

INTRO

This document summarizes and concludes on the results obtained from the empirical tests conducted at Force Technology in the period 01.02.2022 – 08.02.2022.

Tests are conducted at Force Technology, Venlighedsvej 4, 2970 Hørsholm, Danmark. For full test report see appendix.

Nordicco's Northern Air Aggressive Environment HVLS fan tests:

1. Accelerated corrosion test (salt-mist spray)
2. IP5X – Resistance towards dust penetration.
3. IPX5 – Resistance towards water penetration.

OVERALL CONCLUSION

Based on the tests performed at Force Technology the Northern Air Aggressive Environment system is classified as IP54 Rated. Here it is taken into account that the motor IP rating of IP54 is governing as the drive housing itself shows IP55.

Further the accelerated corrosion test of the C4 coating shows great resistance towards corrosion and therefore the system is deemed suitable for aggressive corrosive environments. For sub-conclusions from the individual tests see chapter 1-3.

1. ACCELERATED CORROSION ANALYSIS

The fan incl. motor and drive along with an assorted number of brackets, extension tubes etc. are tested in a salt-mist chamber according to the following test method:

IEC 60068-2-52:2017, Environmental testing Part 2: Tests – Test Kb: Salt mist, cyclic.
Test method: Method 3

The test is conducted to evaluate 3 different types of steel coating:

Coating type	Coating description	Visual test marks
C2 Coating	1-layer powder coating	All black parts
C3 Coating	Sand blasting and 1-layer powder coating	All white parts with a black strip
C4 Coating	Sand blasting, primer coating and top-coat	All white parts without a strip

Besides testing the coating protection itself tests have also been performed to review impact from coating damages and coating repairs.

Further also the safety wire, safety wire lock and airfoils have been tested.

1.1 Conclusion based on the test results:

The test of the C4 coating shows high protection against beginning corrosion as no corrosion was detected on the tested samples. Further coating repairs of pre-applied damages also shows great corrosion resistance.

The conclusion is based on the results from example picture 12 (page 15) which is a C4 coated sample along with the brackets on picture 17 (page 18) which is also C4 coated (including applied damages and repairs). The test notes a light coloration difference between the repair coating and the original coating, but no signs of corrosion.

For the non coated parts such as the airfoils, safety wire and safety wire lock the test shows good resistance towards corrosion.

On the basis of the conducted tests the Northern Air Aggressive Environment in coating C4 is suitable for applications in corrosive environments.

2. IP5X – RESISTANCE TOWARDS DUST PENETRATION

The test is conducted according to:

IEC 60529:2013 Degrees of protection provided by enclosures (IP Code).

Test class: IP5X (dust proof)

2.1 Conclusion

On the basis of the results from the test, where no accumulation of dust have been observed, the drive enclosure is classified as IP5X rated.

3. IPX5 – RESISTANCE TOWARDS WATER PENETRATION

The test is conducted according to:

IEC 60529:2013 Degrees of protection provided by enclosures (IP Code).

Test class: IPX5 (Water jets from all directions)

3.1 Conclusion

On the basis of the results from the test, where no penetration of water have been observed, the drive enclosure is classified as IPX5 rated.

TEST REPORT

Environmental test of indoor fan and fan assembly parts

Nordicco A/S

Report no.: 121-32625-1

Page 1 of 31

1 appendix



Task manager

Responsible

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OVERVIEW

Title	Environmental test of indoor fan and fan assembly parts
Test objects	3 pcs. indoor fans, Part no. NordicX00NA-AE Assorted pieces for fan assembly (See Section 2.2 for details) Detailed information is to be found in Section 2 The test objects were received 1 February 2022
Task no.	121-32625
Report no.	121-32625-1
Test period	1 February 2022 - 8 February 2022
Client	Nordicco A/S Karetmagervej 23 A 7000 Fredericia DENMARK Tel.: +45 73 70 90 83
Contact person	Jesper Hermansen E-mail: jesper@nordicco.eu Tel.: +45 61 48 64 60
Manufacturer	Nordicco A/S
Specifications	IEC 60068-2-52:2017, Test Kb: Salt mist, cyclic IEC 60529:2013 "Degrees of protection provided by enclosures (IP Code)"
Results	For results of the test, see Section 4
Revisions	Initial version
Test site	Venlighedsvej 4, 2970 Hørsholm, Denmark
Test personnel	Kristian Kolbye Jensen Jens Schoustrup-Thomsen

Disclaimer

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The test results only relate to the items tested.

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1 Summary of test

1.1 Test requirements

Test	Test method
Salt mist	IEC 60068-2-52:2017
Dust protection, IP5X	IEC 60529:2013
Enclosure protection, IPX5	IEC 60529:2013

The following tests were carried out as agreed with the client.

The test results relate only to the objects tested.

2 Test objects

2.1 Test object

Name of test object	Indoor fan
Model / type	Northern Air Aggressive Environment
Part no.	NordicX00NA-AE
Serial no.	100314
Manufacturer	Nordicco A/S
Supply voltage	220 – 240 V _{AC}
Comments	Test object for salt mist test

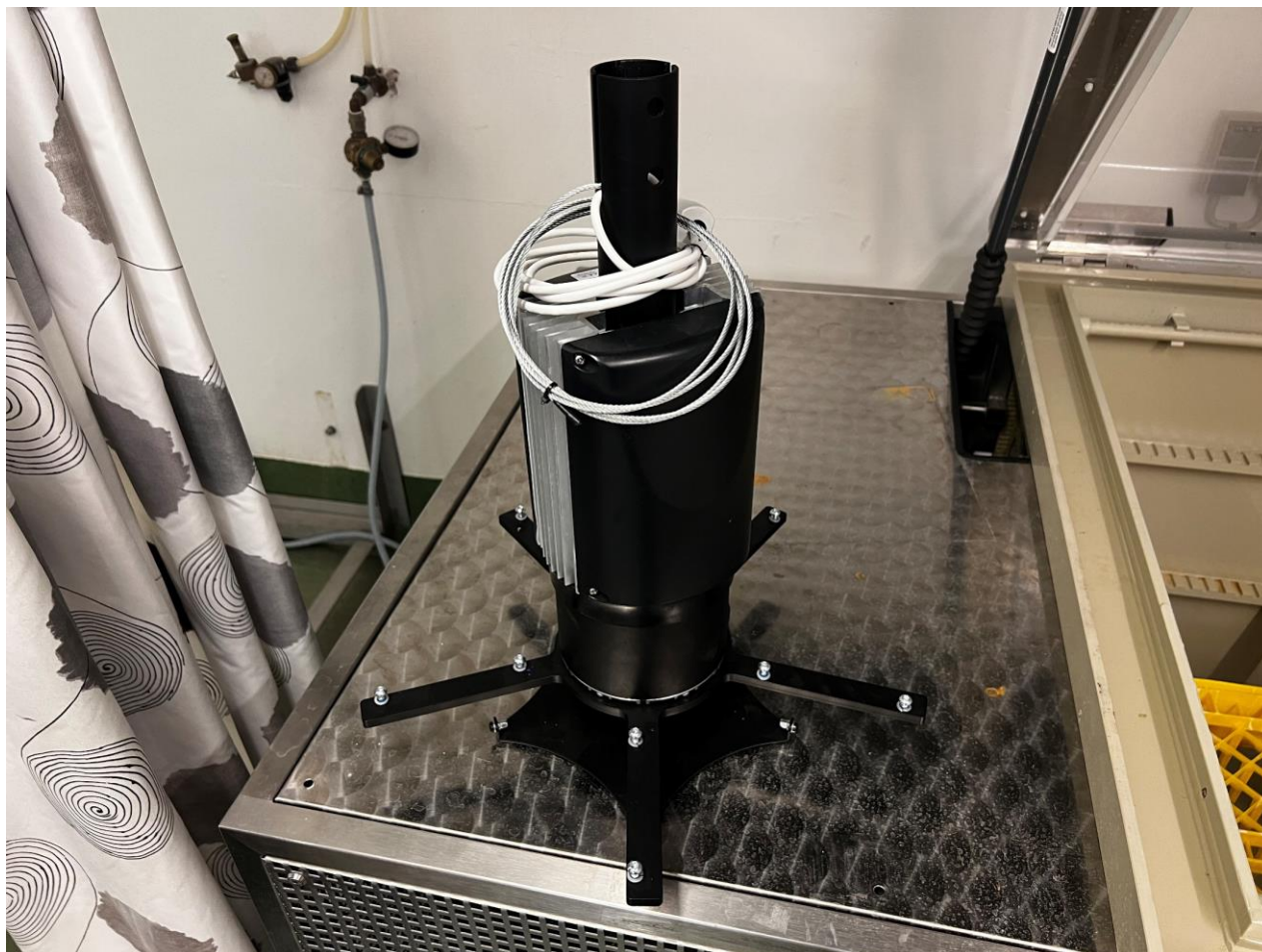


Photo 1 Test object.

2.2 Test object

Name	Part number
Extension tube	20003
Saddle extension plate	20028
Airblade – Air	20201
Guy wire mount plate	20024
Power Distributor	20009
Starfish	20005
Safety wire	300-104
Gripple	10013
Cable retainer	20007
Cable retainer bottom	20008
HEX standoff	20006
Wood/concrete mount	20032

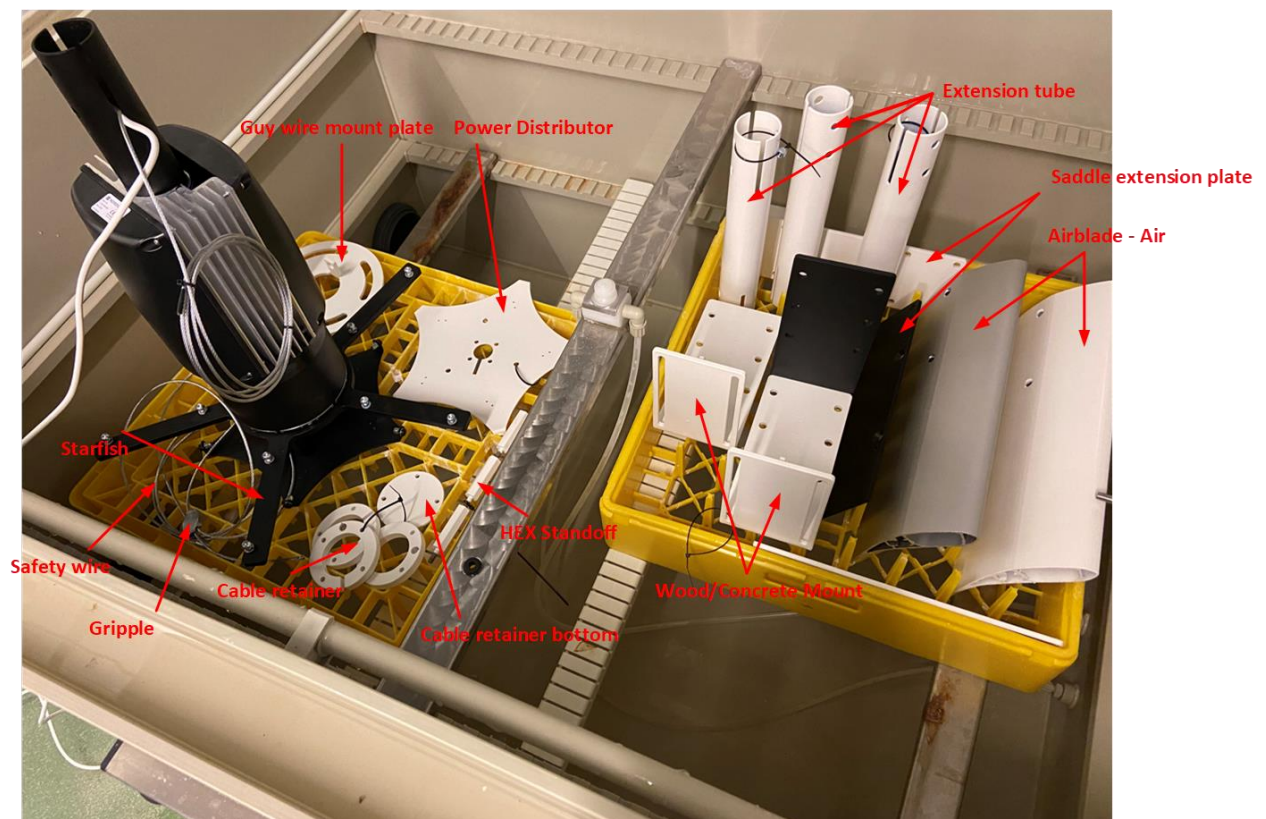


Photo 2 Test objects. Assorted pieces for fan assembly for salt mist test.

Comments Three types of coating are tested. C2, C3 and C4 powder coating and an air blade with/without coating.

2.3 Test object

Name of test object	Indoor fan
Model / type	Northern Air Aggressive Environment
Part no.	NordicX00NA-AE
Serial no.	100311
Manufacturer	Nordicco A/S
Supply voltage	220 – 240 V _{AC}
Comments	Test object for IP5X



Photo 3 Test object. Enclosure boundaries marked by red square.

2.4 Test object

Name of test object	Indoor fan
Model / type	Northern Air Aggressive Environment
Part no.	NordicX00NA-AE
Serial no.	100312
Manufacturer	Nordicco A/S
Supply voltage	220 – 240 V _{AC}
Comments	Test object for IPX5



Photo 4 Test object. Enclosure boundaries marked by red square.

3 General test conditions

3.1 Test set-up

The test set-ups can be seen in Section 4.

3.2 Visual inspection

A visual inspection was carried out by FORCE Technology after each test. The inspection included opening the test object and looking for ingress of dust, water, salt and corrosion.

3.3 Standard environment

Normal environmental condition:

Temperature	:	15 °C - 35 °C
Humidity	:	25 %rh - 75 %rh
Air pressure	:	86 kPa - 106 kPa (860 mbar - 1060 mbar)
Power supply voltage	:	$U_{nom} \pm 3 \%$

4 Test and results

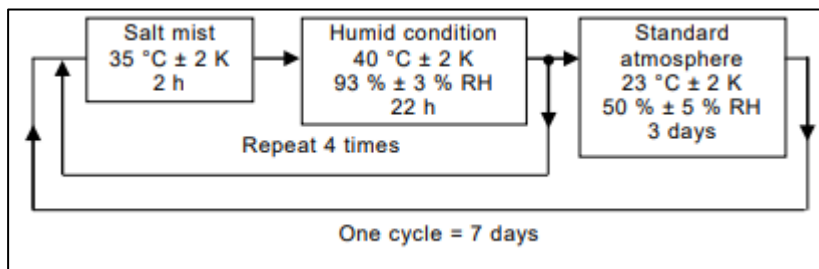
4.1 Salt mist

Test specification and Test method

IEC 60068-2-52:2017, Environmental testing Part 2: Tests – Test Kb: Salt mist, cyclic.

Severity

Test method 3.



Concentration of NaCl	:	5 % NaCl
pH of salt solution	:	6.5 - 7.2
Salt mist condition	:	35 °C (4 x 2 hours)
Humid condition	:	40 °C / 93 %rh (4 x 22 hours)
Standard atmosphere	:	23 °C / 50 %rh (3 days - 72 hours)
Number of cycles	:	1
Total duration	:	7 days

Procedure

The test objects are installed in the salt mist chamber and sprayed with the salt mist solution for a period of 2 hours.

At the end of the spraying period, the test objects are exposed to humidity and stored at a temperature of 40 °C ± 2 °C and a relative humidity of 93 %rh ± 3 %rh for a period of 22 hours. This is repeated four times.

The test objects are then stored under standard atmosphere at a temperature of 23 °C ± 2 °C and a relative humidity of 50 %rh ± 5 %rh for a period of three days.

The above constitutes one cycle.

The test object is deenergised during the exposure.

After the finalisation of the exposure a visual inspection is performed.

Results

The visual inspection conducted after the exposure showed the following results:

- C2 powder coating: Corrosion at client produced test scratches and along sharp edges
- C3 powder coating: Corrosion at client produced test scratches and along sharp edges
- C4 powder coating: Corrosion at client produced test scratches and inside extension tubes without coating. Otherwise, no corrosion observed
- Air blade with/without coating: No changes in appearance

No salt residues were observed on the inside of the test object.

See photos on the following pages for details.



Photo 5 Test set-up salt mist chamber.



Photo 6 Visual inspection (fan). Slight oxidation on aluminium heat sink.



Photo 7 Visual inspection (fan). Corrosion on/inside fan extension tube.



Photo 8 Visual inspection (fan). Corrosion on screw for the lid.

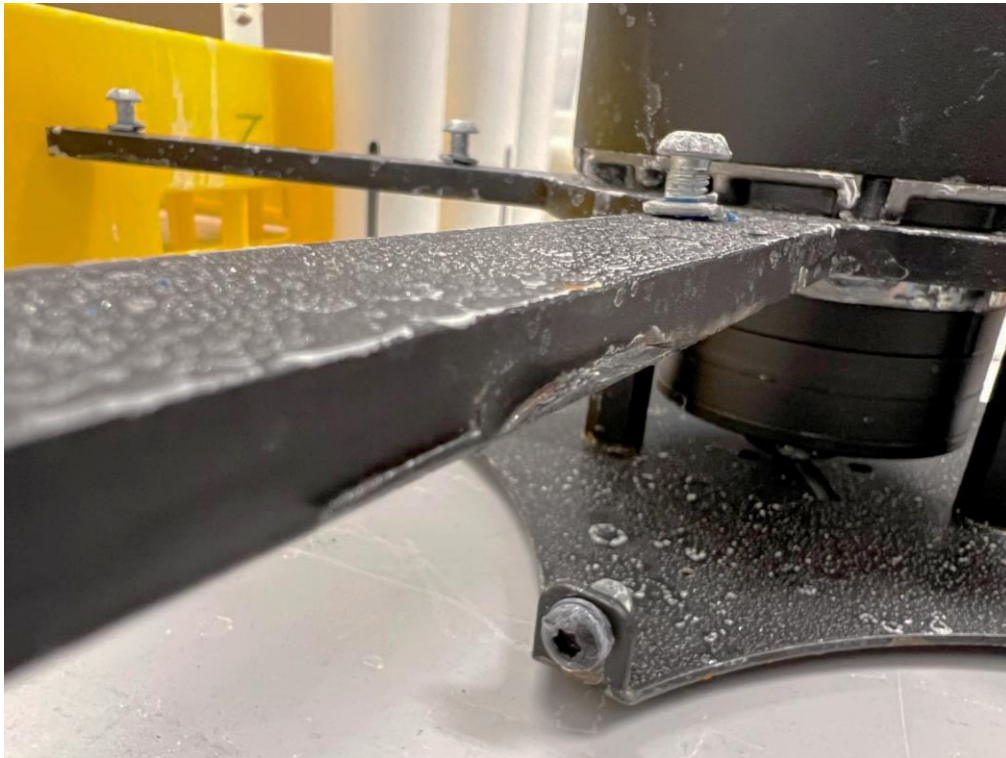


Photo 9 Visual inspection (fan). Corrosion and peeling of coating.



Photo 10 Visual inspection (fan). No signs of corrosion or salt residue inside the test object.



Photo 11 Visual inspection. (Extension tube, P/N: 20003) corrosion on scratch made by the client. Other extension tubes had no changes.

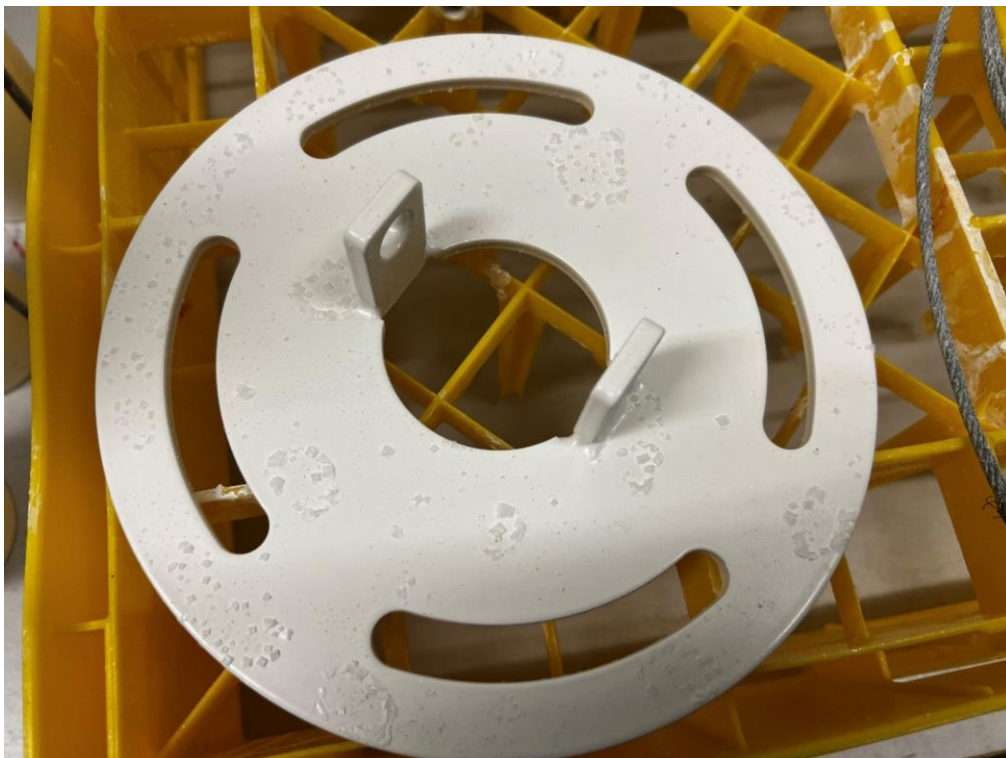


Photo 12 Visual inspection. (Guy wire mount plate, P/N: 20024) no signs of corrosion.



Photo 13 Visual inspection. (Safety wire & Gripple, P/N: 300-104 & 10013). Oxidation and slight corrosion observed.



Photo 14 Visual inspection. (Power distributor, P/N: 20009) slight corrosion along edges.



Photo 15 Visual inspection. (Cable retainers P/N: 20007 & 20008) slight corrosion along edges and scratches made by the client.

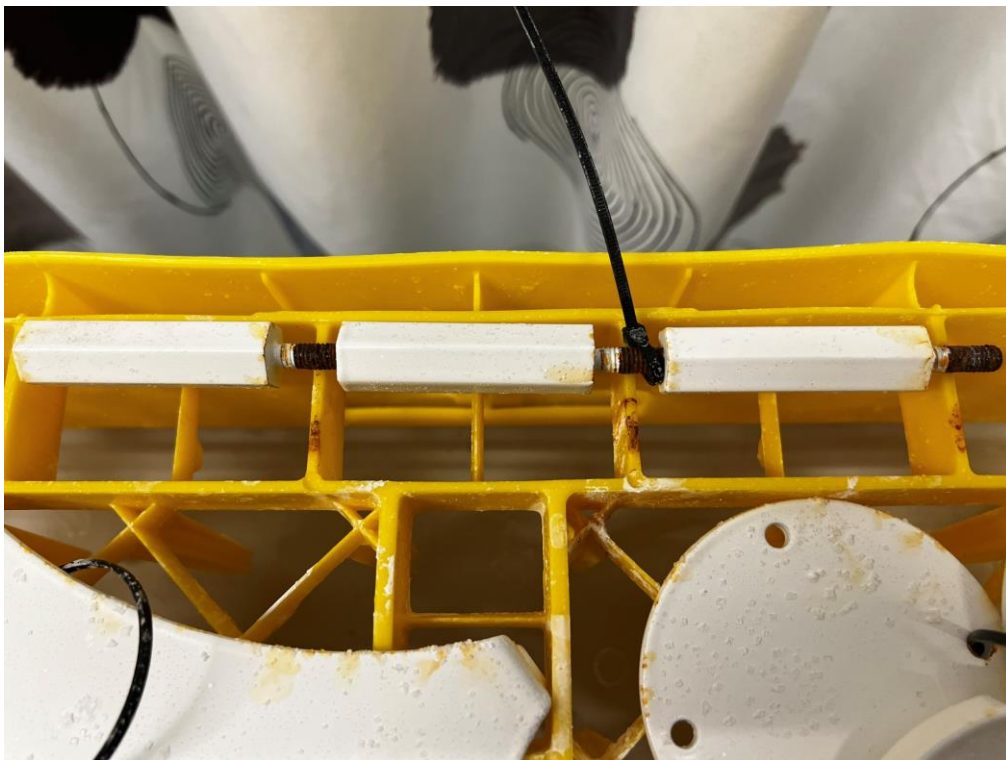


Photo 16 Visual inspection. (Hex standoff P/N: 20006) corrosion along edges and on screw thread.



Photo 17 Visual inspection. (Wood/concrete mount P/N: 20032) slight coloration on repaired cracks, otherwise no change.

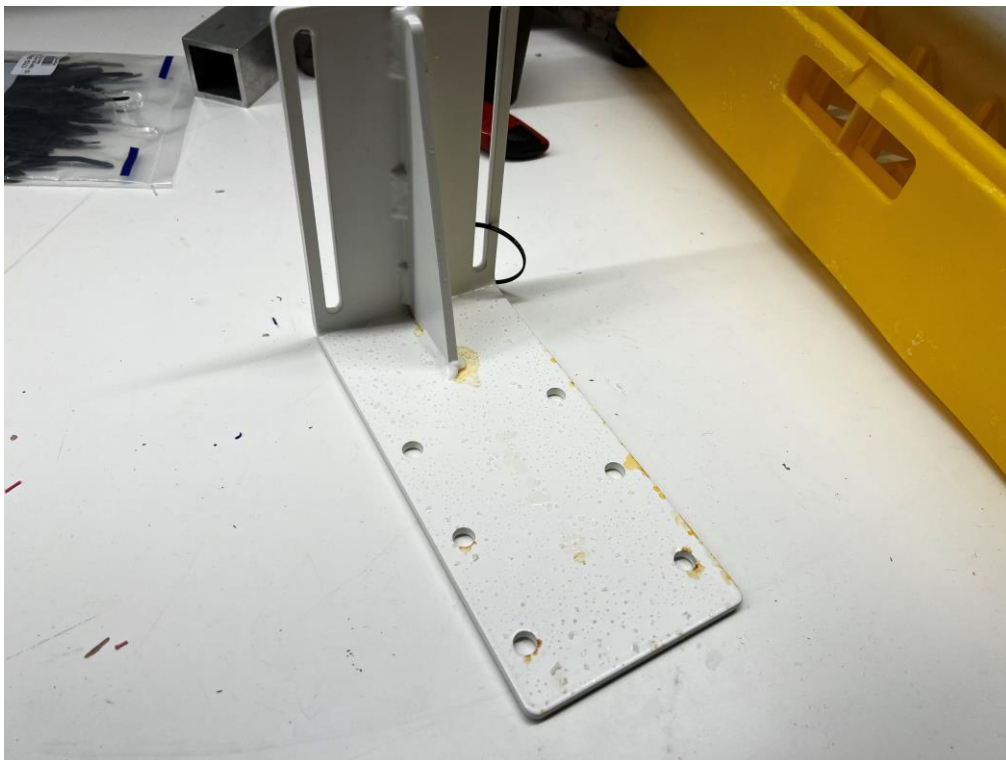


Photo 18 Visual inspection. (Wood/concrete mount P/N: 20032) slight coloration on repaired cracks, and corrosion on edges and crevice from missing welding.

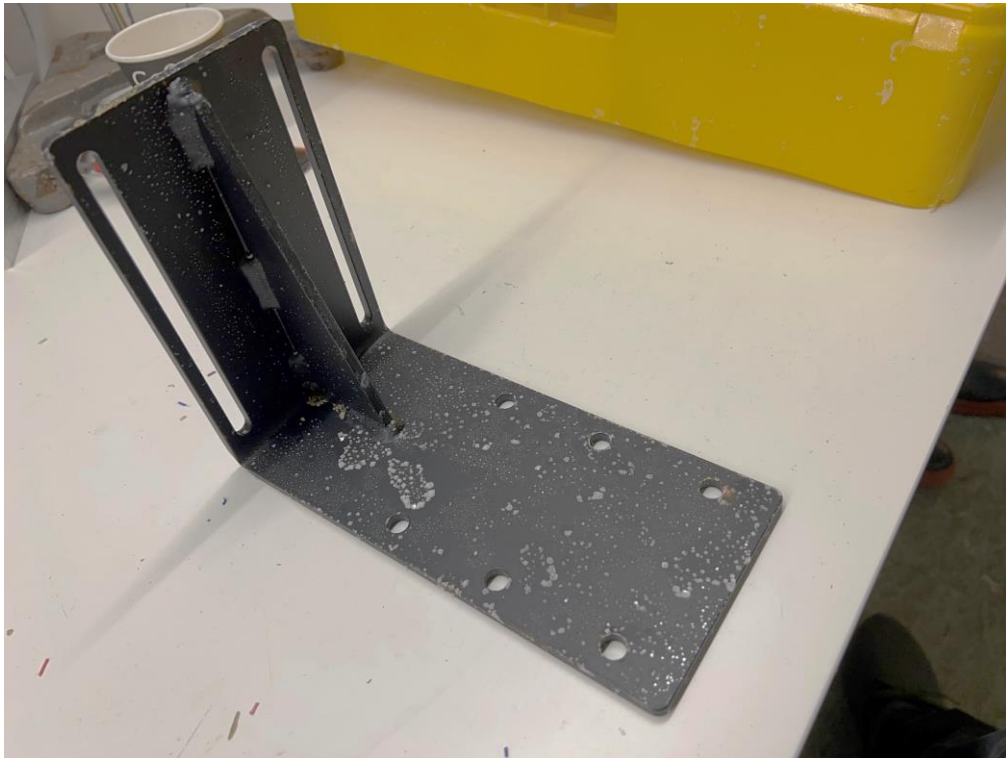


Photo 19 Visual inspection. (Wood/concrete mount P/N: 20032) corrosion on scratches made by the client and along edges and crevices from missing welding.



Photo 20 Visual inspection. (Saddle extension plate P/N: 20028) corrosion on scratches made by the client and along edges.

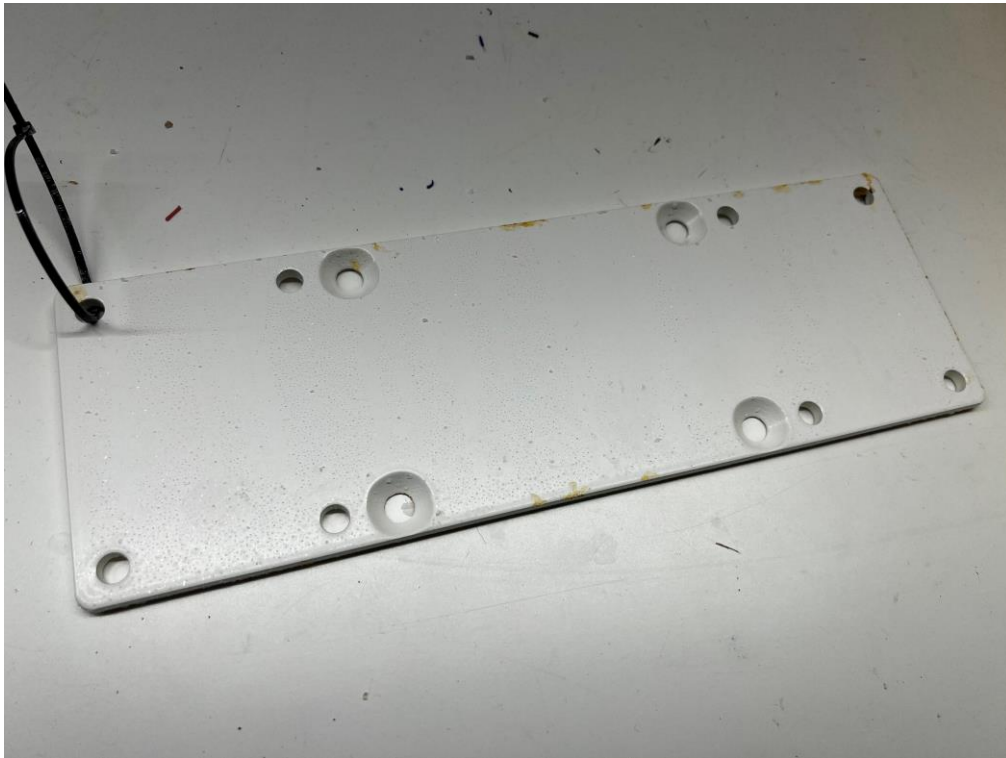


Photo 21 Visual inspection. (Saddle extension plate P/N: 20028) corrosion on scratches made by the client and along edges.

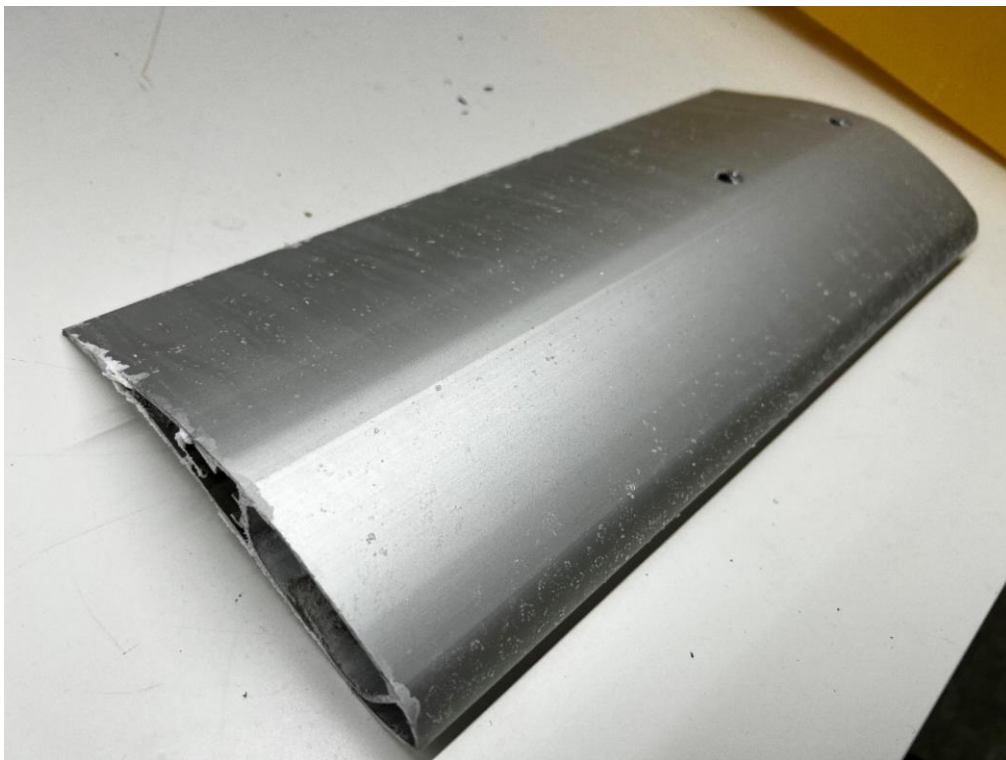


Photo 22 Visual inspection. (Air blade P/N: 20201) no changes observed.

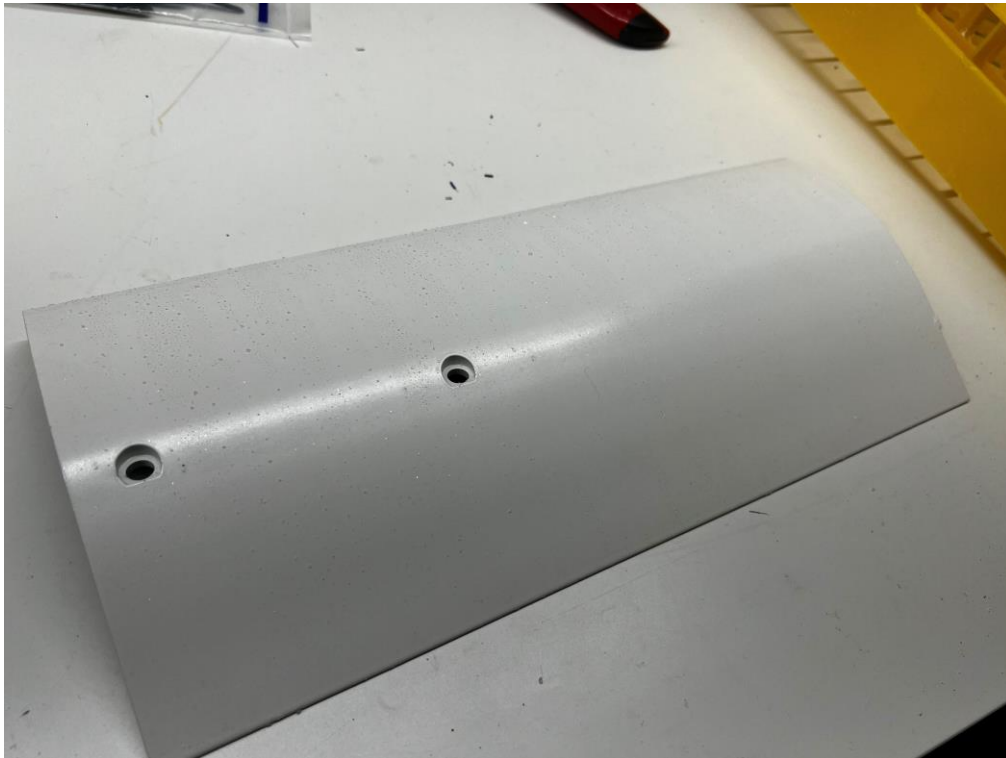


Photo 23 Visual inspection. (Air blade P/N: 20201) no changes observed.

4.2 Dust protection, IP5X

Test specification and Test method

IEC 60529:2013 Degrees of protection provided by enclosures (IP Code).

Severity

IP5X (dust-protected):

Category : 2 (no air pressure reduction)

Enclosures where no pressure difference relative to the surrounding air is present.

Dust medium : Talcum

Air pressure : Normal air pressure

Duration : 8 hours

Procedure

The test object is de-energised during the exposure.

The test object is placed inside the dust test chamber in an upright position as would be expected during normal use. Hereafter, it is exposed to swirling dust conditions as described in the reference specification.

After the exposure, the test object is brushed down on all external surfaces. It is then carefully opened and visually inspected for ingress of dust. Special attention is paid to dust accumulated on parts critical to the functionality of the test object.

Acceptance condition for first characteristic number 5

The protection is satisfactory if, on inspection, dust has not accumulated in a quantity or location that, as with any kind of dust, could interfere with the correct operation of the equipment or impair safety.

Results

The test was performed as specified. A visual inspection showed that there was no accumulated dust inside the enclosure. Furthermore, an \varnothing 1.0 mm test wire could not enter through any holes or openings, and adequate clearance was kept between the test wire and hazardous parts.



Photo 24 Before exposure, IP5X.



Photo 25 After exposure, IP5X.



Photo 26 Visual inspection, IP5X.



Photo 27 Visual inspection. Lid – no ingress of dust observed.



Photo 28 Visual inspection. No ingress of dust observed inside the enclosure of the test object.



Photo 29 Visual inspection. No ingress of dust observed inside the enclosure of the test object.

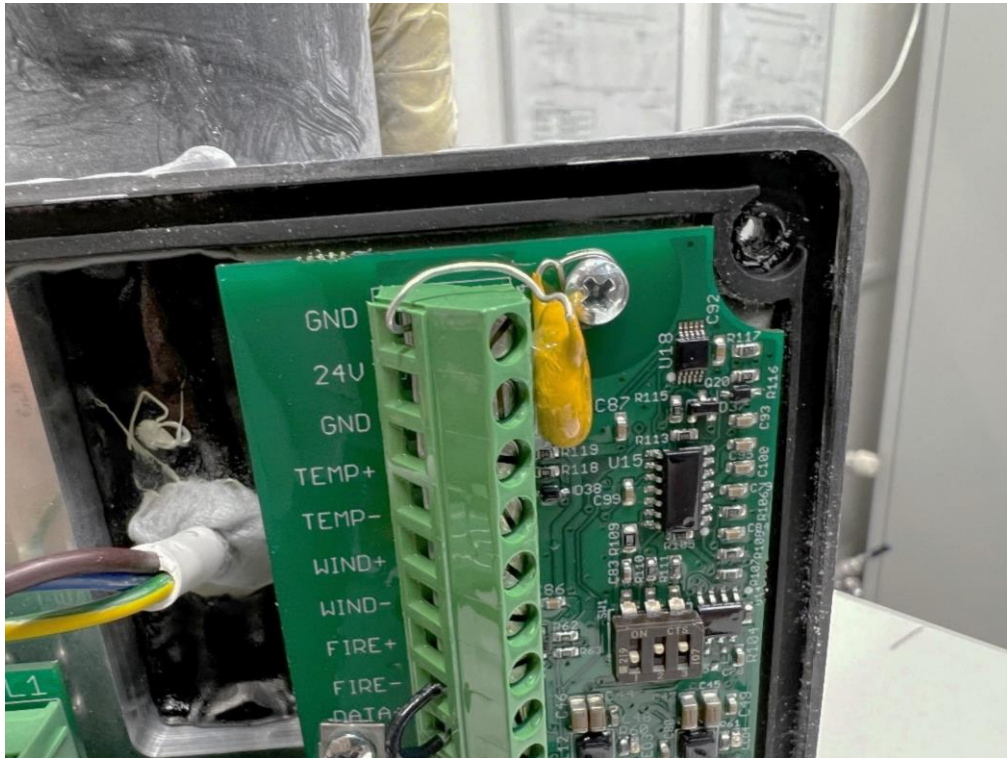


Photo 30 Visual inspection. No ingress of dust observed inside the enclosure of the test object.

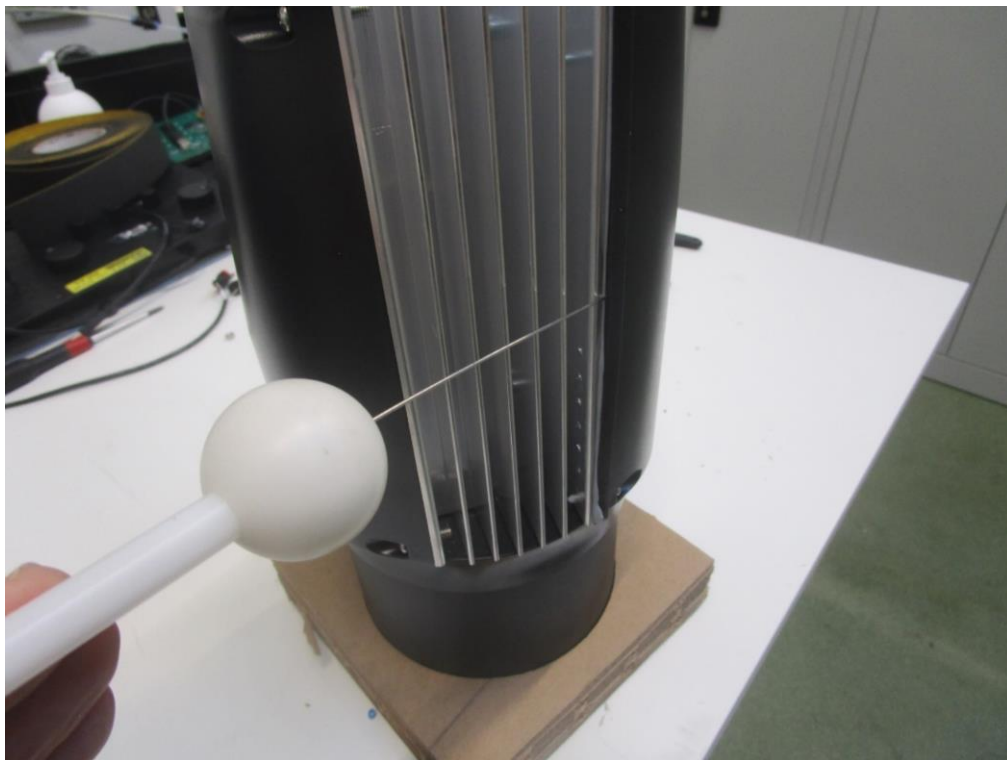


Photo 31 Enclosure protection, IP5X. 1 mm probe could not enter the enclosure and adequate clearance was kept.

4.3 Enclosure protection, IPX5

Test specification and Test method

IEC 60529:2013 Degrees of protection provided by enclosures (IP Code).

Severity

IPX5: (Protection against water jets from all directions)

Internal diameter of the nozzle	:	6.3 mm
Flow	:	12.5 l/min
Test duration	:	1 min per m ² , 3 min. minimum
Distance from nozzle to object	:	2.5 to 3 m

Procedure

The test object is de-energised during the exposure.

The test object is subjected to the specified flow of water for the specified duration from all practical directions.

After the test, the test object is wiped off on all external surfaces, and an internal visual inspection is performed.

Acceptance condition for second characteristic number 5

In general, if any water has entered it shall not be sufficient to interfere with the correct operation of the equipment or impair safety.

Results

The test was performed as specified. The visual inspection showed no ingress of water inside the test object.

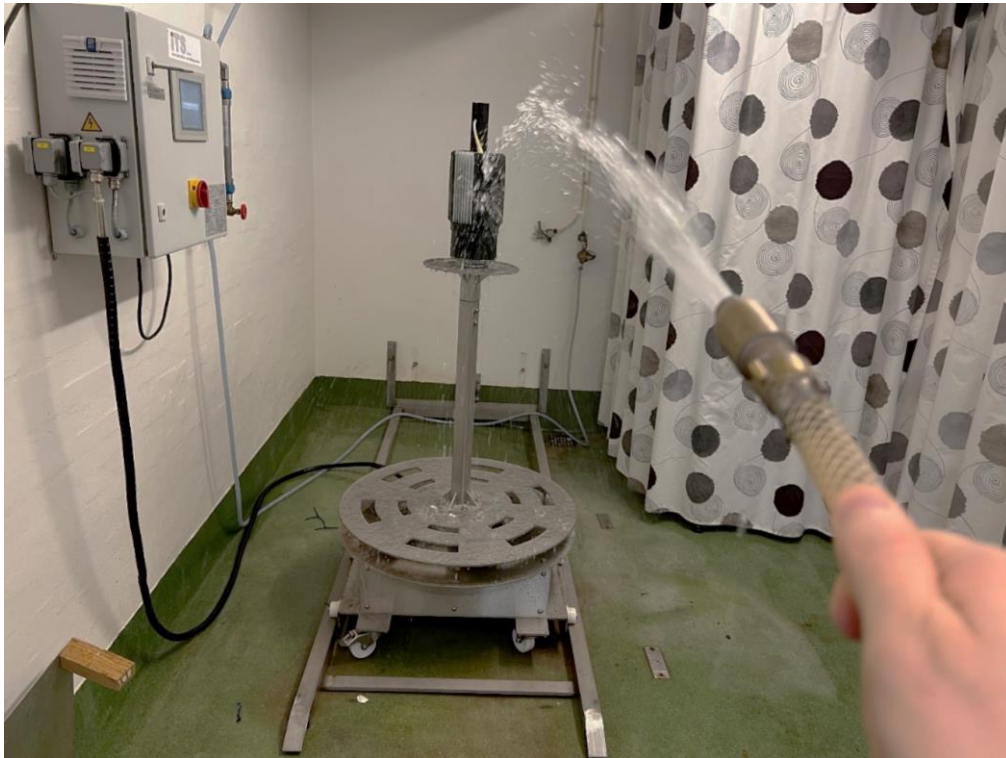


Photo 32 During exposure, IPX5.



Photo 33 After exposure, IPX5.



Photo 34 Visual inspection, IPX5. No ingress of water observed inside lid.



Photo 35 Visual inspection. IPX5. No ingress of water observed inside the enclosure of the test object.



Photo 36 Visual inspection. IPX5. No ingress of water observed inside the enclosure of the test object.



Photo 37 Visual inspection. IPX5. No ingress of water observed inside the enclosure of the test object.

APPENDIX

Appendix 1 List of instruments

NO.	DESCRIPTION	MANUFACTURER	TYPE NO.
EVFGT-33-2	Salt mist chamber	Köhler Automobiltechnik	HKT1000
EVFGT-29	Climatic room	DELTA	V/A
43240	Psychrometer	DELTA	EP3
EVFGT-34	Wet Room	DELTA	IP Water
43280	Flowmeter	Eberhardt/IOSIL	MS 501-T20-1A1A1A
EVFGT-49	IP Dust	Weiss Technik	ST 2000
43257	Humidity Logger	ELPRO-BUCHS	TH1
43301	Tape Measure	Stanley	5m / 300-696
43273	Stopwatch	Hanhart	DELTA E 200
43281	Thermometer	Elma	711
43239	IP Probe test kit	ED&D	A,B,C,D,E,F,G