

# Test Report

## Single Spacer with wire holder

M 0053 / 2016 | 29.04.2016 | english

Requirements according DBV-WU, T, CDF, Type AK40ZS

Tested by: Kiwa GmbH, Garching

## Test report

Client

Max Frank GmbH & Co. KG  
Mitterweg 1  
94339 Leiblfing

Order-no.:

M 0053 / 2016  
Page 1 / 14

Order date : 15. Februar 2016

Test material : Single Spacer with wire holder AK 40 ZS

Project : Determination of the water penetration on concrete specimens with built-in spacers according to DIN 1048, Part 5 freeze-thaw test according to DIN CEN / TS 12390-9 via CDF test methods.  
Examination after thermal cycling

Testing period : 25. März 2016 – 29. April 2016

Tested by : Kiwa GmbH, NL München

Test period : February 2016 – April 2016

Garching, 29. April 2016  
ma/mz

p.p.

*A. M. Hoopes*

Dipl.-Ing. (FH) Andreas  
Matzner  
- Team Leader -



p.p.

Peter Maier  
- person responsible -

The test report contains 15 pages.

The test results relate to the presented sample materials. The sample materials is consumend.

A partial duplication or disclosure of the test report is permitted only with our written permission.

Opinions and interpretations of the inspection are identified in accordance with DIN EN ISO /IEC 17 025, point 5.10.5 italics.

## Contents

<b>1</b>	<b>General</b> .....	<b>3</b>
<b>2</b>	<b>Test methodology</b> .....	<b>4</b>
2.1	Examination water penetration .....	5
2.2	Freeze-thaw testing according CDF method .....	5
2.3	Testing with thermal cycling	6
<b>3</b>	<b>Test results</b> .....	<b>7</b>
3.1	Examination water penetration .....	7
3.2	Freeze-thaw testing according CDF method .....	7
3.2.1	Fluid intake by capillary suction	7
3.2.2	Total amount of scaled material by the frost-thaw stress.....	8
3.3	Temperatur cycling .....	9
<b>4</b>	<b>Summary</b>	

### appendix:

- Photos

## 1 General

Kiwa GmbH was contracted by Max Frank GmbH, represented by Mr. Dipl.-Ing. (FH) Lindner, determine the concrete samples with built in spacers AK 40 ZS to water penetration, the freeze-thaw testing according to the CDF-method and the determine test after thermal cycling.

To this end the spacers were delivered on February delivered by Mr. Lindner .

All samplings and testings where performed by employes of our laboratories in Garching

## 2 Test methodology

The preparation of the concrete specimen (cube with an edge length of 20 and 15 cm) was performed at 03. March 2016, according to the following concrete formula:

Concrete strength class C 35/45 (0/16 mm, F3)

- Cement CEM II/A-LL 42,5
- Number of varieties: 17832204
- Exposure classes: XD3, XF3

In the center cube samples 1 each spacer was set in concreted.

The storage of the samples was carried out ( in the forms covered with foil) for 24 hours at about 20°C. After removal of the forms a circular area with diameter fo about 10 cm at the center area of the testing side with the water pressure was roughenect. Subsequently to test a water storage of about 20°C.

The storage of specimens for the freeze-thaw testing according to the CDF process and testing of the thermal cycling was carried out according to the standard.



## 2.1 Examination water penetration

The test was carried out according to DIN 1048-5, whereby the specimens were applied 5 bar water pressure for 72 hours at the side of the spacer. Subsequently the test specimens were split in the direction of sample height and the depth of water was measured on the cross section of the cleaved sample.

## 2.2 Freez-thaw test according to CDF method

The determination of freeze-/deicing salt resistance with de-icing salts solution was performed according to DIN CEN / TS 12390-9 with CDF method (alternative method) at the surface of the concrete cube with spacers.

This test method determines the weathering amount of surfaces defined by a number of freeze-thaw cycles in the presence of a de-icing agent solution. As a de-icing agent solution a 3% sodium chloride solution was used.

Three days before the start of the pre-saturation with the test solution a lateral seal with aluminum foil with butyl rubber was applied. There after the specimens were stored (seven days in the test solution) for capillary fluid acquisition seven days in the test solution.

Before starting the freeze / thaw cycles loosely adhering particles were removed from the test surface of the specimens by treatment in an ultrasonic bath.

It was followed by a stress on the specimen with 28 freeze / thaw cycles. The duration of one freeze-thaw cycle took 12 hours. The temperature variation corresponded to the requirements of DIN CEN / TS 12390-9, Figure 10 (temperatures between  $\pm 20$  ° C.)

To determine the surface scaling loose components of the test areas was removed after every 6, 10, 14 and 28 freeze / thaw cycles by an ultrasonic bath. The weathered material was collected and filtered. After drying at 105 ° C to constant mass, the mass of scaling was determined and related to the particular test plots.

### **2.3 Testing with thermal cycling**

The test specimen with the cast spacers were subjected to a ten-time thermal cycling at temperatures between + 60 ° C and -10 ° C.

Therefore the dice surfaces were heated by radiant heat for about 8 hours at a temperature of + 60 ° C. Subsequently the cubes were stored for about 16 hours in a freezer at a temperature of -10 ° C.

After ten temperature changes the concrete surfaces were visually inspected and photographed.

Test period: 31. March to 15. April 2016

### 3 Test results

#### 3.1 Examination water penetration

After cleavage, it was found that the samples have an average water penetration of about 0,2 cm. The maximum allowed penetration depth of 5 cm was not exceeded.

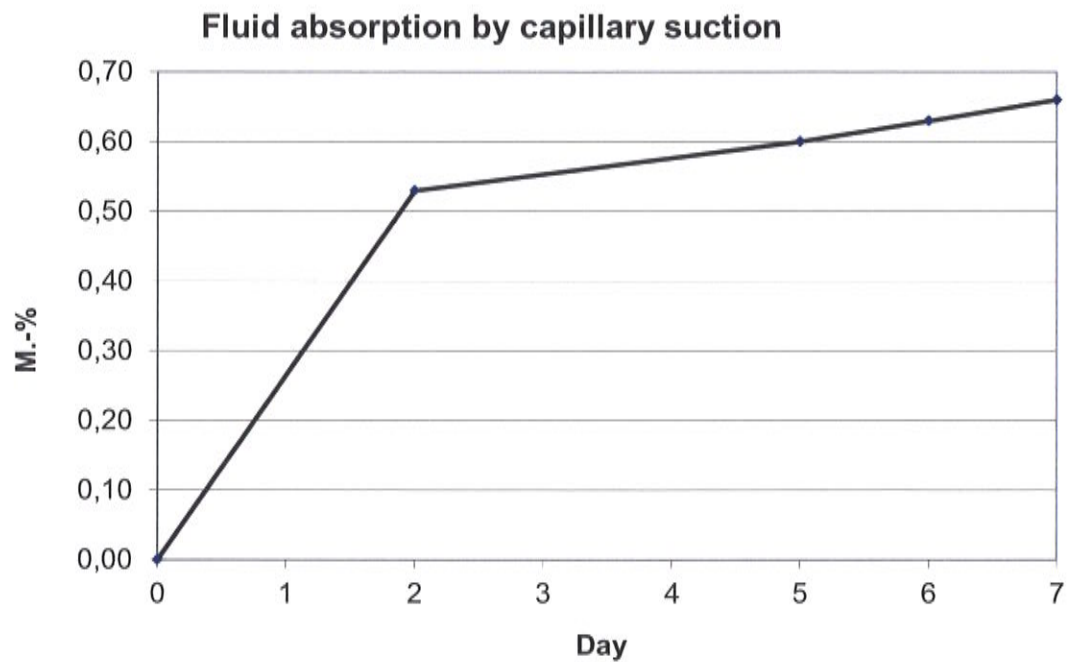
#### 3.2 Total amount of scaled material by the frost-thaw stress

##### 3.2.1 Fluid absorption by capillary suction

Test Nr.	Mass of solution absorbed in M .-% after			
	2 days	5 days	6 days	7 days
1	0,61	0,70	0,74	0,76
2	0,48	0,55	0,57	0,60
3	0,50	0,56	0,58	0,61
MW	0,53	0,60	0,63	0,66
SA	0,07	0,08	0,10	0,09

MW = average, SA = standard deviation





### 3.2.2 Total amount of scaled material by the frost-thaw stress

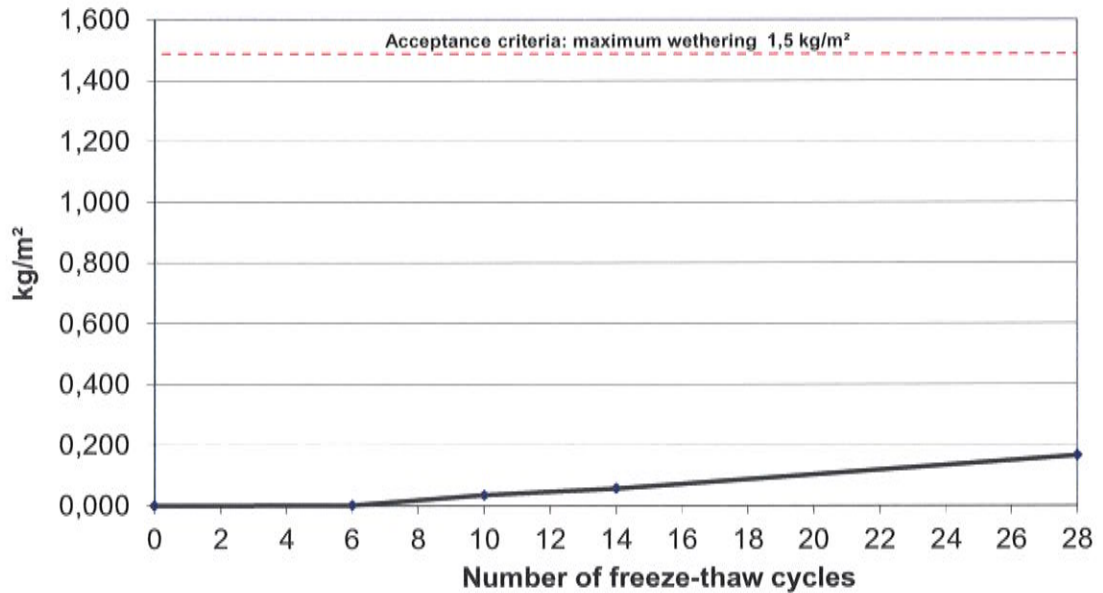
Beginning of the freeze-thaw cycles: 08. April 2016

The end of the freeze-thaw cycles: 29. April 2016

Test Nr.	Test area [m <sup>2</sup> ]	Total mass of the dried scaled material related according to the test area in kg/m <sup>2</sup>			
		6 Zyklen	10 Zyklen	14 Zyklen	28 Zyklen
1	0,0225	0,001	0,027	0,044	0,137
2	0,0225	0,003	0,040	0,065	0,156
3	0,0225	0,002	0,037	0,061	0,203
MW	-	0,002	0,035	0,057	0,165
SA	-	0,00	0,01	0,01	0,03

MW = average, SA = standard deviation

### Weathering by freeze-thaw stress



An audited spacers AK 40 ZS minimal flaking were found.  
(See photo sample 4)

### 3.3 Temperatur cycling

After ten thermal shocks no cracks or cracks or spallings at the vicinity of the indirect un-cast spacers of the concrete surfaces were detected (see photos).

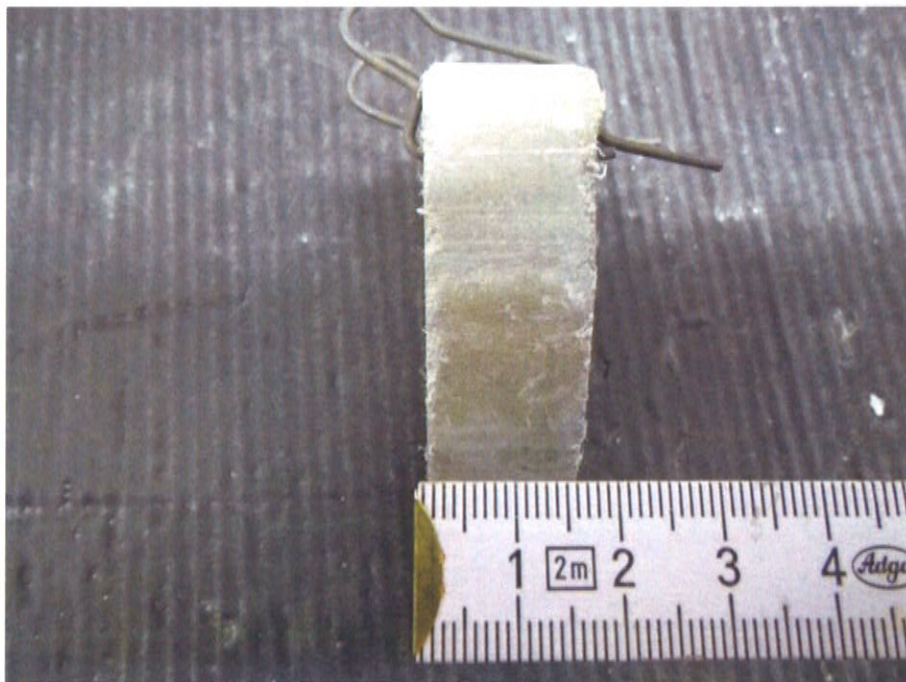
## 4 Summery

All requirements of the DBV data sheet "spacers" are met.

Garching, 29. April 2016

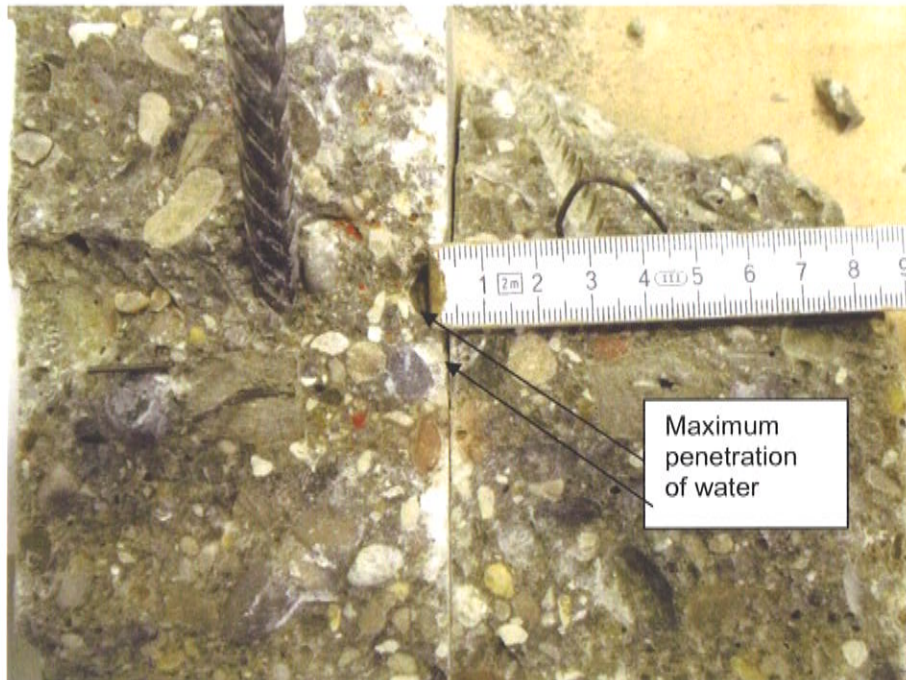


Picture 1: Spacer used

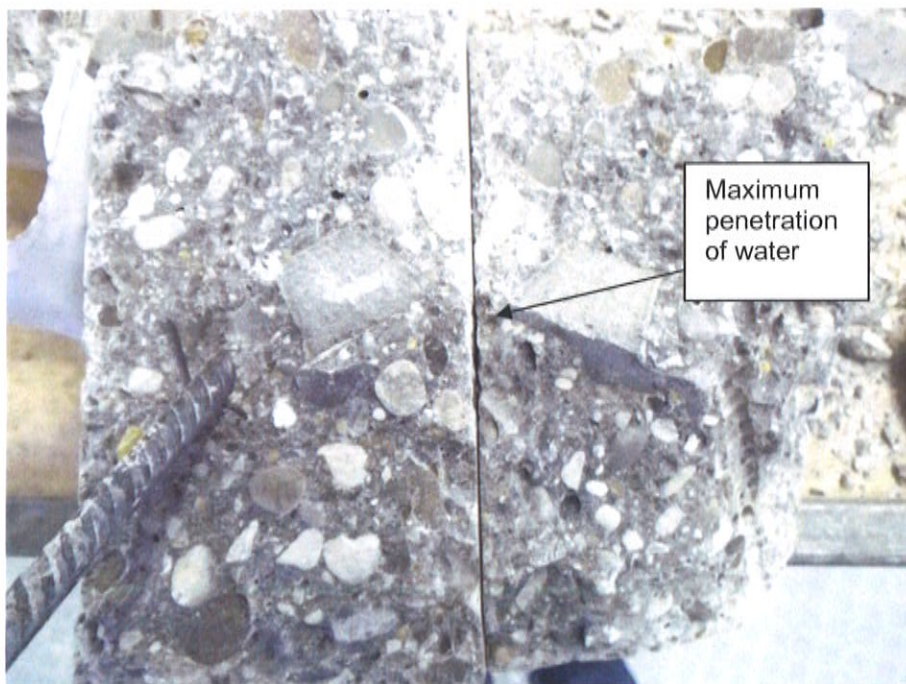


Picture 2: Side view of spacer

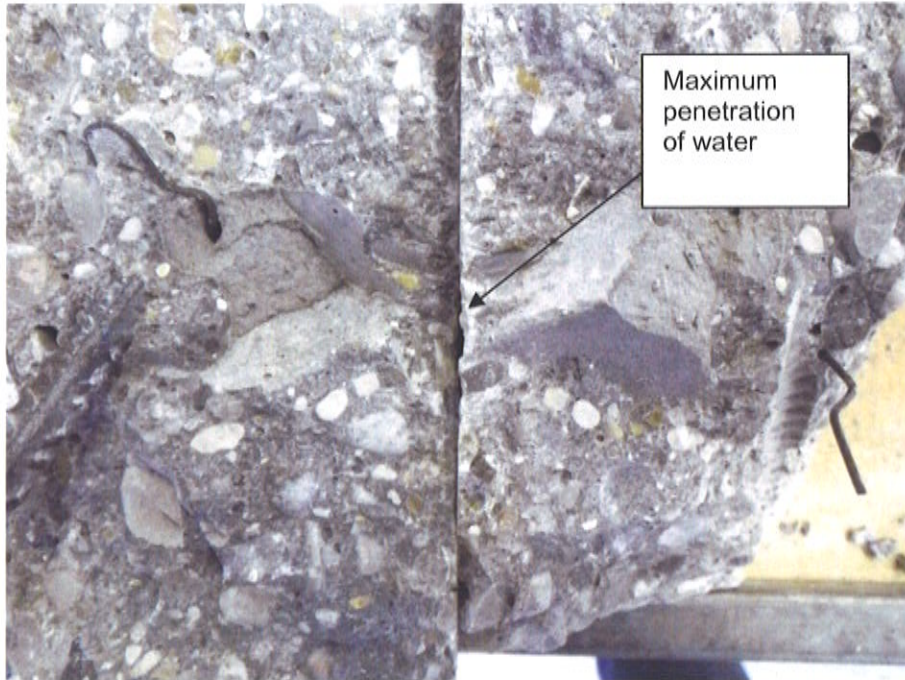




Picture 3: Sample 1 after splitting for measuring the depth of water penetration 3 mm

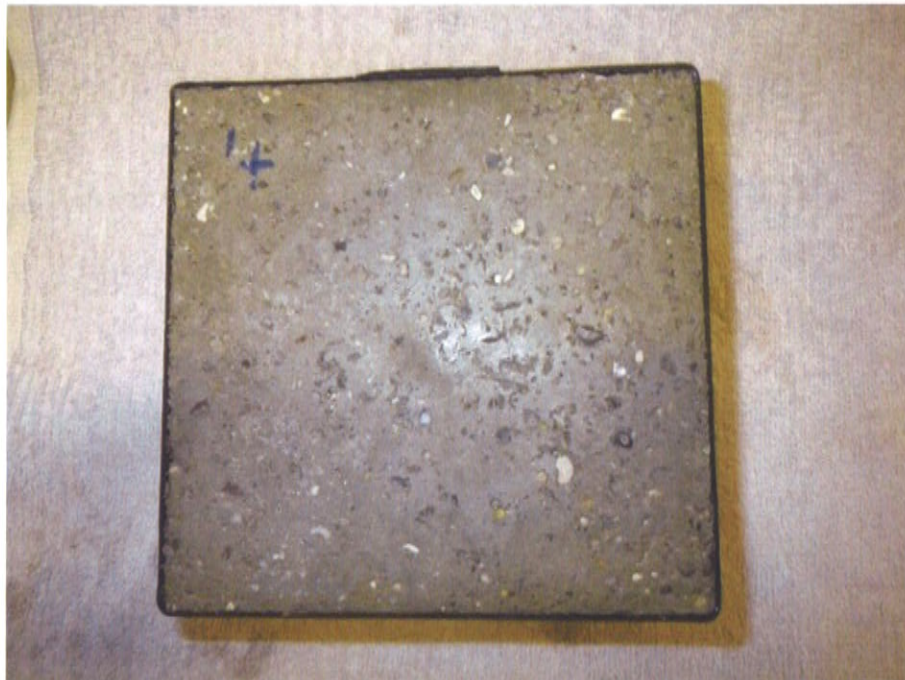


Picture 4: Sample 2 after splitting for measuring the water penetration depth 1 mm



Picture 5 Sample 3 after splitting for measuring the depth of water 1 mm





Picture 6: Sample 4 after 28 freeze thaw resistance. Abgewitterte Surface, no damage on the spacers recognizable



Picture 7: Sample 5 after 28 freeze thaw resistance, abgewitterte surface. No damage on the spacer recognizable



Picture 8: Sample 6 after 28 freeze thaw resistance, abgewitterte surface. No damage on the spacer recognizable.