Assessment Report

Project **22040_3**

Fire resistance of fischer injection system FIS V Zero under fire exposure acc. 1363-1

Employer **fischerwerke GmbH & Co. KG**
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1 General information

Fischerwerke GmbH & Co. KG authorized the evaluation of the fire resistance with the fischer injection system FIS V Zero 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 test results are summarized in test report 20008HK15581_3 [3].

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 the fischer injection system FIS V Zero (ID-7977), Test Report 20008HK15581_3, TU Kaiserslautern, September 2020

[4] C. Thiele, M. Reichert: “Qualifikation von Verbunddübeln im Brandfall”, TU Kaiserslautern, DIBt, June 2017

3 Product description

The fischer injection system FIS V Zero injection system is designed for static and quasi static loads in cracked and uncracked normal weight concrete.

4 Scope of evaluation

The present evaluation of fire resistance for fischer injection system FIS V Zero injection 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” [4] 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 as explained in below.

a. Steel failure:
   Steel failure is assessed according to the research report “Qualifikation von Verbunddübeln im Brandfall” [4].

b. Pullout failure:
   Pullout failure is assessed by the current state of scientific knowledge according to the research report “Qualifikation von Verbunddübeln im Brandfall” [4] 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 10 cover axial loads and shear loads as well.

5 Summary of the fire resistance loads for threaded rods

5.1 Galvanized steel (gvz.)

Table 5-1 to Table 5-4 are showing the fire resistances for the fischer injection system FIS V Zero for use in **cracked** and **non-cracked concrete**. 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-M12, galvanized steel (gvz.)

Anchorage depth hef	Anchorage size	Maximum tension load NRK,fi(t), [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
60	8	0,73	0,55	0,00	0,00
65		0,73	0,55	0,20	0,00
70		0,73	0,55	0,40	0,00
75		0,73	0,55	0,40	0,11
80		0,73	0,55	0,40	0,33
85		0,73	0,55	0,40	0,33
90		0,73	0,55	0,40	0,33
95		0,73	0,55	0,40	0,33
60	10	1,45	0,52	0,00	0,00
65		1,45	0,86	0,00	0,00
70		1,45	1,10	0,20	0,00
75		1,45	1,10	0,53	0,00
80		1,45	1,10	0,81	0,07
85		1,45	1,10	0,81	0,41
90		1,45	1,10	0,81	0,64
95		1,45	1,10	0,81	0,64
100		1,45	1,10	0,81	0,64
105		1,45	1,10	0,81	0,64
110		1,45	1,10	0,81	0,64
70	12	2,53	1,04	0,00	0,00
75		2,53	1,51	0,21	0,00
80		2,53	1,94	0,62	0,00
85		2,53	1,94	1,00	0,03
90		2,53	1,94	1,35	0,47
95		2,53	1,94	1,35	0,85
100		2,53	1,94	1,35	1,10
105		2,53	1,94	1,35	1,10
110		2,53	1,94	1,35	1,10
115		2,53	1,94	1,35	1,10
120		2,53	1,94	1,35	1,10

Table 5-2: Summary of the characteristic resistance for non-cracked concrete, M16-M24, galvanized steel (gvz.)

Anchorage depth hef	Anchorage size	Maximum tension load NRK,fi(t), [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
80	16	4,71	1,51	0,00	0,00
85		4,71	2,13	0,27	0,00
90		4,71	2,84	0,85	0,00
95		4,71	3,61	1,39	0,00
100		4,71	3,61	1,98	0,59
105		4,71	3,61	2,51	1,13
110		4,71	3,61	2,51	1,68
115		4,71	3,61	2,51	2,04
120		4,71	3,61	2,51	2,04
125		4,71	3,61	2,51	2,04
130		4,71	3,61	2,51	2,04
135		4,71	3,61	2,51	2,04
140		4,71	3,61	2,51	2,04
90	20	7,35	2,20	0,00	0,00
95		7,35	3,02	0,52	0,00
100		7,35	3,92	1,25	0,00
105		7,35	4,97	1,94	0,06
110		7,35	5,64	2,68	0,83
115		7,35	5,64	3,49	1,51
120		7,35	5,64	3,92	2,22
125		7,35	5,64	3,92	2,96
130		7,35	5,64	3,92	3,19
135		7,35	5,64	3,92	3,19
140		7,35	5,64	3,92	3,19
145		7,35	5,64	3,92	3,19
150		7,35	5,64	3,92	3,19
155		7,35	5,64	3,92	3,19
95	24	10,37	2,28	0,00	0,00
100		10,59	3,20	0,03	0,00
105		10,59	4,18	0,92	0,00
110		10,59	5,29	1,79	0,00
115		10,59	6,57	2,64	0,20
120		10,59	8,00	3,57	1,18
125		10,59	8,12	4,56	2,04
130		10,59	8,12	5,65	2,89
135		10,59	8,12	5,65	3,79
140		10,59	8,12	5,65	4,59
145		10,59	8,12	5,65	4,59
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
165		10,59	8,12	5,65	4,59
170		10,59	8,12	5,65	4,59

Table 5-3: Summary of the characteristic resistance for cracked concrete, M8-M12, galvanized steel (gvz.)

Anchorage depth hef	Anchorage size	Maximum tension load NRK,fi(t), [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
60	8	0,73	0,52	0,00	0,00
65		0,73	0,55	0,15	0,00
70		0,73	0,55	0,33	0,00
75		0,73	0,55	0,40	0,09
80		0,73	0,55	0,40	0,27
85		0,73	0,55	0,40	0,33
90		0,73	0,55	0,40	0,33
95		0,73	0,55	0,40	0,33
60	10	1,45	0,39	0,00	0,00
65		1,45	0,64	0,00	0,00
70		1,45	0,93	0,15	0,00
75		1,45	1,10	0,39	0,00
80		1,45	1,10	0,64	0,05
85		1,45	1,10	0,81	0,31
90		1,45	1,10	0,81	0,54
95		1,45	1,10	0,81	0,64
100		1,45	1,10	0,81	0,64
105		1,45	1,10	0,81	0,64
110		1,45	1,10	0,81	0,64
70	12	2,53	0,78	0,00	0,00
75		2,53	1,13	0,15	0,00
80		2,53	1,53	0,47	0,00
85		2,53	1,94	0,75	0,03
90		2,53	1,94	1,08	0,35
95		2,53	1,94	1,35	0,64
100		2,53	1,94	1,35	0,94
105		2,53	1,94	1,35	1,10
110		2,53	1,94	1,35	1,10
115		2,53	1,94	1,35	1,10
120		2,53	1,94	1,35	1,10

Table 5-4: Summary of the characteristic resistance for cracked concrete, M16-M24, galvanized steel (gvz.)

Anchorage depth hef	Anchorage size	Maximum tension load NRK,fi(t), [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
80	16	4,71	1,13	0,00	0,00
85		4,71	1,59	0,21	0,00
90		4,71	2,13	0,63	0,00
95		4,71	2,76	1,04	0,00
100		4,71	3,49	1,48	0,44
105		4,71	3,61	1,98	0,85
110		4,71	3,61	2,51	1,26
115		4,71	3,61	2,51	1,69
120		4,71	3,61	2,51	2,04
125		4,71	3,61	2,51	2,04
130		4,71	3,61	2,51	2,04
135		4,71	3,61	2,51	2,04
140		4,71	3,61	2,51	2,04
90	20	6,87	1,65	0,00	0,00
95		7,35	2,27	0,39	0,00
100		7,35	2,94	0,94	0,00
105		7,35	3,73	1,46	0,04
110		7,35	4,62	2,01	0,62
115		7,35	5,64	2,62	1,13
120		7,35	5,64	3,30	1,66
125		7,35	5,64	3,92	2,22
130		7,35	5,64	3,92	2,83
135		7,35	5,64	3,92	3,19
140		7,35	5,64	3,92	3,19
145		7,35	5,64	3,92	3,19
150		7,35	5,64	3,92	3,19
155		7,35	5,64	3,92	3,19
95	24	7,78	1,71	0,00	0,00
100		9,46	2,40	0,02	0,00
105		10,59	3,14	0,69	0,00
110		10,59	3,97	1,34	0,00
115		10,59	4,92	1,98	0,15
120		10,59	6,00	2,68	0,89
125		10,59	7,24	3,42	1,53
130		10,59	8,12	4,23	2,17
135		10,59	8,12	5,16	2,84
140		10,59	8,12	5,65	3,57
145		10,59	8,12	5,65	4,37
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
165		10,59	8,12	5,65	4,59
170		10,59	8,12	5,65	4,59

5.2 Stainless steel (R and HCR)

Table 5-5 to Table 5-8 are showing the fire resistances for the fischer injection system FIS V Zero for use in **cracked** and **non-cracked concrete**. The given fire resistances covers 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 (R 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-M12, R (min. PC 70) and HCR (min. PC 70)

Anchorage depth hef	Anchorage size	Maximum tension load NRK,fi(t), [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
60	8	0,73	0,59	0,00	0,00
65		0,73	0,59	0,20	0,00
70		0,73	0,59	0,44	0,00
75		0,73	0,59	0,44	0,11
80		0,73	0,59	0,44	0,36
85		0,73	0,59	0,44	0,37
90		0,73	0,59	0,44	0,37
95		0,73	0,59	0,44	0,37
60	10	1,45	0,52	0,00	0,00
65		1,45	0,86	0,00	0,00
70		1,45	1,16	0,20	0,00
75		1,45	1,16	0,53	0,00
80		1,45	1,16	0,85	0,07
85		1,45	1,16	0,93	0,41
90		1,45	1,16	0,93	0,72
95		1,45	1,16	0,93	0,81
100		1,45	1,16	0,93	0,81
105		1,45	1,16	0,93	0,81
110		1,45	1,16	0,93	0,81
70	12	2,53	1,04	0,00	0,00
75		2,53	1,51	0,21	0,00
80		2,53	2,04	0,62	0,00
85		2,53	2,11	1,00	0,03
90		2,53	2,11	1,44	0,47
95		2,53	2,11	1,69	0,85
100		2,53	2,11	1,69	1,25
105		2,53	2,11	1,69	1,35
110		2,53	2,11	1,69	1,35
115		2,53	2,11	1,69	1,35
120		2,53	2,11	1,69	1,35

Table 5-6: Summary of the characteristic resistance for non-cracked concrete, M16-M24, R (min. PC 70) and HCR (min. PC 70)

Anchorage depth hef	Anchorage size	Maximum tension load NRK,fi(t), [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
80	16	6,60	1,51	0,00	0,00
85		8,32	2,13	0,27	0,00
90		10,21	2,84	0,85	0,00
95		10,21	3,68	1,39	0,00
100		10,21	4,65	1,98	0,59
105		10,21	5,78	2,63	1,13
110		10,21	7,11	3,35	1,68
115		10,21	7,38	4,21	2,26
120		10,21	7,38	4,55	2,91
125		10,21	7,38	4,55	3,14
130		10,21	7,38	4,55	3,14
135		10,21	7,38	4,55	3,14
140		10,21	7,38	4,55	3,14
90	20	9,16	2,20	0,00	0,00
95		11,28	3,02	0,52	0,00
100		13,76	3,92	1,25	0,00
105		15,93	4,97	1,94	0,06
110		15,93	6,16	2,68	0,83
115		15,93	7,52	3,49	1,51
120		15,93	9,13	4,40	2,22
125		15,93	10,96	5,45	2,96
130		15,93	11,52	6,62	3,78
135		15,93	11,52	7,11	4,68
140		15,93	11,52	7,11	4,90
145		15,93	11,52	7,11	4,90
150		15,93	11,52	7,11	4,90
155		15,93	11,52	7,11	4,90
95	24	10,37	2,28	0,00	0,00
100		12,61	3,20	0,03	0,00
105		15,19	4,18	0,92	0,00
110		18,22	5,29	1,79	0,00
115		21,72	6,57	2,64	0,20
120		22,95	8,00	3,57	1,18
125		22,95	9,65	4,56	2,04
130		22,95	11,50	5,65	2,89
135		22,95	13,61	6,88	3,79
140		22,95	16,02	8,25	4,76
145		22,95	16,59	9,81	5,83
150		22,95	16,59	10,24	7,02
155		22,95	16,59	10,24	7,06
160		22,95	16,59	10,24	7,06
165		22,95	16,59	10,24	7,06
170		22,95	16,59	10,24	7,06

Table 5-7: Summary of the characteristic resistance for cracked concrete, M8-M16, R (min. PC 70) and HCR (min. PC 70)

Anchorage depth hef	Anchorage size	Maximum tension load NRK,fi(t), [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
60	8	0,73	0,52	0,00	0,00
65		0,73	0,59	0,15	0,00
70		0,73	0,59	0,33	0,00
75		0,73	0,59	0,44	0,09
80		0,73	0,59	0,44	0,27
85		0,73	0,59	0,44	0,37
90		0,73	0,59	0,44	0,37
95		0,73	0,59	0,44	0,37
60	10	1,45	0,39	0,00	0,00
65		1,45	0,64	0,00	0,00
70		1,45	0,93	0,15	0,00
75		1,45	1,16	0,39	0,00
80		1,45	1,16	0,64	0,05
85		1,45	1,16	0,90	0,31
90		1,45	1,16	0,93	0,54
95		1,45	1,16	0,93	0,79
100		1,45	1,16	0,93	0,81
105		1,45	1,16	0,93	0,81
110		1,45	1,16	0,93	0,81
70	12	2,53	0,78	0,00	0,00
75		2,53	1,13	0,15	0,00
80		2,53	1,53	0,47	0,00
85		2,53	2,01	0,75	0,03
90		2,53	2,11	1,08	0,35
95		2,53	2,11	1,45	0,64
100		2,53	2,11	1,69	0,94
105		2,53	2,11	1,69	1,27
110		2,53	2,11	1,69	1,35
115		2,53	2,11	1,69	1,35
120		2,53	2,11	1,69	1,35

Table 5-8: Summary of the characteristic resistance for cracked concrete, M16-M24, R (min. PC 70) and HCR (min. PC 70)

Anchorage depth hef	Anchorage size	Maximum tension load NRK,fi(t), [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
80	16	4,95	1,13	0,00	0,00
85		6,24	1,59	0,21	0,00
90		7,78	2,13	0,63	0,00
95		9,59	2,76	1,04	0,00
100		10,21	3,49	1,48	0,44
105		10,21	4,34	1,98	0,85
110		10,21	5,33	2,51	1,26
115		10,21	6,50	3,16	1,69
120		10,21	7,38	3,88	2,18
125		10,21	7,38	4,55	2,74
130		10,21	7,38	4,55	3,14
135		10,21	7,38	4,55	3,14
140		10,21	7,38	4,55	3,14
90	20	6,87	1,65	0,00	0,00
95		8,46	2,27	0,39	0,00
100		10,32	2,94	0,94	0,00
105		12,49	3,73	1,46	0,04
110		15,13	4,62	2,01	0,62
115		15,93	5,64	2,62	1,13
120		15,93	6,84	3,30	1,66
125		15,93	8,22	4,09	2,22
130		15,93	9,80	4,96	2,83
135		15,93	11,52	5,95	3,51
140		15,93	11,52	7,09	4,26
145		15,93	11,52	7,11	4,90
150		15,93	11,52	7,11	4,90
155		15,93	11,52	7,11	4,90
95	24	7,78	1,71	0,00	0,00
100		9,46	2,40	0,02	0,00
105		11,40	3,14	0,69	0,00
110		13,67	3,97	1,34	0,00
115		16,29	4,92	1,98	0,15
120		19,31	6,00	2,68	0,89
125		22,74	7,24	3,42	1,53
130		22,95	8,62	4,23	2,17
135		22,95	10,21	5,16	2,84
140		22,95	12,02	6,19	3,57
145		22,95	14,07	7,35	4,37
150		22,95	16,40	8,65	5,27
155		22,95	16,59	10,13	6,25
160		22,95	16,59	10,24	7,06
165		22,95	16,59	10,24	7,06
170		22,95	16,59	10,24	7,06

Pirmasens, 02st of October 2020

apl. Prof. Dr.-Ing. Catherina Thiele

Heiner Kruse, M.Sc.