

## Test Report

### -TRANSLATION-

Document number: (1204/340/23) – Pan dated 10/07/2024

Client: an.kox GmbH  
Junghansring 52  
72108 Rottenburg, Germany

Subject of the order: Proof of usability of the metal waterstop "AquaproofX 1P PLUS" joint sealing system for sealing of construction joints and controlled crack cross-sections in cast-in-place concrete against pressing and non-pressing water and against ground moisture

Test basis: Testing principles for granting general building authority test certificates for joint sealings in concrete components with a high resistance to water penetration in areas in contact with soil (PG-FBB) in accordance with the Administrative Provisions – Technical Building Rules, sequential no. C 3.30

Samples received: 22/11/2023

Sampling: By the client

Assessment period: January to May 2024

This test report consists of 5 pages, including the cover sheet and 4 annexes.

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## 1 Order

an.kox GmbH commissioned the Civil Engineering Materials Testing Institute (MPA) to carry out tests on a metal waterstop with the designation "AquaproofX 1 PLUS" for sealing of construction joints and controlled crack cross-sections in cast-in-place concrete against pressing and non-pressing water and against ground moisture. The tests were intended to serve the purpose of issuing a general building authority test certificate for products in accordance with the Administrative Provisions – Technical Building Rules seq. no. 3.30.

The metal waterstop AquaproofX 1 PLUS is a galvanised steel sheet with a green polymer coating on one side. The AquaproofX 1 PLUS metal waterstop is manufactured with the dimensions 140 mm x 1.2 mm (height x thickness) without protective film.

To verify the usability of the product, the leakage behaviour under water pressure was tested as part of a component test.

In addition, the following tests were performed to determine the material characteristics and properties:

- Dimensions, mass
- Density
- Infrared spectrum
- Volatile components
- Adhesion to concrete

The presentation of the test results is the subject of this report.

## 2 Tests and results

### 2.1 Verification of tightness

The effective tightness of the metal waterstop AquaproofX 1P PLUS was tested as part of a component test. Images A1 to A3 show the test rig setup. On the test body, which was made of water impermeable concrete (waterproof concrete, grade C 30/37), the joint could be expanded.

The AquaproofX 1P PLUS was installed in the centre of the 30 cm wide joint between the concrete components in accordance with the manufacturer's specifications (Annex 3). The attachment to the reinforcement was made using the corresponding AquaproofX 1P PLUS fixing brackets. The joint areas were butt-jointed and fixed with the one-sided adhesive mounting plates. The minimum embedment depth in the "invert concrete" was 3 cm.

Once the top concrete layer had cured, the construction joint was widened to 1.0 mm and fixed, then water pressure was applied to it. The water pressure was first increased to 1 bar in increments of 0.2 bar with dwell times of 24 hours, then to 5 bar in increments of 1 bar with dwell times of 24 hours and kept constant for 28 days. Test parameters and test results are summarised in table 1 below.

Table 1: Test results of the tightness test

Water pressure (bar)	Duration of the load application (hours)	Test result
0.2	24	tight
0.4	24	tight
0.6	24	tight
0.8	24	tight
1.0	24	tight
2.0	24	tight
3.0	24	tight
4.0	24	tight
5.0	672 (28 d)	tight

## 2.2 Material characteristics and properties

### 2.2.1 Dimensions and mass

The dimensions were determined using a coating thickness gauge (measuring accuracy of 0.01 mm) and a calliper gauge (measuring accuracy of 0.1 mm). The mass and coating thickness were determined by weighing (measuring accuracy of 0.01 g). The averaged values are provided in the table below.

Table 2: Geometry and mass

Cross-section (overall thickness without film/height)	0.86 mm/140 mm
Sheet metal thickness	0.50 mm
Coating thickness	0.70 mm
Mass of the coating	105 g/m

### 2.2.2 Density

The density of the coating was determined in accordance with DIN EN ISO 1183-1 (immersion method). The measurement took place at a test temperature of 23 °C. Table 3 shows the mean value of the triple measurement.

Table 3: Density

Test	Test result
Density	1.059 g/cm <sup>3</sup>

### 2.2.3 Infrared spectroscopy

The infrared spectrum of the polymer coating was recorded using the Golden Gate single-reflection ATR unit without further pre-treatment.

The material quantity was selected to comply with the requirements of DIN 51451 in relation to the extinction ratios.

The spectrum was recorded on a PerkinElmer FTIR unit of type Frontier in a wave number range between 4,000 cm<sup>-1</sup> to 600 cm<sup>-1</sup>.

The spectrum is provided in Annex 4.

### 2.2.4 Volatile matter content

After 24 hours' storage at the 23/50-2 standard climate, three 100 mm long sections of the metal waterstop AquaproofX 1 PLUS were weighed to an accuracy of 0.01 g and then stored in the drying chamber at 70 °C for 7 days. Afterwards, the sections were once again stored at the 23/50-2 standard climate for 24 hours and then weighed. The mean value of the volatile matter content is provided in Table 4 below.

Table 4: Volatile matter content after 7 days at 70 °C

Test	Test result
Volatile matter content	0.52%

### 2.2.5 Adhesive strength of coating material on sheet metal and concrete

The adhesion properties were determined using concrete cylinders (concrete = w/c ratio 0.6; 320 kg CEM I 32.5/m<sup>3</sup>; consistency 0.4) with a diameter of 50 mm, which were concreted on the coating. The tests were carried out in the condition as delivered (storage > 14 days in 23/50-2 standard climate) and after warm storage (7 days, 70 °C) in accordance with Section 4.4.1.1 of the test principles. Table 5 below shows the mean values of the adhesive strength as well as the type of failure.

Table 5: Adhesion properties of coating material on sheet metal and concrete

Storage	Adhesive strength (MPa)	Type of failure <sup>1)</sup>
Standard climate 23/50-2	0.59	100% A/B
23/50-2 standard climate + 70 °C	0.75	100% A/B

<sup>1)</sup> A/B = adhesion failure between coating and concrete

This document is the translated version of the test report no. 1204/340/239 – Pan dated 10/07/2024.  
The legally binding text is the aforementioned German test report.

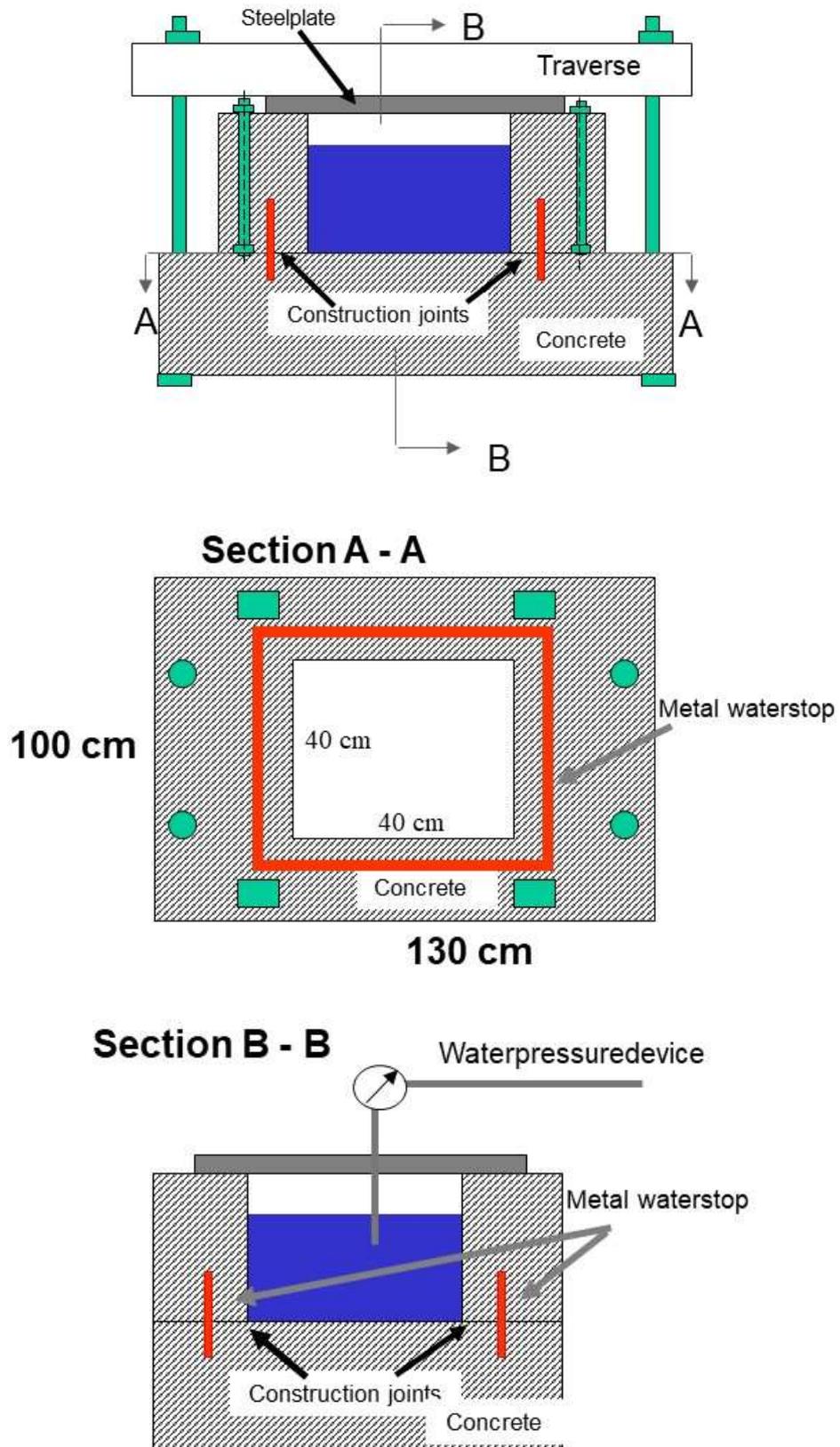
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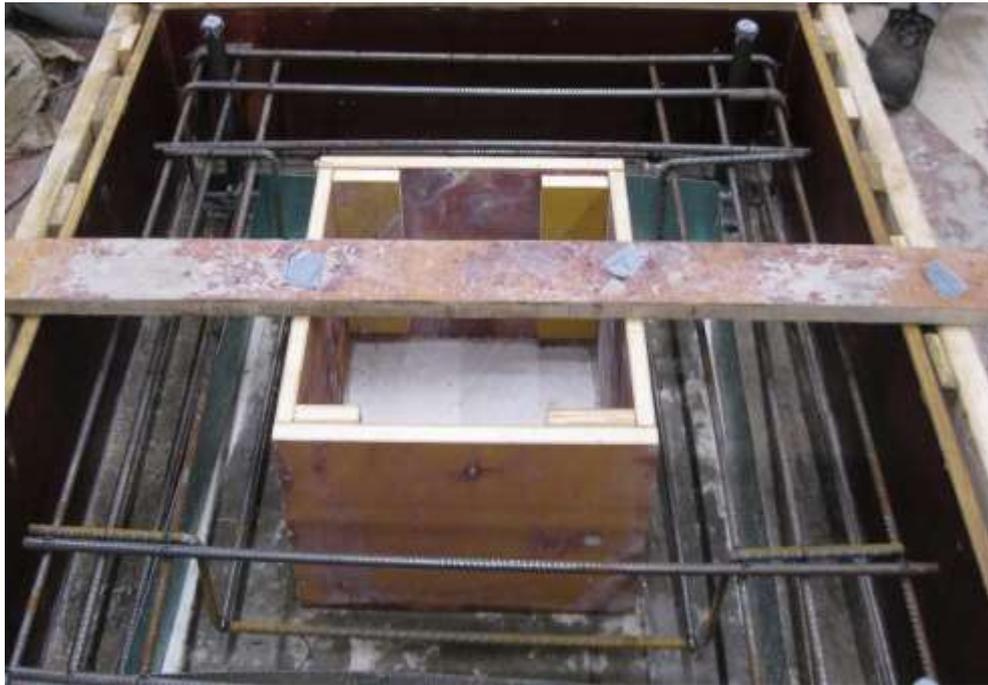
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Deputy Head of Department

signed  
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**Image A1:** Test rig for tightness test (schematic diagram)



**Image A2:** Test specimen before the 2nd concreting



**Image A3:** Tightness test

## Manufacturer's installation instructions (page 1)

The metal water bar **AquaproofX® 1 PLUS** is positioned, with the polymer coating facing towards the water side, along the middle of the joint (base to wall, wall to ceiling), running between the reinforcing rods and fixed in place with the ready-made fixing brackets (around 1 pcs. per metre).

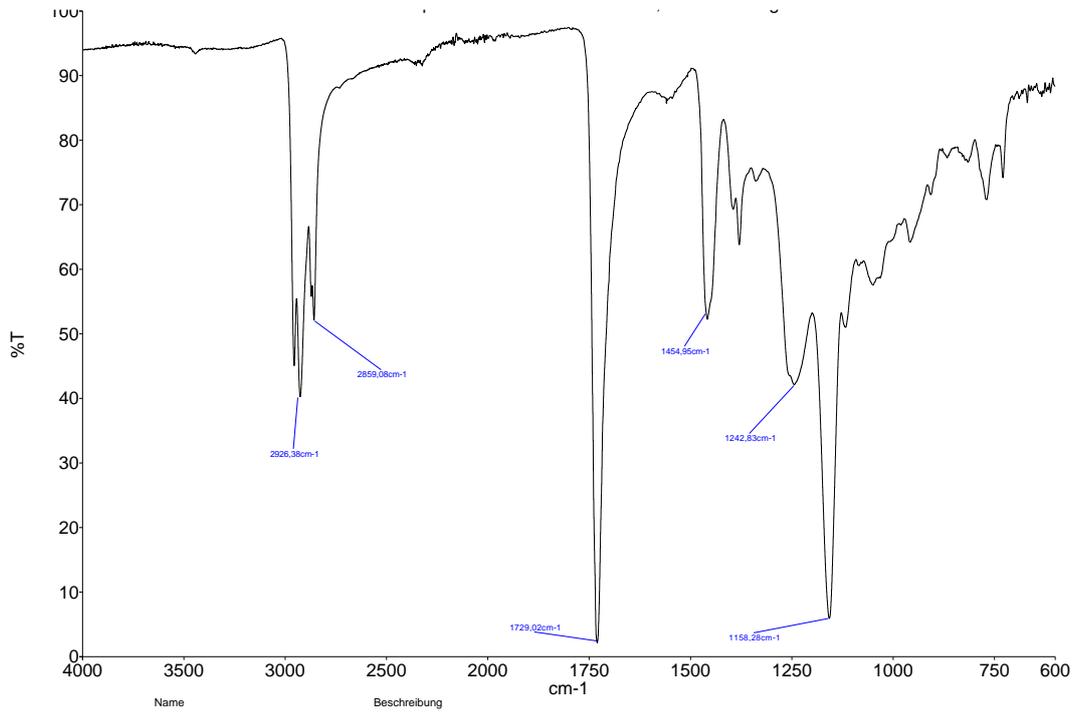
**AquaproofX® 1 PLUS with integrated base** is simply positioned and secured in place by bending the integrated strips around the rebars.

In crack-control joints **AquaproofX® 1 PLUS** is fixed safely in its position along the middle of the joint by preinstalled mounting clips. Mounting clips are locked per impact anchors in a prefab wall at the exterior side wall. In site-mixed concrete walls the mounting clips are locked over binding wires at the exterior reinforcement layer.

Please mind the minimal distance of 3 cm to the reinforcement. **AquaproofX® 1 PLUS** sections are butt joined together and secured with the especial **AquaproofX® 1 PLUS overlap strips**. After the removal of the foil of the overlap strip this will be adhered on the backside of the butt joined **AquaproofX® 1 PLUS**.

With **AquaproofX® 1 PLUS** NO protection foil needs to be removed. An especial concrete contact foil will effectively prevent the **AquaproofX® 1 PLUS** sheets or rolls to stick together during transport and storage. The concrete contact foil will dissolve automatically after the concrete pour.

Curves as well as corners are bent into position on-site. Damaged or dirty sheets must not be installed and have to be changed.



**Image A4:** Infrared spectrum of polymer coating