REPORT No 12051

Date of issue: *October 7, 2026*

Status: FINAL REPORT

****

IEC 60529

DEGREES OF PROTECTION PROVIDED BY ENCLOSURES (IP CODE)

Program: SQO-IP1 (Round 9)

****

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1. FOREWORD

This report summarizes the results of the **SQO-IP1 (Round 9)** proficiency testing program on the classification of degrees of protection of enclosures. This program is carried out under a simultaneous participation format, as described in clause A.2.2 of ISO/IEC 17043: 2023 (Types of PT schemes).

South Quality conducted the testing program between July and September 2026. The aim of the program was to assess the ability of laboratories to competently perform the nominated tests.

2. ORGANIZATION

Program Coordinator:	Eng. Esteban Di Marco
Assistant Technician:	Valentyn Kravchenko
Statistics:	Lic. Manuel Tozaki
Supervision:	Eng. Emiliano Medina

3. OBJECTIVE

The objective of this proficiency testing program is to determine the minimum approved IP code protection level for the samples provided, in accordance with the following standard:

Standard
IEC 60529 Ed. 2.2

To perform this verification, batches of luminaires and industrial enclosures were selected.

Participants in this program have not been informed in advance about the expected behavior of the samples they receive.

4. PARTICIPANTS

In the present round, 24 laboratories have participated with the following details:

CODE	Country	ISO 17025 accredited	Results delivered
01	Hong Kong	Yes	Yes
02	Romania	Yes	Yes
03	Pakistan	No	No
04	China	Yes	Yes
05	Malaysia	Yes	Yes
06	France	Yes	Yes
07	Colombia	No	Yes
08	Spain	Yes	No
09	Spain	Yes	Yes
10	Brazil	Yes	Yes
11	Brazil	Yes	Yes
12	Portugal	Yes	Yes
13	Argentina	No	Yes
14	Peru	Yes	Yes
15	England	Yes	No
16	South Korea	Yes	Yes
17	Chile	Yes	Yes
18	Germany	Yes	Yes
19	Thailand	Yes	Yes
20	Mexico	Yes	Yes
21	Italy	Yes	Yes
22	Netherlands	Yes	Yes
23	Netherlands	Yes	Yes
24	Belgium	Yes	No

5. HOMOGENEITY

Several batches were prepared identically by the staff at South Quality.

Subsequently, a homogeneity study was conducted with an ISO 17025 accredited laboratory.

The control process followed ISO 33405: 2024, clauses 7.4.1.1 / 7.4.1.2. Stratified random sampling was applied, and the samples were selected using random-number-generation software.

The results of this test are presented below:

Size of each batch: **50 units** Tested samples from each batch: **10 units**

DETERMINATION	LUMINAIRE - HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES		
	BATCH: LIP3527	BATCH: LIP3528	BATCH: LIP3529
IP code	YES	YES	YES

Size of each batch: **50 units** Tested samples from each batch: **10 units**

DETERMINATION	INDUSTRIAL ENCLOSURE - HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES		
	BATCH: LIP4238	BATCH: LIP4239	BATCH: LIP4240
IP code	YES	NO	YES

Samples for this program are taken from the selected batches identified as **LIP3528**, and **LIP4240**.

The analysis of the test data indicated that the selected samples exhibited sufficient homogeneity for the program. Therefore, the results of participants identified as outliers cannot be attributed to sample variability.

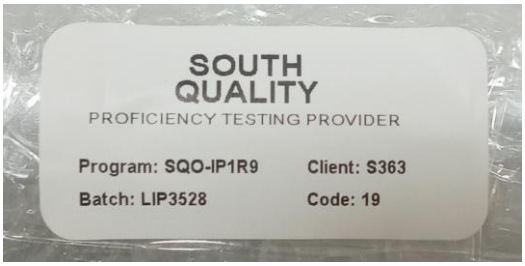
6. SAMPLE INFORMATION

The following samples were sent for testing (Participant **Code 19**):

Batch:	LIP3528
Sample ID:	19
Characteristics:	Garden lamp stand - No lamp

Batch:	LIP4240
Sample ID:	25
Characteristics:	Industrial enclosure - 8.0 x 7.5 x 6.5 cm

7. IMAGES

SAMPLES
  
GARDEN LAMP STAND
  
INDUSTRIAL ENCLOSURE

8. ASSIGNED RESULTS

The assigned results are derived from the consensus of the valid results reported by participating laboratories (**Consensus values**).

Results submitted after the deadline, missing results, and results excluded under the statistical procedure are not included in the consensus.

9. STATISTICS

The results must be treated as quantitative.

For quantitative results the comparison is made according to B.4.1.3 of ISO 17043 and the appropriate technique is to compare participant results with the assigned values. The results can be compared using difference ***D*.**

$$D = (x - X)$$

x is the participant's result

X is the assigned value

The performance evaluation is carried out with the following criteria:

$|D| = 0$ indicates "satisfactory" performance and generates no signal;

$|D| = 1$ indicates "questionable" performance and generates a warning signal;

$|D| > 1$ indicates "unsatisfactory" performance and generates an action signal;

10. PARTICIPANTS' RESULTS

LABORATORY CODE	IP CODE			
	Batch: LIP3528		Batch: LIP4240	
	First characteristic numeral	Second characteristic numeral	First characteristic numeral	Second characteristic numeral
01	5	3	5	4
02	5	3	5	5
04	5	3	5	4
05	NP	3	NP	4
07	5	3	5	4
09	5	2	5	4
10	5	3	5	4
11	5	3	5	4
12	3	3	5	6
13	5	3	5	4
14	5	3	6	4
16	5	3	5	4
17	5	ND	NP	NP
18	5	3	5	2
19	NP	6	NP	4
20	5	3	5	4
21	3	5	6	6
22	2	3	5	4
23	5	3	6	4

ASSIGNED VALUES				
PROPERTY	**Batch: LIP3528**		**Batch: LIP4240**	
IP CODE	**5**	**3**	**5**	**4**

Legends: **ND**: Not determined

NP: Not performed

11. EVALUATION OF PERFORMANCE

LABORATORY CODE	$\|D\|$			
	Batch: LIP3528		Batch: LIP4240	
	First characteristic numeral	Second characteristic numeral	First characteristic numeral	Second characteristic numeral
01	0	0	0	0
02	0	0	0	1
04	0	0	0	0
05	-	0	-	0
07	0	0	0	0
09	0	1	0	0
10	0	0	0	0
11	0	0	0	0
12	2	0	0	2
13	0	0	0	0
14	0	0	1	0
16	0	0	0	0
17	0	-	-	-
18	0	0	0	2
19	-	3	-	0
20	0	0	0	0
21	2	2	1	2
22	3	0	0	0
23	0	0	1	0

Laboratory **Code 01**: The laboratory obtained **SATISFACTORY** results in the verification of all parameters.

Laboratory **Code 02**: The laboratory obtained a **QUESTIONABLE** result in the verification of the second characteristic numeral for batch **LIP4240**. However, it achieved **SATISFACTORY** results in the verification of the remaining parameters.

Laboratory **Code 03**: The laboratory did not send the results before the deadline.

Laboratory **Code 04**: The laboratory obtained **SATISFACTORY** results in the verification of all parameters.

Laboratory **Code 05**: The laboratory did not perform the determination of the first characteristic numeral for either batch, as it does not carry out dust testing. It obtained **SATISFACTORY** results in the verification of the second characteristic numeral for both batches.

Laboratory **Code 06**: The laboratory did not send the results before the deadline.

Laboratory **Code 07**: The laboratory obtained **SATISFACTORY** results in the verification of all parameters.

Laboratory **Code 08**: The laboratory did not send the results before the deadline.

Laboratory **Code 09**: The laboratory obtained a **QUESTIONABLE** result in the verification of the second characteristic numeral for batch **LIP3528**. However, it achieved **SATISFACTORY** results in the verification of the remaining parameters.

Laboratory **Code 10**: The laboratory obtained **SATISFACTORY** results in the verification of all parameters.

Laboratory **Code 11**: The laboratory obtained **SATISFACTORY** results in the verification of all parameters.

Laboratory **Code 12**: The laboratory obtained **UNSATISFACTORY** results in the verification of the first characteristic numeral for batch **LIP3528** and of the second characteristic numeral for batch **LIP4240**. However, it achieved **SATISFACTORY** results in the verification of the remaining parameters.

Laboratory **Code 13**: The laboratory obtained **SATISFACTORY** results in the verification of all parameters.

Laboratory **Code 14**: The laboratory obtained a **QUESTIONABLE** result in the verification of the first characteristic numeral for batch **LIP4240**. However, it achieved **SATISFACTORY** results in the verification of the remaining parameters.

Laboratory **Code 15**: The laboratory did not send the results before the deadline.

Laboratory **Code 16**: The laboratory obtained **SATISFACTORY** results in the verification of all parameters.

Laboratory **Code 17**: The laboratory obtained a **SATISFACTORY** result in the verification of the first characteristic numeral for batch **LIP3528**. For the second characteristic numeral of batch **LIP3528**, it did not determine compliance: it only indicated the degree that was not met, without stating the degree that was met. It did not submit the results for batch **LIP4240** before the deadline.

Laboratory **Code 18**: The laboratory obtained an **UNSATISFACTORY** result in the verification of the second characteristic numeral for batch **LIP4240**. However, it achieved **SATISFACTORY** results in the verification of the remaining parameters.

Laboratory **Code 19**: The laboratory did not perform the determination of the first characteristic numeral for either batch, because its dust testing equipment failed. It obtained an **UNSATISFACTORY** result in the verification of the second characteristic numeral for batch **LIP3528** and a **SATISFACTORY** result for batch **LIP4240**.

Laboratory **Code 20**: The laboratory obtained **SATISFACTORY** results in the verification of all parameters.

Laboratory **Code 21**: The laboratory obtained **UNSATISFACTORY** results in the verification of both characteristic numerals for batch **LIP3528** and of the second characteristic numeral for batch **LIP4240**. It obtained a **QUESTIONABLE** result in the verification of the first characteristic numeral for batch **LIP4240**.

Laboratory **Code 22**: The laboratory obtained an **UNSATISFACTORY** result in the verification of the first characteristic numeral for batch **LIP3528**. However, it achieved **SATISFACTORY** results in the verification of the remaining parameters.

Laboratory **Code 23**: The laboratory obtained a **QUESTIONABLE** result in the verification of the first characteristic numeral for batch **LIP4240**. However, it achieved **SATISFACTORY** results in the verification of the remaining parameters.

Laboratory **Code 24**: The laboratory did not send the results before the deadline.

12. CONCLUSIONS

The overall performance of the laboratories participating in the **SQO-IP1 (Round 9)** program, based on expected results from the participating laboratories, was as follows:

- Participants Codes **01, 04, 05, 07, 10, 11, 13, 16, 17,** and **20** have obtained a **SUFFICIENT** performance according to the expected results and should not take action.

- Participants Codes **02, 09, 14,** and **23** have obtained an **ALMOST SUFFICIENT** performance according to the expected results and must evaluate if it is necessary to take corrective action.

- Participants Codes **12, 18, 19, 21,** and **22** have obtained an **INSUFFICIENT** performance in accordance with the expected results and must take corrective action (See annex B).

The criteria used for the evaluation of the overall performance are the following:

- **SUFFICIENT** performance: No unsatisfactory/questionable results obtained.

- **ALMOST SUFFICIENT** performance: No unsatisfactory results were obtained, but one questionable result was found.

- **INSUFFICIENT** performance: An unsatisfactory result or two questionable results were obtained.

APPENDIX A

A1 - PARTICIPANT DATA

Company: **STI Environmental Reliability Laboratory Co., Ltd.**

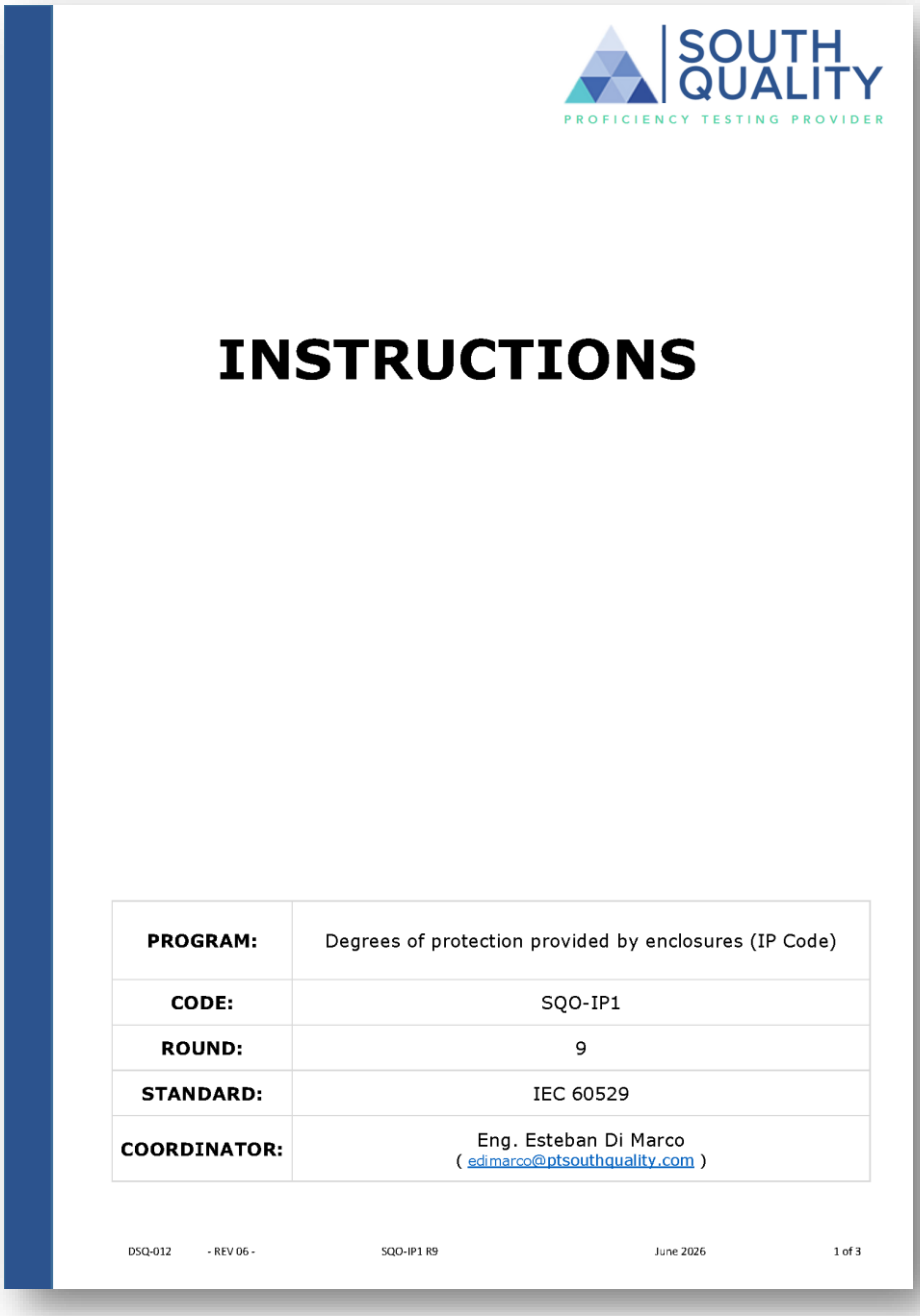
Country: Thailand

Client ID: S363

Contact person: Bunyarit Hemtanon

bunyarit@stilaboratory.com

A2 - INSTRUCTIONS



INSTRUCTIONS

PROGRAM:	Degrees of protection provided by enclosures (IP Code)
CODE:	SQO-IP1
ROUND:	9
STANDARD:	IEC 60529
COORDINATOR:	Eng. Esteban Di Marco (edimarco@ptsouthquality.com)

DSQ-012 - REV 06 - SQO-IP1 R9 June 2026 1 of 3

1 - General

This document serves as a guide for managing the results of the **SQO-IP1 (Round 9)** program.

2 - Standard

IEC 60529 Ed. 2.2

3 - Participant

STI Environmental Reliability Laboratory Co., Ltd.	**CODE 19**

4 - Tests involved

TEST
Classification - Minimum approved degree of protection (First and second characteristic number)

5 - Samples

CODE	SAMPLE	QUANTITY
LIP3528-19	Garden lamp stand - No lamp	1
LIP4240-19	Industrial enclosure - 8.0 x 7.5 x 6.5 cm	1

6 - Notes

a) The deadline for the delivery of results is **August 21, 2026**.
b) The participant must submit the results using the usual report employed by their laboratory.
c) The maximum IP ratings to be verified (inclusive) are as follows:

LIP3528	IP 56
LIP4240	IP 66

d) The samples are to be handled as routine lab samples, with all testing, documentation, and reporting adhering to **IEC 60529**.
e) To review the results, test images would be appreciated. Images can be attached at the end of this document or sent by email.

PHOTOGRAPHS

A3 - PARTICIPANT RESULTS (TEST REPORT #S511/2026-A1)

Test Report

Report Number: S511/2026-A1 - SQO-IP1 (Round 9)

Report Name: Degrees of protection provided by enclosures (IP Code)

Applicant Name: STI Environmental Reliability Laboratory Co., LTD. (CODE 19)

Report Date: Sep 02,2026

STI Environmental Reliability Laboratory Co., LTD.

STI Environmental Reliability Laboratory Co.,Ltd.

Test Report

Signature Approval

Prepared by:	Wu fan	Sep 02,2026
Verified by:	Zhang Chong	Sep 02,2026
Approved by:	Zhang Jiajia	Sep 02,2026

Test Report

1.Sample Information

Name	Model	Serial Number	Dimension	Quantity	Weight
Garden lamp stand - No lamp	/	2#:LIP3528-19	/	1	/
Industrial enclosure	/	1#:LIP4240-25	8.0 x 7.5 x 6.5 cm	1	/
Manufacturer	Name	/			
	Contact Address	/			
Applicant	Name	STI Environmental Reliability Laboratory Co., LTD.			
	Contact Address	700/912 Moo 3, Tambon Nongkakha, Amphur Panthong, Chonburi 20160			
Appearance	normal (the pictures shown on Page 5)				
Receiving Date	Jul 14,2026	Test Classification	Check and accept		

2.Test Basis/Items

Test Basis	IEC 60529: Ed.2.2
Test Items	IPX6 test; IPX5 test; IPX4 test

3.Test Result / Conclusion

1)After the IPX6 test, there were no water droplets inside the lamp cover of 2#sample, water droplets appeared on the outer side of the base, and no water droplets were found on the electrical connection part on the inner side of the base. This did not affect the electrical performance of the sample and met the requirements of the IPX6 test result. The IPX6 test has been passed.

2)After the IPX6 test, there were numerous water droplets inside 1#sample , which affected the electrical performance of the sample and did not conform to the requirements of the IPX6 test results. The IPX6 test failed.

3)After the IPX5 test, there were water droplets inside 1#sample , which affected the electrical performance of the sample and did not conform to the requirements of the IPX5 test results. The IPX5 test failed.

4)After the IPX4 test, there were no water droplets inside the 1#sample. The IPX4 test has been passed.

Sample	Test	Test Result
1#: Industrial enclosure	IPX6	Fail
	IPX5	Fail
	IPX4	PASS
2#: Garden lamp stand - No lamp	IPX6	PASS

Test Report

Test Engineer	Wu fan	STI Environmental Reliability Laboratory Co., LTD.	
Verifier	Zhang Chong	Sep 02,2026	
Deviation: /			
Remarks: /			

4.Test Information

Test Date	Aug 21,2026~Sep 02,2026	Temperature	26℃~27℃
Test Director	Wu fan	Humidity(RH)	47%~55%
Test Engineer	Wu fan	Quality Director	Zhang Chong
Test Location	STI Environmental Reliability Laboratory Co., LTD.		
Test Procedure	IEC 60529: Ed.2.2 (IPX6;IPX5;IPX4)		
Test Methods/ Conditions	the test methods/ conditions shown from page 6 to page 20		

5. Test Equipments

No.	Equipment Name	Model	Serial Number	Calibration due date
1	Waterproof testing device(multi)	SDFC-IP1-6-9K	231380053	May 09 ,2027
2	Tape measure	5m	/	Apr 12,2027

Test Report

1、Sample Appearance Pictures

Fig. 1 1#Sample appearance pictures



Fig. 2 2#Sample appearance pictures



Test Report

2. Test Methods/ Conditions

No.	Test Item	Sample Name	Model	Serial Number
1	IPX6	Garden lamp stand - No lamp	/	2#:LIP3528-19
		Industrial enclosure	/	1#:LIP4240-25
2	IPX5	Industrial enclosure	/	1#:LIP4240-25
3	IPX4	Industrial enclosure	/	1#:LIP4240-25

1. IPX6

1.1 Test Purpose

Verify the waterproofing capability of the sample under IPX6 testing conditions

1.2 Test Methods/Conditions:

The conditions to be observed are as follows:

internal diameter of the nozzle: 12.5 mm;

delivery rate: 100 l/min ± 5 %;

water pressure: to be adjusted to achieve the specified delivery rate;

core of the substantial stream: circle of approximately 120 mm diameter at 2.5 m distance from nozzle;

test duration per square metre of enclosure surface area likely to be sprayed: 1 min;

minimum test duration: 3 min;

distance from nozzle to enclosure surface: between 2,5 m and 3 m.

Test Report

2. Test Methods/ Conditions（continue）

1.3 Test Pictures and Curves

Fig. 3 Appearance of the 1#sample before the IPX6 test

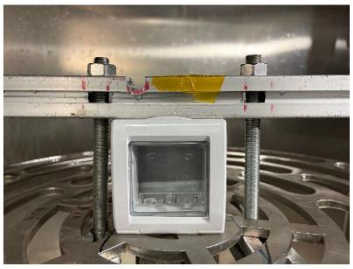


Fig. 4 Photos taken during the IPX6 1#sample test process



Test Report

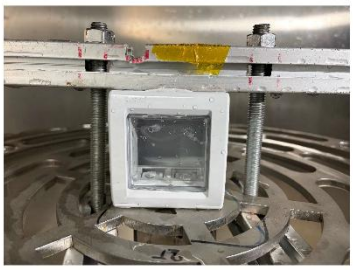
2. Test Methods/ Conditions（continue）

1.3 Test Pictures and Curves

Fig. 5 1#Sample IPX6 test monitoring data



Fig. 6 Appearance of the 1#sample before the IPX6 test



Test Report

2. Test Methods/ Conditions（continue）

1.3 Test Pictures and Curves

Fig. 7 Appearance of the 2#sample before the IPX6 test



Fig. 8 Photos taken during the IPX6 2#sample test process



Test Report

2. Test Methods/ Conditions（continue）

1.3 Test Pictures and Curves

Fig. 9 2#Sample IPX6 test monitoring data



Fig. 10 Appearance of the 1#sample before the IPX6 test



Test Report

2. Test Methods/ Conditions（continue）

1.3 Test Pictures and Curves

Fig. 11 Appearance inspection of the1# sample after the IPX6 test(1)



Fig. 12 Appearance inspection of the1# sample after the IPX6 test(2)



Test Report

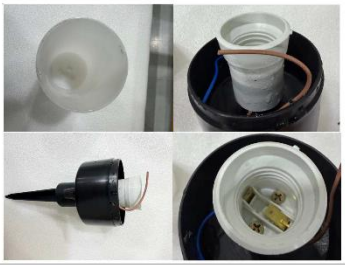
2. Test Methods/ Conditions（continue）

1.3 Test Pictures and Curves

Fig. 13 Appearance inspection of the2# sample after the IPX6 test(1)



Fig. 14 Appearance inspection of the2# sample after the IPX6 test(2)



Test Report

2. Test Methods/ Conditions

2. IPX5

2.1 Test Purpose

Verify the waterproofing capability of the sample under IPX5 testing conditions

2.2 Test Methods/Conditions:

According to the IEC 60529: Ed.2.2 (IPX5)

The conditions to be observed are as follows:

- internal diameter of the nozzle: 6,3 mm;
- delivery rate: 12,5 l/min ± 5 %;
- water pressure: to be adjusted to achieve the specified delivery rate;
- core of the substantial stream: circle of approximately 40 mm diameter at 2,5 m distance from nozzle;
- test duration per square metre of enclosure surface area likely to be sprayed: 1 min;
- minimum test duration: 3 min;
- distance from nozzle to enclosure surface: between 2,5 m and 3 m

Test Report

2. Test Methods/ Conditions（continue）

2.3 Test Pictures and Curves

Fig. 15 Appearance of the 1#sample before the IPX5 test

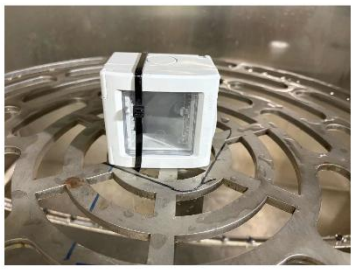


Fig. 16 Photos taken during the IPX5 1#sample test process



Test Report

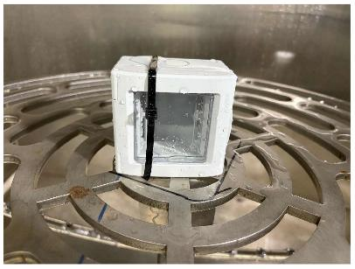
2. Test Methods/ Conditions（continue）

2.3 Test Pictures and Curves

Fig. 17 1#Sample IPX5 test monitoring data



Fig. 18 Appearance of the 1#sample before the IPX5 test



Test Report

2. Test Methods/ Conditions（continue）

2.3 Test Pictures and Curves

Fig. 19 Appearance inspection of the1# sample after the IPX5 test(1)
There is a water droplet at the marked location



Fig. 20 Appearance inspection of the1# sample after the IPX5 test(2)
There is a water droplet at the marked location



Test Report

2. Test Methods/ Conditions

3. IPX4

3.1 Test Purpose

Verify the waterproofing capability of the sample under IPX4 testing conditions

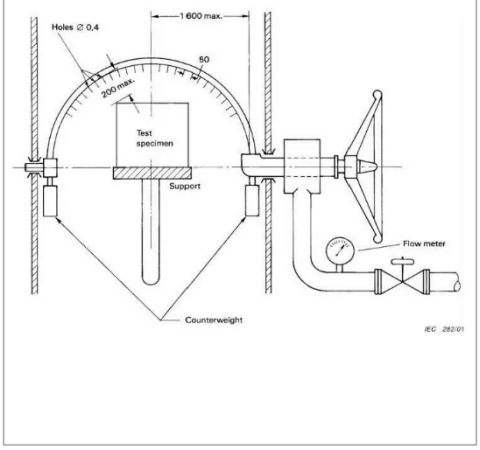
3.2 Test Methods/Conditions:

According to the IEC 60529: Ed.2.2 (IPX4)

The conditions to be observed are as follows:

delivery rate: 1.8 l/min ± 5 %;

The duration of the test is 10 min.



2. Test Methods/ Conditions（continue）

3.3 Test Pictures and Curves

Fig. 21 Appearance of the 1#sample before the IPX4 test



Fig. 22 Photos taken during the IPX4 1#sample test process



2. Test Methods/ Conditions（continue）

3.3 Test Pictures and Curves

Fig. 23 1#Sample IPX4 test monitoring data



Fig. 24 Appearance of the 1#sample before the IPX4 test



2. Test Methods/ Conditions（continue）

3.3 Test Pictures and Curves

Fig. 25 Appearance inspection of the1# sample after the IPX4 test(1)



Fig. 26 Appearance inspection of the1# sample after the IPX4 test(2)



Announcement

1. The report shall not be partially produced without approval of the laboratory.
2. The test results in this report are only valid for the submitted test items.
3. The report is invalid without laboratory's stamp.
4. The report is invalid without the signature of preparer, verifier and approval.
5. The report altered is invalid.
6. Objections to the test report must be submitted to the laboratory within 15 days
7. Disclaimer

① When the customer requires the item to be tested or calibrated acknowledging a deviation from specified conditions, the laboratory shall include a disclaimer in the report indicating which results may be affected by the deviation.

② The laboratory shall be responsible for all the information provided in the report, except when information is provided by the customer. Data provided by a customer shall be clearly identified. In addition, a disclaimer shall be put on the report when the information is supplied by the customer and can affect the validity of results.

8. Client should take samples away from laboratory one month after receipt of report, or laboratory will handle the specimen our own.

STI Environmental Reliability Laboratory Co., LTD.

Contact Address：700/912 Moo 3, Tambon Nongkakha, Amphur Panthong, Chonburi, Thailand 20160
Tel：0822587106
Fax：0512-69377035
Email：daniel.oversea@chinasti.com

APPENDIX B

FINDINGS

When an interlaboratory comparison is conducted, findings are derived from the evaluation of practices, procedures, and results reported by all participating laboratories.

Any identified differences in the application of the test method may be documented in this report.

Where unsatisfactory or discrepant results are identified, participating laboratories are expected to address the relevant areas for improvement to ensure compliance with the applicable standard (IEC 60529) and to maintain the reliability of future results.

Laboratories are therefore requested to implement appropriate corrective actions to enhance their performance in subsequent rounds.

The following differences were observed for participant **code 19**:

Aspect (IEC 60529)	Laboratory **CODE 19**	Most participants (*)
Sample fastening during water tests (second characteristic numeral - LIP3528)	Enclosure (white housing) secured with cable ties, which could apply pressure to the housing beyond its as-received enclosure condition.	Sample held only at the base (as for ground mounting); white housing not fastened

(*) Participants with insufficient performance are excluded from the evaluation.

The findings described above refer exclusively to observed differences among the results submitted by participants. They do not imply, in any way, that the participant's result is directly attributable to these differences.

The participant is expected to conduct an internal analysis of any deviations that may have occurred during testing and to take appropriate corrective measures.

----- END OF REPORT -----