

Assessment Report

Project **22043_2**

**Fire resistance of the anchor system MKT Capsule
Adhesive Anchor VZ under fire exposure acc. DIN
EN 1363-1**

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1 General information

MKT Metall-Kunststoff-Technik GmbH & Co.KG authorized the evaluation of the fire resistance of the MKT Capsule Adhesive Anchor VZ for axial and shear loads.

The evaluation of the fire resistance for axial tension and shear loads is based on tests that were conducted by the Technical University Kaiserslautern under fire exposure according to DIN EN 1363-1:2012 [5] and Technical Report TR020 [4]. The test results are summarized in test report 20010HK15582_1 [2], 20010HK15582_2 [6] and 21036CT15511 [7]. This evaluation provides fire resistances, which cover anchors with fire attack from one side only.

2 Reference documents

- [1] Systems for Post – installed rebar connections with mortar, EAD 330087-00-0601, May 2018.
 - [2] Test report 20010HK15582_1: Report on fire tests for post installed rebars according EAD 330087-00-0601 with the MKT Capsule Adhesive Anchor VZ, 03.12.2020, TU Kaiserslautern
 - [3] Instruction for use MKT Capsule Adhesive Anchor VZ, Juli 2020
 - [4] Evaluation of Anchorages in Concrete Concerning Resistance to fire, EOTA TR020, Edition May 2004
 - [5] Feuerwiderstandsprüfungen – Teil 1: Allgemeine Anforderungen, DIN EN 1363-1; Edition Oktober 2012
 - [6] Report on fire tests according to TR020 with the MKT Capsule Adhesive Anchor VZ, Test Report 20010HK15582_2, TU Kaiserslautern, December 2020
 - [7] Feuerwiderstände von Edelstahl im Brandfall, Projekt 21036CT15511, TU Kaiserslautern, Januar 2021
 - [8] Eurocode 2 – Bemessung und Konstruktion von Stahlbeton- und Spannbetontragwerken – Teil 4: Bemessung der Verankerung von Befestigungen in Beton; DIN EN 1992-4:2018
 - [9] C. Thiele, M. Reichert: “Qualifikation von Verbunddübeln im Brandfall”, TU Kaiserslautern, DIBt, June 2017
 - [10] European Technical Assessment 20/0533, April 2021
 - [11] Prüfbericht und Beiblatt zum Prüfbericht (3681/0206)-CM, Materialprüfanstalt für das Bauwesen Braunschweig, März 2006
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3 Scope of evaluation fire resistance for axial tension and shear loads

The present evaluation of fire resistance for MKT Capsule Adhesive Anchor VZ in concrete is assessed with respect to its fire resistance properties as anchor applications in walls and ceilings.

First, heating sleeve tests according to EAD 330087-00-0601 [1] were performed to obtain a bond stress-temperature relationship. Then fire tests were performed to verify the calculated resistance against pullout failure. 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) [5]. In the tests a fixture according to TR020 [4] was used, therefore the following fire resistances cover only anchors protected from fire by attachments similar to the fixture according to TR020 [4]. The assessment of steel failure is carried out in dependence on “Qualifizierung von Verbunddübeln im Brandfall” [9] which is based on the TR020 [4] and various test reports [6], [7], [11]. The assessment of concrete cone failure is carried out in dependence on TR020 [4] and the DIN EN 1992-4 [8]. 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” [9] and various test reports [6], [7], [11].
- b. Pullout failure:
Pullout failure is assessed by the current state of scientific knowledge according to the research report “Qualifikation von Verbunddübeln im Brandfall” [9] A combination of thermal simulation and assessment of test results was used.
- c. Concrete cone failure:
Concrete cone failure is assessed according to TR020 [4].

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

4 Product description

The bonded fastener MKT Capsule Adhesive Anchor VZ has an European Technical Assessment (ETA-20/0533) [10]. Product details and installation instructions can be found in the instruction for use [3]. The MKT Capsule Adhesive Anchor VZ is designed for static and quasi static loads in cracked and uncracked normal weight concrete.

5 Summary

5.1 Summary of the fire resistance loads for MKT V-A threaded rods, carbon steel grade 5.8

Table 5-1 and Table 5-2 are showing the fire resistances for the use of anchor system MKT Capsule Adhesive Anchor VZ 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 distance and spacing have to be chosen so that steel – or pullout failure is decisive.

For the grey coloured values steel failure is decisive.

Table 5-1: Summary of the characteristic resistance for **non-cracked** concrete, M8-M24, carbon steel (strength class 5.8)

Anchorage depth h_{ef}	Anchorage size	Maximum characteristic tension load $N_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30 [min]	60 [min]	90 [min]	120 [min]
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
80	8	0,73	0,55	0,40	0,33
90	10	2,67	2,09	1,45	0,99
110	12	3,88	2,78	1,77	1,26
125	16	7,22	5,18	3,30	2,36
170	20	11,27	8,09	5,15	3,68
210	24	16,24	11,65	7,41	5,30

Table 5-2: Summary of the characteristic resistance for **cracked** concrete, M8-M24, carbon steel (strength class 5.8)

Anchorage depth h_{ef}	Anchorage size	Maximum characteristic tension load $N_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30 [min]	60 [min]	90 [min]	120 [min]
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
80	8	0,73	0,55	0,40	0,33
90	10	2,67	2,09	1,45	0,87
110	12	3,88	2,78	1,77	1,26
125	16	7,22	5,18	3,30	2,36
170	20	11,27	8,09	5,15	3,68
210	24	16,24	11,65	7,41	5,30

5.2 Summary of the fire resistance loads for MKT V-A threaded rods, carbon steel grade 8.8

Table 5-3 and Table 5-4 are showing the fire resistances for the use of anchor system MKT Capsule Adhesive Anchor VZ 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 distance and spacing have to be chosen so that steel – or pullout failure is decisive.

For the grey coloured values steel failure is decisive.

Table 5-3: Summary of the characteristic resistance for **non-cracked** concrete, M8-M24, carbon steel (strength class 8.8)

Anchorage depth h_{ef}	Anchor size	Maximum characteristic tension load $N_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30 [min]	60 [min]	90 [min]	120 [min]
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
80	8	1,68	1,32	0,92	0,69
90	10	2,67	2,09	1,45	1,16
110	12	3,88	2,78	1,77	1,26
125	16	7,22	5,18	3,30	2,36
170	20	11,27	8,09	5,15	3,68
210	24	16,24	11,65	7,41	5,30

Table 5-4: Summary of the characteristic resistance for **cracked** concrete, M8-M24, carbon steel (strength class 8.8)

Anchorage depth h_{ef}	Anchor size	Maximum characteristic tension load $N_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30 [min]	60 [min]	90 [min]	120 [min]
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
80	8	1,68	1,32	0,92	0,52
90	10	2,67	2,09	1,45	0,87
110	12	3,88	2,78	1,77	1,26
125	16	7,22	5,18	3,30	2,36
170	20	11,27	8,09	5,15	3,68
210	24	16,24	11,65	7,41	5,30

5.3 Summary of the fire resistance loads for MKT V-A threaded rods, stainless steel

Table 5-5 and Table 5-6 are showing the fire resistances for the use of anchor system MKT Capsule Adhesive Anchor VZ 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 distance and spacing have to be chosen so that steel – or pullout failure are decisive.

The values below are valid for stainless steels of material numbers 1.4404, 1.4541, 1.4401, 1.4578 and 1.4571.

For the grey coloured values steel failure is decisive.

*Table 5-5: Summary of the characteristic resistance for **non-cracked** concrete, M8-M24, stainless steels of material numbers 1.4404, 1.4541, 1.4401, 1.4578 and 1.4571 (strength class ≥ 70)*

Anchorage depth h_{ef}	Anchorage size	Maximum characteristic tension load $N_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30 [min]	60 [min]	90 [min]	120 [min]
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
80	8	2,45	1,94	1,26	0,69
90	10	3,89	3,07	1,96	1,16
110	12	8,43	6,15	3,79	2,61
125	16	15,70	10,53	6,40	4,32
170	20	24,50	17,89	11,03	7,60
210	24	35,30	25,77	15,89	10,94

Table 5-6: Summary of the characteristic resistance for **cracked** concrete, M8-M24, stainless steels of material numbers 1.4404, 1.4541, 1.4401, 1.4578 and 1.4571 (strength class ≥ 70)

Anchorage depth h_{ef}	Anchorage size	Maximum characteristic tension load $N_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30 [min]	60 [min]	90 [min]	120 [min]
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
80	8	2,45	1,79	0,95	0,52
90	10	3,89	2,68	1,47	0,87
110	12	8,43	5,22	3,05	2,00
125	16	15,70	7,90	4,80	3,24
170	20	24,50	17,89	11,03	7,60
210	24	35,30	25,77	15,89	10,94

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