MFPA Leipzig GmbH

Testing, Inspection and Certification Authority for
Construction Products and Construction Types

Leipzig Institute for Materials Research and Testing
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Notice of extension of the Expert Opinion No. GS 3.2/14-087-1

1 March 2019
No. Copy 1

Subject matter:	fischer injection system FIS GREEN Orientating fire protection assessment according to TR 020 of the injection system FIS GREEN
Client:	fischerwerke GmbH & Co. KG Otto-Hahn-Straße 15 79211 Denzlingen
Date of order:	14 February 2019
Person in charge:	Dipl.-Ing. S. Bauer

This notice consists of two pages. It is only valid in conjunction with the above-mentioned expert opinion and may only be used in conjunction with it.

Gesellschaft für Materialforschung und Prüfungsanstalt für das Bauwesen Leipzig mbH (MFPA Leipzig GmbH)

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1 General

MFPA Leipzig GmbH was commissioned on 14 February 2019 to extend the expert opinion no. GS 3.2/14-087-1 of 17 December 2014.

2 Basics

[1] Technical Report TR 020 „Evaluation of Anchorages in Concrete concerning Resistance to Fire" (May 2004) of the European Organisation for Technical Approvals (EOTA),

[2] European Technical Assessment ETA-14/0408 of DIBt Berlin: „fischer injection system FIS GREEN" dated 19 December 2014,

[3] Expert opinion no. GS 3.2/14-087-1 of MFPA Leipzig GmbH dated 17 December 2014.

3 Validity

This notice extends the period of validity of the expert opinion No. GS 3.2/14-087-1 of MFPA Leipzig GmbH dated 17 December 2014.

The validity of the expert opinion is unlimited and ends as soon as technical regulations change or the reference documents become invalid.

The results of the tests exclusively relate to the items tested. This document does not replace a certificate of conformity or suitability according to national and European building codes.

Leipzig, 1 March 2019

Dipl.-Ing. S. Hauswaldt
Head of Business Division

Dipl.-Ing. S. Bauer
Testing Engineer

MFPA Leipzig GmbH

Testing, Inspection and Certification Authority for
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Advisory Opinion No. GS 3.2/14-087-1

17 December 2014
No. Copy 1

Translation of the original German document GS 3.2/14-087-1

Subject matter:	**fischer injection system FIS GREEN** Preliminary fire protection assessment acc. to TR 020 for the injection system FIS GREEN
Client:	**fischerwerke GmbH & Co. KG** Otto-Hahn-Straße 15 D – 79211 Denzlingen
Date of order:	10 June 2014
Person in charge:	Dipl.-Wirtsch.-Ing. S. Kramer Dipl.-Ing. S. Hauswaldt,

The validity of this advisory opinion expires on 16 December 2019.
This document consists of 6 pages of text and 3 annexes.

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Test laboratory accredited by DAkkS GmbH according to DIN EN ISO/IEC 17025. The accreditation only applies to the test methods listed in the certificate (in this document marked with *) which can be seen on www.mfpa-leipzig.de

Gesellschaft für Materialforschung und Prüfungsanstalt für das Bauwesen Leipzig mbH (MFPA Leipzig GmbH)

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1 Objective and request

On 10 June 2014 the firm of fischerwerke GmbH & Co. KG commissioned MFPA Leipzig GmbH to prepare an advisory opinion on the fire behaviour of the fischer injection system FIS GREEN, i.e. the fischer injection mortar FIS GREEN in conjunction with the fischer threaded rod, fischer anchor with internal thread RG MI, fischer reinforcement anchors FRA as well as reinforcing steels, in each case arranged vertically to the surfaces of boards and walls that were exposed to fire on one side.

2 Principles and documents for the advisory opinion

The following principles and documents were used for the advisory opinion:

[1] Technical Report TR 020 "Evaluation of Anchorages in Concrete concerning Resistance to Fire" (May 2004) of the European Organisation for Technical Approvals (EOTA),

[2] European Technical Approval ETA-14/0408 from December 2014 of the DIBt Berlin: bonded anchors in the sizes M8 to M20 for anchorage in concrete,

[3] Kordina, K.; Meyer-Ottens, C.: Beton Brandschutz Handbuch, Verlag Bau und Technik, 1999,

[4] prEN 13381-3:2012 – Test methods for determining the contribution to the fire resistance of structural members - Part 3: Applied protection to concrete members

Apart from these documents, the extensive testing experience of MFPA Leipzig with respect to the fire behaviour of fastenings and of reinforced concrete constructions is incorporated in the fire protection assessment.

In accordance with [4], temperature curves were taken as a basis for the advisory opinion, in particular for the heating behaviour of reinforced concrete elements made of normal concrete with quartzite aggregates. Figure 1 shows the temperatures as a function of the concrete coverage for building components exposed to fire on one side.

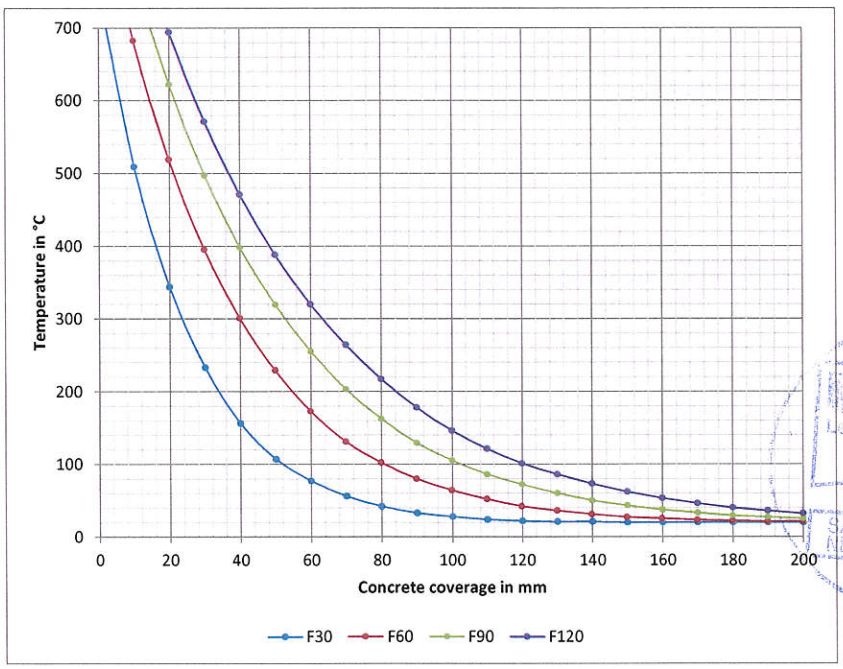


Figure 1 *Temperatures in reinforced concrete elements after 30, 60, 90 and 120 minutes with an exposure to fire on one side through the standard temperature-time curve (ETK) acc. to EN 1363-1, data from [4]*

3 Description of the construction to be assessed

The European Technical Approval [2] contains a detailed description of the fischer injection system FIS GREEN. Variable anchoring depths are permissible for threaded rods. The injection mortar FIS GREEN is a bio-based injection mortar on the basis of methacrylic resin with renewable raw materials. No further description of the injection will be provided here and reference is made to ETA [2].

4 Fire protection assessment concept

The characteristic values for the resistance in the event of a fire are determined for the failure types "pull-out" of the concrete $N_{Rk,p,fi(t)}$ and "steel failure" $N_{Rk,s,fi(t)}$. The steel failure values were determined with the aid of the characteristic tensile strengths for carbon steel and stainless steel of the steel grade A4 acc. to TR 020 [1]. The shear failure of the bonded surface was determined by pull-out tests.

4.1 Anchorage of fischer anchor rods FIS A and fischer anchors with internal threads RG MI with the fischer injection system FIS GREEN

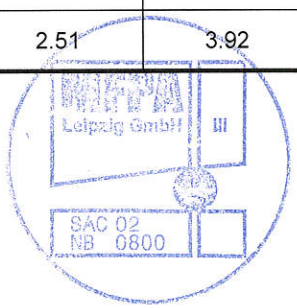
The characteristic tension resistance for the steel failure of various thread diameters with a central tension is listed in Table 1 and Table 2 as a function of the determined fire-resistance period.

Table 1 *Characteristic tension resistance $N_{Rk,s,fi(t)}$ in kN for the steel failure of the injection system FIS GREEN, determined for carbon steel corresponding to EN 10025, steel grade 5.8 or higher*

FIS GREEN		M8	M10	M12	M16	M20
30 min	$N_{Rk,s,fi(30)}$	0.37	0.87	1.69	3.14	4.90
60 min	$N_{Rk,s,fi(60)}$	0.33	0.75	1.27	2.36	3.68
90 min	$N_{Rk,s,fi(90)}$	0.26	0.58	1.10	2.04	3.19
120 min	$N_{Rk,s,fi(120)}$	0.18	0.46	0.84	1.57	2.45

Table 2 *Characteristic tension resistance $N_{Rk,s,fi(t)}$ in kN for the steel failure of the injection system FIS GREEN, determined for stainless steel of at least the steel grade A4-50 corresponding to ISO 3506*

FIS GREEN		M8	M10	M12	M16	M20
30 min	$N_{Rk,s,fi(30)}$	0.73	1.45	2.53	4.71	7.35
60 min	$N_{Rk,s,fi(60)}$	0.59	1.16	2.11	3.93	6.13
90 min	$N_{Rk,s,fi(90)}$	0.44	0.93	1.69	3.14	4.90
120 min	$N_{Rk,s,fi(120)}$	0.37	0.81	1.35	2.51	3.92



The characteristic resistance of the anchorage against pulling out of concrete is determined by the equation

$$N_{Rk,p,fi(t)} = h_{ef} \cdot d \cdot \pi \cdot \tau_{Rk,p,fi(t)} \quad (1)$$

with the effective anchoring depth h_{ef}, the thread diameter d and the shear resistance $\tau_{Rk,p,fi(t)}$. The shear resistance is determined as a function of the concrete temperature. To this end, the shear behaviour of the bonded surface is assessed as a function of the failure temperature (see Figure 2).

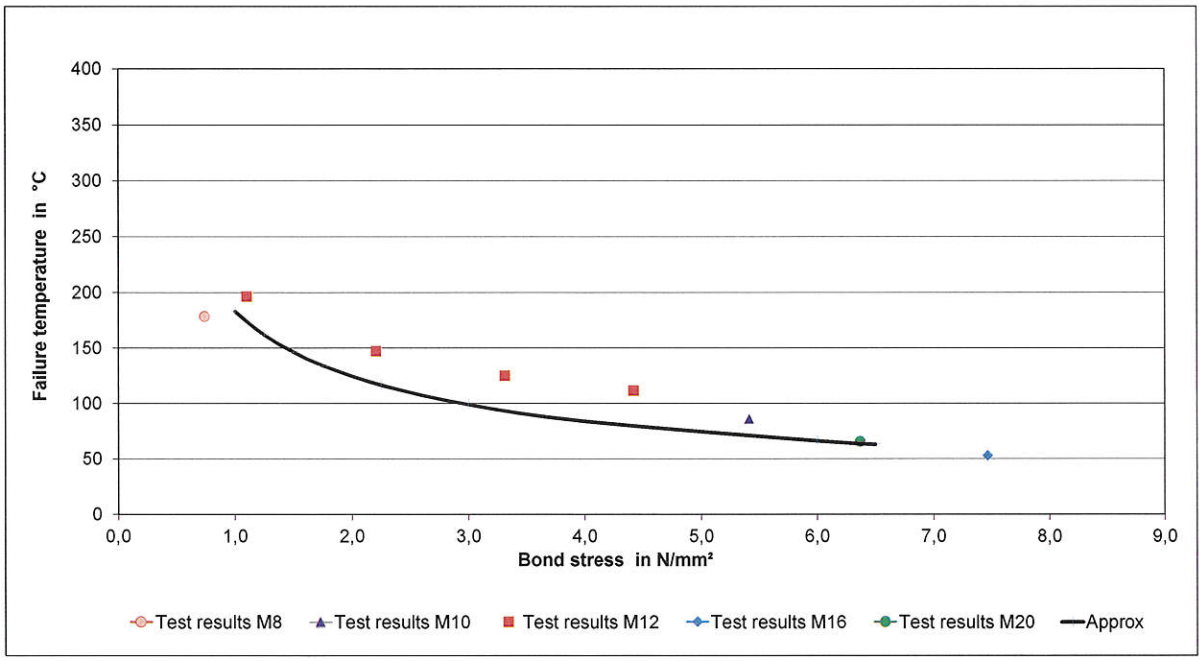


Figure 2 *Graphic display of the test results for the fischer injection system FIS GREEN and the design curve for the failure temperature as a function of the bond stress*

The shear resistance can accordingly be quoted through the identified approximation function

$$\tau_{Rk,p,fi}(\theta) = (0{,}005181 \ \theta_{c,d} + 0{,}05181)^{-1{,}923} \quad (2)$$

as a function of the concrete temperature $\theta_{c,d}$. However, this value is restricted on the one hand by the maximum failure temperature of 180°C resulting from the tests, and on the other hand by the characteristic bond strengths quoted in the approval [2] for anchor rods of the size M 20 to 6.5 N/mm².

If the concrete temperature is known, the characteristic tensile load can be determined with

$$N_{Rk,p,fi(t)} = h_{ef} \cdot d \cdot \pi \cdot (0{,}005181 \ \theta_{c,d} + 0{,}05181)^{-1{,}923} \quad (3)$$

as a function of the temperature.

The characteristic values of the failure types "steel failure" and "pulling out of the mortar" are to be calculated depending on the variable anchoring depths. The assessment of the injection system FIS GREEN was carried out according to TR 020, equation 2.1. The partial safety factor of the resistances under a fire load is $\gamma_{M,fi}$ = 1.0. The smaller resistance

$$N_{Rd,fi(t)} = \min(N_{Rk,p,fi(t)}, N_{Rk,s,fi(t)}) \quad (4)$$

of the two possible failure cases "steel tension failure" and "pulling out of the concrete" is to be used for the assessment.

In accordance with the temperature distribution with a one-sided fire load at the fire times 30, 60, 90 and 120 minutes that is analysed graphically in Figure 1, the characteristic tensile loads $N_{Rk,p,fi(t)}$ for various anchoring depths were calculated and compared to the characteristic tension resistances $N_{Rk,s,fi(t)}$ of the steel failure. Annex 2 and 3 compile the resulting maximum tension resistances $N_{Rd,fi(t)}$ as functions of the anchoring depths for anchor rods and anchors with internal threads.

The characteristic values of the failure types "concrete break-out" are to be calculated as a function of the variable anchoring depths with the equations 2.11 and 2.12 acc. to TR 020.

4.2 Reinforcement connection with the fischer injection system FIS GREEN Proof of concrete steel for use as an anchor

The characteristic values for the resistance in the event of a fire for the failure type "pulling out of concrete" $N_{Rk,p,fi(t)}$ were also determined for concrete steel used as an anchor through the integration of the critical temperature-dependent bond stresses as a function of the anchoring depth h_{ef} of the reinforcing rod and the duration of heating. Figure 3 explains how the anchor is used. The anchorage zone of the reinforcement is located vertical to the surface of the element exposed to fire and lies in different temperature areas.

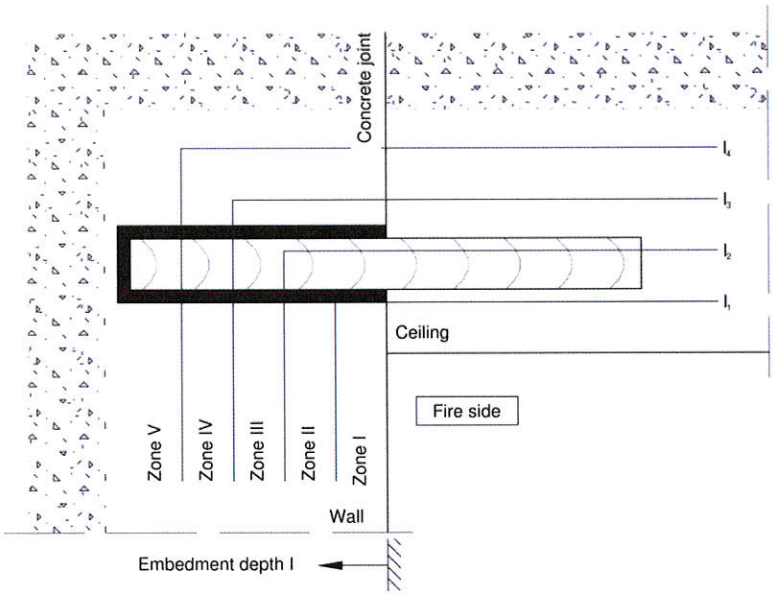


Figure 3 *Schematic diagram of the reinforcement connection variant "anchorage"*

The assessment concept applies for concrete steel grades with apparent limits of elasticity from 500 MPa, for rods with a nominal diameter of ø 8 to ø 20 and for fire-resistance periods of 30 minutes to 120 minutes. The partial safety factor for the resistances under a fire load was set at γ_{Fi} = 1.0.

The characteristic values against pulling out are compiled in annex 1 for B 500 B. The characteristic values for the resistance for the fire case for the failure type "steel failure" limit the values for the failure type "pulling out" and are shown with a grey background. Interim values may be interpolated. An extrapolation is not allowed. The quoted loads apply for the stress directions central tension, lateral tension and diagonal tension at every angle.

The failure types "steel failure" and "concrete break-out" were not taken into account in this assessment. The connected structural element must display the same fire resistance as the anchor application.

5 Special notes

The foregoing assessment applies for the fischer injection system FIS GREEN in concrete that is installed in accordance with the installation regulations of ETA-14/0408 [2].

The assessment applies in general for a one-sided fire load of the structural elements. In the event of a fire load on several sides the verification procedure can only be applied if the gap to the outer edge of the plug is c ≥ 300 mm and ≥ 2 h_{ef}.

The permissible loads determined for the fischer injection system FIS GREEN with fischer threaded rods can be transferred to the fischer injection system FIS GREEN with fischer anchors with internal threads RG MI and concrete steel B 500 B on account of at least the same geometric dimensions and past test experience.

Taking this as a basis, the following permissible loads can be determined for the fischer injection system FIS GREEN with concrete steel B 500 B as well as fischer threaded rods and anchors with internal threads RG MI (see enclosures 1, 2 and 3). The loads also apply for lateral tension and/or diagonal tension.

The determined loads can only serve for orientation purposes on account of the low number of tests.

The assessment only applies in conjunction with reinforced concrete ceilings in the strength class ≥ C 20/25 and≤ C 50/60 acc. to EN 206-1: 2000-12 that have at least the same fire resistance rating as the fire-resistance period of the anchor. In addition, the notes contained in DIN EN 1992-1-2 (see section 4.5) on the avoidance of concrete spallation also apply.

The results of the tests exclusively refer to the described test objects but not to the main unit. This document does not replace a certificate of conformity or suitability according to national and European building codes.

Leipzig, 17 December 2014

Dipl.-Ing. S. Hauswaldt	Dipl.-Ing. M. Juknat	Dipl.-Wirtsch.-Ing. S. Kramer
Head of Business Division	*Head of Work Group*	*Testing Engineer*

List of annexes

Annex 1.1 to 1.6: Characteristic tensile load in a fire case for concrete steel B 500 B used as an anchor as a function of the fire-resistance period tu

Annex 2: Maximum tensile load as a function of the fire load on the FIS GREEN with threaded rods and with anchors with an internal thread RG MI from carbon steel corresponding to EN 10025

Annex 3: Maximum tensile load as a function of the fire load on the FIS GREEN with threaded rods and with anchors with an internal thread RG MI of stainless steel of at least the steel grade A4 corresponding to ISO 3506

Table A 1.1 *FIS GREEN with grade 8 B 500 B used as an anchor (concrete steel is not exposed to the fire)*

Rod diameter in mm	Nom. bore diameter in mm	Anchoring depth in mm	Characteristic tensile load as a function of the fire-resistance period in kN			
			R30	R60	R90	R120
8	10 or 12	60	1.31	0.00	0.00	0.00
		70	2.80	0.35	0.00	0.00
		80	4.44	0.92	0.00	0.00
		90	6.07	1.79	0.38	0.00
		100	7.70	3.09	0.94	0.31
		110	9.34	4.73	1.75	0.76
		120	10.97	6.36	2.86	1.37
		130	12.60	8.00	4.37	2.21
		140	14.24	9.63	6.00	3.31
		150	15.87	11.26	7.64	4.76
		160	17.51	12.90	9.27	6.40

grey background = steel failure decisive

Table A 1.2 *FIS GREEN with grade 10 B 500 B used as an anchor (concrete steel is not exposed to the fire)*

Rod diameter in mm	Nom. bore diameter in mm	Anchoring depth in mm	Characteristic tensile load as a function of the fire-resistance period in kN			
			R30	R60	R90	R120
10	12 or 14	60	1.64	0.00	0.00	0.00
		70	3.50	0.44	0.00	0.00
		80	5.55	1.15	0.00	0.00
		90	7.59	2.24	0.48	0.00
		100	9.63	3.87	1.18	0.39
		110	11.67	5.91	2.18	0.95
		120	13.71	7.95	3.57	1.72
		130	15.76	9.99	5.46	2.76
		140	17.80	12.04	7.50	4.14
		150	19.84	14.08	9.54	5.95
		160	21.88	16.12	11.59	8.00
		170	23.92	18.16	13.63	10.04
		180	25.97	20.20	15.67	12.08
		190	28.01	22.25	17.71	14.12
		200	30.05	24.29	19.75	16.16

grey background = steel failure decisive

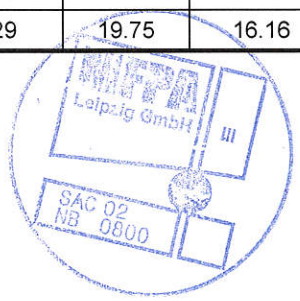


Table A 1.3 *FIS GREEN with grade 12 B 500 B used as an anchor (concrete steel is not exposed to the fire)*

Rod diameter in mm	Nom. bore diameter in mm	Anchoring depth in mm	Characteristic tensile load as a function of the fire-resistance period in kN			
			R30	R60	R90	R120
12	14 or 16	70	4.20	0.53	0.00	0.00
		80	6.65	1.38	0.00	0.00
		90	9.11	2.69	0.57	0.00
		100	11.56	4.64	1.41	0.47
		110	14.01	7.09	2.62	1.14
		120	16.46	9.54	4.29	2.06
		130	18.91	11.99	6.55	3.31
		140	21.36	14.44	9.00	4.96
		150	23.81	16.89	11.45	7.14
		160	26.26	19.35	13.90	9.59
		170	28.71	21.80	16.35	12.04
		180	31.16	24.25	18.80	14.50
		190	33.61	26.70	21.25	16.95
		200	36.06	29.15	23.71	19.40
		210	38.51	31.60	26.16	21.85
		220	40.96	34.05	28.61	24.30
		230	43.41	36.50	31.06	26.75
		240	45.86	38.95	33.51	29.20

grey background = steel failure decisive

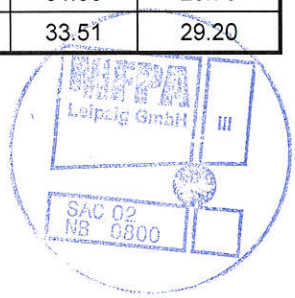


Table A 1.4 *FIS GREEN with grade 14 B 500 B used as an anchor (concrete steel is not exposed to the fire)*

Rod diameter in mm	Nom. bore diameter in mm	Anchoring depth in mm	Characteristic tensile load as a function of the fire-resistance period in kN			
			R30	R60	R90	R120
14	18	70	4.91	0.62	0.00	0.00
		80	7.76	1.61	0.00	0.00
		90	10.62	3.13	0.67	0.00
		100	13.48	5.42	1.65	0.55
		110	16.34	8.28	3.06	1.33
		120	19.20	11.13	5.00	2.41
		130	22.06	13.99	7.64	3.86
		140	24.92	16.85	10.50	5.79
		150	27.78	19.71	13.36	8.33
		160	30.63	22.57	16.22	11.19
		170	33.49	25.43	19.08	14.05
		180	36.35	28.29	21.94	16.91
		190	39.21	31.15	24.80	19.77
		200	42.07	34.00	27.66	22.63
		210	44.93	36.86	30.51	25.49
		220	47.79	39.72	33.37	28.35
		230	50.65	42.58	36.23	31.21
		240	53.51	45.44	39.09	34.06
		250	56.36	48.30	41.95	36.92
		260	59.22	51.16	44.81	39.78
		270	62.08	54.02	47.67	42.64
		280	64.94	56.88	50.53	45.50

grey background = steel failure decisive

Table A 1.5 *FIS GREEN with grade 16 B 500 B used as an anchor (concrete steel is not exposed to the fire)*

Rod diameter in mm	Nom. bore diameter in mm	Anchoring depth in mm	Characteristic tensile load as a function of the fire-resistance period in kN			
			R30	R60	R90	R120
16	20	80	8.87	1.84	0.00	0.00
		90	12.14	3.58	0.76	0.00
		100	15.41	6.19	1.89	0.63
		110	18.68	9.46	3.49	1.52
		120	21.94	12.72	5.72	2.75
		130	25.21	15.99	8.74	4.42
		140	28.48	19.26	12.00	6.62
		150	31.74	22.53	15.27	9.53
		160	35.01	25.79	18.54	12.79
		170	38.28	29.06	21.80	16.06
		180	41.55	32.33	25.07	19.33
		190	44.81	35.60	28.34	22.59
		200	48.08	38.86	31.61	25.86
		210	51.35	42.13	34.87	29.13
		220	54.61	45.40	38.14	32.40
		230	57.88	48.66	41.41	35.66
		240	61.15	51.93	44.68	38.93
		250	64.42	55.20	47.94	42.20
		260	67.68	58.47	51.21	45.46
		270	70.95	61.73	54.48	48.73
		280	74.22	65.00	57.74	52.00
		290	77.49	68.27	61.01	55.27
		300	80.75	71.54	64.28	58.53
		310	84.02	74.80	67.55	61.80
		320	87.29	78.07	70.81	65.07

grey background = steel failure decisive

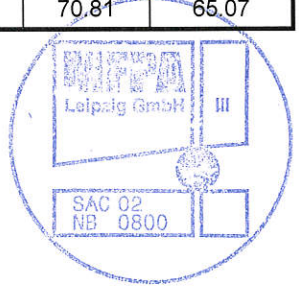


Table A 1.6 *FIS GREEN with grade 20 B 500 B used as an anchor (concrete steel is not exposed to the fire)*

Rod diameter in mm	Nom. bore diameter in mm	Anchoring depth in mm	Characteristic tensile load as a function of the fire-resistance period in kN			
			R30	R60	R90	R120
20	25	90	15.18	4.48	0.95	0.00
		100	19.26	7.74	2.36	0.78
		110	23.34	11.82	4.36	1.90
		120	27.43	15.91	7.15	3.44
		130	31.51	19.99	10.92	5.52
		140	35.60	24.07	15.00	8.27
		150	39.68	28.16	19.09	11.91
		160	43.76	32.24	23.17	15.99
		170	47.85	36.33	27.26	20.07
		180	51.93	40.41	31.34	24.16
		190	56.02	44.49	35.42	28.24
		200	60.10	48.58	39.51	32.33
		210	64.18	52.66	43.59	36.41
		220	68.27	56.75	47.68	40.49
		230	72.35	60.83	51.76	44.58
		240	76.44	64.91	55.84	48.66
		250	80.52	69.00	59.93	52.75
		260	84.60	73.08	64.01	56.83
		270	88.69	77.17	68.10	60.92
		280	92.77	81.25	72.18	65.00
		290	96.86	85.33	76.27	69.08
		300	100.94	89.42	80.35	73.17
		310	105.03	93.50	84.43	77.25
		320	109.11	97.59	88.52	81.34
		330	113.19	101.67	92.60	85.42
		340	117.28	105.76	96.69	89.50
		350	121.36	109.84	100.77	93.59
		360	125.45	113.92	104.85	97.67
		370	129.53	118.01	108.94	101.76
		380	133.61	122.09	113.02	105.84
		390	137.70	126.18	117.11	109.92
		400	141.78	130.26	121.19	114.01

grey background = steel failure decisive

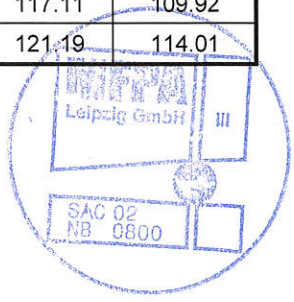


Table A 2.1 *Maximum tensile load as a function of the fire load on the FIS GREEN with threaded rods (5.8 or 8.8) of carbon steel corresponding to EN 10025*

Thread	Nom. bore diameter in mm	Anchoring depth in mm	Characteristic tensile load as a function of the fire-resistance period			
			R30	R60	R90	R120
M8	10	60	0.37	0.00	0.00	0.00
		70	0.37	0.33	0.00	0.00
		80	0.37	0.33	0.00	0.00
		90	0.37	0.33	0.26	0.00
		100	0.37	0.33	0.26	0.18
M10	12	60	0.87	0.00	0.00	0.00
		70	0.87	0.44	0.00	0.00
		80	0.87	0.75	0.00	0.00
		90	0.87	0.75	0.48	0.00
		100	0.87	0.75	0.58	0.39
		110	0.87	0.75	0.58	0.46
M12	14	70	1.69	0.53	0.00	0.00
		80	1.69	1.26	0.00	0.00
		90	1.69	1.26	0.57	0.00
		100	1.69	1.26	1.10	0.47
		110	1.69	1.26	1.10	0.84
M16	18	80	3.14	1.84	0.00	0.00
		90	3.14	2.36	0.76	0.00
		100	3.14	2.36	1.89	0.63
		110	3.14	2.36	2.04	1.52
		120	3.14	2.36	2.04	1.57
M20	24	90	4.90	3.68	0.95	0.00
		100	4.90	3.68	2.36	0.78
		110	4.90	3.68	3.19	1.90
		120	4.90	3.68	3.19	2.45

grey background = steel failure decisive

Table A 2.2 *Maximum tensile load as a function of the fire load on the FIS GREEN with fischer anchors with an internal thread RG MI (5.8 or 8.8) of carbon steel corresponding to EN 10025*

Thread	Nom. bore diameter in mm	Anchoring depth in mm	Characteristic tensile load as a function of the fire-resistance period			
			R30	R60	R90	R120
M8	14	90	0.37	0.33	0.26	0.00
M10	18	90	0.87	0.75	0.48	0.00
M12	20	125	1.69	1.26	1.10	0.84
M16	24	160	3.14	2.36	2.04	1.57

grey background = steel failure decisive

Table A 3.1 *Maximum tensile load as a function of the fire load on the FIS GREEN with threaded rods of stainless steel of at least the steel grade A4-50 corresponding to ISO 3506*

Thread	Nom. bore diameter in mm	Anchoring depth in mm	Characteristic tensile load as a function of the fire-resistance period			
			R30	R60	R90	R120
M8	10	60	0.73	0.00	0.00	0.00
		70	0.73	0.35	0.00	0.00
		80	0.73	0.59	0.00	0.00
		90	0.73	0.59	0.38	0.00
		100	0.73	0.59	0.44	0.31
		110	0.73	0.59	0.44	0.37
M10	12	60	1.45	0.00	0.00	0.00
		70	1.45	0.44	0.00	0.00
		80	1.45	1.15	0.00	0.00
		90	1.45	1.16	0.48	0.00
		100	1.45	1.16	0.93	0.39
		110	1.45	1.16	0.93	0.81
M12	14	70	2.53	0.53	0.00	0.00
		80	2.53	1.38	0.00	0.00
		90	2.53	2.11	0.57	0.00
		100	2.53	2.11	1.41	0.47
		110	2.53	2.11	1.69	1.14
		120	2.53	2.11	1.69	1.35
M16	18	80	4.71	1.84	0.00	0.00
		90	4.71	3.58	0.76	0.00
		100	4.71	3.93	1.89	0.63
		110	4.71	3.93	3.14	1.52
		120	4.71	3.93	3.14	2.51
M20	24	90	7.35	4.48	0.95	0.00
		100	7.35	6.13	2.36	0.78
		110	7.35	6.13	4.36	1.90
		120	7.35	6.13	4.90	3.44
		130	7.35	6.13	4.90	3.92

grey background = steel failure decisive

Table A 3.2 *Maximum tensile load as a function of the fire load on the FIS GREEN with fischer anchors with an internal thread RG MI of stainless steel of at least the steel grade A4-50 corresponding to ISO 3506*

Thread	Nom. bore diameter in mm	Anchoring depth in mm	Characteristic tensile load as a function of the fire-resistance period			
			R30	R60	R90	R120
M8	10	90	0.73	0.59	0.38	0.00
M10	12	90	1.45	1.16	0.48	0.00
M12	14	125	2.53	2.11	1.69	1.35
M16	18	160	4.71	3.93	3.14	2.51

grey background = steel failure decisive