Assessment Report

Project **22020e**

Fire resistance of Injection System VME plus under fire exposure acc. DIN EN 1363-1

Employer
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Auf dem Immel 2
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1 General information

MKT Metall-Kunststoff-Technik GmbH & Co. KG authorized the evaluation of the fire resistance of the Injection System VME 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 TR 020 [1]. The test results are summarized in test report 17061MR15557 [3].

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

2 Reference documents

[1] Evaluation of Anchorages in Concrete Concerning Resistance to fire, EOTA TR 020, Edition May 2004

[2] Feuerwiderstandsprüfungen – Teil 1: Allgemeine Anforderungen, DIN EN 1363-1; Edition Oktober 2012

[3] Report on fire tests according TR020, Test Report 17061MR15557_2, TU Kaiserslautern, May 2018

[4] Report on fire tests for post installed rebars according to EAD 330087-00-0601 Test Report 17061MR15557_1, TU Kaiserslautern, May 2017

[5] Guideline for European technical approval of metal anchors for use in concrete, EOAT ETAG 001, Edition April 2013

[6] Eurpäisch Technische Bewertung ETA-19/0483: “Injection System VME plus”, EOTA, DIBt, 30 August 2019

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

[8] Report on fire tests according TR020, Test Report 17027MR15552, TU Kaiserslautern, June 2017

[9] Assessment report on fire resistance of under fire exposure acc. DIN EN 1363-1, Assessment Report 21737, Ingenieurbüro Thiele, August 2017

3 Product description

The Injection System VME plus is a bonded anchor system consisting of a plastic cartridge containing the injection mortar and a steel part.

The Injection System VME plus is designed for the use in concrete according to the European Technical Assessment ETA-19/0483 [6].

4 Scope of evaluation

The present evaluation of fire resistance for Injektion System VME plus anchor systems 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 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 and 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 TR020 [1]. In some cases more than one anchor size is assessed together

b. Pullout failure:
   Pullout failure is assessed by the current state of scientific knowledge according to the research report “Qualfikation von Verbunddübeln im Brandfall” [7] 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 and 6 covers axial loads and shear loads.

5 Summary of the fire resistance loads for threaded rods

Table 5-1 to Table 5-4 are showing the fire resistances for the use of Injektion System VME plus for use in **cracked** and **non-cracked concrete**. The given fire resistances covers axial and shear loads.

The failure types steel failure, concrete failure and pull-out failure were considered in the evaluation. Values for which the steel failure of the anchor rod represents the decisive failure type are highlighted in gray.

The failure loads, the maximum anchorage depth specified in the table, also apply to the maximum anchorage depths specified in [6], which are greater than the anchorage depths specified in the following tables.

The listed fire resistances are valid for single anchors with an edge distance of more than c_{cr}=2 h_{ef} and a spacing to the adjacent anchor of s= 2 c_{cr}= 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), stainless steel (1.4401, 1.4404, 1.4571, 1.4572 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. The values are valid for all drilling methods.

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

Anchorage depth h_{ef}	Anchor size	Characteristic tension resistance $N_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
80	8	1,10	0,88	0,44	0,00
85		1,10	0,88	0,66	0,02
90		1,10	0,88	0,66	0,25
95		1,10	0,88	0,66	0,51
100		1,10	0,88	0,66	0,51
105		1,10	0,88	0,66	0,51
90	10	1,74	1,39	0,87	0,00
95		1,74	1,39	1,04	0,20
100		1,74	1,39	1,04	0,64
105		1,74	1,39	1,04	0,81
110		1,74	1,39	1,04	0,81
115		1,74	1,39	1,04	0,81
100	12	3,03	2,28	1,45	0,14
105		3,03	2,28	1,60	0,70
110		3,03	2,28	1,60	1,17
115		3,03	2,28	1,60	1,18
120		3,03	2,28	1,60	1,18
110	16	5,65	3,98	1,89	0,09
115		5,65	4,24	2,50	0,73
120		5,65	4,24	2,98	1,44
125		5,65	4,24	2,98	2,06
130		5,65	4,24	2,98	2,20
135		5,65	4,24	2,98	2,20
140		5,65	4,24	2,98	2,20
120	20	8,82	5,22	2,43	0,09
125		8,82	5,98	3,21	0,79
130		8,82	6,62	3,97	1,73
135		8,82	6,62	4,66	2,55
140		8,82	6,62	4,66	3,33
145		8,82	6,62	4,66	3,43
150		8,82	6,62	4,66	3,43
155		8,82	6,62	4,66	3,43

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

Anchorage depth h_{ef}	Anchor size	Characteristic tension resistance $N_{Rk,fi(t),}$ [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
130	24	12,71	6,67	3,07	0,10
135		12,71	7,58	4,03	0,87
140		12,71	8,49	4,97	2,07
145		12,71	9,40	5,89	3,10
150		12,71	9,53	6,71	4,06
155		12,71	9,53	6,71	4,94
160		12,71	9,53	6,71	4,94
165		12,71	9,53	6,71	4,94
170		12,71	9,53	6,71	4,94
135	27	15,25	7,40	3,08	0,01
140		16,52	8,43	4,20	0,37
145		16,52	9,47	5,29	1,74
150		16,52	10,49	6,33	2,99
155		16,52	11,52	7,38	4,13
160		16,52	12,39	8,41	5,21
165		16,52	12,39	8,72	6,26
170		16,52	12,39	8,72	6,43
175		16,52	12,39	8,72	6,43
180		16,52	12,39	8,72	6,43
185		16,52	12,39	8,72	6,43
140	30	17,15	8,19	3,07	0,00
145		18,88	9,35	4,38	0,19
150		20,20	10,50	5,60	1,24
155		20,20	11,65	6,79	2,80
160		20,20	12,80	7,96	4,14
165		20,20	13,94	9,12	5,38
170		20,20	15,12	10,27	6,58
175		20,20	15,15	10,66	7,74
180		20,20	15,15	10,66	7,85
185		20,20	15,15	10,66	7,85
190		20,20	15,15	10,66	7,85
195		20,20	15,15	10,66	7,85

*Table 5-3: Summary of the characteristic resistance for **cracked** concrete, M8-M20*

Anchorage depth h_{ef}	Anchor size	Characteristic tension resistance $N_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
80	8	1,10	0,88	0,33	0,00
85		1,10	0,88	0,55	0,01
90		1,10	0,88	0,66	0,19
95		1,10	0,88	0,66	0,42
100		1,10	0,88	0,66	0,51
105		1,10	0,88	0,66	0,51
90	10	1,74	1,39	0,65	0,00
95		1,74	1,39	0,92	0,15
100		1,74	1,39	1,04	0,48
105		1,74	1,39	1,04	0,76
110		1,74	1,39	1,04	0,81
115		1,74	1,39	1,04	0,81
100	12	3,03	2,19	1,09	0,11
105		3,03	2,28	1,42	0,52
110		3,03	2,28	1,60	0,88
115		3,03	2,28	1,60	1,18
120		3,03	2,28	1,60	1,18
110	16	5,65	2,99	1,42	0,07
115		5,65	3,43	1,87	0,55
120		5,65	3,88	2,32	1,08
125		5,65	4,24	2,77	1,54
130		5,65	4,24	2,98	1,99
135		5,65	4,24	2,98	2,20
140		5,65	4,24	2,98	2,20
120	20	8,00	3,91	1,82	0,07
125		8,82	4,48	2,41	0,59
130		8,82	5,05	2,98	1,30
135		8,82	5,61	3,54	1,92
140		8,82	6,22	4,11	2,50
145		8,82	6,62	4,66	3,07
150		8,82	6,62	4,66	3,43
155		8,82	6,62	4,66	3,43

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

Anchorage depth h_{ef}	Anchor size	Characteristic tension resistance $N_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
130	24	10,17	5,00	2,30	0,08
135		11,26	5,69	3,03	0,66
140		12,40	6,37	3,72	1,56
145		12,71	7,05	4,41	2,33
150		12,71	7,74	5,10	3,05
155		12,71	8,51	5,78	3,74
160		12,71	9,39	6,46	4,43
165		12,71	9,53	6,71	4,94
170		12,71	9,53	6,71	4,94
135	27	11,44	5,55	2,31	0,01
140		12,63	6,32	3,15	0,28
145		13,90	7,10	3,97	1,30
150		15,16	7,86	4,75	2,24
155		16,52	8,64	5,53	3,10
160		16,52	9,42	6,31	3,91
165		16,52	10,31	7,07	4,69
170		16,52	11,30	7,84	5,47
175		16,52	12,37	8,60	6,24
180		16,52	12,39	8,72	6,43
185		16,52	12,39	8,72	6,43
140	30	12,86	6,14	2,30	0,00
145		14,16	7,01	3,28	0,14
150		15,52	7,87	4,20	0,93
155		16,96	8,74	5,09	2,10
160		18,43	9,60	5,97	3,10
165		19,92	10,45	6,84	4,03
170		20,20	11,34	7,70	4,93
175		20,20	12,36	8,56	5,81
180		20,20	13,49	9,41	6,67
185		20,20	14,69	10,27	7,53
190		20,20	15,15	10,66	7,85
195		20,20	15,15	10,66	7,85

6 Use of internal threaded rods

The use of internal threaded rods is permitted. Table 6-1 and Table 6-2 are showing the fire resistances for the use of internal threaded rods set with VME plus for use in cracked and non-cracked concrete. The failure types steel failure, concrete failure and pull-out failure were considered in the evaluation. Values for which the steel failure of the anchor rod represents the decisive failure type are highlighted in gray.

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}=2 h_{ef} and a spacing to the adjacent anchor of s= 2 c_{cr}= 4 $h_{ef.}$ Edge distances and spacings 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), stainless steel (1.4401, 1.4404, 1.4571, 1.4572 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.

Table 6-1: Summary of the characteristic resistance for ***uncracked*** *concrete, IG M6 – M10*

Anchorage depth h_{ef}	Anchor size	Characteristic tension resistance $N_{Rk,fi(t),}$ [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
90	IG M6	0,29	0,23	0,17	0,00
95		0,29	0,23	0,17	0,14
100		0,29	0,23	0,17	0,14
100	IG M8	1,10	0,88	0,66	0,14
105		1,10	0,88	0,66	0,51
110		1,10	0,88	0,66	0,51
110	IG M10	1,74	1,39	1,04	0,09
115		1,74	1,39	1,04	0,73
120		1,74	1,39	1,04	0,81
125		1,74	1,39	1,04	0,81

Table 6-2: Summary of the characteristic resistance for ***cracked*** *concrete, IG M6 – M10*

Anchorage depth h_{ef}	Anchor size	Characteristic tension resistance $N_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
90	IG M6	0,29	0,23	0,17	0,00
95		0,29	0,23	0,17	0,14
100		0,29	0,23	0,17	0,14
100	IG M8	1,10	0,88	0,66	0,11
105		1,10	0,88	0,66	0,51
110		1,10	0,88	0,66	0,51
110	IG M10	1,74	1,39	1,04	0,07
115		1,74	1,39	1,04	0,55
120		1,74	1,39	1,04	0,81
125		1,74	1,39	1,04	0,81

Pirmasens, 14.5.2020

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