MFPA Leipzig GmbH

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

Division III - Structural Fire Protection
Dipl.-Ing. Sebastian Hauswaldt

Team 3.2 - Fire Behaviour of Building Types and Special Structures
Dipl.-Ing. S. Bauer
Phone +49 (0) 341-6582-194
s.bauer@mfpa-leipzig.de

Advisory opinion no. GS 3.2/18-159-1-r1

Replacement for: GS 3.2/18-159-1 from 1 June 2018

4 July 2018
1st copy

Subject matter:	fischer FIS VL injection system Fire protection assessment of the characteristic steel stresses under tensile stress based on the Technical Report TR 020 "Evaluation of anchorages in concrete concerning Resistance to Fire" (May 2004).
Client:	fischerwerke GmbH & Co. KG Klaus-Fischer-Straße 1 72178 Waldachtal Germany
Date of order:	14 May 2018
Person in charge:	Dipl.-Ing. S. Bauer
Validity:	The validity of the expert opinion is unlimited and ends as soon as technical regulations change or the reference documents become invalid.

This document consists of 4 text pages and 3 enclosures.

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

Registered office: Hans-Weigel-Str. 2b – 04319 Leipzig/Germany
Managing Director: Dr.-Ing. habil. Jörg Schmidt
Company Register: District Court Leipzig HRB 17719
VAT ID No.: DE 813200649
Phone: +49 (0) 341-6582-0
Fax: +49 (0) 341-6582-135

1 Objective and request

On 14 May 2018, MFPA Leipzig GmbH was commissioned by fischerwerke GmbH & Co. KG to assess the fischer FIS VL injection system under one-sided fire exposure and anchored in a reinforced concrete base to determine the characteristic parameters for a load under tensile stress for electrogalvanized steel and stainless steel.

2 Description of the tested structure

The fischer FIS VL injection system is a bonded anchor for anchoring in concrete. It consists of a mortar cartridge with fischer FIS VL injection mortar and a fischer FIS A anchor rod or the fischer RG MI internally threaded anchor. The steel part is inserted in a bore hole which is filled with injection mortar in accordance with the manufacturer's instructions and anchored by the bond between the steel part, the mortar and the concrete.

The injection system may be anchored under mainly static and quasi-static load in reinforced and unreinforced standard concrete with a stability class between C20/25 and C50/60 in accordance with DIN EN 206-1: 2001-07 in cracked and uncracked concrete. No further description of the fischer FIS VL injection system will be provided here and reference is made to ETA-10/0352 [4].

The steel parts are made of electrogalvanized steel, stainless steel or highly corrosion-resistant steel. The injection system with anchor rods made of stainless steel was already tested in 2002 at IBMB Braunschweig. For the test set-up and the results of this series of tests, please refer to the test report UB no. 3038/3141-3-Nau-[6].

In 2016, the fischer injection system was re-tested in sizes M8 and M12 with the corresponding minimum setting depth of 65 mm (for M8) or 95 mm (for M12) in the electrogalvanized version with a tensile strength of approx. 650 N/mm². For comparison, three M8 anchor rods with a tensile strength of approx. 900 N/mm² were tested. The test set-up and the results of this series of tests are shown in test report PB 3.2/16-100-1 [5].

3 Test analysis and evaluation

The test analysis of the anchors made of electrogalvanized steel which were re-tested by MFPA was performed strictly in accordance with TR 020 Evaluation of anchorages in concrete concerning resistance to fire: 2004-05[1]. A graphical analysis of the test results can be found in enclosure 2.

To determine the characteristic tensile stresses for the electrogalvanized steel, the values for M8 and M12 were analysed based on the test results. The results for M10 were calculated by the interpolation of the values for M8 and M12 on the basis of the bonded surface. For anchor rods > M12, the bond stress of M12 was transferred.

The parameters for stainless steel were determined for M8 to M12 based on the test results by IBMB Braunschweig [6]. Here, the analysis could only be performed based on TR 020 [1] since 5 test results, at least 4 of which reached fire resistance periods of more than 60 minutes were not available for every case. For M16 to M30, the bond stresses of M12 were transferred. For the graphical analysis for the stainless steel anchor rods, please refer to enclosure 3.

The following characteristic parameters for the load under central tension can be quoted for the fischer FIS VL injection system on this basis (Table 1 and Table 2). 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 parameters for other failure types (e. g. "pulling out", or "concrete break-out") was not the subject of the tests; they can be determined according to the simplified verification procedure described in TR 020 [1], or experimentally according to the method described in TR 020.

Table 1 Characteristic tension resistance for the fischer FIS VL injection system in combination with anchor rods (stability class≥ 5.8) with the dimensions M8 to M30, electrogalvanized version

Anchor size	Anchoring depth min. h_{ef} [mm]	Fire-resistance period in minutes			
		30 max. N [kN]	60 max. N [kN]	90 max. N [kN]	120 max. N [kN]
M8	**65**	0.75	0.57	0.39	0.30
M10	**80**	1.86	1.51	1.15	0.98
M12	**95**	3.23	2.66	2.09	1.80
M16	**128**	5.81	4.78	3.75	3.24
M20	**160**	9.07	7.47	5.86	5.06
M24	**192**	13.06	10.75	8.44	7.29
M30	**240**	20.41	16.80	13.19	11.38

Table 2 Characteristic tension resistance for the fischer FIS VL injection system in combination with anchor rods A4 (stability class ≥ 50) with the dimensions M8 to M30, stainless steel version (test results from [6])

Anchor size	Anchoring depth min. h_{ef} [mm]	Fire-resistance period in minutes			
		30 max. N [kN]	60 max. N [kN]	90 max. N [kN]	120 max. N [kN]
M8	**65**	1.49	0.91	0.34	0.05
M10	**80**	5.51	3.38	1.25	0.19
M12	**95**	9.08	6.91	4.74	3.66
M16	**128**	16.31	12.42	8.52	6.58
M20	**160**	25.49	19.40	13.32	10.28
M24	**192**	36.70	27.94	19.18	14.80
M30	**240**	57.35	43.66	29.97	23.12

4 Special notes

The assessment above only applies to the fischer FIS VL injection system which was installed in accordance with the installation instructions of fischerwerke GmbH & Co. KG based on the guidelines of ETA-10/0352 [4].

Furthermore, the assessment only applies to fischer anchor rods made of electrogalvanized steel of stability class ≥ 5.8 and stainless steel grade A4 of stability class ≥ 50.

The results for stainless steel may also be transferred to anchor rods made of highly corrosion-resistant steel.

MFPA Leipzig GmbH III
SAC 02
NB 0800

The results for electrogalvanized steel and the results for stainless steel may also be transferred safely to the RG MI internally threaded anchors of the same material and the same stability class.

The anchor rods FIS A M6 to M30 and the internally threaded anchors RG MI M8 to M20 according to [4] for use in uncracked concrete only.

The assessment applies in general to a one-sided fire exposure of the structural elements. In the event of exposure to fire on several sides, the verification procedure can only be applied if the distance to the outer edge of the injection system is $c \geq 300$ mm and $\geq 2\ h_{ef}$.

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

The assessment only applies in combination with reinforced concrete ceilings of strength class ≥ C 20/25 and ≤ C 50/60 acc. to EN 206-1: 2000-12, which have at least the fire-resistance rating which corresponds to the fire-resistance period of the anchors. In addition, the notes contained in DIN EN 1992-1 (see section 4.5) on the avoidance of concrete spallation also 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, 4 July 2018

Dipl.-Ing. S. Hauswaldt	Dipl.-Ing. M. Juknat	Dipl.-Ing. S. Bauer
Head of Division	*Head of Work Group*	*Test Engineer*

Sources

[1] Technical Report TR 020 *Evaluation of Anchorages in Concrete concerning Resistance to Fire:* 2004-05 of the European Organisation for Technical Approvals (EOTA)

[2] ETAG 001, Annex A: *European technical approval guideline for metal anchors for use in concrete*, edition 1997

[3] DIN EN 1363-1: 2012 Fire resistance tests - Part 1: General requirements

[4] European Technical Approval ETA-10/0352, issued by the Deutsches Institut für Bautechnik on 10 August 2017

[5] Test report PB 3.2/16-100-1 from 25 April 2016 of MFPA Leipzig GmbH: Test according to Technical Report TR 020 to determine the characteristic steel stresses under tensile stress

[6] Test report UB no. 3038/3141-3-Nau- from 10 January 2002 by IBMB Braunschweig: Testing and assessment of fischer injection anchors, dimensions M8 to M30, which were installed in the tensile area of reinforced concrete ceiling sections and loaded with tensile stress, for their reaction to fire under exposure to fire in accordance with DIN 4102-2: 1977-09 to determine the fire-resistance class

[7] Manufacturer's declaration on the FIS VL product by fischerwerke GmbH & Co. KG dated 08 May 2018

MFPA Leipzig GmbH III SAC 02 NB 0800

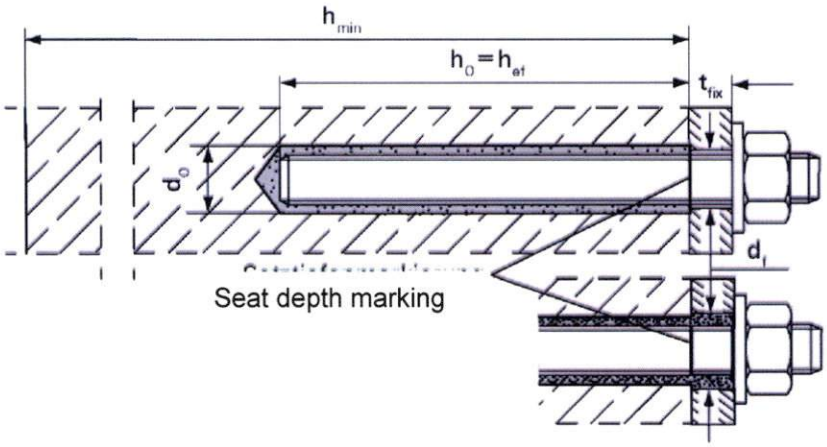
List of enclosures

Enclosure 1 Installation parameters of the FIS VL injection system

Enclosure 2 Graphical analysis der of the anchor tests according to TR 020 for electrogalvanised steel

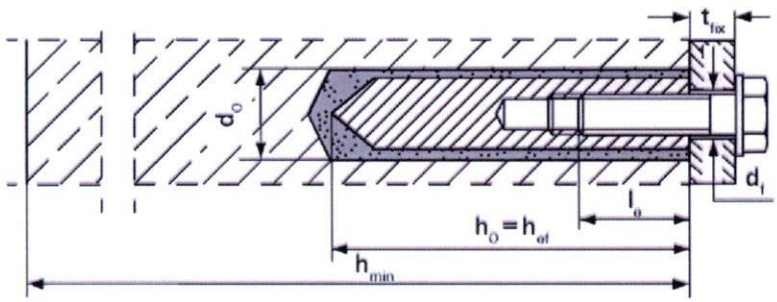
Enclosure 3 Graphical analysis of the anchor tests based on TR 020 for stainless steel

Enclosure 1 Installation parameters of the FIS VL injection system



fischer anchor rods
Pre-positioned installation

Push-through installation
(annular gap in attachment part filled with mortar)



fischer RG MI internally-threaded anchor
Pre-positioned installation only

Table B2: Installation parameters for anchor rods

Size			**M6**[2]	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**[2]	**M30**
Wrench size	SW		10	13	17	19	24	30	36	41	46
Nominal drill diameter	d_0		8	10	12	14	18	24	28	30	35
Bore hole depth	h_0		$h_0 = h_{ef}$								
Effective anchoring depth[3]	$h_{ef,min}$		50	60	60	70	80	90	96	108	120
	$h_{ef,max}$		72	160	200	240	320	400	480	540	600
Min. centre-to-centre and edge distance	s_{min} = c_{min}	[mm]	40	40	45	55	65	85	105	125	140
Diameter of the through hole in the attachment part[1]	Pre-positioned installation d_f		7	9	12	14	18	22	26	30	33
	Push-through installation d_f		9	11	14	16	20	26	30	32	40
Minimum thickness of the concrete part	h_{min}		h_{ef} + 30 (≥ 100)				h_{ef} + 2 d_0				
Maximum installation torque	$T_{inst,max}$	[Nm]	5	10	20	40	60	120	150	200	300

[1] For larger through holes in the attachment part, see TR 029, 4.2.2.1 or CEN/TS 1992-4-1:2009, 5.2.3.1
[2] M6 not part of the assessment; the values of M24 can be used for M27
[3] Minimum anchoring depths must comply with Tables 1 and 2!

Table B3: Installation parameters for fischer RG MI internally threaded anchors

Size			**M8**	**M10**	**M12**	**M16**	**M20**
Sleeve diameter	d_H	[mm]	12	16	18	22	28
Nominal drill diameter	d_0		14	18	20	24	32
Bore hole depth	h_0		$h_0 = h_{ef} = L_H$				
Effective anchoring depth	h_{ef}		90	90	125	160	200
Min. centre-to-centre and edge distance	s_{min} = c_{min}		55	65	75	95	125
Diameter of the through hole in the attachment part[1)]	d_f		9	12	14	18	22
Minimum thickness of the concrete part	h_{min}		120	125	165	205	260
Maximum screw depth	$l_{E,max}$		18	23	26	35	45
Minimum screw depth	$l_{E,min}$		8	10	12	16	20
Maximum installation torque	$T_{inst,max}$	[Nm]	10	20	40	80	120

[1)] For larger through holes in the attachment part, see TR 029, 4.2.2.1 or CEN/TS 1992-4-1:2009, 5.2.3.1

Enclosure 2 Graphical analysis of the anchor tests according to TR 020 for electrogalvanized steel

Diagram A2.1 Graphical analysis M8 – electrogalvanized

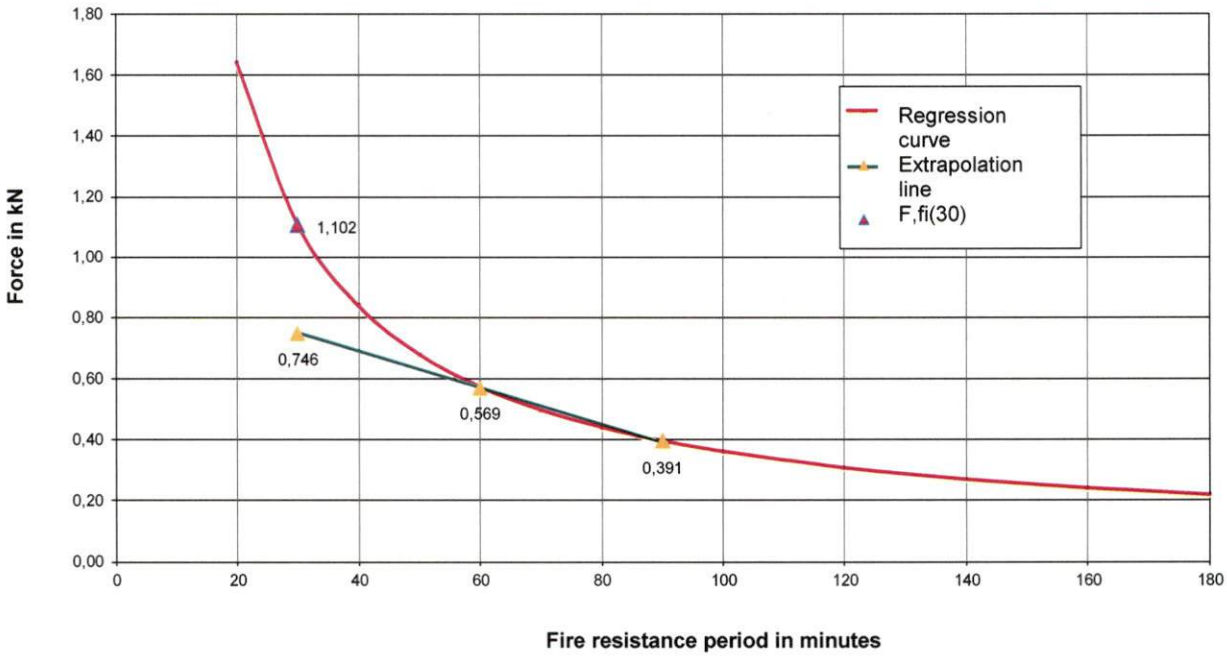
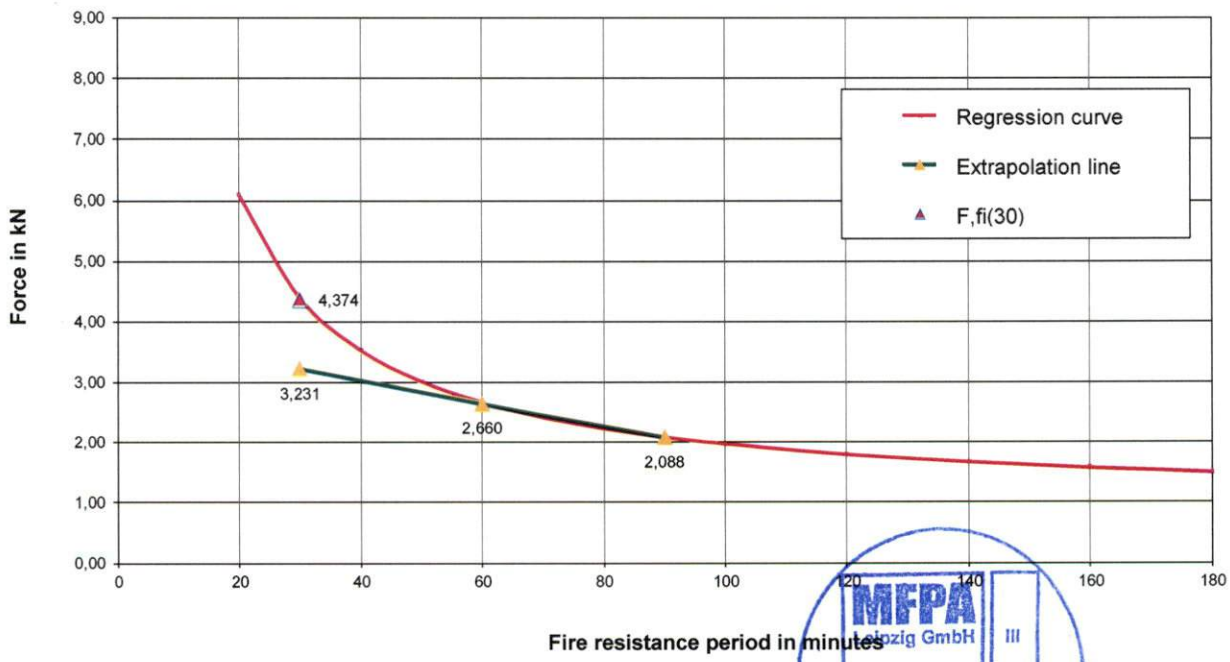


Diagram A2.2 Graphical analysis M12 – electrogalvanized



MFPA Leipzig GmbH III
SAC 02
NB 0800

Enclosure 3 Graphical analysis of the anchor tests based on TR 020 for stainless steel

Diagram A3.1 Graphical analysis M8 – stainless steel A4

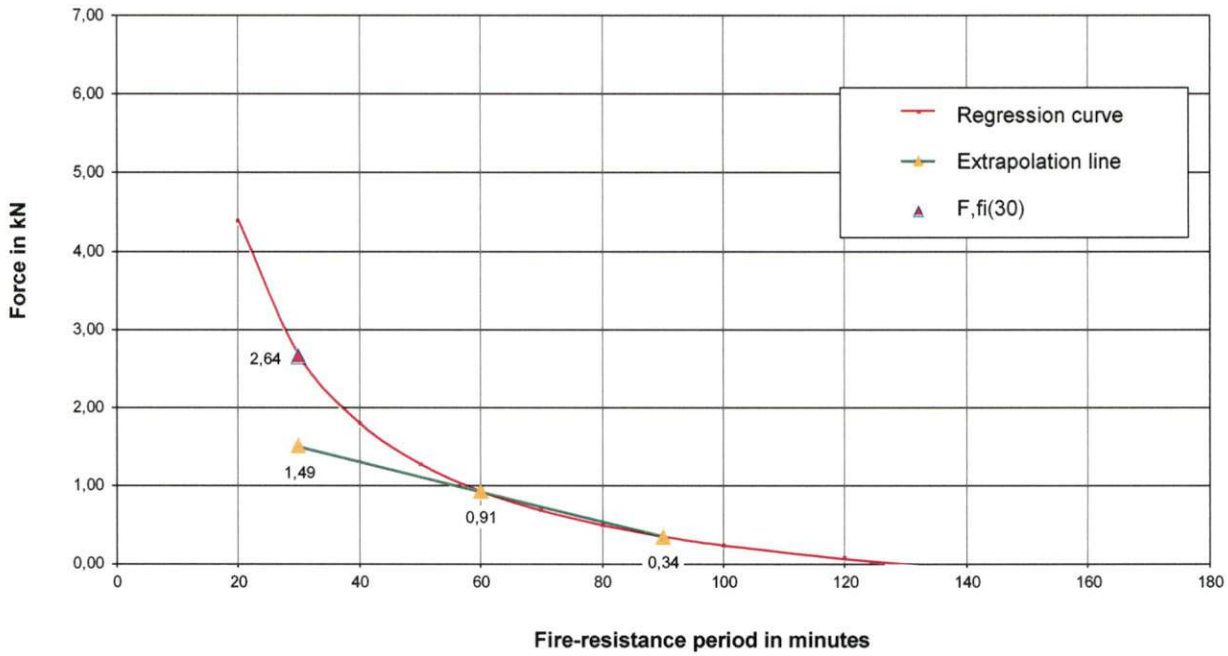


Diagram A3.2 Graphical analysis M10 – stainless steel A4

MFPA Leipzig GmbH III
SAC 02
NB 0800

Diagram A3.3 Graphical analysis M12 – stainless steel A4