



Mfpa Leipzig GmbH

Testing, inspection and certification body for
building materials, building products and building systems

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Advisory opinion no. GS 3.2/15-464-2

from 18 April 2017

1st copy

Subject matter: Injection system fischer Powerbond FPB
Fire protection assessment of the characteristic steel stresses under tensile stress in accordance with the Technical Report TR 020 "Evaluation of anchorages in concrete concerning resistance to fire" (May 2004).

Client: fischerwerke GmbH & Co. KG
Otto-Hahn-Straße 15
79211 Denzlingen

Date of order: 10 December 2015

Person in charge: Dipl.-Wirtsch.-Ing. S. Kramer

Validity: 08 February 2022

This advisory opinion consists of 4 pages and 5 enclosures.

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1 Objective and request

MFPA Leipzig GmbH was presented with a request on 10 December 2015 by fischerwerke GmbH & Co. KG to assess the Injection system fischer Powerbond FPB with one-sided fire exposure and anchorage in a reinforced concrete base, in order to determine the characteristic parameters for a load under tensile stress.

2 Description of the tested structure

The Injection system fischer Powerbond FPB is a bonded anchor system consisting of the fischer FIS PM or FIS HB bonding mortar, a sheet metal sleeve fischer Powersleeve FIS PS, and a threaded rod with nut and washer made of electrogalvanised steel, stainless steel or highly corrosion-resistant steel, in sizes M10 to M24. The anchorage of the Injection system fischer Powerbond FPB is achieved through the bond between the anchor rod, adhesive and concrete base.

The bonding system may under predominantly static and quasi-static load in reinforced and unreinforced normal concrete of a strength class of at least C20/25 and maximum C50/60 be anchored in accordance with DIN EN 206: 2014-07 [1]. No further description of the product will be provided here and reference is made to ETA-12/0160 [2].

These tests on the Injection system fischer Powerbond FPB were conducted with the bonding mortar FIS HB 345 S in sizes M10 and M16 in electrogalvanised form, with minimum tensile stability class 8.8. The test set-up and the results of this series of tests are shown in test report PB 3.2/15-464-1 [3].

3 Test analysis and evaluation

Since with the tests described with the minimum embedding depth, the almost only cause of failure was the bond between the threaded rod and the bonding mortar, these results cannot be used to determine the steel failure. However, the test was analysed in accordance with TR 020: 2004-05 [4]. A graphical analysis of the test results can be found in Enclosure 2.

In order to determine the characteristic bond stresses, the values for M10 and M16 were evaluated on the basis of the test results. The results for size M12 emerge from the interpolation of the values for sizes M10 and M16 on the basis of the bonded surface. For the bonding anchors > M16, the bond stress of size M16 was transferred. The results can be seen in Table 1. The average bond stresses resulting are applied in order to determine the characteristic extraction values for higher embedding depths.

Table 1 Average bond stresses for the Injection system fischer Powerbond FPB (electrogalvanised)

Injection system fischer Powerbond FPB			M10	M12	M16	M20	M24
Minimum embedding depth	h_{nom}	[mm]	60	72	96	120	144
30 min	$\tau_{Rk,p,fi(30)}$	[N/mm ²]	0.65	0.78	1.12	1.12	1.12
60 min	$\tau_{Rk,p,fi(60)}$	[N/mm ²]	0.40	0.52	0.83	0.83	0.83
90 min	$\tau_{Rk,p,fi(90)}$	[N/mm ²]	0.14	0.26	0.55	0.55	0.55
120 min	$\tau_{Rk,p,fi(120)}$	[N/mm ²]	0.01	0.12	0.41	0.41	0.41



The characteristic steel failure values originate from the expert opinion GS 3.2/12-023-1 [5] and can be seen in table 2.

Table 2 Characteristic steel stresses for the Injection system fischer Powerbond FPB (electrogalvanised)

Steel of stability class			≥ 8.8 or 80	≥ 70	≥ 5.8 or 50
30 min	$\sigma_{Rk,s,fi(30)}$	[N/mm ²]	50.0	43.5	31.5
60 min	$\sigma_{Rk,s,fi(60)}$	[N/mm ²]	39.0	34.0	24.5
90 min	$\sigma_{Rk,s,fi(90)}$	[N/mm ²]	30.0	26.0	19.0
120 min	$\sigma_{Rk,s,fi(120)}$	[N/mm ²]	25.0	21.5	16.0

The following characteristic parameters for the load under central tension given in the enclosure can be quoted for the Injection system fischer Powerbond FPB on these bases (enclosure 3 to enclosure 5). The characteristic steel stress at normal temperature also has to be taken into account for the assessment; the smaller stress value is decisive in each case.

The determination of the characteristic values for failure type "concrete break-out" was not a subject of the tests; they can be determined using the simplified verification procedure of the methods described in TR 020: 2004-05 [4].

4 Special notes

The foregoing evaluation only applies for Injection system fischer Powerbond FPB that has been installed in compliance with the installation regulations of fischerwerke GmbH & Co. KG or a general building inspectorate approval or European Technical Approval.

The assessment continues to apply only to bonding anchors made of electrogalvanised steel with a minimum stability class of ≥ 5.8 in non-cracked and cracked reinforced concrete. Transferring the results to A4 stainless steel and highly corrosion-resistant steel is possible due to the more favourable behaviour at high temperatures.

The assessment applies in general to a one-sided fire loading of the structural elements. In the event of a fire load on several sides, the verification procedure can only be applied if the distance to the outer edge of the bonded anchor is $c \geq 300$ mm and ≥ 2 hef.

Based on this, the specified loads also apply to shear and/or diagonal tension.


The assessment only applies in conjunction with reinforced concrete ceilings of strength class $\geq C 20/25$ and $\leq C 50/60$ acc. to DIN EN 206: 2014-07 [1] that have at least the same fire resistance rating as the fire-resistance period of the anchors. In addition, the notes contained in DIN EN 1992-1-2: 2010-12 [6] (see section 4.5) on the avoidance of concrete spalling apply. This means that the moisture content must be less than three % by weight (or four according to the National Annex).

This document does not replace any certificate of conformity or usability as defined by the building regulations (national/European).

Leipzig, 18 April 2017



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List of enclosures

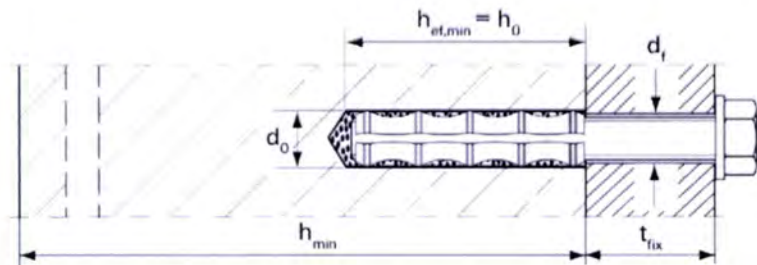
- Enclosure 1 Installation parameters of the tested fischer Powerbond FPB injection system
- Enclosure 2 Graphical analysis of the test results in accordance with TR 020: 2004-05 [4]
- Enclosure 3 Characteristic fire resistance rates for the fischer Powerbond FPB injection system with threaded rods made of electrogalvanised steel of stability class 8.8, of stainless steel of stability class A4-80 or highly corrosion-resistant steel of stability class C-80
- Enclosure 4 Characteristic fire resistance rates for the fischer Powerbond FPB injection system with threaded rods made of stainless steel of stability class A4-70
- Enclosure 5 Characteristic fire resistance rates for the fischer Powerbond FPB injection system with threaded rods made of electrogalvanised steel of stability class 5.8, of stainless steel of stability class A4-50 or highly corrosion-resistant steel of stability class C-50

Corresponding documents

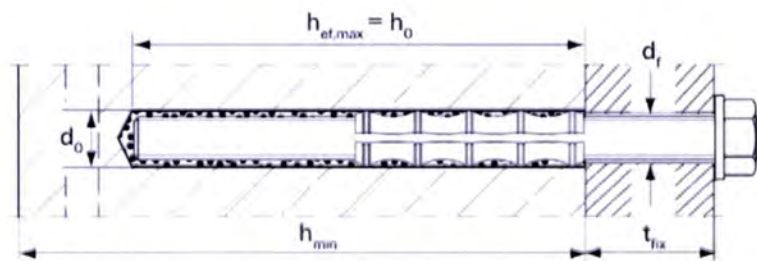
- [1] DIN EN 206: 2014-07 *Concrete - determination, properties, production and conformity*
- [2] European Technical Assessment ETA-12/0160 *Trade name: Injection system fischer Powerbond, product family: bonding anchors for use in concrete: 21 April 2016, fischerwerke GmbH & Co. KG*
- [3] Test report PB 3.2/15-464-1 *Injection system Fischer Powerbond - Test in accordance with TR 020 for determining the characteristic steel stresses under tensile stress, MFWA Leipzig GmbH: 10 April 2017, fischerwerke GmbH & Co. KG*
- [4] TR 020: 2004-05 *Evaluation of the fire resistance rating of anchors in concrete*
- [5] Expert opinion GS 3.2/12-023-1 *Fire protection measurement concept for the fischer Powerbond injection system, MFWA Leipzig GmbH: 15 May 2012, fischerwerke GmbH & Co. KG*
- [6] DIN EN 1992-1-2: 2010-12 *Design and construction of reinforced and stressed concrete structures - Part 1-2: General - Structural fire design*



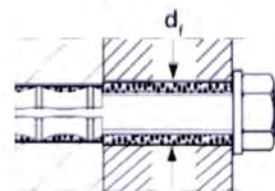
Enclosure 1 Installation parameters of the tested Injection system fischer Powerbond FPB



$h_{ef,min}$ = sleeve length L_H
(see Table B2)



$h_{ef,max}$ = 2 • sleeve length L_H
(see Table B2)



Push-through anchorage
(annular gap filled with mortar)

Size (anchor rod)		M10	M12	M16	M20	M24	
Width across flat	SW [mm]	17	19	24	30	36	
Nominal drill bit diameter	d_0 [mm]	14	16	20	25	28	
Depth of drill hole	h_0 [mm]	$h_0 = h_{ef}$					
Corresponding Power Sleeve	FIS [-]	PS M10	PS M12	PS M16	PS M20	PS M24	
Length of sleeve	L_H [mm]	60	72	96	120	144	
Diameter of sleeve	d_H [mm]	14	16	20	25	28	
Effective anchorage depth ¹⁾	$h_{ef,min}$ [mm]	60	72	96	120	144	
6 • d to 12 • d	$h_{ef,max}$ [mm]	120	144	192	240	288	
Minimum edge distance and minimum spacing for $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$							
Cracked concrete	$s_{min} = c_{min}$ [mm]	50	55	60	80	100	
Uncracked concrete	$s_{min} = c_{min}$ [mm]	55	55	65	80	100	
Diameter of clearance hole in the fixture ²⁾	Pre positioned anchorage	d_f [mm]	12	14	18	22	26
	Push through anchorage	d_f [mm]	15	17	21	26	30
Minimum thickness of concrete member	h_{min} [mm]	$h_{ef} + 30$ (≥ 100)	$h_{ef} + 2d_0$				
Max. torque moment	$T_{inst,max}$ [Nm]	20	40	60	100	120	

¹⁾ $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$ is possible

²⁾ For larger clearance holes in the fixture see TR 029, 4.2.2.1 or CEN/TS 1992-4-1:2009, 5.2.3.1

Enclosure 2 Graphical analysis of the test results in accordance with TR 020: 2004-05 [4]

Diagram A2.1 Graphical analysis of the bonding anchor for size M10

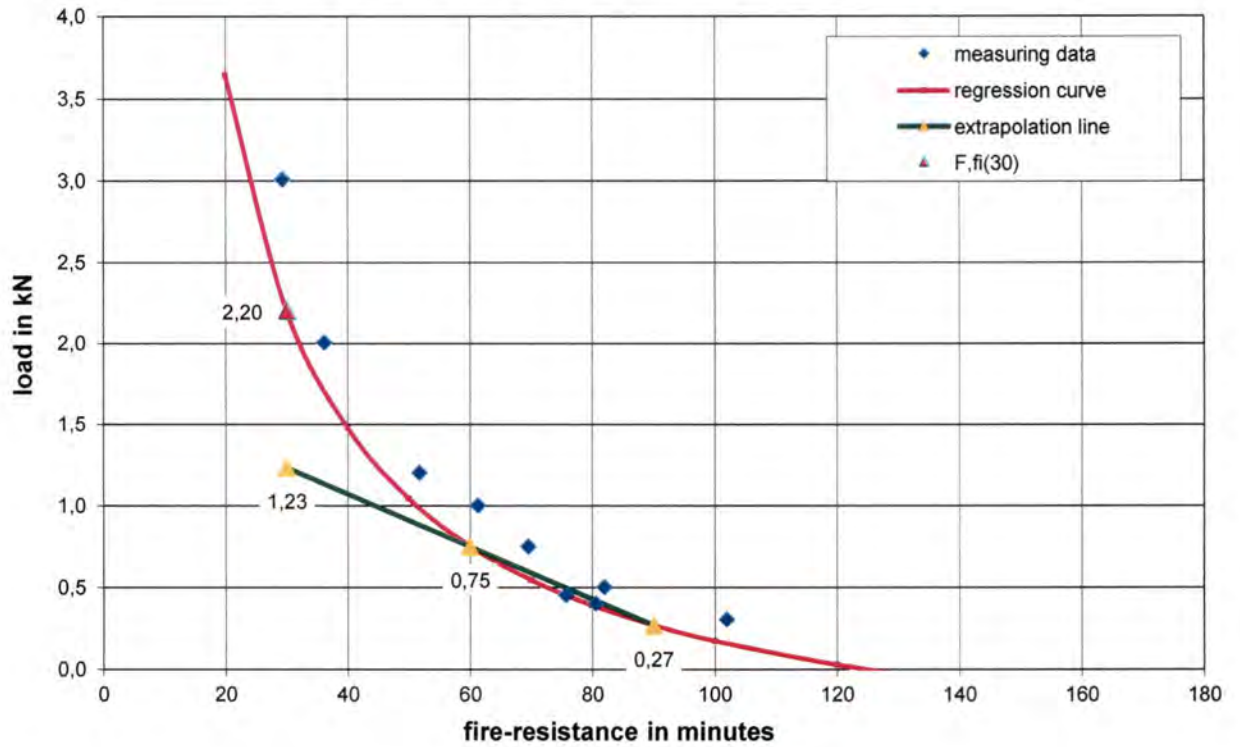
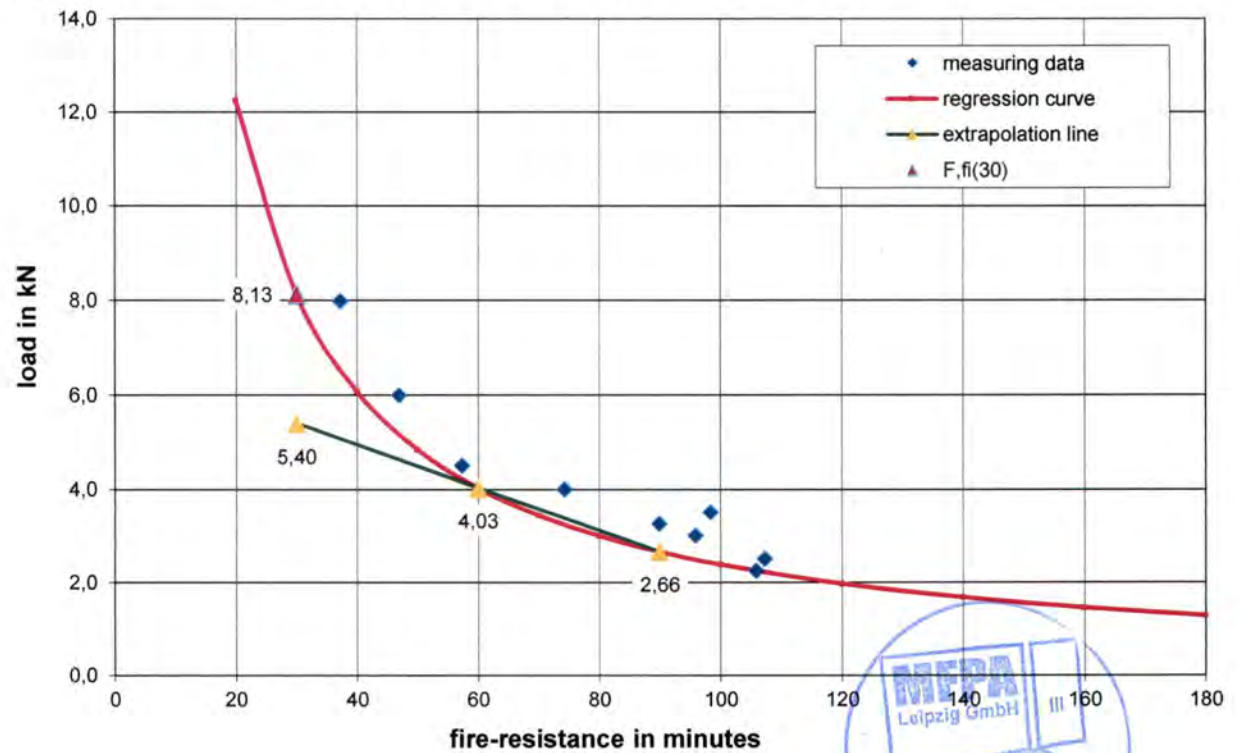


Diagram A2.2 Graphical analysis of the bonding anchor for size M16



Enclosure 3 Characteristic fire resistance rates for the fischer Powerbond FPB injection system with threaded rods made of electrogalvanised steel of stability class 8.8, of stainless steel of stability class A4-80 or highly corrosion-resistant steel of stability class C-80

Table A3.1 Characteristic fire resistance rates for the fischer Powerbond FPB injection system with threaded rods made of electrogalvanised steel of stability class 8.8, of stainless steel of stability class A4-80 or highly corrosion-resistant steel of stability class C-80 with size M10 to M16

Size of anchor	embedding depth [mm]	Fire resistance			
		F30 [kN]	F60 [kN]	F90 [kN]	F120 [kN]
M10	60	1,23	0,75	0,27	0,03
	70	1,44	0,87	0,31	0,03
	80	1,64	1,00	0,36	0,03
	90	1,85	1,12	0,40	0,04
	100	2,05	1,25	0,44	0,04
	110	2,26	1,37	0,49	0,05
	120	2,46	1,50	0,53	0,05
M12	72	2,08	1,37	0,66	0,31
	80	2,37	1,57	0,77	0,38
	90	2,66	1,77	0,87	0,42
	100	2,96	1,96	0,97	0,47
	110	3,25	2,16	1,07	0,52
	120	3,55	2,36	1,16	0,57
	130	3,84	2,55	1,26	0,61
	140	4,14	2,75	1,36	0,66
M16	144	4,22	2,83	1,39	0,68
	96	5,40	4,03	2,66	1,97
	100	5,62	4,20	2,77	2,06
	110	6,18	4,61	3,05	2,26
	120	6,75	5,03	3,32	2,47
	130	7,31	5,45	3,60	2,67
	140	7,85	5,87	3,88	2,88
	150	7,85	6,12	4,15	3,08
	160	7,85	6,12	4,43	3,29
	170	7,85	6,12	4,71	3,49
	180	7,85	6,12	4,71	3,70
	190	7,85	6,12	4,71	3,91
192	7,85	6,12	4,71	3,93	



Table A3.2 Characteristic fire resistance rates for the *fischer Powerbond FPB injection system with threaded rods made of electrogalvanised steel of stability class 8.8, of stainless steel of stability class A4-80 or highly corrosion-resistant steel of stability class C-80 with size M20 to M24*

Size of anchor	embedding depth [mm]	Fire resistance				
		F30 [kN]	F60 [kN]	F90 [kN]	F120 [kN]	
M20	120	8,42	6,28	4,15	3,08	
	130	9,13	6,82	4,50	3,34	
	140	9,84	7,34	4,85	3,60	
	150	10,54	7,87	5,19	3,85	
	160	11,24	8,39	5,54	4,11	
	170	11,95	8,91	5,88	4,37	
	180	12,25	9,44	6,23	4,63	
	190	12,25	9,56	6,58	4,88	
	200	12,25	9,56	6,92	5,14	
	210	12,25	9,56	7,27	5,40	
M24	220	12,25	9,56	7,35	5,65	
	230	12,25	9,56	7,35	5,91	
	240	12,25	9,56	7,35	6,13	
	144	12,13	9,06	5,98	4,44	
	150	12,65	9,44	6,23	4,63	
	160	13,49	10,07	6,65	4,93	
	170	14,33	10,70	7,06	5,24	
	180	15,18	11,33	7,48	5,55	
	190	16,02	11,96	7,89	5,86	
	200	16,86	12,59	8,31	6,17	
	210	17,65	13,21	8,72	6,48	
	220	17,65	13,77	9,14	6,78	
	230	17,65	13,77	9,55	7,09	
	240	17,65	13,77	9,97	7,40	
	250	17,65	13,77	10,38	7,71	
	260	17,65	13,77	10,59	8,02	
	270	17,65	13,77	10,59	8,33	
280	17,65	13,77	10,59	8,63		
288	17,65	13,77	10,59	8,83		



Enclosure 4 Characteristic fire resistance rates for the fischer Powerbond FPB injection system with threaded rods made of stainless steel of stability class A4-70

Table A4.1 Characteristic fire resistance rates for the fischer Powerbond FPB injection system with threaded rods made of stainless steel of stability class A4-70 with size M10 to M16

Size of anchor	embedding depth [mm]	Fire resistance			
		F30 [kN]	F60 [kN]	F90 [kN]	F120 [kN]
M10	60	1,23	0,75	0,27	0,03
	70	1,44	0,87	0,31	0,03
	80	1,64	1,00	0,36	0,03
	90	1,85	1,12	0,40	0,04
	100	2,05	1,25	0,44	0,04
	110	2,26	1,37	0,49	0,05
	120	2,46	1,50	0,53	0,05
M12	72	2,08	1,37	0,66	0,31
	80	2,37	1,57	0,77	0,38
	90	2,66	1,77	0,87	0,42
	100	2,96	1,96	0,97	0,47
	110	3,25	2,16	1,07	0,52
	120	3,55	2,36	1,16	0,57
	130	3,67	2,55	1,26	0,61
	140	3,67	2,75	1,36	0,66
	144	3,67	2,83	1,39	0,68
M16	96	5,40	4,03	2,66	1,97
	100	5,62	4,20	2,77	2,06
	110	6,18	4,61	3,05	2,26
	120	6,75	5,03	3,32	2,47
	130	6,83	5,34	3,60	2,67
	140	6,83	5,34	3,88	2,88
	150	6,83	5,34	4,08	3,08
	160	6,83	5,34	4,08	3,29
	170	6,83	5,34	4,08	3,38
	180	6,83	5,34	4,08	3,38
	190	6,83	5,34	4,08	3,38
	192	6,83	5,34	4,08	3,38



Table A4.2 Characteristic fire resistance rates for the Fischer Powerbond FPB injection system with threaded rods made of stainless steel of stability class A4-70 with size M20 to M24

Size of anchor	embedding depth [mm]	Fire resistance				
		F30 [kN]	F60 [kN]	F90 [kN]	F120 [kN]	
M20	120	8,42	6,28	4,15	3,08	
	130	9,13	6,82	4,50	3,34	
	140	9,84	7,34	4,85	3,60	
	150	10,54	7,87	5,19	3,85	
	160	10,66	8,33	5,54	4,11	
	170	10,66	8,33	5,88	4,37	
	180	10,66	8,33	6,23	4,63	
	190	10,66	8,33	6,37	4,88	
	200	10,66	8,33	6,37	5,14	
	210	10,66	8,33	6,37	5,27	
M24	220	10,66	8,33	6,37	5,27	
	230	10,66	8,33	6,37	5,27	
	240	10,66	8,33	6,37	5,27	
	144	12,13	9,06	5,98	4,44	
	150	12,65	9,44	6,23	4,63	
	160	13,49	10,07	6,65	4,93	
	170	14,33	10,70	7,06	5,24	
	180	15,18	11,33	7,48	5,55	
	190	15,36	11,96	7,89	5,86	
	200	15,36	12,00	8,31	6,17	
	210	15,36	12,00	8,72	6,48	
	220	15,36	12,00	9,14	6,78	
	230	15,36	12,00	9,18	7,09	
	240	15,36	12,00	9,18	7,40	
	250	15,36	12,00	9,18	7,59	
	260	15,36	12,00	9,18	7,59	
	270	15,36	12,00	9,18	7,59	
	280	15,36	12,00	9,18	7,59	
288	15,36	12,00	9,18	7,59		



Enclosure 5 Characteristic fire resistance rates for the fischer Powerbond FPB injection system with threaded rods made of electrogalvanised steel of stability class 5.8, of stainless steel of stability class A4-50 or highly corrosion-resistant steel of stability class C-50

Table A5.1 Characteristic fire resistance rates for the fischer Powerbond FPB injection system with threaded rods made of electrogalvanised steel of stability class 5.8, of stainless steel of stability class A4-50 or highly corrosion-resistant steel of stability class C-50 with size M10 to M16

Size of anchor	embedding depth [mm]	Fire resistance			
		F30 [kN]	F60 [kN]	F90 [kN]	F120 [kN]
M10	60	1,23	0,75	0,27	0,03
	70	1,44	0,87	0,31	0,03
	80	1,64	1,00	0,36	0,03
	90	1,83	1,12	0,40	0,04
	100	1,83	1,25	0,44	0,04
	110	1,83	1,37	0,49	0,05
	120	1,83	1,42	0,53	0,05
M12	72	2,08	1,37	0,66	0,31
	80	2,37	1,57	0,77	0,38
	90	2,66	1,77	0,87	0,42
	100	2,66	1,96	0,97	0,47
	110	2,66	2,07	1,07	0,52
	120	2,66	2,07	1,16	0,57
	130	2,66	2,07	1,26	0,61
	144	2,66	2,07	1,39	0,68
M16	96	4,95	3,85	2,66	1,97
	100	4,95	3,85	2,77	2,06
	110	4,95	3,85	2,98	2,26
	120	4,95	3,85	2,98	2,47
	130	4,95	3,85	2,98	2,51
	140	4,95	3,85	2,98	2,51
	150	4,95	3,85	2,98	2,51
	160	4,95	3,85	2,98	2,51
	170	4,95	3,85	2,98	2,51
	180	4,95	3,85	2,98	2,51
	190	4,95	3,85	2,98	2,51
	192	4,95	3,85	2,98	2,51



Table A5.2 Characteristic fire resistance rates for the *fischer Powerbond FPB injection system with threaded rods made of electrogalvanised steel of stability class 5.8, of stainless steel of stability class A4-50 or highly corrosion-resistant steel of stability class C-50 with size M20 to M24*

Size of anchor	embedding depth [mm]	Fire resistance				
		F30 [kN]	F60 [kN]	F90 [kN]	F120 [kN]	F120 [kN]
M20	120	7,72	6,00	4,15		3,08
	130	7,72	6,00	4,50		3,34
	140	7,72	6,00	4,66		3,60
	150	7,72	6,00	4,66		3,85
	160	7,72	6,00	4,66		3,92
	170	7,72	6,00	4,66		3,92
	180	7,72	6,00	4,66		3,92
	190	7,72	6,00	4,66		3,92
	200	7,72	6,00	4,66		3,92
	210	7,72	6,00	4,66		3,92
M24	220	7,72	6,00	4,66		3,92
	230	7,72	6,00	4,66		3,92
	240	7,72	6,00	4,66		3,92
	144	11,12	8,65	5,98		4,44
	150	11,12	8,65	6,23		4,63
	160	11,12	8,65	6,65		4,93
	170	11,12	8,65	6,71		5,24
	180	11,12	8,65	6,71		5,55
	190	11,12	8,65	6,71		5,65
	200	11,12	8,65	6,71		5,65
	210	11,12	8,65	6,71		5,65
	220	11,12	8,65	6,71		5,65
	230	11,12	8,65	6,71		5,65
	240	11,12	8,65	6,71		5,65
	250	11,12	8,65	6,71		5,65
	260	11,12	8,65	6,71		5,65
	270	11,12	8,65	6,71		5,65
	280	11,12	8,65	6,71		5,65
288	11,12	8,65	6,71		5,65	

