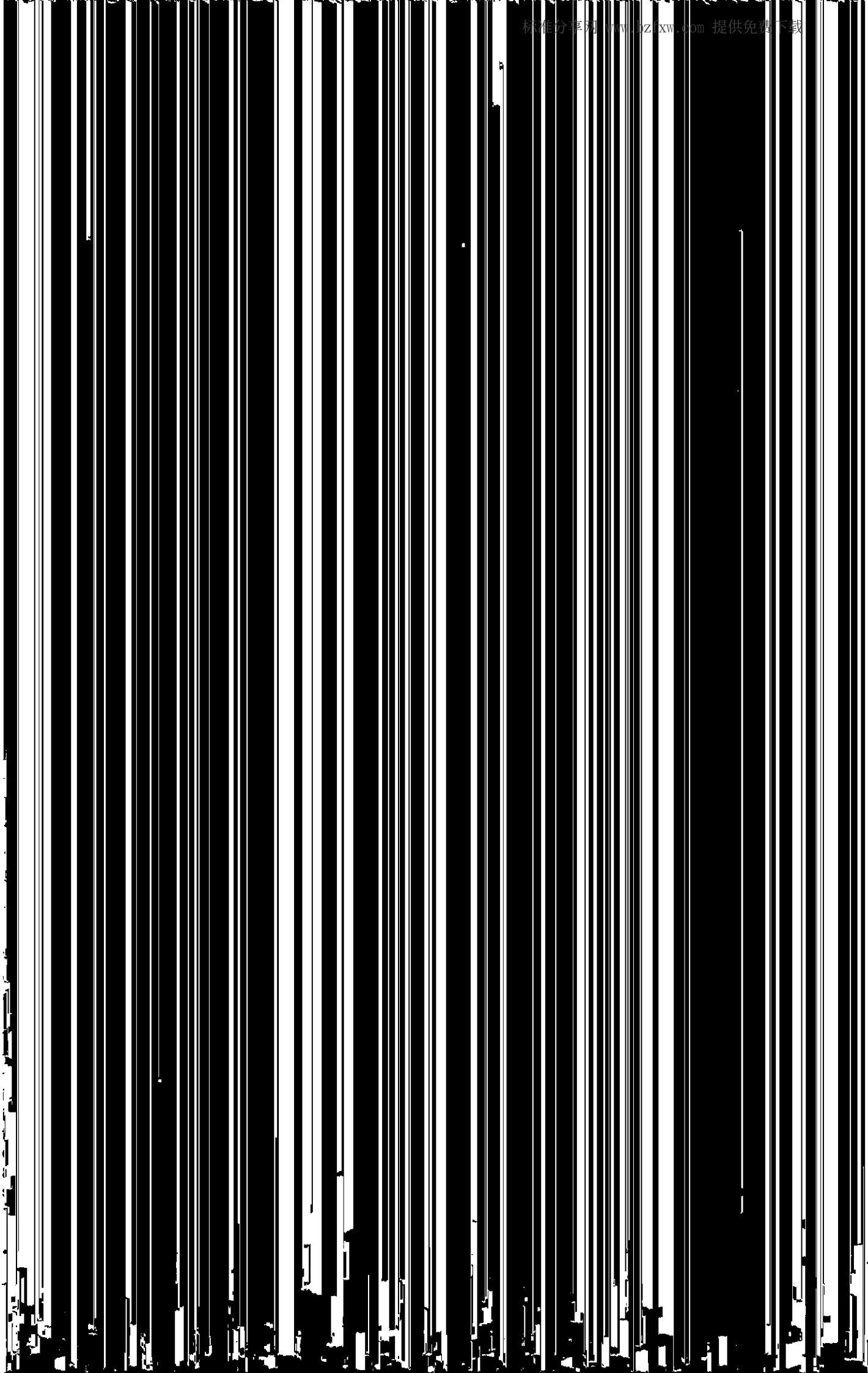
NOTE 1 The compl
temperature change

NOTE 2 Care shou
measurement.

10.4.3.3 Calcu

a) Plot the valu
squares-fit cu

b) From the slo
Calculate α,



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a)

b)

c)

d)

e)

f)

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Su
mo
gro
sha
of

10.

a)

b)

c)

- wind
- amb
- a 10
- wind

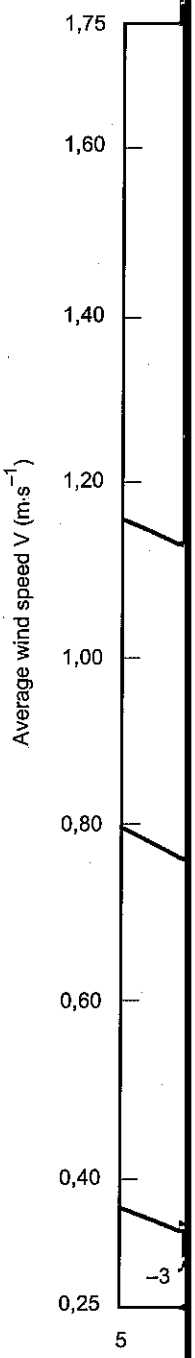
d) From a
300 W·
($T_J - T_a$

e) Determ
value o

f) Calcula
associa
from Fig

g) Add the
sum is

h) Repeat
they ar
third da



10.6 Performanc

10.6.1 Purpose

To determine hov
(1 000 W·m^{-2}, 25
irradiance distribu
reference solar spe

10.

a)

b)

c)

d)

e)

10.

10.

Mai
1 0
usi
IEC

10.

Hea
irra
IEC
req

If t
calc

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To
irra
IEC

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a)

b)

c)

d)

e)

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Det
of 2
usin
sha

6164

does
redu

10.8

10.8.

To m
outdo
detec

NOTE
becau
be use

10.8.

a) A
±

b) M
in

c) A

10.8.

a) A
m
re

b) S
u

10.8.

Repe

10.8.

– nc
– th
– in

10.9

10.9.

To d
meltir
shadc

10.9.

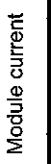
Hot-s
circui
occur
which

NOTE
cells. T
reverse

NOTE 2
shading. C
are clearly

NOTE 3
conditions

Figure 3
cells, wh
the shad
develope
dissipate
generate
This is t
power cu



Fig

10.9.3

Solar cel

Case S:

Case PS

Case SP

Each con

10.9.4 Appar

a) Radiant sou
conforming
b) Module I-V
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 p
precondition
b) Short-circuit
c) Starting fro
Move the c
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
temperature
condition of
the I_{sc} within
j) Maintain the
k) At the end o
appropriate

10.9.5.2 Case

a) Expose the
attained, me

b) Shor
mod
dete

c) Re-n

d) Appl
of 1

e) At th
appr

10.9.5.3

a) Expo
stabi
maxi

b) Ther
follo

I_{min} /

P: nu

c) Shor

d) Start
comp
(num
rang
dissi

e) Cut t

f) Move
at a
rang
maxi
shall

g) Re-m

h) Place

i) Expo
temp
cond
the I_t

j) Main

k) At th
appr

10.9.6

Repeat t

NOTE Th

10.9.7

– No e

– Insul

NOTE 1

NOTE 2
film layers

10.10 UV

10.10.1 Pr

To precond
freeze test
degradatio

10.10.2 A

a) Equipm
equipm

b) Means
±2 °C.
module
to moni

c) Instrum
light so
320 nm

d) A UV l
±15 % c
below 2
regions

e) A load s

10.10.3 Pr

a) Using th
and en
250 W·r
±15 % c

b) Attach
selecte
tempera

c) Subject
betwee
band be
prescrib

10.10.4 Fi

Repeat test

10.10.5 Re

– no evide
– insulatio

10.11 The

10.11.1 Pu

To determi
stresses ca

10.11.

a) A
an
or

b) Me
cir
low

c) Me
±1

d) Me
mo

10.11.

a) Ins

b) Co
tem
mic
tem

c) Clo
–40
cha
the
10
the

d) Thr
mo

10.11.

After a

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To
hu

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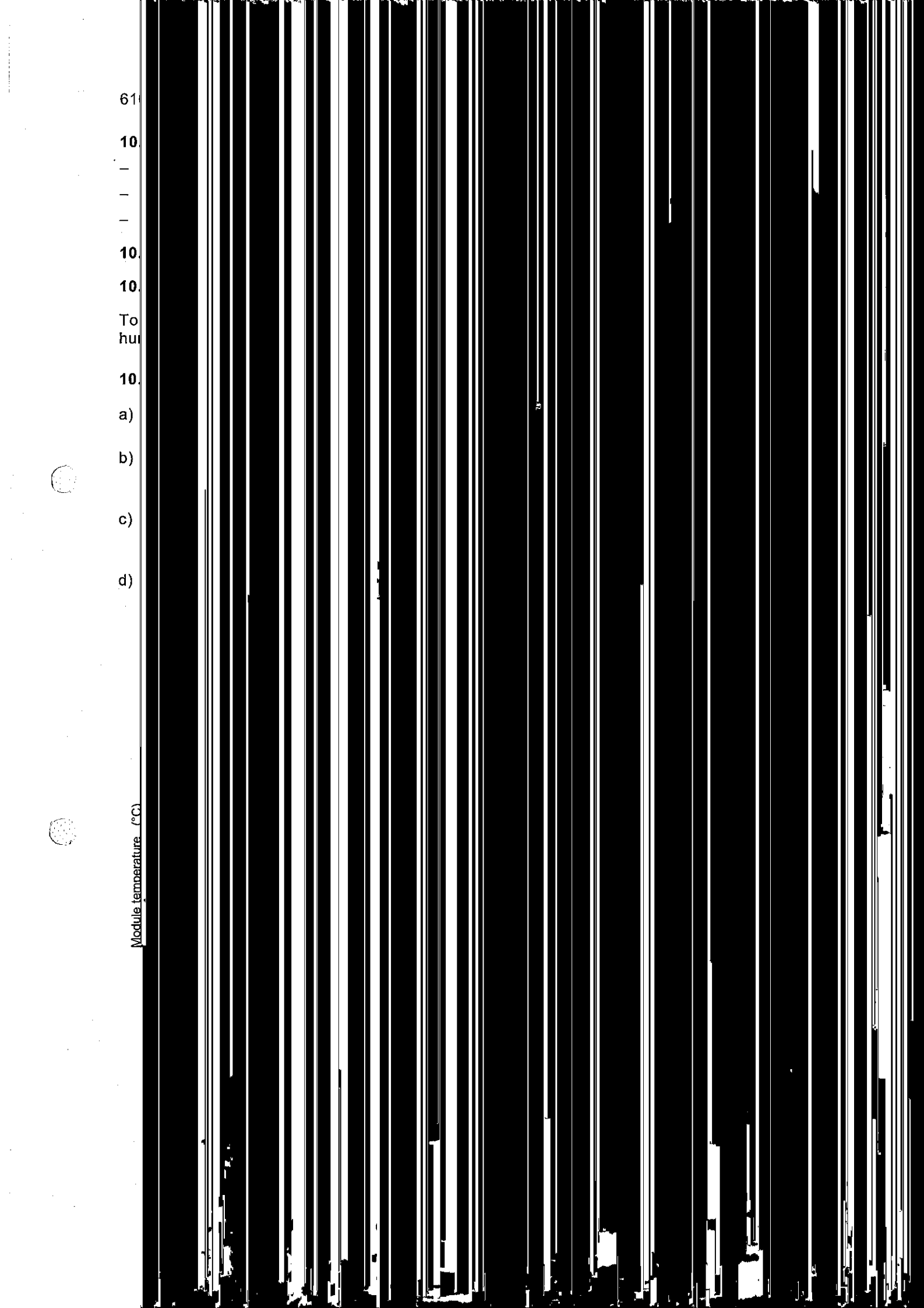
a)

b)

c)

d)

Module temperature (°C)



10.12.3 Pr

a) Attach a
middle.

b) Install t

c) Connec

d) After cl
Figure 5
levels a
the max

e) Through
module(

10.12.4 Fi

Repeat test

10.12.5 Re

– No evid

– Insulatio

– No oper

10.13 Dam

10.13.1 Pu

To determi
humidity.

10.13.2 Pr

The test sh

a) Precond

The mo
precond

b) Severiti

The foll

Test tem

Relative

Test dur

10.13.3 Fi

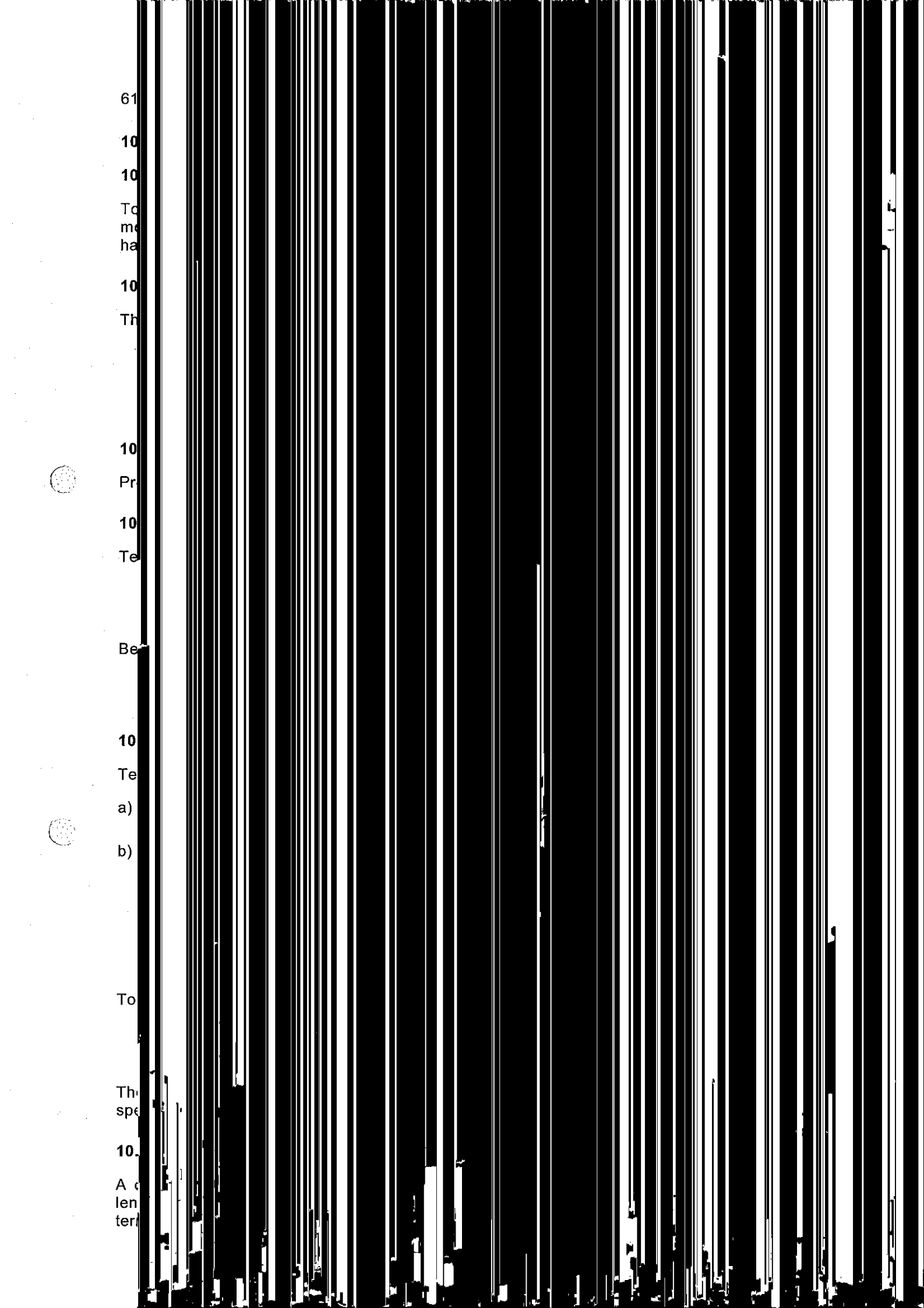
After a reco

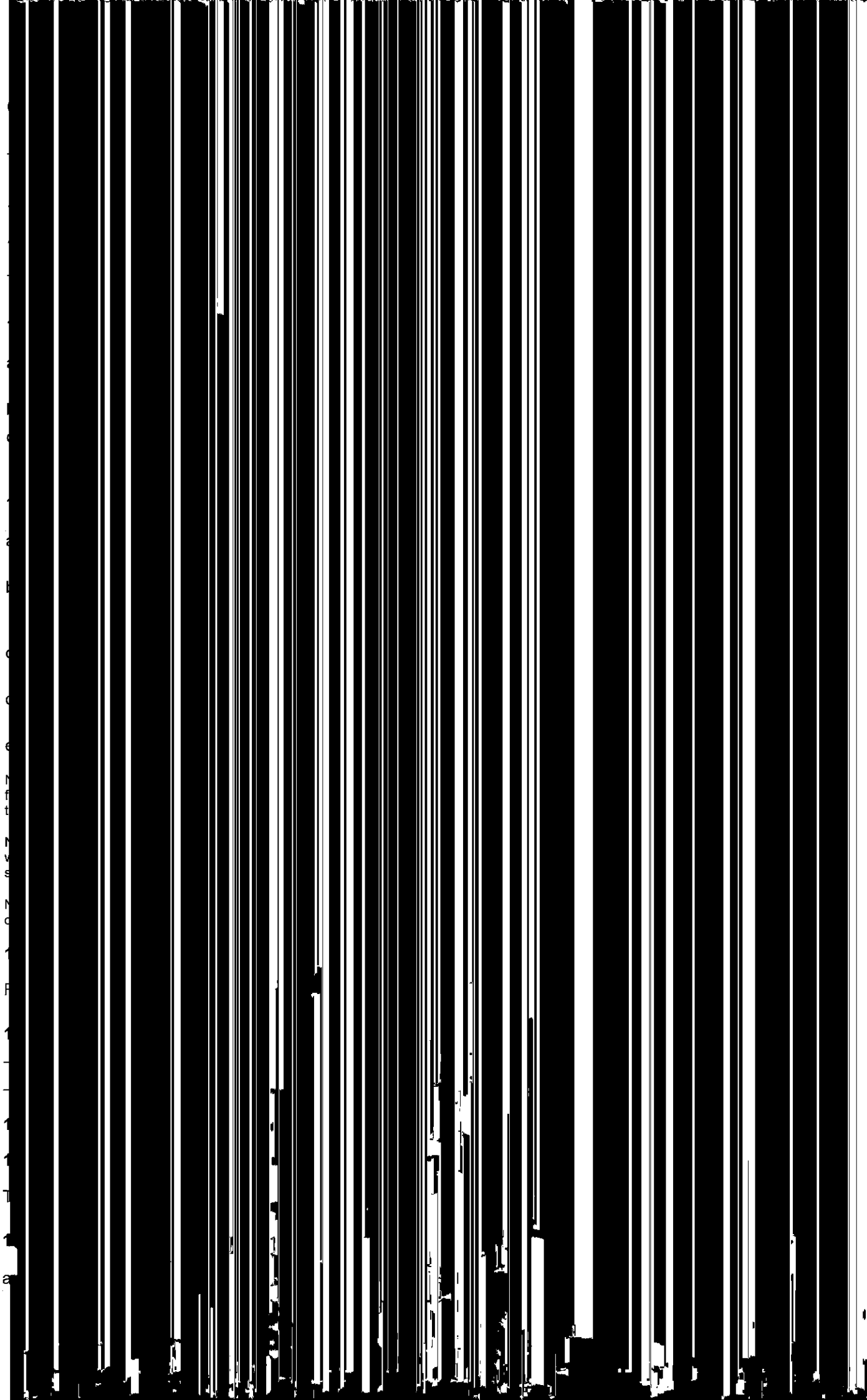
10.13.4 Re

– No evide

– Insulatio

– Wet leak





b) A freezer, controlled

c) A storage container

d) A launcher capable hit the module with launcher to the mod the test requirement

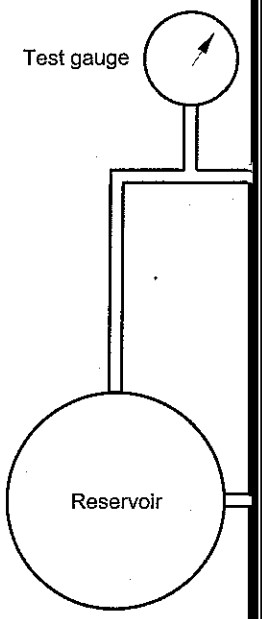
e) Rigid mount for supp with the impact surfa

f) A balance for determ

g) An instrument for velocity sensor shall

As an example, Figur horizontal pneumatic electronically measures beams.

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



10.17.3 Proce

a) Using the m
including so

b) Examine ea
requirement
- no crack
- diameter
- mass wit

c) Place the ba

d) Ensure that
room temper

e) Fire a numb
adjust the la
in the presc
Table 2.

f) Install the m
normal to the

g) Take an ice
first impact l
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 a

i) If the module is undamaged, repeat steps g) and h) for all the ot 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 th
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 impac

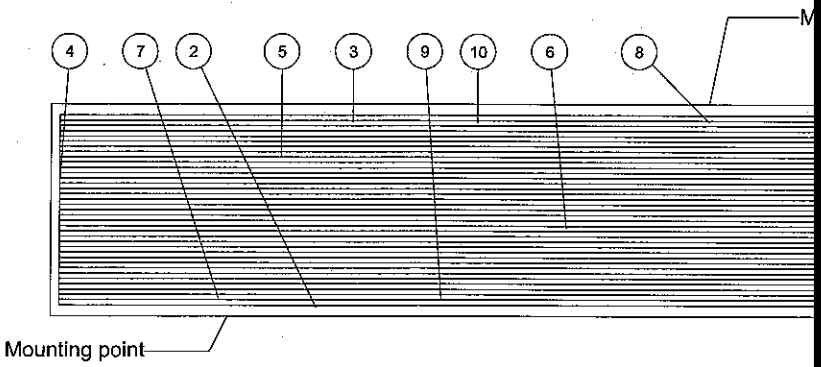


Figure 7 – Impact locations

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 initia

10.18 Bypass diode thermal test

10.18.1 Purpose

To assess the adequacy of the thermal design and relative long-term reli diodes used to limit the detrimental effects of module hot-spot susceptibilit

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

be an active
during the tes
only for the by

10.18.2 Appa

a) Means for

b) Means for
±1 °C.

c) Means for
Measurem
or by mea
should be
transfer pa

d) Means for

e) Means for
module ur
throughou

10.18.3 Proc

a) Electrically

b) Determine
sheet.

c) Measure th

d) Connect w
terminals
the wiring

NOTE 1 So
jumper cable

e) Heat the m
current of
voltage of

f) Using the
temperatur
using the f

where

T_j =

T_{case} =

R_{THjc} =

V_D =

I_D =

NOTE 2 If th
diode, this te
43 °C ± 3 °C

g) Increase th
measured
current flow

h) Verify that

NOTE 3 Diode opera

10.18.4 Procedu

a) Electrically sh

b) Determine the sheet.

c) Connect the le

d) It is recommer

NOTE The lead wire

e) Put the modul reaches satura

f) Apply the puls module, measu

g) As the same pı

h) As the same pı

i) As the same pı

j) Then, obtain th and V_{D4}.

NOTE This V_D certification.

k) Heat the modu current of the voltage of the

l) Using the V_D v test in k).

m) Increase the a measured at S

n) Maintain the cu

o) Verify that the

10.18.5 Final Mea

Repeat tests 10.1

61646

10.18

– Th
th
– N
– In
– Th

10.19

10.19

To st
simul

10.19

a) A
b) A
c) M
re
d) M
e) Re
po

10.19

a) At
m
b) W
60
c) Du
10
d) Su
oc
int
fol
me
wi
e) Re

10.19.

Repea

10.19.

– No
– Ins
– Aft
of

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photovoltaic (PV) device

IEC 61853, *Performance testing and energy rating of terrestrial p*

[1] Under consideration.