Hilti Entwicklungs GmbH
86916 Kaufering I Germany
Hiltistraße 6

www.hilti.group

Test Report

No. 21/0009
of 14 Dec 2021

Trade name(s)	**Injection system Hilti HIT-RE 500 V4**
Scope of document	**Information on the water tightness of fastening points set with HIT-RE 500 V4**
Execution of test by	Bautechnische Versuchsanstalt Rankweil Negrellistrasse 50 6830 Rankweil Austria
Test procedure	On basis of EN 12390-8:2019

document is subject to revision – valid until 12/2023

BAUTECHNISCHE VERSUCHSANSTALT
at the HTL RANKWEIL
Akkreditierte Prüf- und Inspektionsstelle

DEPARTMENT FOR BUILDING MATERIALS AND COMPONENTS

NEGRELLISTRASSE 50
A-6830 RANKWEIL

TEL +43 5522 44004
FAX +43 5522 44004 89
E-MAIL va-baustoffe@htl-rankweil.at

TEST-REPORT

PENETRATION OF WATER UNDER PRESSURE WITH **500 kPa**
IN HARDENED CONCRETE OF STRENGTH CLASS C25/30

SAMPLES WITH ANCHOR ROD HAS-U A4 M12x160
INSTALLED WITH HILTI HIT-RE 500 V4

Test procedure on the basis of EN 12390-8:2019: Testing hardened concrete – Part 8: Depth of penetration of water under pressure

description of order

Ordering party	Hilti Entwicklungsgesellschaft mbH Development – Business Unit Anchors
Address of ordering party	Hiltistr. 6 86916 KAUFERING GERMANY
Date of order Order No.	April 28th, 2021
Test material	HAS-U A4 M12x160 Hilti HIT-RE 500 V4
Receipt of test material	June 29th, 2021

Test Report No.	151/21
Date of issue	July 26th, 2021
This report consists of:	Text 7 pages Appendix 1 1 page Appendix 2 1 page Appendix 3 1 page

The reported test results relate only to the tested items. If this test report is transcribed or copied, the wording and layout may not be changed, nothing may be omitted and no additions may be made. Extracts may only be copied or published with the written permission of the testing station. The Testing Laboratory at the HTL Rankweil (Bautechnische Versuchsanstalt) is attached to the HTBLuVA Rankweil. The Testing Laboratory is accredited by AA, BMDW GZ: 2020-0.289.417 from 19.05.2020 as Testing Laboratory according to EN 17025:2017.

document is subject to revision – valid until 12/2023

1 MISCELLANEOUS

The Hilti Entwicklungsgesellschaft mbH contracted the Testing Laboratory at the HTL Rankweil (Bautechnische Versuchsanstalt an der HTL Rankweil) to conduct tests to determine the depth of penetration of water under pressure in hardened concrete, when anchor rods HAS-U A4 M12x160 are installed with the adhesive mortar Hilti HIT-RE 500 V4.

The following test procedure was agreed between the ordering party and the Testing Laboratory:

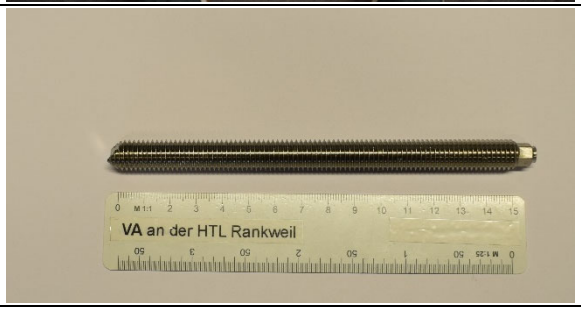
- casting of 5 concrete samples using C25/30 D_{max} 22, cubes with 200 mm edge length;
- installation of the anchor rods HAS-U A4 M12x160 with Hilti HIT-RE 500 V4 according to the instructions given by the ordering party;
- testing the samples on the basis of EN 12390-8:2019 respectively of ISO 1920-5:2018 by applying a water pressure with (500 ± 50) kPa for the duration of (72 ± 2) hours.

It was agreed upon, that the specimens, in which the anchors were installed, are not water-cured for the whole period between demolding and testing.

2 Test material

The test material, i.e. anchor rods HAS-U A4 M12x160 and adhesive mortar Hilti HIT-RE 500 V4, are shown in Table 1.

Table 1. Test material, article number, lot number, date of sample receipt.

Hilti HIT-RE 500 V4 Article no.: #2287557 Lot no.: 14738669 Receipt: June 29th, 2021 Comp. A: 9016564 Comp. B: 9117866	
HAS-U A4 M12x160 Article no.: #2223844 Lot no.: 14558030 Receipt: June 29th, 2021	

3 CONCRETE MIX DESIGN - CASTING OF CONCRETE SAMPLES

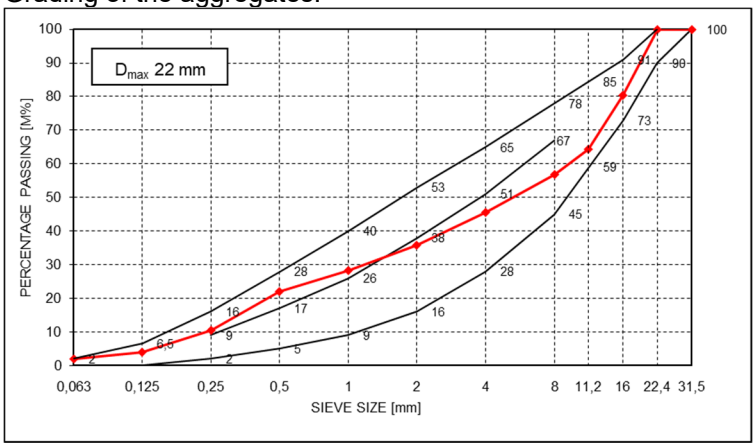
3.1 CONCRETE MIX DESIGN

Cement: 321 kg/m³ CEM II/A-LL 42,5 N, Holcim, Fluvio 4
Water: drinking water 170 kg/m³
W/C - ratio: 0,53

Aggregate - natural rounded gravel

0/4:	46%:	900 kg/m³	Zech-Kies GmbH
4/8:	9%:	179 kg/m³	Zech-Kies GmbH
8/16:	25%:	498 kg/m³	Zech-Kies GmbH
16/22:	20%:	398 kg/m³	Zech-Kies GmbH

Grading of the aggregates:



3.2 CASTING OF CONCRETE SPECIMENS

The concrete components were first mixed dry in a laboratory compulsory mixer. Then the mixing water was gradually added continuing the mixing for another 2 minutes.
Afterwards, fresh concrete properties, i.e. concrete flow spread, density, temperature and air content, were determined (given in Table 2). In total, four concrete charges were casted. After filling the different moulds, the concrete was compacted with a vibrating table at 7500 R/min during at least 30 sec.

The density of the hardened concrete and the compressive strength at the date of setting the anchor rods (July 5th, 2021) are given in Appendix 3.

Table 2. Fresh concrete properties and fabricated specimens.

concrete charge no.	1	2	3	4
date of casting	22.04.2021	22.04.2021	22.04.2021	22.04.2021
concrete flow spread	42 cm	43 cm	44 cm	46 cm
density of fresh concrete	2465 kg/m³	2473 kg/m³	2460 kg/m³	N.D.
air content	1,7 %	1,3 %	1,3%	N.D.
temperature of fresh concrete	20,0 °C	20,2 °C	18,9 °C	19,3 °C
fabricated specimens				
5 cubes 200x200x200 mm	21.151 01-02	21.151 03-05		
5 cubes 200x200x200 mm			21.152 06-07	21.152 08-10
3 slabs 200x200x120 mm	21.151 15	21.151 16	-	21.152 19
3 cubes 150x150x150 mm	-	21.151 12	21.152 13	21.152 14

Remark: The results of water penetration tests conducted on specimens with laboratory numbers 21.152 06-10 are given in test report no. 152/21.

document is subject to revision – valid until 12/2023

Storing and curing the specimens:
All samples were stored 24 hours within the mould at room temperature (20 ± 2) °C and the concrete surface was covered with plastic foil.

After demoulding, the specimens were stored as follow:

- cubes to test water-penetration of concrete with installed adhesive anchors and cubes to test the compressive strength
  - until the age of 7 days immersed in water at a temperature of (20 ± 2) °C;
  - afterwards, at room temperature (20 ± 2) °C until installing the anchors and testing; in case of the compressive strength tests, until testing.
- slabs to test the water penetration: immersed in water until testing.

4 TEST PROCEDURE AND TEST RESULTS

4.1 SETTING THE ADHESIVE ANCHORS

USED ANCHORING SYSTEM

Adhesive Mortar:	**Hilti HIT-RE 500 V4**
Anchor rod:	**HAS-U A4 M12x160**

SETTING DETAILS

Drill bit:	TE-CX 14
Cutting diameter of used drill bit:	d_{cut} = 14,34 mm
Depth of borehole:	130 mm
installation depth:	125 mm
Rotary hammer drill:	TE30-A36
Borehole cleaning:	dust removal with compressed air (6 bar) 2 times brushing with steel-wire brush RB 14 2 times dust removal with compressed air (6 bar) 2 times

SETTING PROCEDURE

The hole was drilled vertically downwards in the centre of a casted surface perpendicular to the direction of casting. After cleaning, the diameter of the drilled holes was measured by means of calibrated steel cylinders of known diameter. The borehole depth was checked by using a calliper with a depth rod. The results are given in Table 3.

Table 3. Borehole and setting parameters.

specimen no	bore hole diameter	bore hole depth	depth of embedment
21.151 01	13,9 mm	≥ 130 mm	125 mm
21.151 02	13,9 mm	≥ 130 mm	125 mm
21.151 03	13,9 mm	≥ 130 mm	125 mm
21.151 04	13,9 mm	≥ 130 mm	125 mm
21.151 05	13,9 mm	≥ 130 mm	125 mm

The static mixer Hilti HIT-RE-M was tightly attached to the foil pack manifold. Each 500 ml foil pack was inserted in the foil pack holder, which in turn was put into the mechanical dispenser Hilti HDM 500. At least 4 strokes were discarded with each new foil pack.

The borehole was filled with the injection mortar starting at the back of the borehole. With each trigger pull the mixer was slowly withdrawn. The borehole was filled up to approximately 2/3 of the height. Afterwards, the anchor rod was set to the required embedment depth, which was marked with an adhesive tape.

The ambient temperature at the time of setting was ≥ 20°C.

document is subject to revision – valid until 12/2023

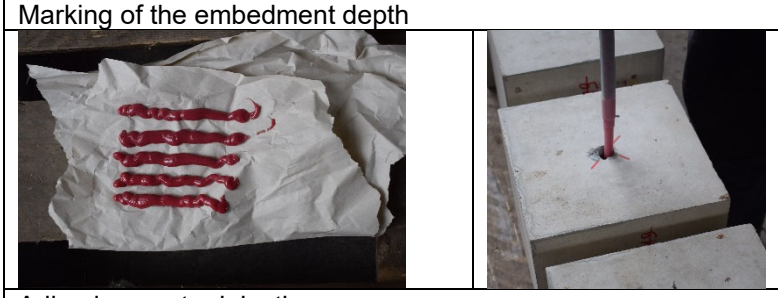
Five samples were prepared and setting was done on July 5th, 2021. After setting the anchors, the adhesive was allowed to cure for > 24 hours at ambient temperature (20 ± 2) °C.

In Table 4, the borehole drilling and borehole cleaning procedure as well as further steps of the the setting procedure are shown.

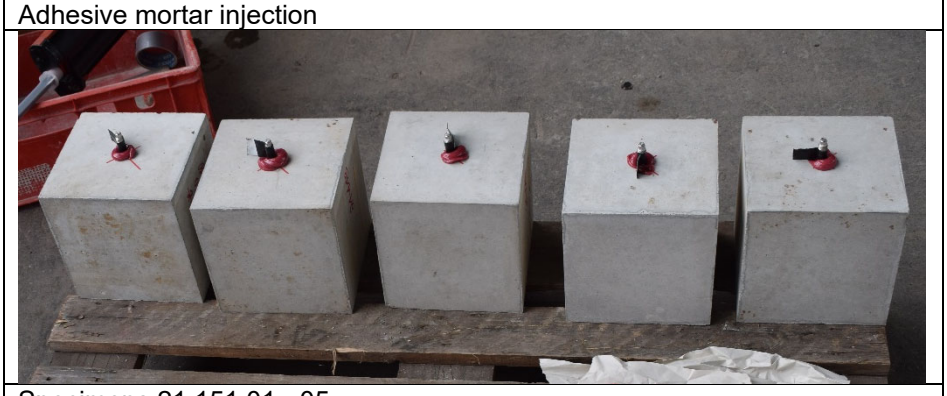
Table 4. Setting procedure.

Drilling and borehole cleaning

Marking of the embedment depth



Adhesive mortar injection



Specimens 21.151 01 - 05

4.2 PENETRATION OF WATER UNDER PRESSURE 500 kPa
SAMPLES WITHOUT ANCHOR RODS

Test procedure: EN 12390-8:2019, section 7
ISO 1920-5:2018, section 5.4

Deviation from the standard test method: none

Details of test:

date of start of testing:	July 6th, 2021
end of testing:	July 9th, 2021
age of concrete at start of testing:	75 days
compressive strength at setting the rods:	55,4 N/mm²
direction of application of water pressure:	on bottom of the specimen perpendicular to the direction of casting
applied water pressure:	**(500 ± 10) kPa** during (72 ± 2) h
specimens:	slabs with 200x200x120 mm

TEST RESULTS – WATER PENETRATION

Table 5. Test results of water penetration in concrete slabs.

specimen no.	21.151 15		21.151 16		21.152 19	
maximum depth of penetration mm	16	16	13	13	21	22
deviation of the water penetration from the acceptable one	none		none		none	
leakage	none		none		none	
opposite surface after testing	dry		dry		dry	
overall mean of maximum depth of water penetration	**17 mm**					
penetration front curve	see Appendix 1, Page 1					

4.3 PENETRATION OF WATER UNDER PRESSURE 500 kPa
SAMPLES WITH **Hilti HIT-RE 500 V4** AND **HAS-U A4 M12x160**

Test procedure: EN 12390-8:2019, section 7
ISO 1920-5:2018, section 5.4

Deviation from the standard test method:

- curing of the concrete cubes immersed in water only to the age of 7 days
- Installation of anchor rods

Details of test:

date of start of testing:	July 6th, 2021
end of testing:	July 9th, 2021
age of concrete at start of test:	75 days
compressive strength at setting the rods:	55,4 N/mm²
direction of application of water pressure:	on bottom of the specimen perpendicular to the direction of casting and parallel to the axis of the adhesive anchor
applied water pressure:	**(500 ± 10) kPa** during (72 ± 2) h
exposed concrete area:	the surface with the installed anchor was exposed to the water pressure; an area according to a circle with 100 mm diameter with the anchor in its centre was exposed to the water pressure
specimens:	cubes with 200 mm edge length

document is subject to revision – valid until 12/2023

TEST RESULTS – WATER PENETRATION

Table 6. Test results of water penetration in concrete cubes with installed anchor rods.

specimen no.	21.151 01	21.151 02	21.151 03	21.151 04	21.151 05
maximum depth of water penetration mm	0 0	17 12	30 14	0 0	12 5
deviation of the water penetration from the acceptable one	none	none	none	none	none
leakage	none	none	none	none	none
opposite surface after testing	dry	dry	dry	dry	dry
overall mean of maximum depth of water penetration	**9 mm**				
penetration front curve	see Appendix 2, Page 1				

Decision rule according to EN ISO/IEC 17025, in agreement with the ordering party:

- Depth of water penetration:
  expanded measurement uncertainty U (95% confidence level): ± 3 mm

Rankweil, July 26th, 2021

Dipl.-Ing. Dr. techn. M. Drexel
Deputy head of the department
Authorised person

Dipl.-Ing. W. Wechner
Head of the department
Authorised person

document is subject to revision – valid until 12/2023

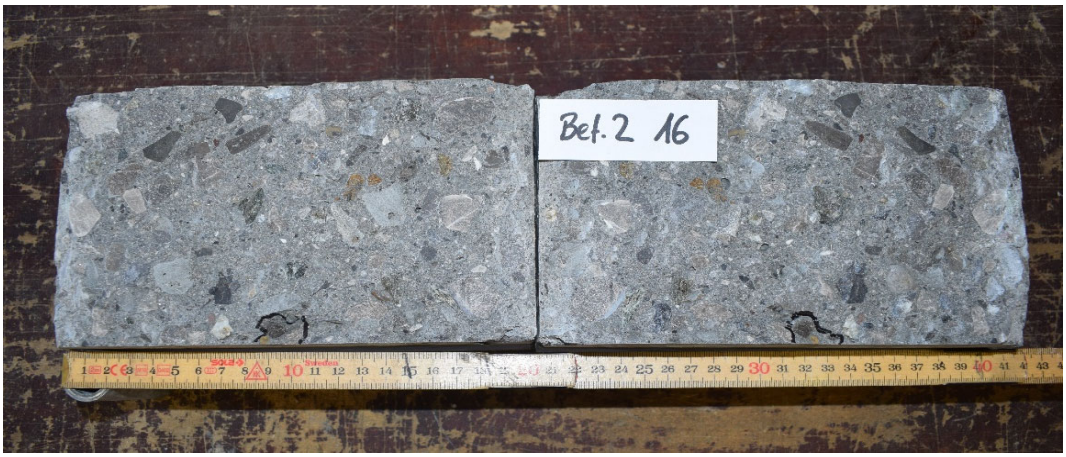
WATER PENETRATION CURVE

Concrete specimens 200x200x120 mm

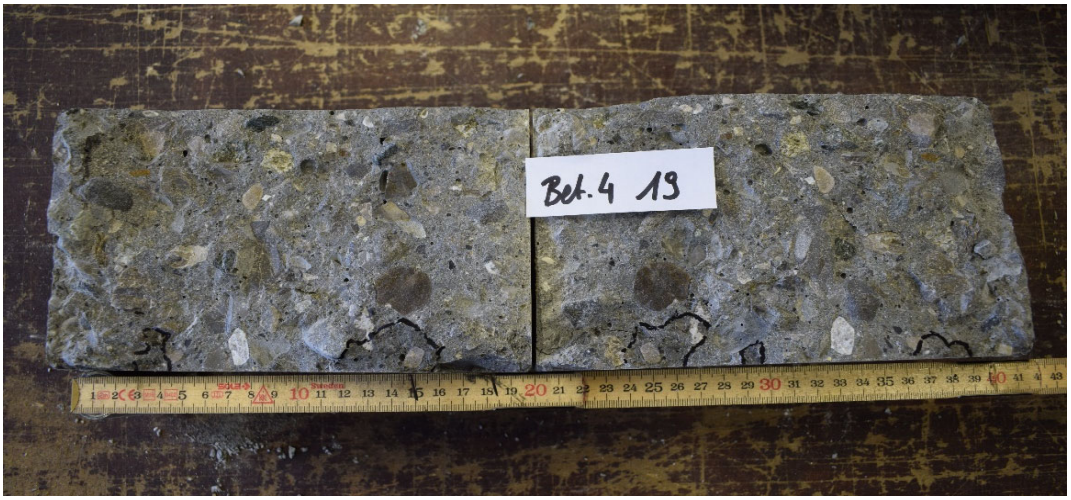
Test procedure according to EN 12390-8

21.151 15

21.151 16



21.152 19



document is subject to revision – valid until 12/2023

WATER PENETRATION CURVE

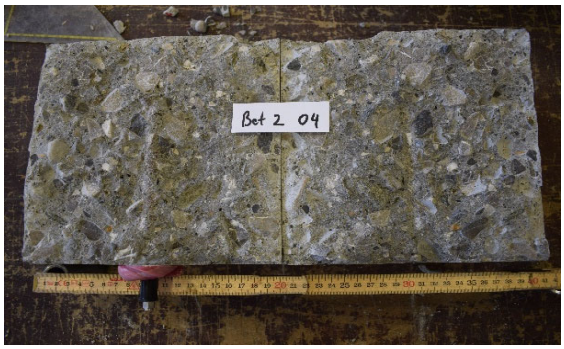
Concrete specimens 200x200x200 mm
with anchor rods HAS-U A4 M12x160 installed with Hilti HIT-RE 500 V4

21.151 01

21.151 02

21.151 03

21.151 04



21.151 05

document is subject to revision – valid until 12/2023

TEST REPORT
TESTING OF CONCRETE - COMPRESSIVE STRENGTH

ONR 23303:2010 (issue date: 01.09.2010) resp. EN 12390-3:2019

ORDERING PARTY Hilti Entwicklungsgesellschaft mbH
Hiltistraße 6, 86916 Kaufering, Germany

BASE MATERIAL **specimens for testing the penetration of water under pressure**

TEST SAMPLES 3 cubes with 15 cm edge length

INFORMATION GIVEN BY THE TESTING LABORATORY

CONCRETE: **C25/30 Dmax 22 F3**

Mix design no. -
Casting plant VA-HTL Rankweil

Concrete-Mixture:

Aggregates:	Dmax 22	Admixtures:	none	Consistency (Flow table test): see Table 2
Cement:	CEM II/A-LL 42,5 N	Cement content:	321 kg/m³	Air content: see Table 2
Date of casting:	22.04.2021	w/c-ratio:	0,53	Concrete temperature: see Table 2

TEST RESULTS:

Storage of specimens after receipt: according to ONR 23303:2010
Preparation of specimens: without any preparation
Surface conditions at testing: air-dry
Test procedure: according to ONR 23303:2010, chapter 9.1 and 9.2 and EN 12390-3:2019

Specimen No.	marks on the specimens		mass	length	width	height	ultimate load	bulk density [1]	compr. strength
	no.	other marks	kg	mm	mm	mm	kN	kg/m³	MPa
21.151 12	Bet2-12		8,195	149,9	149,8	149,6	1291	2440	57,48
21.152 13	Bet3-13		8,053	150,0	149,1	149,5	1159	2409	51,81
21.152 14	Bet4-14		8,174	150,5	149,7	149,7	1283	2424	56,95
date of testing		age at testing	mean value:					**2420**	**55,4**
05.07.2021		74 days	compressive strength (SI-units):					**55,4 MPa**	

[1] calculated from measured values determined on specimens without preparation or conditioning

The authorized signatory declares, as the person responsible for testing, that the tests were carried out according the reference test method given in ONR 23303:2010, with the exception of the specified deviations from the reference test method.

Decision rule according to EN ISO/IEC 17025, in agreement with the ordering party:
Expanded measurement uncertainty U (95 % confidence level): 3,8 %

Rankweil, July 26, 2021

Dipl.-Ing. Dr. techn. M. Drexel
Deputy head of department
Authorised person

Dipl.-Ing. W. Wechner
Head of department
Authorised person

The reported test results relate only to the tested items. If this test report is transcribed or copied, the wording and layout may not be changed, nothing may be omitted and no additions may be made. Extracts may only be copied or published with the written permission of the testing laboratory. The Bautechnische Versuchsanstalt (Testing laboratory at the HTL Rankweil) is attached to the HTBL u VA Rankweil and is accredited by BMDW GZ: 2020-0.289.417, dated May 19th, 2020 as testing laboratory according to EN ISO/IEC 17025:2017.

document is subject to revision – valid until 12/2023