

Assessment Report

Project **22044_enshort**

**Fire resistance of fischer injection system FIS V
Plus under fire exposure acc. to DIN EN 1363-1**

Employer **Fischerwerke GmbH & Co. KG
Otto-Hahn-Straße 15
D – 79211 Denzlingen**

Pages **15**

Author

INGENIEURBÜRO THIELE
TRAGWERKSPLANUNG GMBH

UNTERER SOMMERWALDWEG 1
TRAGWERK@INGENIEURBUERO THIELE .DE

66953 PIRMASENS
TEL. 06331 55470

Table of contents

1	General information.....	3
2	Reference documents	3
3	Product description	4
4	Scope of evaluation.....	4
5	Fire resistance loads for threaded rods.....	5
5.1	Galvanized steel	5
5.2	Stainless steel.....	10

1 General information

Fischerwerke GmbH & Co. KG authorized the evaluation of the fire resistance of the chemical anchor system FIS V Plus for axial tension and shear loads. The evaluation is based on tests that were conducted by the Technical University Kaiserslautern under fire exposure according to DIN EN 1363-1:2012 [2] and Technical Report TR020 [1]. The following document is based on the test results of the test report 18049HK15563 [3] and the expertise "Project 20037HK/15511_3" [7].

This evaluation provides fire resistances, which cover anchors with fire attack from one side only.

2 Reference documents

- [1] Evaluation of Anchorages in Concrete Concerning Resistance to fire, EOTA TR020, Edition May 2004
 - [2] Feuerwiderstandsprüfungen – Teil 1: Allgemeine Anforderungen, DIN EN 1363-1; Edition Oktober 2012
 - [3] Report on fire tests according to TR020 with FIS V 360 S adhesive, Test Report 18049HK15563, TU Kaiserslautern, April 2019
 - [4] Europäisch Technische Bewertung ETA-20/0603: "fischer Injektionssystem FIS V plus", EOTA, DIBt, November 2020
 - [5] C. Thiele, M. Reichert: "Qualifikation von Verbunddübeln im Brandfall", TU Kaiserslautern, DIBt, June 2017
 - [6] Report on fire tests for post installed rebars according to EAD 330087-00-0601 with the fischer FIS V, fischer FIS VS and fischer VW injection system, TU Kaiserslautern, Dezember 2018
 - [7] Assessment of heating sleeve tests with fischer injection systems FIS V in mixing ratio 10:1 respectively FIS V Plus and FIS V in mixing ratio 5:1 in different versions according to EAD 330087-00-0601, Project 20037HK/15511_3, TU Kaiserslautern, November 2020
-

3 Product description

The fischer FIS V Plus adhesive is a bonded anchor system in a 2 component cartridge system for use in cracked and non-cracked normal weight concrete. Due to the almost identical high temperature properties of the fischer FIS V Plus, fischer FIS V Plus Low Speed and fischer FIS V Plus High Speed injection system, the report applies to all mentioned products [6].

The injection system FIS V Plus is designed for the use in concrete according to the European Technical Assessment ETA-20/0603 [4].

4 Scope of evaluation

The present evaluation of fire resistance for fischer FIS V Plus anchor system in concrete is assessed with respect to its fire resistance properties as anchor applications in walls and ceilings. The tests, which this evaluation refers to, are executed with vertical arranged anchors and axial load application. Furthermore, the anchors were exposed to the standard temperature-time curve (ETK) [2]. In the tests a fixture according to TR020 [1] was used, therefore the following fire resistances cover only anchors protected from fire by attachments similar to the fixture according to TR020 [1].

The assessment of steel failure is carried out in dependence on “Qualifizierung von Verbunddübeln im Brandfall” [5] which is based on the TR020 [1]. The assessment of concrete cone failure is carried out in dependence on TR020 [1]. Additionally the failure type pullout failure is assessed.

- a. Steel failure:
Steel failure is assessed according to the research report “Qualifikation von Verbunddübeln im Brandfall” [5].
- b. Pullout failure:
Pullout failure is assessed by the current state of scientific knowledge according to the research report “Qualifikation von Verbunddübeln im Brandfall” [5] A combination of thermal simulation and assessment of test results was used.
- c. Concrete cone failure:
Concrete cone failure is assessed according to TR020 [1].

The fire resistances, which are given in chapter 5 cover axial loads and shear loads as well.

5 Fire resistance loads for threaded rods

5.1 Galvanized steel

Table 5-1 to Table 5-4 are showing the decisive fire resistances of the injection system FIS V Plus for use in **cracked** and **non-cracked concrete** for pullout, steel and concrete failure. The given fire resistances cover axial and shear loads.

The listed fire resistances are valid for single anchors with an edge distance of more than $c_{cr,fi}=2 h_{ef}$ and a spacing to the adjacent anchor of $s= 2 c_{cr,fi}= 4 h_{ef}$. Edge and spacing distances have to be chosen so that steel – or pullout failure are decisive.

The values below are valid for the use of carbon steel (minimum grade 5.8 acc. to ISO 898-1).

For the grey coloured values steel failure is decisive.

Table 5-1: Summary of the characteristic resistance for **non-cracked** concrete, M8-M20

Anchorage depth h_{ef}	Anchorage size	Maximum characteristic tension load $N_{Rk,fi(t)}$ and shear load $V_{Rk,fi(t)}$ [kN] depending on the fire resistance time			
		30 [min]	60 [min]	90 [min]	120 [min]
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
75	8	0,73	0,55	0,39	0,08
80		0,73	0,55	0,40	0,19
85		0,73	0,55	0,40	0,33
75	10	1,45	1,10	0,28	0,00
80		1,45	1,10	0,47	0,08
85		1,45	1,10	0,72	0,22
90		1,45	1,10	0,81	0,39
95		1,45	1,10	0,81	0,60
100		1,45	1,10	0,81	0,64
85	12	2,53	1,89	0,56	0,08
90		2,53	1,94	0,85	0,25
95		2,53	1,94	1,22	0,45
100		2,53	1,94	1,35	0,70
105		2,53	1,94	1,35	1,01
110		2,53	1,94	1,35	1,10
115	16	2,53	1,94	1,35	1,10
95		4,71	2,53	0,76	0,10
100		4,71	3,38	1,14	0,34
105		4,71	3,61	1,62	0,60
110		4,71	3,61	2,20	0,92
115		4,71	3,61	2,51	1,32
120		4,71	3,61	2,51	1,81
125		4,71	3,61	2,51	2,04
130	4,71	3,61	2,51	2,04	
105	20	7,35	3,38	1,06	0,16
110		7,35	4,43	1,54	0,47
115		7,35	5,64	2,13	0,80
120		7,35	5,64	2,86	1,22
125		7,35	5,64	3,71	1,71
130		7,35	5,64	3,92	2,30
135		7,35	5,64	3,92	3,02
140		7,35	5,64	3,92	3,19
145		7,35	5,64	3,92	3,19

Table 5-2: Summary of the characteristic resistance for **non-cracked** concrete, M24-M30

Anchorage depth h_{ef}	Anchorage size	Maximum characteristic tension load $N_{Rk,fi(t)}$, and shear load $V_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30 [min]	60 [min]	90 [min]	120 [min]
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
115	24	10,59	4,49	1,45	0,27
120		10,59	5,74	2,04	0,65
125		10,59	7,21	2,77	1,07
130		10,59	8,12	3,63	1,57
135		10,59	8,12	4,65	2,17
140		10,59	8,12	5,65	2,88
145		10,59	8,12	5,65	3,72
150		10,59	8,12	5,65	4,59
155		10,59	8,12	5,65	4,59
160		10,59	8,12	5,65	4,59
120		27	13,77	4,87	1,53
125	13,77		6,20	2,16	0,63
130	13,77		7,73	2,91	1,08
135	13,77		9,49	3,81	1,61
140	13,77		10,56	4,87	2,22
145	13,77		10,56	6,10	2,97
150	13,77		10,56	7,34	3,82
155	13,77		10,56	7,34	4,83
160	13,77		10,56	7,34	5,97
165	13,77		10,56	7,34	5,97
170	13,77	10,56	7,34	5,97	
120	30	16,83	4,13	1,05	0,00
125		16,83	5,34	1,63	0,11
130		16,83	6,75	2,29	0,59
135		16,83	8,38	3,10	1,09
140		16,83	10,24	4,04	1,65
145		16,83	12,37	5,15	2,31
150		16,83	12,90	6,43	3,08
155		16,83	12,90	7,90	3,97
160		16,83	12,90	8,98	5,01
165		16,83	12,90	8,98	6,21
170		16,83	12,90	8,98	7,29
175		16,83	12,90	8,98	7,29
180		16,83	12,90	8,98	7,29

Table 5-3: Summary of the characteristic resistance for **cracked** concrete, M10-M20

Anchorage depth h_{ef}	Anchorage size	Maximum characteristic tension load $N_{Rk,fi(t)}$, and shear load $V_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30 [min]	60 [min]	90 [min]	120 [min]
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
75	10	1,45	0,85	0,21	0,00
80		1,45	1,10	0,35	0,06
85		1,45	1,10	0,54	0,17
90		1,45	1,10	0,78	0,29
95		1,45	1,10	0,81	0,45
100		1,45	1,10	0,81	0,64
85	12	2,53	1,42	0,42	0,06
90		2,53	1,93	0,64	0,19
95		2,53	1,94	0,92	0,34
100		2,53	1,94	1,27	0,53
105		2,53	1,94	1,35	0,76
110		2,53	1,94	1,35	1,05
115	16	2,53	1,94	1,35	1,10
95		4,71	1,90	0,57	0,07
100		4,71	2,54	0,86	0,25
105		4,71	3,30	1,21	0,45
110		4,71	3,61	1,65	0,69
115		4,71	3,61	2,19	0,99
120		4,71	3,61	2,51	1,36
125		4,71	3,61	2,51	1,80
130	4,71	3,61	2,51	2,04	
105	20	7,35	2,54	0,79	0,12
110		7,35	3,32	1,15	0,35
115		7,35	4,25	1,60	0,60
120		7,35	5,32	2,14	0,91
125		7,35	5,64	2,78	1,28
130		7,35	5,64	3,55	1,73
135		7,35	5,64	3,92	2,26
140		7,35	5,64	3,92	2,89
145		7,35	5,64	3,92	3,19

Table 5-4: Summary of the characteristic resistance for **cracked** concrete, M24-M30

Anchorage depth h_{ef}	Anchorage size	Maximum characteristic tension load $N_{Rk,fi(t)}$ and shear load $V_{Rk,fi(t)}$ [kN] depending on the fire resistance time			
		30 [min]	60 [min]	90 [min]	120 [min]
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
115	24	10,59	3,36	1,09	0,21
120		10,59	4,31	1,53	0,49
125		10,59	5,41	2,08	0,81
130		10,59	6,67	2,72	1,18
135		10,59	8,10	3,49	1,63
140		10,59	8,12	4,38	2,16
145		10,59	8,12	5,40	2,79
150		10,59	8,12	5,65	3,51
155		10,59	8,12	5,65	4,36
160		10,59	8,12	5,65	4,59
120		27	13,77	3,65	1,14
125	13,77		4,65	1,62	0,47
130	13,77		5,79	2,18	0,81
135	13,77		7,11	2,86	1,20
140	13,77		8,63	3,65	1,67
145	13,77		10,34	4,58	2,23
150	13,77		10,56	5,64	2,87
155	13,77		10,56	6,86	3,62
160	13,77		10,56	7,34	4,49
165	13,77		10,56	7,34	5,49
170	13,77	10,56	7,34	5,97	
120	30	14,21	3,10	0,79	0,00
125		16,80	4,01	1,22	0,08
130		16,83	5,06	1,72	0,44
135		16,83	6,29	2,32	0,81
140		16,83	7,68	3,03	1,24
145		16,83	9,28	3,86	1,73
150		16,83	11,05	4,82	2,31
155		16,83	12,90	5,93	2,98
160		16,83	12,90	7,19	3,76
165		16,83	12,90	8,61	4,65
170		16,83	12,90	8,98	5,68
175		16,83	12,90	8,98	6,84
180		16,83	12,90	8,98	7,29

5.2 Stainless steel

Table 5-5 to Table 5-8 are showing the decisive fire resistances of the injection system FIS V Plus for use in **cracked** and **non-cracked concrete** for pullout, steel and concrete failure. The given fire resistances cover axial and shear loads.

The listed fire resistances are valid for single anchors with an edge distance of more than $c_{cr,fi}=2 h_{ef}$ and a spacing to the adjacent anchor of $s= 2 c_{cr,fi}= 4 h_{ef}$. Edge and spacing distances have to be chosen so that steel – or pullout failure are decisive.

The values below are valid for the use of stainless steel (1.4401, 1.4404, 1.4571, 1.4439, 1.4362, 1.4062, 1.4662, 1.4462 acc. to EN 10088, minimum grade 70 acc. to ISO 3506) or high corrosion resistant steel (HCR 1.4529, 1.4565 acc. to EN 10088, minimum grade 70 acc. to ISO 3506) anchor rods.

For the grey coloured values steel failure was decisive.

Table 5-5: Summary of the characteristic resistance for **non-cracked** concrete, M8-M20

Anchorage depth h_{ef}	Anchorage size	Maximum characteristic tension load $N_{Rk,fi(t)}$, and shear load $V_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30 [min]	60 [min]	90 [min]	120 [min]
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
75	8	0,73	0,59	0,39	0,08
80		0,73	0,59	0,44	0,19
85		0,73	0,59	0,44	0,33
90		0,73	0,59	0,44	0,37
75	10	1,45	1,14	0,28	0,00
80		1,45	1,16	0,47	0,08
85		1,45	1,16	0,72	0,22
90		1,45	1,16	0,93	0,39
95		1,45	1,16	0,93	0,60
100		1,45	1,16	0,93	0,81
85	12	2,53	1,89	0,56	0,08
90		2,53	2,11	0,85	0,25
95		2,53	2,11	1,22	0,45
100		2,53	2,11	1,69	0,70
105		2,53	2,11	1,69	1,01
110		2,53	2,11	1,69	1,35
115	16	2,53	2,11	1,69	1,35
95		10,21	2,53	0,76	0,10
100		10,21	3,38	1,14	0,34
105		10,21	4,40	1,62	0,60
110		10,21	5,60	2,20	0,92
115		10,21	6,99	2,92	1,32
120		10,21	7,38	3,78	1,81
125		10,21	7,38	4,55	2,40
130		10,21	7,38	4,55	3,10
135		10,21	7,38	4,55	3,14
105	20	13,66	3,38	1,06	0,16
110		15,93	4,43	1,54	0,47
115		15,93	5,66	2,13	0,80
120		15,93	7,09	2,86	1,22
125		15,93	8,74	3,71	1,71
130		15,93	10,59	4,73	2,30
135		15,93	11,52	5,91	3,02
140		15,93	11,52	7,11	3,85
145		15,93	11,52	7,11	4,84
150		15,93	11,52	7,11	4,90

Table 5-6: Summary of the characteristic resistance for **non-cracked** concrete, M24-M30

Anchorage depth h_{ef}	Anchorage size	Maximum characteristic tension load $N_{Rk,fi(t)}$, and shear load $V_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30 [min]	60 [min]	90 [min]	120 [min]
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
115	24	17,79	4,49	1,45	0,27
120		20,94	5,74	2,04	0,65
125		22,95	7,21	2,77	1,07
130		22,95	8,89	3,63	1,57
135		22,95	10,80	4,65	2,17
140		22,95	12,94	5,83	2,88
145		22,95	15,33	7,20	3,72
150		22,95	16,59	8,77	4,68
155		22,95	16,59	10,24	5,81
160		22,95	16,59	10,24	7,06
120		27	19,91	4,87	1,53
125	23,30		6,20	2,16	0,63
130	26,92		7,73	2,91	1,08
135	29,84		9,49	3,81	1,61
140	29,84		11,50	4,87	2,22
145	29,84		13,78	6,10	2,97
150	29,84		16,24	7,52	3,82
155	29,84		19,02	9,15	4,83
160	29,84		21,57	10,97	5,99
165	29,84		21,57	13,01	7,32
170	29,84		21,57	13,31	8,83
175	29,84	21,57	13,31	9,18	
120	30	18,94	4,13	1,05	0,00
125		22,40	5,34	1,63	0,11
130		26,01	6,75	2,29	0,59
135		30,00	8,38	3,10	1,09
140		34,30	10,24	4,04	1,65
145		36,47	12,37	5,15	2,31
150		36,47	14,74	6,43	3,08
155		36,47	17,39	7,90	3,97
160		36,47	20,28	9,59	5,01
165		36,47	23,44	11,47	6,21
170		36,47	26,37	13,61	7,57
175		36,47	26,37	15,95	9,13
180		36,47	26,37	16,27	10,87
185		36,47	26,37	16,27	11,22

Table 5-7: Summary of the characteristic resistance for **cracked** concrete, M10-M20

Anchorage depth h_{ef}	Anchorage size	Maximum characteristic tension load $N_{Rk,fi(t)}$, and shear load $V_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30 [min]	60 [min]	90 [min]	120 [min]
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
75	10	1,45	0,85	0,21	0,00
80		1,45	1,16	0,35	0,06
85		1,45	1,16	0,54	0,17
90		1,45	1,16	0,78	0,29
95		1,45	1,16	0,93	0,45
100		1,45	1,16	0,93	0,65
105		1,45	1,16	0,93	0,81
85	12	2,53	1,42	0,42	0,06
90		2,53	1,93	0,64	0,19
95		2,53	2,11	0,92	0,34
100		2,53	2,11	1,27	0,53
105		2,53	2,11	1,69	0,76
110		2,53	2,11	1,69	1,05
115		2,53	2,11	1,69	1,35
95	16	7,83	1,90	0,57	0,07
100		9,46	2,54	0,86	0,25
105		10,21	3,30	1,21	0,45
110		10,21	4,20	1,65	0,69
115		10,21	5,24	2,19	0,99
120		10,21	6,42	2,83	1,36
125		10,21	7,38	3,58	1,80
130		10,21	7,38	4,45	2,33
135		10,21	7,38	4,55	2,95
140		10,21	7,38	4,55	3,14
105	20	10,24	2,54	0,79	0,12
110		12,26	3,32	1,15	0,35
115		14,42	4,25	1,60	0,60
120		15,93	5,32	2,14	0,91
125		15,93	6,56	2,78	1,28
130		15,93	7,95	3,55	1,73
135		15,93	9,48	4,43	2,26
140		15,93	11,19	5,46	2,89
145		15,93	11,52	6,62	3,63
150		15,93	11,52	7,11	4,48
155		15,93	11,52	7,11	4,90

Table 5-8: Summary of the characteristic resistance for **cracked** concrete, M24-M30

Anchorage depth h_{ef}	Anchorage size	Maximum characteristic tension load $N_{Rk,fi(t)}$, and shear load $V_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30 [min]	60 [min]	90 [min]	120 [min]
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
115	24	13,35	3,36	1,09	0,21
120		15,71	4,31	1,53	0,49
125		18,24	5,41	2,08	0,81
130		20,98	6,67	2,72	1,18
135		22,95	8,10	3,49	1,63
140		22,95	9,71	4,38	2,16
145		22,95	11,49	5,40	2,79
150		22,95	13,45	6,58	3,51
155		22,95	15,59	7,90	4,36
160		22,95	16,59	9,38	5,33
165		22,95	16,59	10,24	6,44
170		22,95	16,59	10,24	7,06
120	27	14,93	3,65	1,14	0,15
125		17,48	4,65	1,62	0,47
130		20,19	5,79	2,18	0,81
135		23,15	7,11	2,86	1,20
140		26,33	8,63	3,65	1,67
145		29,83	10,34	4,58	2,23
150		29,84	12,18	5,64	2,87
155		29,84	14,27	6,86	3,62
160		29,84	16,52	8,23	4,49
165		29,84	18,95	9,76	5,49
170	29,84	21,55	11,45	6,62	
175	29,84	21,57	13,31	7,90	
180	29,84	21,57	13,31	9,18	
120	30	14,21	3,10	0,79	0,00
125		16,80	4,01	1,22	0,08
130		19,51	5,06	1,72	0,44
135		22,50	6,29	2,32	0,81
140		25,72	7,68	3,03	1,24
145		29,16	9,28	3,86	1,73
150		32,84	11,05	4,82	2,31
155		36,47	13,04	5,93	2,98
160		36,47	15,21	7,19	3,76
165		36,47	17,58	8,61	4,65
170		36,47	20,15	10,20	5,68
175		36,47	22,90	11,96	6,84
180		36,47	25,86	13,89	8,16
185		36,47	26,37	16,01	9,61
190	36,47	26,37	16,27	11,22	

Pirmasens, 26st of November 2020



apl. Prof. Dr.-Ing. Catherina Thiele



Heiner Kruse, M.Sc.