SOUTH QUALITY

PROFICIENCY TESTING PROVIDER

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)

****

This document is issued by the Company subject to its Terms and Conditions, available on request or accessible at https://www.ptsouthquality.com/terms-and-conditions. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Copyright © 2026 South Quality, Buenos Aires, ARGENTINA

Prepared by:	Reviewed by:	Approved by:
cn=VALENTYN E. KRAVCHENKO, o=PT SOUTH QUALITY SAS, ou=SOUTH QUALITY, email=tech@ptsouthquality.com, c=AR 2026.10.07 16:59:10 -03'00'	cn=ESTEBAN DI MARCO, o=PT SOUTH QUALITY SAS, ou=SOUTH QUALITY, email=edimarco@ptsouthquality.com, c=AR 2026.10.08 09:38:03 -03'00'	cn=Emiliano Medina, o=SOUTH QUALITY, ou=PT SOUTH QUALITY SAS, email=quality@ptsouthquality.com, c=ES 2026.10.08 14:18:17 -03'00'
Valentyn Kravchenko Assistant Technician	**Eng. Esteban Di Marco** Electromechanical expert	**Eng. Emiliano Medina** Quality Assurance Lead

TABLE OF CONTENTS

1. FOREWORD 3

2. ORGANIZATION 3

3. OBJECTIVE 3

4. PARTICIPANTS 4

5. HOMOGENEITY 5

6. SAMPLE INFORMATION 5

7. IMAGES 6

8. ASSIGNED RESULTS 7

9. STATISTICS 7

10. PARTICIPANTS' RESULTS 8

11. EVALUATION OF PERFORMANCE 9

12. CONCLUSIONS 12

APPENDICES

APPENDIX A

A1 - PARTICIPANT DATA 13

A2 - INSTRUCTIONS 13

A3 - PARTICIPANT RESULTS (TR No 4400039280-1) 16

A3 - PARTICIPANT RESULTS (TR No 4400039280-2) 25

APPENDIX B 33

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.

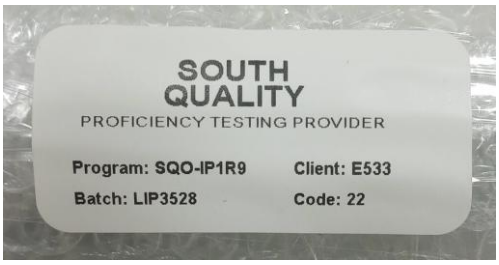
6. SAMPLE INFORMATION

The following samples were sent for testing (Participant **Code 22**):

Batch:	LIP3528
Sample ID:	22
Characteristics:	Garden lamp stand - No lamp

Batch:	LIP4240
Sample ID:	22
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.

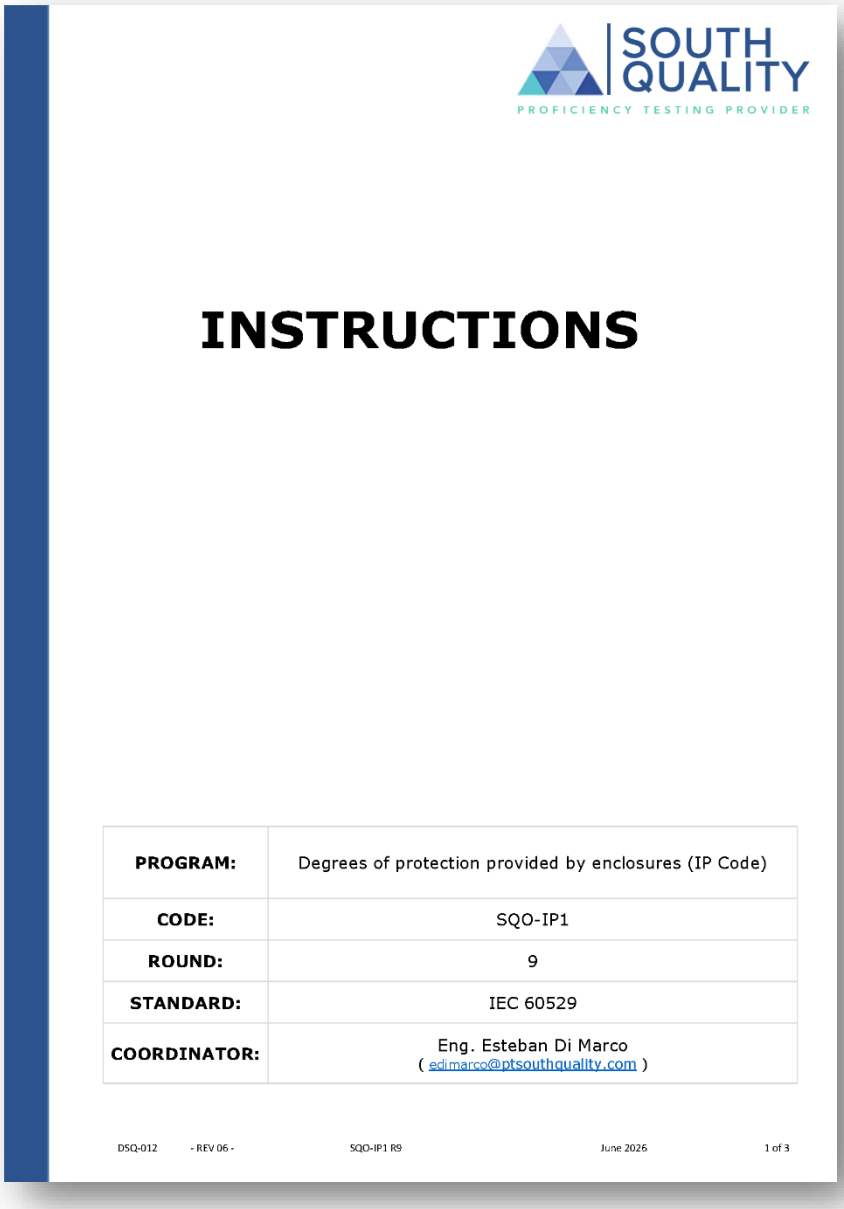
- **INSUFFICIENT** performance: An unsatisfactory result or two questionable results were obtained.

APPENDIX A

A1 - PARTICIPANT DATA

Company:	**KEMA B.V.**
Laboratory:	**MPSA Laboratory**
Country:	Netherlands
Client ID:	E533
Contact person:	Richard Roelofs - Test Specialist
	richard.roelofs@kema.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

KEMA B.V. MPSA Laboratory	**CODE 22**

4 - Tests involved

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

5 - Samples

CODE	SAMPLE	QUANTITY
LIP3528-22	Garden lamp stand - No lamp	1
LIP4240-22	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 No. 4400039280-1)

KEMA Labs
CESI Group

TEST REPORT

Report No.
4400039280-1

Concerning	Inter-Laboratory Comparison (ILC) SQO-IP1 (Round 9)
Type	Garden lamp stand – No lamp
Code	LIP3528-22
Program Coordinator	South Quality, proficiency testing provider
Date(s) of tests	August 3, 2026 till September 1, 2026
Tested by	KEMA B.V. ("KEMA Labs"), Klingelbeekseweg 195, Arnhem, The Netherlands
Test specification	The testing was executed within the framework of an Inter-Laboratory Comparison (ILC). The scope comprised partial testing of a garden lamp stand assembly for the Ingress Protection (IP). The specimen was subjected to several tests to identify the minimum degree of protection, in accordance with IEC 60529 (Edition 2.2).

This report applies only to the objects tested. KEMA Labs makes no representations or warranties with respect to any device other than the objects tested. It is the responsibility of the applicable device manufacturer to ensure that any other devices or units having the same name and descriptions as the objects tested are identical.

This report comprises 33 pages in total.

Issued by KEMA B.V.



Marc Achterkamp
KEMA Labs - MPSA

Arnhem, September 3, 2026

Copyright 2026, KEMA B.V. Please note that the original, protected .pdf version of this document is the only version that has been validated by KEMA Labs and KEMA Labs makes no representations or guarantees regarding any modifications or changes to any subsequent copies made by any other entity. A sealed and bound version of this document may be available 'for information only'.

INFORMATION SHEET

The type of documents presented below can be issued by test laboratories which are part of KEMA Labs.
Details of these and all other types of certificates and reports issued by KEMA Labs are given on the website, which can be accessed through the QR code on the front sheet. The title on the front sheet of the document indicates which type of document is under review. All documents comprise a record of the (type) tests carried out. Mandatory requirements for items 1, 2, 3, 4 and 5 are that the object tested is clearly identified and verified by technical description, drawings and/or additional specifications. The condition of the object after testing is assessed and recorded, if applicable.

1 Certificate
A Certificate is issued when the object tested has fulfilled the requirements of (the named (sub)clauses of) a recognized standard. The relevant ratings assigned by the manufacturer are endorsed by KEMA Labs. All relevant test results and observations are given in the records of proving tests (items 3, 4, 5 and 6) which form the basis of a Certificate and are referred to in this Certificate.

2 Calibration Certificate
A Calibration Certificate is issued when a calibration program has been successfully executed. The calibration program refers to an accredited calibration procedure that is according to recognized standards, manufacturer's specifications or validated internal methods.

3 Type Test Report
A Type Test Report is issued for products in the segments of low voltage, railway applications, automotive, metering and protection & substation automation when the object tested has successfully passed the requested type tests (of the named (sub)clauses) in accordance with a recognized standard. The tests required in these (sub)clauses could cover a complete or partial set of type tests.
The sentence on the front sheet of a Type Test Report will state that the tests have been carried out in accordance with ..... The object has complied with the relevant requirements of the standard and justify the relevant ratings assigned by the manufacturer as listed in chapter 1.

4 Design Verification Report
A Design Verification Report is issued when the object tested has successfully passed the requested design verification tests of the named (sub)clauses in accordance with IEC 61439. The tests series required in these (sub)clauses could cover a complete or selected set of design verification tests.
The sentence on the front sheet of a Design Verification Report will state that the tests have been carried out in accordance with IEC 61439. The object has complied with the relevant requirements of the standard and justify the relevant ratings assigned by the manufacturer as listed in chapter 1.

5 Report of Performance or Type Test Report
A Report of Performance or Type Test Report is issued for products in the segments of MV and HV transmission and distribution when the object tested has successfully passed the requested (type) tests of the named (sub)clauses in accordance with a recognized standard. The tests required in these (sub)clauses could cover a complete or partial set of (type) tests.
The sentence on the front sheet of a Report of Performance or Type Test Report will state that the tests have been carried out in accordance with ..... The object has complied with the relevant requirements of the standard.
However, a Report of Performance or Type Test Report does not confirm any assigned rating.

6 Test Report
A Test Report is issued in all other cases.

7 Identification of official test documents
The official test documents of KEMA Labs are issued in digital form through .pdf files. Only integral reproduction of this document is permitted without written permission from KEMA Labs. A sealed and bound version of the test document may be available for the convenience of the client and has the status 'for information only'. The copyright must be respected.
Items 1 and 2 are identified by a gold watermark and a gold seal with red ribbon on its front sheet. Items 3, 4 and 5 are identified by a silver watermark and a silver seal with green ribbon on its front sheet. Item 6 is identified by a blue watermark on its front sheet.

8 Disclaimers
No certificate or other report issued by KEMA Labs for the purpose of confirming the performance of a test object in relation to the testing requirements of a national or international standard, or in relation to any other testing specification, shall constitute a warranty as to the adequacy or quality of the design or construction of the test object. No other document issued by KEMA Labs for the purpose of reporting, explaining or describing any engineering or consulting services performed by KEMA Labs shall constitute a warranty as to the adequacy or quality of the design or construction of any apparatus or system that is the subject of the document. Information provided by the client or manufacturer can affect the validity of results. KEMA Labs is not responsible for the consequences in such cases.

9 Accreditation
All laboratories which are part of KEMA Labs are accredited in accordance with ISO/IEC 17025 by the respective national accreditation bodies. Detailed information on these accreditations can be found on the last page of this document.

REVISION OVERVIEW

The edition with the highest revision number always replaces the earlier issued editions.

Rev. No.	Date of issue	Page no. and changes
0	August 12, 2026	First issue, test for IP56
1	September 2, 2026	Second issue, added investigation for minimum degree of protection.

TABLE OF CONTENTS

2 Summary 5
3 Tests carried out 6
3.1 Test Report Form (TRF) 6
4 Equipment 14
5 figures 15
6 Tables 17
7 Photographs of the equipment 19

2 SUMMARY

Projectnumber : 4400039280-1
SQO-IP1 (Round 9)
Test object : Garden lampstand – No lamp
Code: LIP3528-22

The test object is tested 'as received'.
It came with no manual, mounting instructions or provisions to connect the electrical wires.

Final conclusion after investigation:
The garden lamp stand, code LIP3528-22, does meet the IP23 requirements of:
IEC 60529:2013 (Ed. 2.2) : Degrees of protection provided by enclosures (Code IP)

- Degrees of protection against access to hazardous parts indicated by the first characteristic numeral, IP2X: Protected against access to hazardous parts with a finger.
- Degrees of protection against water indicated by the second characteristic numeral, IPX3: Protected against spraying water.

Based on a non-recurrent examination.

3 TESTS CARRIED OUT

3.1 Test Report Form (TRF)

Legend for verdict

Pass (P)	Meets the requirement(s)	**NP**	Not performed
Fail (F)	Does not meet the requirement(s)	**NA**	Not applicable

IEC 60529:2013			
Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
11	**General requirements for tests**		
11.1	**Atmospheric conditions for water or dust tests**		
	Temperature range	15 °C to 35 °C	P
	Relative humidity	25 % to 75 %	P
	Air pressure	86 kPa to 106 kPa (860 mbar to 1 060 mbar)	P
11.2	**Test means**		
	Unless otherwise specified in a relevant product standard, the test samples for each test shall be in a clean and new condition, with all parts in place and mounted in the manner stated by the manufacturer		NP
	If it is impracticable to test the complete equipment, representative parts or smaller equipment having the same full-scale design details shall be tested		NA
	The relevant product standard shall specify details such as:		
	– the number of samples to be tested	No relevant product standard available	NP
	– conditions for mounting, assembling and positioning of the samples, for example by the use of an artificial surface (ceiling, floor or wall)	No relevant product standard available	NP
	– the pre-conditioning, if any, which is to be used	No relevant product standard available	NP
	– whether to be tested energized or not	No relevant product standard available	NP
	– whether to be tested with its parts in motion or not	No relevant product standard available	NP
	In the absence of such specification, the manufacturer's instructions shall apply	No manufacturer's instruction available	NP
11.3	**Application of test requirements and interpretation of test results**		
	The application of the general requirements for tests and the acceptance conditions for equipment containing drain-holes or ventilation openings is the responsibility of the relevant technical committee	No specification available	NP
	In the absence of such specification the requirement of this standard shall apply	Requirements of this standard are applied	P
	The interpretation of test results is the responsibility of the relevant technical committee. In the absence of a specification the acceptance conditions of this standard shall at least apply	Acceptance conditions of this standard are applied	P
11.4	**Combination of test conditions for the first characteristic numeral**		
	Table 5 – Test conditions for degrees of protection indicated by the first characteristic numeral		
	Test for protection against		
	First characteristic numeral: access to hazardous parts: solid foreign objects		
	0: No test required: No test required		NP

IEC 60529:2013			
Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
	1 The sphere of 50 mm Ø shall not fully penetrate and adequate clearance shall be kept		NP
	2 The jointed test finger may penetrate up to its 80 mm length, but adequate clearance shall be kept	The sphere of 12,5 mm Ø shall not fully penetrate	P
	3 The test rod of 2,5 mm Ø shall not penetrate and adequate clearance shall be kept		P
	4 The test wire of 1,0 mm Ø shall not penetrate and adequate clearance shall be kept		P
	5 The test wire of 1,0 mm Ø shall not penetrate and adequate clearance shall be kept	Dust-protected as specified in table 2	P
	6 The test wire of 1,0 mm Ø shall not penetrate and adequate clearance shall be kept	Dust-tight as specified in table 2	NP
	In the case of the first characteristic numerals 1 and 2, "not fully penetrate" means that the full diameter of the sphere shall not pass through an opening of the enclosure.		P
11.5	**Empty enclosures**		
	If the enclosure is tested without equipment inside, detailed requirements shall be indicated by the enclosure manufacturer in his instructions for the arrangement and spacing of hazardous parts or parts which might be affected by the penetration of foreign objects or water	Enclosure has no means of connecting the wires. No manufacturers instruction present.	NP
	The manufacturer of the final assembly shall ensure that after the electrical equipment is enclosed the enclosure meets the declared degree of protection of the final product		NA

IEC 60529:2013			
Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
12	**Tests for protection against access to hazardous parts indicated by the first characteristic numeral**		
12.1	**Access probes**		
	Access probes to test the protection of persons against access to hazardous parts are given in table 6.		P
12.2	**Test conditions**		
	The access probe is pushed against or (in case of the test for first characteristic numeral 2) inserted through any openings of the enclosure with the force specified in table 6.		P
	For tests on low-voltage equipment, a low-voltage supply (of not less than 40 V and not more than 50 V) in series with a suitable lamp should be connected between the probe and the hazardous parts inside the enclosure	The jointed testfinger is not able to penetrate into the object	P
	Hazardous live parts covered only with varnish or paint, or protected by oxidation or by a similar process, are covered by a metal foil electrically connected to those parts which are normally live in operation	No live parts covered or treated.	NA
	The signal-circuit method should also be applied to the hazardous moving parts of highvoltage equipment	No moving parts	NA

IEC 60529:2013			
Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
	Internal moving parts may be operated slowly, where this is possible	No moving parts	NA
12.3	**Acceptance conditions**		
	Test for protection against		
	First characteristic numeral: access to hazardous parts		
	0: No test required		NP
	1: The sphere of 50 mm Ø shall not fully penetrate and adequate clearance shall be kept		NP
	2: The jointed test finger may penetrate up to its 80 mm length, but adequate clearance shall be kept	The test finger can not enter the openings	P
	3: The test rod of 2,5 mm Ø shall not penetrate and adequate clearance shall be kept	The test finger can touch live wires	F
	4: The test wire of 1,0 mm Ø shall not penetrate and adequate clearance shall be kept	The test finger can touch live wires	F
	5: The test wire of 1,0 mm Ø shall not penetrate and adequate clearance shall be kept	The test finger can touch live wires	F
	6: The test wire of 1,0 mm Ø shall not penetrate and adequate clearance shall be kept		NP
	In the case of the first characteristic numerals 1 and 2, "not fully penetrate" means that the full diameter of the sphere shall not pass through an opening of the enclosure.		P

IEC 60529:2013				
Clause	**Requirement + Test**		**Result - Remark**	**Verdict**
13	**Tests for protection against solid foreign objects indicated by the first characteristic numeral**			
13.1	**Test means**			
	Table 7 – Test means for the tests for protection against solid foreign objects			
	First characteristic numeral	Test means (object probes and dust chamber)	Test force	Test conditions, see
	0	No test required	-	-
	1	Rigid sphere without handle or guard 50 mm diameter	50 N ± 10 %	13.2
	2	Rigid sphere without handle or guard 12,5 mm diameter	30 N ± 10 %	13.2
	3	Rigid steel rod 2,5 mm diameter, with edges free from burrs	3 N ± 10 %	13.2
	4	Rigid steel rod 1,0 mm diameter, with edges free from burrs	1 N ± 10 %	13.2

IEC 60529:2013				
Clause	**Requirement + Test**		**Result - Remark**	**Verdict**
	5 Dust chamber figure 2, with or without underpressure	-	13.4 + 13.5	P
	6 Dust chamber figure 2, with underpressure	-	13.4 + 13.6	NA
13.4	**Dust test for first characteristic numerals 5 and 6**			
	The test is made using a dust chamber incorporating the basic principles shown in figure 2 whereby the powder circulation pump may be replaced by other means suitable to maintain the talcum powder in suspension in a closed test chamber.		The powder circulation pump is replaced by other means to maintain the circulation.	P
	The talcum powder used shall be able to pass through a square-meshed sieve the nominal wire diameter of which is 50 µm and the nominal width of a gap between wires 75 µm.			P
	The amount of talcum powder to be used is 2 kg per cubic metre of the test chamber volume.			P
	It shall not have been used for more than 20 tests.			P
	Dust test according first characteristic		IP5X, Category 2	P
	Category 1: Enclosures where the normal working cycle of the equipment causes reductions in air pressure within the enclosure below that of the surrounding air, for example, due to thermal cycling effects.			NA
	Category 2: Enclosures where no pressure difference relative to the surrounding air is present.			P
	Category 1 enclosures:			
	The enclosure under test is supported inside the test chamber and the pressure inside the enclosure is maintained below the surrounding atmospheric pressure by a vacuum pump.			NA
	The suction connection shall be made to a hole specially provided for this test. If not otherwise specified in the relevant product standard, this hole shall be in the vicinity of the vulnerable parts.			NA
	The object of the test is to draw into the enclosure, by means of depression, a volume of air 80 times the volume of the sample enclosure tested without exceeding the extraction rate of 60 volumes per hour.		Extraction rate:	NA
	In no event shall the depression exceed 2 kPa (20 mbar) on the manometer shown in figure 2.		Pressure:	NA
	Test duration.		Test duration:	NA
	Category 2 enclosures:			
	The enclosure under test is supported in its normal operating position inside the test chamber, but is not connected to a vacuum pump.			P
	Any drain-hole normally open shall be left open for the duration of the test.			P
	Test duration.		Test duration: 8 hr	P
13.5	**Special conditions for first characteristic numeral 5**			
13.5.1	Test conditions for first characteristic numeral 5			
	The enclosure shall be deemed category 1 unless the relevant product standard for the equipment specifies that the enclosure is category 2.		Tested as Category 2	P
13.5.2	Acceptance conditions for first characteristic numeral 5			

IEC 60529:2013			
Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
	The protection is satisfactory if, on inspection, talcum powder has not accumulated in a quantity or location such that, as with any other kind of dust, it could interfere with the correct operation of the equipment or impair safety.	Dust accumulated at the bottom. The bare wiring is exposed to dust. It interferes with correct operation of the equipment.	F
	Except for special cases to be clearly specified in the relevant product standard, no dust shall deposit where it could lead to tracking along the creepage distances.	No special cases specified.	NA
13.6	**Special conditions for first characteristic numeral 6**		
13.6.1	Test conditions for first characteristic numeral 6		
	The enclosure shall be deemed category 1, whether reductions in pressure below the atmospheric pressure are present or not.		NA
13.6.2	Acceptance conditions for first characteristic numeral 6		
	The protection is satisfactory if no deposit of dust is observable inside the enclosure at the end of the test.		NA

14	**Tests for protection against water indicated by the second characteristic numeral**				
14.1	**Test means**				
	Table 8 - Test means and main test conditions for the tests for protection against water				
	Second characteristic numer	Test means	Water flow rate	Duration of test	Test conditions, see
	0	No test required			NA
	1	Drip box. Enclosure on turntable.	1 mm/min	10 min	14.2.1 NA
	2	Drip box. Enclosure in 4 fixed positions of 15° tilt	3 mm/min	2,5 min for each position of tilt	14.2.2 NA
	3	Oscillating tube Spray ± 60° from vertical, distance max. 200 mm or Spray nozzle Spray ± 60° from vertical	0,07 l/min ± 5 % per hole, multiplied by number of holes or 10 l/min ± 5 %	10 min or 1 min/m² at least 5 min	14.2.3 a) or 14.2.3 b) P
	4	As for numeral 3 Spray ± 180° from vertical	As for numeral 3		14.2.4 P
	5	Water jet hose nozzle Nozzle 6,3 mm diameter, distance 2,5 m to 3 m	12,5 l/min ± 5 %	1 min/m² at least 3 min	14.2.5 NA
	6	Water jet hose nozzle Nozzle 12,5 mm diameter, distance 2,5 m to 3 m	100 l/min ± 5 %	1 min/m² at least 3 min	14.2.6 P
	7	Immersion tank Water-level on enclosure: 0,15 m above top, 1 m above bottom	-	30 min	14.2.7 NA
	8	Immersion tank Water-level: by agreement	-	by agreement	14.2.8 NA
	9	Fan jet nozzle Small enclosure on turntable Turntable speed (5 ± 1) r/min Spray at 0°, 30°, 60°, 90° Or Large enclosures as per intended use. Spray from all practical directions Distance (175 ± 25) mm	(15 ± 1) l/min	30 s per Position or 1 min/m2 at least 3 min	14.2.9 a) or 14.2.9 b) NA

14.2	**Test conditions**		
	Water test according second characteristic	IPX3	P
14.2.3	Test for second characteristic numeral 3 with oscillating tube		
	Conditions when using the test device as in figure 4 (oscillating tube)		P
	The total flow rate is adjusted as specified in table 9 and is measured with a flow meter		P
	The oscillating tube is provided with spray holes over an arc of 60° either side of the centre point. The support is not perforated		P
	The enclosure to be tested is placed at the centre point of the semicircle. The tube is caused to oscillate through an angle of 120°, 60° on either side of the vertical, the time for one complete oscillation (2 × 120") being about 4 s and the test duration being 5 min		P
	The enclosure is then turned through an horizontal angle of 90° and the test is continued for a further 5 min		P
	The maximum acceptable radius of the oscillating tube is 1 600 mm	Radius is 400 mm	P
	If for certain types of apparatus it is not possible to wet all parts of the enclosure under test, the support of the enclosure may be moved up or down		P
	Water test according second characteristic	IPX4	P
14.2.4	Test for second characteristic numeral 4 with oscillating tube		
	Conditions when using the test device as in figure 4 (oscillating tube)		P
	The total flow rate is adjusted as specified in table 9 and is measured with a flow meter		P
	The oscillating tube has spray holes over the whole 180" of the semicircle		P
	The tube is caused to oscillate through an angle of almost 360°, 180° on either side of the vertical, the time for one complete oscillation (2 × 360°) being about 12 s		P
	The duration of the test is 10 min		P
	If not specified otherwise in the relevant product standard, the support for the enclosure under test is perforated so as to avoid acting as a baffle and the enclosure is sprayed from every direction by oscillating the tube to the limit of its travel in each direction		P
	Water test according second characteristic	IPX6	P
14.2.4	Test for second characteristic numeral 6 with the 12,5 mm nozzle		
	The test is made by spraying the enclosure from all practicable directions with a stream of water from a standard test nozzle as shown in figure 6		P
	internal diameter of the nozzle: 12,5 mm		P
	delivery rate: 100 l/min ± 5 %		P
	water pressure: to be adjusted to achieve the specified delivery rate		P
	core of the substantial stream: circle of approximately 120 mm diameter at 2,5 m distance from nozzle		P

	test duration per square metre of enclosure surface area likely to be sprayed: 1 min	Enclosure < 3 m²	P
	minimum test duration: 3 min	Test duration: 3 min	P
	distance from nozzle to enclosure surface: between 2,5 m and 3 m		P
14.3	**Acceptance conditions after IPX4 and IPX6**		
	After testing in accordance with the appropriate requirements of 14.2.4 (IPX4) and 14.2.6 (IPX6), the enclosure shall be inspected for ingress of water.		
	In general, if any water has entered, it shall not:		
	• be sufficient to interfere with the correct operation of the equipment or impair safety	Water accumulated at the bottom. The wire ends are exposed. It interfers with correct operation of the equipment.	F
	• deposit on insulation parts where it could lead to tracking along the creepage distances	As equipment is not delivered with connection means this can not be evaluated.	NP
	• reach live parts or windings not designed to operate when wet	Water reached live parts	F
	• accumulate near the cable end or enter the cable if any	Water accumulate near the cable ends.	F
	If the enclosure is provided with drain-holes, it should be proved by inspection that any water which enters does not accumulate and that it drains away without doing any harm to the equipment.	The cable outlet functions as a drainhole, but the water still accumulate.	F
	For enclosures without drain-holes, the relevant product standard shall specify the acceptance conditions if water can accumulate to reach live parts.	No product standard available	NA
	Acceptance conditions after IPX3		
	After testing in accordance with the appropriate requirements of 14.2.3 (IPX3), the enclosure shall be inspected for ingress of water.		
	In general, if any water has entered, it shall not:		
	• be sufficient to interfere with the correct operation of the equipment or impair safety	Water did not enter the equipment.	P
	• deposit on insulation parts where it could lead to tracking along the creepage distances	As equipment is not deliverd with connection means this can not be evaluated.	NP
	• reach live parts or windings not designed to operate when wet	Water did not reached live parts	P
	• accumulate near the cable end or enter the cable if any	Water did not accumulate near the cable ends.	P
	If the enclosure is provided with drain-holes, it should be proved by inspection that any water which enters does not accumulate and that it drains away without doing any harm to the equipment.	The cable outlet functions as a drainhole, but the water did not accumulate.	P
	For enclosures without drain-holes, the relevant product standard shall specify the acceptance conditions if water can accumulate to reach live parts.	No product standard available	NA

4 EQUIPMENT

4	Equipment used for tests					
4.1	Dusttest IP5X and IP6X					
	Assetnumber	Description	Calibration Due	Specs	Remarks	
	AB102261	Dust chamber	NA	1 cubic meter	-	P
	AB101912	Flowmeter air	June 2027	0.2 to 1.0 l/min	-	NA
	AB103874	Mano meter	May 2027	0 to 25 mbar	-	NA
	-	-	-	-	-	
4.2	Test probes IP					
	Assetnumber	Description	Calibration Due	Specs	Remarks	
	AB101935	Test rod 2.5 mm Ø	Jan 2028	-	-	P
	AB104776	Jointed test finger	June 2027	-	-	P
	-	-	-	-	-	
4.3	Watertest IPX3 and IPX4					
	Assetnumber	Description	Calibration Due	Specs	Remarks	
	AB102260	Water chamber	NA	-	-	P
	AB101818	Flowmeter water	June 2027	0.5 to 4 l/min	-	P
	-	-	-	-	-	
4.4	Watertest IPX6					
	Assetnumber	Description	Calibration Due	Specs	Remarks	
	AB101970	Flowmeter water	June 2028	10 to 190 l/min	Max: 300 PSI	P
	AB101967	Spacer nozzle	June 2030	-	-	P
	AB101968	Nozzle 12.5 mm	June 2030	-	-	P
	-	-	-	-	-	
4.5	General equipment					
	Assetnumber	Description	Calibration Due	Specs	Remarks	
	AB101765	Thermometer	Feb 2027	-199,9 to 199,9 °C	-	P
	AB104035	Tape measure	Nov 2026	-	-	P
	AB103813	Stopwatch	Dec 2026	-	-	P
	-	-	-	-	-	

5 FIGURES

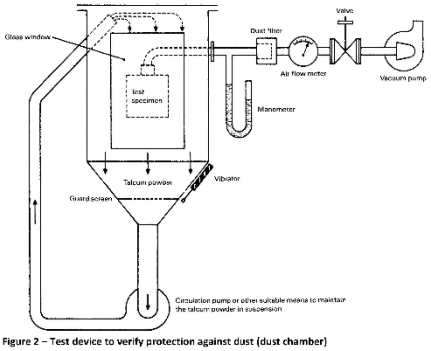
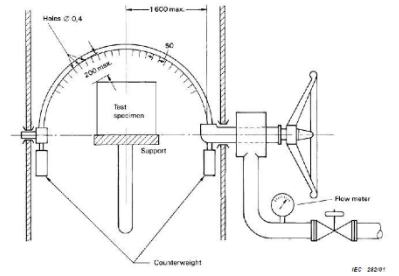


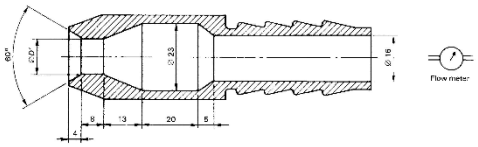
Figure 2 – Test device to verify protection against dust (dust chamber)



Dimensions in millimetres

NOTE The range of holes is shown as for second characteristic numeral 3 (see 14.2.3 a)).

Figure 4 – Test device to verify protection against spraying and splashing water; second characteristic numerals 3 and 4 (oscillating tube)



D' = 6,3 for the test of 14.2.5 (second characteristic numeral 5)
D' = 12,5 for the test of 14.2.6 (second characteristic numeral 6)

Figure 6 – Test device to verify protection against water jets (hose nozzle)

6 TABLES

Table 6 – Access probes for the tests for protection of persons against access to hazardous parts

First numeral	Addit. letter	Access probe	Test force
1	A	Sphere 50 mm diameter Approx. 100 Handle (insulating material) Guard Rigid test sphere (Metal) IEC 273/01	50 N ± 10 %
2	B	Jointed test finger Stop face (Ø 50 x 20) See figure 1 for full dimensions Insulating material Jointed test finger (Metal) 80 IEC 274/01	10 N ± 10 %
3	C	Test rod 2,5 mm diameter, 100 mm long Sphere 35 ± 0,2 Approx. 100 100 ± 0,2 Handle (insulating material) Stop face (insulating material) Rigid test rod (Metal) IEC 275/01 Edges free from burrs	3 N ± 10 %

Table 9 – Total water flow rate *qv* under IPX3 and IPX4 test conditions – Mean flow rate per hole *qvl* = 0,07 l/min

Tube radius *R* mm	Degree IPX3		Degree IPX4	
	Number of open holes *N*[1)]	Total water flow q_V l/min	Number of open holes *N*[1)]	Total water flow q_V l/min
200	8	0,56	12	0,84
400	16	1,1	25	1,8
600	25	1,8	37	2,6
800	33	2,3	50	3,5
1 000	41	2,9	62	4,3
1 200	50	3,5	75	5,3
1 400	58	4,1	87	6,1
1 600	67	4,7	100	7,0

[1)] Depending on the actual arrangement of the hole centres at the specified distance, the number of open holes *N* may be increased by 1.

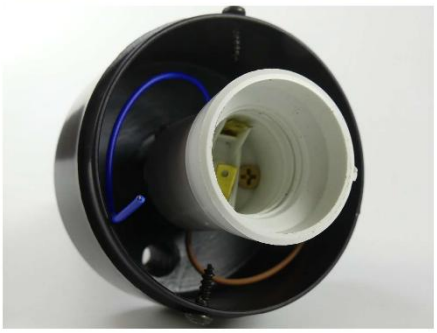
7 PHOTOGRAPHS OF THE EQUIPMENT

As received before tests



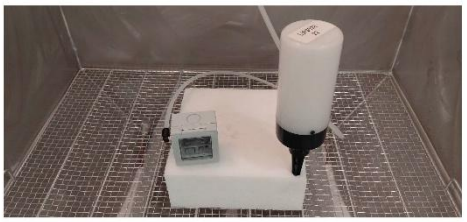






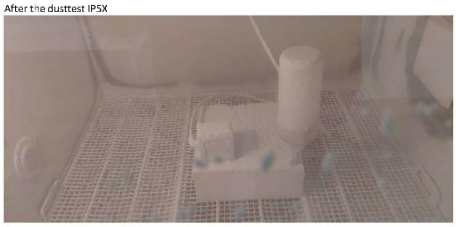
Prepared for dusttest IP5X



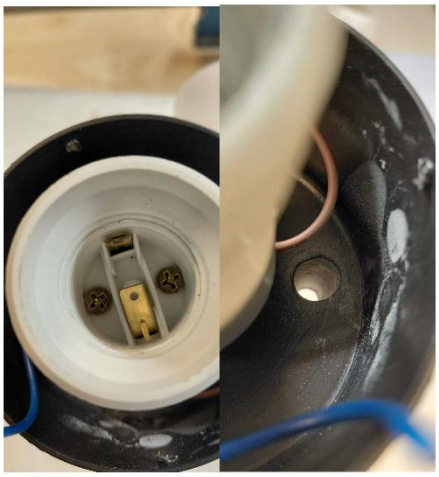




After the dusttest IP5X





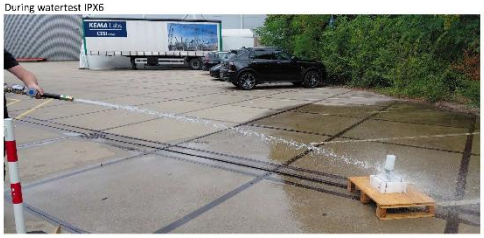




Before watertest IPX6



During watertest IPX6





After watertest IPX6



Before and during watertest IPX4

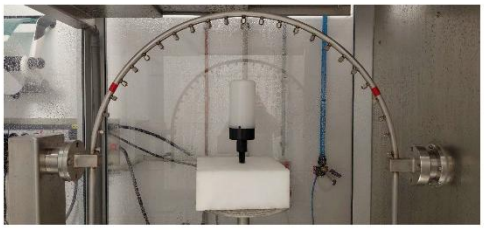


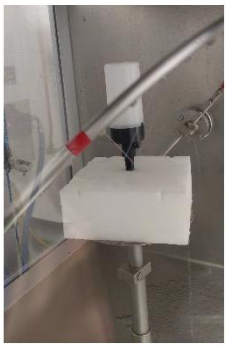


After Watertest IPX4



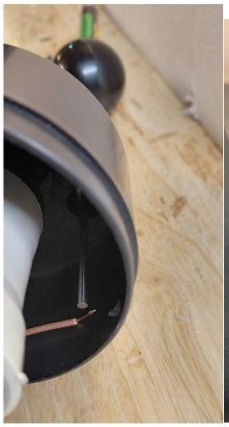
Before and during watertest IPX3





Investigation with test rod IP3X







Investigation with jointed testfinger IP2X



END OF DOCUMENT

The laboratories of KEMA Labs are:

- CESI S.p.A., Milan, Italy, accredited by ACCREDIA in accordance with ISO/IEC 17025:2017 under no. 00026 Testing.
- FGH Engineering & Test GmbH, Mannheim, Germany, accredited by DAkkS in accordance with DIN EN ISO/IEC 17025:2018 under no. D-PL-12110-01-00.
- IPH Institut "Prüffeld für elektrische Hochleistungstechnik" GmbH, Berlin, Germany accredited by DAkkS in accordance with DIN EN ISO/IEC 17025: 2018 under nos. D-PL-12107-01-00 and D-K-12107-01-00.
- KEMA B.V., Arnhem, The Netherlands, accredited by RvA in accordance with EN ISO/IEC 17025 2017 under nos. L020, L218 and K006.
- KEMA Labs, Zkušebnictví, a.s., Prague, the Czech Republic, testing laboratory no. 1025 accredited by CAI in accordance with ČSN EN ISO/IEC 17025:2018.
- KEMA-Powertest, LLC, Chalfont, United States, accredited by A2LA in accordance with ISO/IEC 17025:2017 under no. 0553.01.

Tests are carried out under the scope of accreditation, unless otherwise indicated in the chapter "Tests carried out".

A4 - PARTICIPANT RESULTS (TEST REPORT No. 4400039280-2)

KEMA Labs
CESI Group

TEST REPORT

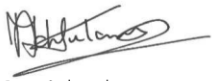
Report No.
4400039280-2

Concerning	Inter-Laboratory Comparison (ILC) SQO-IP1 (Round 9)
Type	Industrial enclosure
Code	LIP4240-22
Program Coordinator	South Quality, proficiency testing provider
Date(s) of tests	August 3, 2026 till September 1, 2026
Tested by	KEMA B.V. ("KEMA Labs"), Klingelbeekseweg 195, Arnhem, The Netherlands
Test specification	The testing was executed within the framework of an Inter-Laboratory Comparison (ILC). The scope comprised partial testing of an industrial enclosure assembly for the Ingress Protection (IP). The specimen was subjected to several tests to identify the minimum degree of protection, in accordance with IEC 60529 (Edition 2.2).

This report applies only to the objects tested. KEMA Labs makes no representations or warranties with respect to any device other than the objects tested. It is the responsibility of the applicable device manufacturer to ensure that any other devices or units having the same name and descriptions as the objects tested are identical.

This report comprises 29 pages in total.

Issued by KEMA B.V.



Marc Achterkamp
KEMA Labs - MPSA

Arnhem, September 3, 2026

Copyright 2026, KEMA B.V. Please note that the original, protected .pdf version of this document is the only version that has been validated by KEMA Labs and KEMA Labs makes no representations or guarantees regarding any modifications or changes to any subsequent copies made by any other entity. A sealed and bound version of this document may be available 'for information only'.

INFORMATION SHEET

The type of documents presented below can be issued by test laboratories which are part of KEMA Labs.
Details of these and all other types of certificates and reports issued by KEMA Labs are given on the website, which can be accessed through the QR code on the front sheet. The title on the front sheet of the document indicates which type of document is under review. All documents comprise a record of the (type) tests carried out. Mandatory requirements for items 1, 2, 3, 4 and 5 are that the object tested is clearly identified and verified by technical description, drawings and/or additional specifications. The condition of the object after testing is assessed and recorded, if applicable.

1 Certificate
A Certificate is issued when the object tested has fulfilled the requirements of (the named (sub)clauses of) a recognized standard. The relevant ratings assigned by the manufacturer are endorsed by KEMA Labs. All relevant test results and observations are given in the records of proving tests (items 3, 4, 5 and 6) which form the basis of a Certificate and are referred to in this Certificate.

2 Calibration Certificate
A Calibration Certificate is issued when a calibration program has been successfully executed. The calibration program refers to an accredited calibration procedure that is according to recognized standards, manufacturer's specifications or validated internal methods.

3 Type Test Report
A Type Test Report is issued for products in the segments of low voltage, railway applications, automotive, metering and protection & substation automation when the object tested has successfully passed the requested type tests (of the named (sub)clauses) in accordance with a recognized standard. The tests required in these (sub)clauses could cover a complete or partial set of type tests.
The sentence on the front sheet of a Type Test Report will state that the tests have been carried out in accordance with ..... The object has complied with the relevant requirements of the standard and justify the relevant ratings assigned by the manufacturer as listed in chapter 1.

4 Design Verification Report
A Design Verification Report is issued when the object tested has successfully passed the requested design verification tests of the named (sub)clauses in accordance with IEC 61439. The tests series required in these (sub)clauses could cover a complete or selected set of design verification tests.
The sentence on the front sheet of a Design Verification Report will state that the tests have been carried out in accordance with IEC 61439. The object has complied with the relevant requirements of the standard and justify the relevant ratings assigned by the manufacturer as listed in chapter 1.

5 Report of Performance or Type Test Report
A Report of Performance or Type Test Report is issued for products in the segments of MV and HV transmission and distribution when the object tested has successfully passed the requested (type) tests of the named (sub)clauses in accordance with a recognized standard. The tests required in these (sub)clauses could cover a complete or partial set of (type) tests.
The sentence on the front sheet of a Report of Performance or Type Test Report will state that the tests have been carried out in accordance with ..... The object has complied with the relevant requirements of the standard.
However, a Report of Performance or Type Test Report does not confirm any assigned rating.

6 Test Report
A Test Report is issued in all other cases.

7 Identification of official test documents
The official test documents of KEMA Labs are issued in digital form through .pdf files. Only integral reproduction of this document is permitted without written permission from KEMA Labs. A sealed and bound version of the test document may be available for the convenience of the client and has the status 'for information only'. The copyright must be respected.
Items 1 and 2 are identified by a gold watermark and a gold seal with red ribbon on its front sheet. Items 3, 4 and 5 are identified by a silver watermark and a silver seal with green ribbon on its front sheet. Item 6 is identified by a blue watermark on its front sheet.

8 Disclaimers
No certificate or other report issued by KEMA Labs for the purpose of confirming the performance of a test object in relation to the testing requirements of a national or international standard, or in relation to any other testing specification, shall constitute a warranty as to the adequacy or quality of the design or construction of the test object. No other document issued by KEMA Labs for the purpose of reporting, explaining or describing any engineering or consulting services performed by KEMA Labs shall constitute a warranty as to the adequacy or quality of the design or construction of any apparatus or system that is the subject of the document. Information provided by the client or manufacturer can affect the validity of results. KEMA Labs is not responsible for the consequences in such cases.

9 Accreditation
All laboratories which are part of KEMA Labs are accredited in accordance with ISO/IEC 17025 by the respective national accreditation bodies. Detailed information on these accreditations can be found on the last page of this document.

REVISION OVERVIEW

The edition with the highest revision number always replaces the earlier issued editions.

Rev. No.	Date of issue	Page no. and changes
0	August 12, 2026	First issue, test for IP66
1	September 2, 2026	Second issue, added investigation for minimum degree of protection.

TABLE OF CONTENTS

2 Summary 5
3 Tests carried out 6
3.1 Test Report Form (TRF) 6
4 equipment 13
5 figures 14
6 Tables 16
7 Photographs of the equipment 17

2 SUMMARY

Projectnumber : 4400039280-2
SQO-IP1 (Round 9)
Test object : Industrial enclosure
Code: LIP4240-22

The test object is tested 'as received'.
It came with no manual, mounting instructions or internal electrical content.

Final conclusion after investigation:
The industrial enclosure, code LIP4240-22, does meet the IP54 requirements of:
IEC 60529:2013 (Ed. 2.2) : Degrees of protection provided by enclosures (Code IP)

- Degrees of protection against access to hazardous parts indicated by the first characteristic numeral, IP5X Dust test, Category 2: Enclosures where no pressure difference relative to the surrounding air is present
- Degrees of protection against water indicated by the second characteristic numeral, IPX4: Water penetration test, Test with the oscillating tube

Based on a non-recurrent examination.

3 TESTS CARRIED OUT

3.1 Test Report Form (TRF)

Legend for verdict

Pass (P)	Meets the requirement(s)	**NP**	Not performed
Fail (F)	Does not meet the requirement(s)	**NA**	Not applicable

IEC 60529:2013			
Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
11	**General requirements for tests**		
11.1	**Atmospheric conditions for water or dust tests**		
	Temperature range	15 °C to 35 °C	P
	Relative humidity	25 % to 75 %	P
	Air pressure	86 kPa to 106 kPa (860 mbar to 1 060 mbar)	P
11.2	**Test means**		
	Unless otherwise specified in a relevant product standard, the test samples for each test shall be in a clean and new condition, with all parts in place and mounted in the manner stated by the manufacturer		NP
	If it is impracticable to test the complete equipment, representative parts or smaller equipment having the same full-scale design details shall be tested		NA
	The relevant product standard shall specify details such as:		
	– the number of samples to be tested	No relevant product standard available	NP
	– conditions for mounting, assembling and positioning of the samples, for example by the use of an artificial surface (ceiling, floor or wall)	No relevant product standard available	NP
	– the pre-conditioning, if any, which is to be used	No relevant product standard available	NP
	– whether to be tested energized or not	No relevant product standard available	NP
	– whether to be tested with its parts in motion or not	No relevant product standard available	NP
	In the absence of such specification, the manufacturer's instructions shall apply	No manufacturer's instruction available	NP
11.3	**Application of test requirements and interpretation of test results**		
	The application of the general requirements for tests and the acceptance conditions for equipment containing drain-holes or ventilation openings is the responsibility of the relevant technical committee	No specification available	NP
	In the absence of such specification the requirement of this standard shall apply	Requirements of this standard are applied	P
	The interpretation of test results is the responsibility of the relevant technical committee. In the absence of a specification the acceptance conditions of this standard shall at least apply	Acceptance conditions of this standard are applied	P
11.4	**Combination of test conditions for the first characteristic numeral**		
	Table 5 – Test conditions for degrees of protection indicated by the first characteristic numeral		
	Test for protection against		
	First characteristic numeral / access to hazardous parts / solid foreign objects		
	0 / No test required / No test required		NP

IEC 60529:2013			
Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
	1 The sphere of 50 mm Ø shall not fully penetrate and adequate clearance shall be kept		NP
	2 The jointed test finger may penetrate up to its 80 mm length, but adequate clearance shall be kept	The sphere of 12,5 mm Ø shall not fully penetrate	NP
	3 The test rod of 2,5 mm Ø shall not penetrate and adequate clearance shall be kept		NP
	4 The test wire of 1,0 mm Ø shall not penetrate and adequate clearance shall be kept		NP
	5 The test wire of 1,0 mm Ø shall not penetrate and adequate clearance shall be kept	Dust-protected as specified in table 2	P
	6 The test wire of 1,0 mm Ø shall not penetrate and adequate clearance shall be kept	Dust-tight as specified in table 2	P
	In the case of the first characteristic numerals 1 and 2, "not fully penetrate" means that the full diameter of the sphere shall not pass through an opening of the enclosure.		P
11.5	**Empty enclosures**		
	If the enclosure is tested without equipment inside, detailed requirements shall be indicated by the enclosure manufacturer in his instructions for the arrangement and spacing of hazardous parts or parts which might be affected by the penetration of foreign objects or water	Enclosure has no electrical content. No manufacturers instruction present.	NP
	The manufacturer of the final assembly shall ensure that after the electrical equipment is enclosed the enclosure meets the declared degree of protection of the final product		NA

IEC 60529:2013				
Clause	**Requirement + Test**		**Result - Remark**	**Verdict**
13	**Tests for protection against solid foreign objects indicated by the first characteristic numeral**			
13.1	**Test means**			
	Table 7 – Test means for the tests for protection against solid foreign objects			
	First characteristic numeral	Test means (object probes and dust chamber)	Test force	Test conditions, see
	0	No test required	-	- NA
	1	Rigid sphere without handle or guard 50 mm diameter	50 N ± 10 %	13.2 NA
	2	Rigid sphere without handle or guard 12,5 mm diameter	30 N ± 10 %	13.2 NA
	3	Rigid steel rod 2,5 mm diameter, with edges free from burrs	3 N ± 10 %	13.2 NA

IEC 60529:2013					
Clause	**Requirement + Test**			**Result - Remark**	**Verdict**
	4	Rigid steel rod 1,0 mm diameter, with edges free from burrs	1 N ± 10 %	13.2	NA
	5	Dust chamber figure 2, with or without underpressure	-	13.4 + 13.5	P
	6	Dust chamber figure 2, with underpressure	-	13.4 + 13.6	P
13.4	**Dust test for first characteristic numerals 5 and 6**				
	The test is made using a dust chamber incorporating the basic principles shown in figure 2 whereby the powder circulation pump may be replaced by other means suitable to maintain the talcum powder in suspension in a closed test chamber.			The powder circulation pump is replaced by other means to maintain the circulation.	P
	The talcum powder used shall be able to pass through a square-meshed sieve the nominal wire diameter of which is 50 µm and the nominal width of a gap between wires 75 µm.				P
	The amount of talcum powder to be used is 2 kg per cubic metre of the test chamber volume.				P
	It shall not have been used for more than 20 tests.				P
	Dust test according first characteristic			IP6X, Category 1	P
	Category 1: Enclosures where the normal working cycle of the equipment causes reductions in air pressure within the enclosure below that of the surrounding air, for example, due to thermal cycling effects.				P
	Category 2: Enclosures where no pressure difference relative to the surrounding air is present.				NA
	Category 1 enclosures:				
	The enclosure under test is supported inside the test chamber and the pressure inside the enclosure is maintained below the surrounding atmospheric pressure by a vacuum pump.				P
	The suction connection shall be made to a hole specially provided for this test. If not otherwise specified in the relevant product standard, this hole shall be in the vicinity of the vulnerable parts.			A suction hole is made by KEMA engineer.	P
	The object of the test is to draw into the enclosure, by means of depression, a volume of air 80 times the volume of the sample enclosure tested without exceeding the extraction rate of 60 volumes per hour.			Extraction rate: 0,33 l/min	P
	In no event shall the depression exceed 2 kPa (20 mbar) on the manometer shown in figure 2.			Pressure: 2 mbar	P
	Test duration.			Test duration: 8 h	P
	Category 2 enclosures:				
	The enclosure under test is supported in its normal operating position inside the test chamber, but is not connected to a vacuum pump.				P
	Any drain-hole normally open shall be left open for the duration of the test.				NA
	Test duration.			Test duration: 8 hr	P
13.5	**Special conditions for first characteristic numeral 5**				
13.5.1	Test conditions for first characteristic numeral 5				
	The enclosure shall be deemed category 1 unless the relevant product standard for the equipment specifies that the enclosure is category 2.			Tested as category 2	P
13.5.2	Acceptance conditions for first characteristic numeral 5				

IEC 60529:2013			
Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
	The protection is satisfactory if, on inspection, talcum powder has not accumulated in a quantity or location such that, as with any other kind of dust, it could interfere with the correct operation of the equipment or impair safety.	No accumulation of powder inside the equipment	P
	Except for special cases to be clearly specified in the relevant product standard, no dust shall deposit where it could lead to tracking along the creepage distances.	No dust deposit inside the equipment	P
13.6	**Special conditions for first characteristic numeral 6**		
13.6.1	Test conditions for first characteristic numeral 6		
	The enclosure shall be deemed category 1, whether reductions in pressure below the atmospheric pressure are present or not.	Tested as Category 1	P
13.6.2	Acceptance conditions for first characteristic numeral 6		
	The protection is satisfactory if no deposit of dust is observable inside the enclosure at the end of the test.	Dust accumulated in the equipment.	F

14	Tests for protection against water indicated by the second characteristic numeral					
14.1	Test means					
	Table 8 - Test means and main test conditions for the tests for protection against water					
	Second characteristic numer	Test means	Water flow rate	Duration of test	Test conditions, see	
	0	No test required				NA
	1	Drip box. Enclosure on turntable.	1 mm/min	10 min	14.2.1	NA
	2	Drip box. Enclosure in 4 fixed positions of 15° tilt	3 mm/min	2,5 min for each position of tilt	14.2.2	NA
	3	Oscillating tube Spray ± 60° from vertical, distance max. 200 mm or Spray nozzle Spray ± 60° from vertical	0,07 l/min ± 5 % per hole, multiplied by number of holes or 10 l/min ± 5 %	10 min or 1 min/m² at least 5 min	14.2.3 a) or 14.2.3 b)	NA
	4	As for numeral 3 Spray ± 180° from vertical	As for numeral 3		14.2.4	P
	5	Water jet hose nozzle Nozzle 6,3 mm diameter, distance 2,5 m to 3 m	12,5 l/min ± 5 %	1 min/m² at least 3 min	14.2.5	NA
	6	Water jet hose nozzle Nozzle 12,5 mm diameter, distance 2,5 m to 3 m	100 l/min ± 5 %	1 min/m² at least 3 min	14.2.6	P
	7	Immersion tank Water-level on enclosure: 0,15 m above top, 1 m above bottom	-	30 min	14.2.7	NA
	8	Immersion tank Water-level: by agreement	-	by agreement	14.2.8	NA
	9	Fan jet nozzle Small enclosure on turntable Turntable speed (5 ± 1) r/min Spray at 0°, 30°, 60°, 90° Or Large enclosures as per intended use. Spray from all practical directions Distance (175 ± 25) mm	(15 ± 1) l/min	30 s per Position or 1 min/m2 at least 3 min	14.2.9 a) or 14.2.9 b)	NA

14.2	Test conditions		
	Water test according second characteristic	IPX4	P
14.2.4	Test for second characteristic numeral 4 with oscillating tube		
	Conditions when using the test device as in figure 4 (oscillating tube)		P
	The total flow rate is adjusted as specified in table 9 and is measured with a flow meter		P
	The oscillating tube has spray holes over the whole 180° of the semicircle		P
	The tube is caused to oscillate through an angle of almost 360°, 180° on either side of the vertical, the time for one complete oscillation (2 × 360°) being about 12 s		P
	The duration of the test is 10 min		P
	If not specified otherwise in the relevant product standard, the support for the enclosure under test is perforated so as to avoid acting as a baffle and the enclosure is sprayed from every direction by oscillating the tube to the limit of its travel in each direction		P
	Water test according second characteristic	IPX6	P
14.2.6	Test for second characteristic numeral 6 with the 12,5 mm nozzle		
	The test is made by spraying the enclosure from all practicable directions with a stream of water from a standard test nozzle as shown in figure 6.		P
	The conditions to be observed are as follows:		
	• internal diameter of the nozzle: 12,5 mm		P
	• delivery rate: 100 l/min ± 5 %;		P
	• water pressure: to be adjusted to achieve the specified delivery rate		P
	• core of the substantial stream: circle of approximately 120 mm diameter at 2,5 m distance from nozzle		P
	• test duration per square metre of enclosure surface area likely to be sprayed: 1 min	Enclosure < 3 m²	NA
	• minimum test duration: 3 min	Test duration: 3 min	P
	• distance from nozzle to enclosure surface: between 2,5 m and 3 m		P
14.3	Acceptance conditions after IPX4		
	After testing in accordance with the appropriate requirements of 14.2.4 (IPX4), the enclosure shall be inspected for ingress of water.		
	In general, if any water has entered, it shall not:		
	• be sufficient to interfere with the correct operation of the equipment or impair safety	Water did not enter the enclosure	P
	• deposit on insulation parts where it could lead to tracking along the creepage distances	Water did not enter the enclosure	P
	• reach live parts or windings not designed to operate when wet	Enclosure has no electrical content	NP
	• accumulate near the cable end or enter the cable if any	Enclosure has no electrical content	NP
	If the enclosure is provided with drain-holes, it should be proved by inspection that any water which enters does not accumulate and that it drains away without doing any harm to the equipment.	The enclosure has no drainholes	NP

	For enclosures without drain-holes, the relevant product standard shall specify the acceptance conditions if water can accumulate to reach live parts.	No product standard available	NA
14.3	Acceptance conditions after IPX6		
	After testing in accordance with the appropriate requirements of 14.2.1 to 14.2.9, the enclosure shall be inspected for ingress of water.		
	In general, if any water has entered, it shall not:		
	• be sufficient to interfere with the correct operation of the equipment or impair safety	Water accumulated in the equipment. It shall interfere with correct operation of the equipment.	F
	• deposit on insulation parts where it could lead to tracking along the creepage distances	As equipment is not deliverd with internal content this can not be evaluated.	NP
	• reach live parts or windings not designed to operate when wet	As equipment is not deliverd with internal content this can not be evaluated.	NP
	• accumulate near the cable end or enter the cable if any	Water accumulate at the bottom cable entry.	F
	If the enclosure is provided with drain-holes, it should be proved by inspection that any water which enters does not accumulate and that it drains away without doing any harm to the equipment.	No instruction for opening drainholes where present.	NP
	For enclosures without drain-holes, the relevant product standard shall specify the acceptance conditions if water can accumulate to reach live parts.	No instruction or relevant product standard for opening drainholes where present.	NP

4 EQUIPMENT

4	Equipment used for tests					
4.1	Dusttest IP5X and IP6X					
	Assetnumber	Description	Calibration Due	Specs	Remarks	
	AB102261	Dust chamber	NA	1 cubic meter	-	P
	AB101912	Flowmeter air	June 2027	0.2 to 1.0 l/min	-	NA
	AB103874	Mano meter	May 2027	0 to 25 mbar	-	NA
	-	-	-	-	-	
4.2	Test probes IP					
	Assetnumber	Description	Calibration Due	Specs	Remarks	
	AB101935	Test rod 2.5 mm Ø	Jan 2028	-	-	P
	AB104776	Jointed test finger	June 2027	-	-	P
	-	-	-	-	-	
4.3	Watertest IPX3 and IPX4					
	Assetnumber	Description	Calibration Due	Specs	Remarks	
	AB102260	Water chamber	NA	-	-	P
	AB101818	Flowmeter water	June 2027	0.5 to 4 l/min	-	P
	-	-	-	-	-	
4.4	Watertest IPX6					
	Assetnumber	Description	Calibration Due	Specs	Remarks	
	AB101970	Flowmeter water	June 2028	10 to 190 l/min	Max: 300 PSI	P
	AB101967	Spacer nozzle	June 2030	-	-	P
	AB101968	Nozzle 12.5 mm	June 2030	-	-	P
	-	-	-	-	-	
4.5	General equipment					
	Assetnumber	Description	Calibration Due	Specs	Remarks	
	AB101765	Thermometer	Feb 2027	-199,9 to 199,9 °C	-	P
	AB104035	Tape measure	Nov 2026	-	-	P
	AB103813	Stopwatch	Dec 2026	-	-	P
	-	-	-	-	-	

5 FIGURES

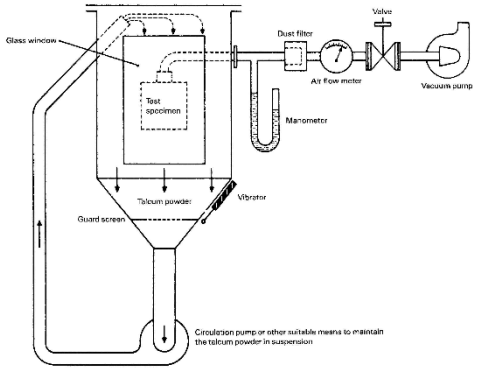
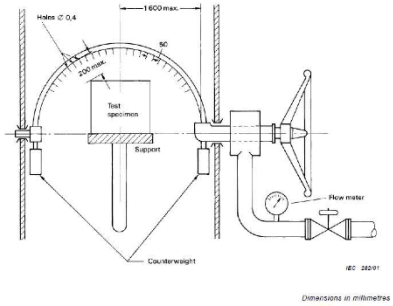


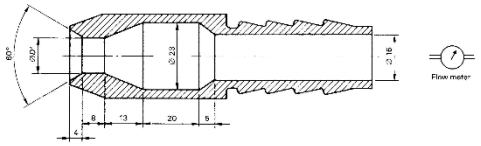
Figure 2 – Test device to verify protection against dust (dust chamber)



Dimensions in millimetres

NOTE The range of holes is shown as for second characteristic numeral 3 (see 14.2.3 a)).

Figure 4 – Test device to verify protection against spraying and splashing water; second characteristic numerals 3 and 4 (oscillating tube)



D' = 6,3 for the test of 14.2.5 (second characteristic numeral 5)
D' = 12,5 for the test of 14.2.6 (second characteristic numeral 6)

Figure 6 – Test device to verify protection against water jets (hose nozzle)

6 TABLES

Table 9 – Total water flow rate *qv* under IPX3 and IPX4 test conditions – Mean flow rate per hole *qvl* = 0,07 l/min

Tube radius *R* mm	Degree IPX3		Degree IPX4	
	Number of open holes *N*[1)]	Total water flow q_v l/min	Number of open holes *N*[1)]	Total water flow q_v l/min
200	8	0,56	12	0,84
400	16	1,1	25	1,8
600	25	1,8	37	2,6
800	33	2,3	50	3,5
1 000	41	2,9	62	4,3
1 200	50	3,5	75	5,3
1 400	58	4,1	87	6,1
1 600	67	4,7	100	7,0

[1)] Depending on the actual arrangement of the hole centres at the specified distance, the number of open holes *N* may be increased by 1.

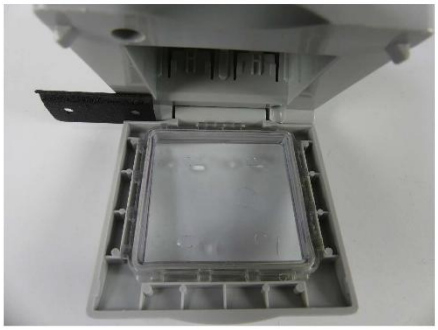
7 PHOTOGRAPHS OF THE EQUIPMENT

As received before tests









Preparing hole for underpressure IP6X

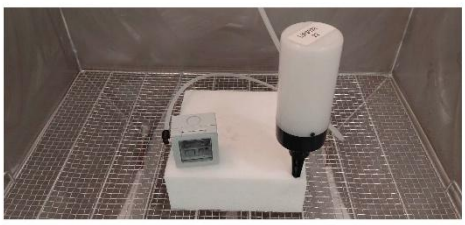






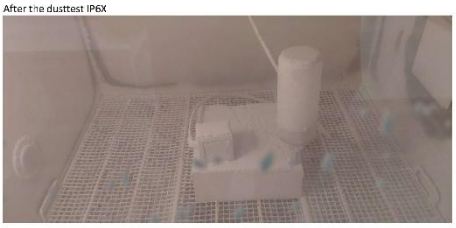
Prepared for dusttest IP6X

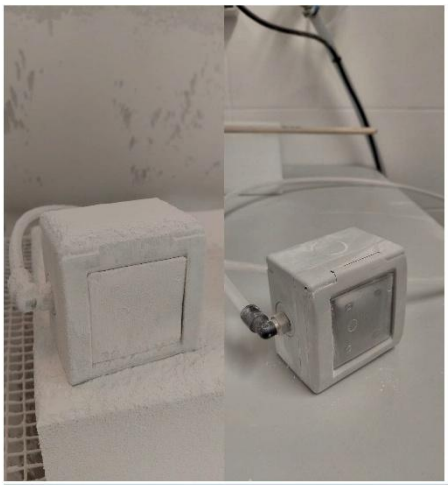






After the dusttest IP6X







Before watertest IPX6



During watertest IPX6



After watertest IPX6





After dusttest IP5X



During watertest IPX6





END OF DOCUMENT

The laboratories of KEMA Labs are:

- CESI S.p.A., Milan, Italy, accredited by ACCREDIA in accordance with ISO/IEC 17025:2017 under no. 00026 Testing.
- FGH Engineering & Test GmbH, Mannheim, Germany, accredited by DAkkS in accordance with DIN EN ISO/IEC 17025:2018 under no. D-PL-12110-01-00.
- IPH Institut "Prüffeld für elektrische Hochleistungstechnik" GmbH, Berlin, Germany accredited by DAkkS in accordance with DIN EN ISO/IEC 17025: 2018 under nos. D-PL-12107-01-00 and D-K-12107-01-00.
- KEMA B.V., Arnhem, The Netherlands, accredited by RvA in accordance with EN ISO/IEC 17025 2017 under nos. L020, L218 and K006.
- KEMA Labs, Zkušebnictví, a.s., Prague, the Czech Republic, testing laboratory no. 1035 accredited by CAI in accordance with ČSN EN ISO/IEC 17025:2018.
- KEMA Powertest, LLC, Chalfont, United States, accredited by A2LA in accordance with ISO/IEC 17025:2017 under no. 0553.01.

Tests are carried out under the scope of accreditation, unless otherwise indicated in the chapter "Tests carried out".

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 22**:

Aspect (IEC 60529)	Laboratory **CODE 22**	Most participants (*)
Cable installation (as-received / intended condition of use) (first characteristic numeral - LIP3528)	Cable not installed for the tests	Sample tested with the cable installed as for intended use
Access probe tests - Sample condition (first characteristic numeral - LIP3528)	Probe tests performed with the sample disassembled and without cable	Probe tests performed with the sample assembled and with the cable installed as for intended use

(*) 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 -----