

Allgemeine bauaufsichtliche Zulassung

Zulassungsstelle für Bauprodukte und Bauarten

Bautechnisches Prüfamt

Eine vom Bund und den Ländern
gemeinsam getragene Anstalt des öffentlichen Rechts
Mitglied der EOTA, der UEAtc und der WFTAO

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Z-21.8-1872

Geltungsdauer

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bis: **31 July 2013**

Antragsteller:

MKT

Metall-Kunststoff-Technik GmbH & Co. KG

Auf dem Immel 2
67685 Weilerbach

Zulassungsgegenstand:

MKT Injektionssystem VME zur Verankerung nachträglich eingemörtelter

Bewehrungsanschlüsse

MKT Injection System VME for post-installed rebar connections

The above-named construction product is hereby granted *allgemeine bauaufsichtliche Zulassung* ('national technical approval').

This *allgemeine bauaufsichtliche Zulassung* ('national technical approval') comprises seven pages and twelve annexes.

English translation prepared by DIBt – Original version in German language

DIBt

I GENERAL CONDITIONS

- 1 The *allgemeine bauaufsichtliche Zulassung* ('national technical approval') verifies the usability and applicability of the construction product in accordance with the *Landesbauordnungen* ('building regulations of the German Laenders').
- 2 The *allgemeine bauaufsichtliche Zulassung* ('national technical approval') does not replace the legally prescribed authorisations, approvals and certifications for carrying out construction projects.
- 3 The *allgemeine bauaufsichtliche Zulassung* ('national technical approval') is granted without prejudice to the rights of third parties, particularly private intellectual property rights.
- 4 Manufacturers and distributors for the construction project must, without prejudice to additional regulations in the "Special conditions", provide the user of the construction product with copies of the *allgemeine bauaufsichtliche Zulassung* ('national technical approval') and indicate that this *allgemeine bauaufsichtliche Zulassung* ('national technical approval') shall be present at the site of use. The public authorities concerned shall be provided with copies of the *allgemeine bauaufsichtliche Zulassung* ('national technical approval') upon request.
- 5 The *allgemeine bauaufsichtliche Zulassung* ('national technical approval') may only be duplicated in its entirety. Publication of extracts requires the approval of the Deutsches Institut für Bautechnik. Text and drawings in advertising materials shall not contradict the *allgemeine bauaufsichtliche Zulassung* ('national technical approval'). Translations of the *allgemeine bauaufsichtliche Zulassung* ('national technical approval') shall contain the note "This translation of the German original document has not been verified by the Deutsches Institut für Bautechnik".
- 6 The *allgemeine bauaufsichtliche Zulassung* ('national technical approval') may be withdrawn. The provisions of the *allgemeine bauaufsichtliche Zulassung* ('national technical approval') can be subsequently supplemented and amended, particularly where this is necessitated by new technical findings.

II SPECIAL CONDITIONS

1 Construction product and area of application

1.1 Construction product

The subject of this approval is the application of the post-installed rebar connection with the MKT Injection System VME according to European Technical Approval ETA-07/0299.

1.2 Area of application

The rebar connection may be used in normal weight concrete with a minimum grade of C12/15 and maximum grade of C50/60 according to DIN EN 206-1:2001-7; it may also be used in concrete with a minimum grade of B 15 and maximum grade of B 55 according to DIN 1045:1988-07.

The rebar connection may be used in non-carbonated concrete with a permissible chloride content of 0.40% (CL 0.40) in relation to the cement content, according to EN 206-1.

Rebar connections with reinforcing bars BSt 500 S may be used for primarily static and primarily non-static loads. Rebar connections with tension anchor ZA may only be used for primarily static loads.

This adhesive may be used for fastenings where fire resistance requirements apply.

Rebar connections may only be carried out in a manner, which is also possible with cast-in straight reinforcing bars, e.g. those in the following applications (see Annex 2).

- an overlap joint with existing reinforcement in a building component (Fig. 1 and 2),
- anchoring of the reinforcement for the support of slabs or beams (e.g. according to Fig. 3: end support of a slab, designed simply supported, as well as an appropriate general reinforcement for restraint forces),
- anchoring of reinforcement of building components stressed primarily in compression (Fig. 4),
- anchoring of reinforcement to cover the envelope line of tensile force in the bending member (Fig. 5).

The post-installed rebar connections may be used within a temperature range of -40°C to $+80^{\circ}\text{C}$ (maximum short-term temperature $+80^{\circ}\text{C}$ and maximum long-term temperature $+50^{\circ}\text{C}$).

The approval covers anchoring in drilled holes made with hammer drilling, compressed air or diamond drilling.

The post-installed rebar connection may be installed into dry or wet concrete but not in flooded drilled holes.

2 Conditions for the construction product

2.1 Properties and composition

The MKT Injection System VME shall conform to ETA-07/0299.

The rebars to be bonded-in consist of BSt 500 S and shall conform to DIN 488-1:1984-09. BSt 500 rebars with *allgemeine bauaufsichtliche Zulassung* ('national technical approval') may also be used.

MKT Tension Anchors ZA in sizes M12, M16 and M20 conforming to ETA-07/0299 may also be used.

2.2 Packaging, storage and labelling

Packaging, storage and labelling of the MKT Injection System VME shall conform to ETA-07/0299.

3 Conditions for design and dimensioning

3.1 Drafting

Rebar connections should be designed in keeping with good engineering practice. Design calculations and drawings shall be prepared that take into consideration the verifiable loads to be anchored.

The design of connections with BSt 500 rebar or Tension Anchors ZA should be based upon DIN 1045-1:2001-07 according to section 3.2 of this *allgemeine bauaufsichtliche Zulassung* ('national technical approval').

Fire protection requirements should be considered in the design according to section 3.2.9. In addition, the nature, arrangement and attachment of any required fire protection cladding should be specified according to section 3.2.9.

3.2 Design according to DIN 1045-1:2001-07

3.2.1 General

The actual position of the reinforcement in the existing structure shall be determined based upon the construction documentation and taken into account when designing.

The design of post-installed rebar connections according to Annex 1 and determination of the internal section forces to be transferred in the construction joint shall be verified in accordance with DIN 1045-1:2001-07. When determining the tensile force in the rebar, the statically effective height of the bonded-in reinforcement should be considered.

For components with fire-protection requirements section 3.2.9 shall be observed.

The verification of the immediate local force transfer into the concrete has been provided. Transfer of the loads to be anchored to the component shall be provided.

3.2.2 Determination of the basic anchoring length

The basic anchoring length ℓ_b shall be determined according to DIN 1045-1:2001-07, section 12.6.2:

$$\ell_b = (d_s / 4) \cdot (f_{yd} / f_{bd})$$

with: d_s = Diameter of the rebar

f_{yd} = Design value of the yield strength of the rebar

f_{bd} = Design value of the bond strength according to ETA-07/0299 based on the coefficient for the quality of the bond conditions and the coefficient for the bar diameter, as well as the drilling method

3.2.3 Determination of the required anchorage length

The required design anchorage length $\ell_{b,net}$ shall be determined in accordance with DIN 1045-1:2001-07, section 12.6.2:

$$\ell_{b,net} = \alpha_a \cdot \ell_b \cdot (A_{s,erf} / A_{s,vorh}) \geq \ell_{b,min}$$

with: ℓ_b = according to section 3.2.2

α_a = Coefficient for the effectiveness of the specific kind of anchorage according to DIN 1045-1:2001-07, Table 26

$A_{s,erf}$ = calculated required cross-sectional area of the reinforcement

$A_{s,vorh}$ = existing cross-sectional area of the reinforcement

$\ell_{b,min}$ = minimum anchorage length according to DIN 1045-1:2001-07 and ETA-07/0299

= $\max \{0.3 \cdot \alpha_a \cdot \ell_b; 10d_s; 100 \text{ mm}\}$ under tension

$$= \max \{0.6 \cdot l_b; 10d_s; 100 \text{ mm}\} \text{ under tension}$$

In the case of diamond wet drilling, multiply the results by 1.5.

The maximum permissible embedment depth is specified in ETA-07/0299.

3.2.4 Overlap joints

The required design lap length l_s shall be determined according to DIN 1045-1:2001-07, section 12.8.2:

$$l_s = \alpha_1 \cdot l_{b,net} \geq l_{s,min}$$

with: $l_{b,net}$ = according to section 3.2.3

α_1 = coefficient for the lap length according to DIN 1045-1:2001-07, Table 27

$l_{s,min}$ = minimum lap length according to EN 1992-1-1 and ETA-07/0299
 $= \max \{0.3 \cdot \alpha_a \cdot \alpha_1 \cdot l_b; 15d_s; 200 \text{ mm}\}$

In the case of diamond wet drilling, multiply the results by 1.5.

3.2.5 Embedment depth for overlap joints

When calculating the effective embedment depth of overlap joints, the concrete cover on the front side of the existing rebar shall be considered:

$$l_v \geq l_s + c$$

with: l_s = required lap length according to section 3.2.4

c = concrete coverage on the front side of the existing rebar

If the clear distance between the overlapping rebars is greater than $4 d_s$, the lap length shall be extended by the difference between the existing clear distance and $4 d_s$.

The maximum permissible embedment depth is specified in ETA-07/0299.

3.2.6 Concrete cover

The required concrete cover for the bonded-in rebars, according to ETA-07/0299, shall be observed.

The minimum concrete cover according to DIN 1045-1:2001-07, Section 6.3, Table 4, shall also be observed.

3.2.7 Transverse reinforcement

The required transverse reinforcement in the area of the post-installed rebar connection shall comply with DIN 1045-1:2001-07, Section 12.8.3.

3.2.8 Connecting joint

The transfer of shear forces between new concrete and existing structure shall be designed according to DIN 1045-1:2001-07. The joints in contact with the new concrete shall be roughened to at least such an extent that aggregate protrudes.

In case of carbonated surface of the existing concrete structure, the carbonated layer shall be removed in the area of the post-installed rebar connection with a diameter of $d_s + 6 \text{ cm}$ before the installation of the new rebar.

The depth of concrete to be removed shall correspond to at least the minimum concrete cover for the respective environmental conditions according to DIN 1045-1:2001-07.

This does not apply in the case of new, non-carbonated components and components in a dry environment.

3.2.9 Fire protection

Where fire-protection requirements apply, reinforcement connections shall also be verified in flat components (ceilings and walls) according to Annex 3 through 8.

Under fire exposure, the loads from rebar connections positioned perpendicular to the component surface with fire exposure, shall not exceed the values specified in Annex 3 through 5.

The maximum rebar loads for the thread of the tension anchor ZA are specified depending on the fire-resistance duration in Annex 8.

Annex 6 and 7 specify the bond stresses depending on the concrete cover for classification in fire resistance ratings for rebar connections, which are positioned parallel to the component surface with fire exposure. The required embedment depth shall be determined according to the specifications in Annex 5. The calculated anchorage or lap length shall be designed at a maximum of $80 d_s$. The maximum embedment depth specified in ETA-07/0299 shall be observed. With concrete cover above 50 mm, a protective reinforcement should be designed according to DIN 4102-4:1994-03, Section 3.1.5.2.

The fire protection requirements may also be fulfilled via plaster coverings according to DIN 4102-4:1994-03 or via other coverings, if their suitability is confirmed by a national technical test certificate (e.g. mineral fibre insulation board of building material class A with a melting point of $\geq 1000^\circ\text{C}$ and an unfinished density of $\geq 150 \text{ kg/m}^3$ as well as calcium silicate or vermiculite boards). For the coverings described above, 2 cm concrete cover can be replaced by 1 cm thickness covering. The fastenings for the covering shall also meet fire protection requirements, which shall be verified separately.

4 Conditions for implementation

4.1 General

The company contracted to install the rebar connection shall have

- a qualified manager,
- a responsible construction manager,
- expert construction site personnel who are specially trained for installing the rebar connection and
- the necessary equipment

according to Annex 10 through 12 "Requirements for the company installing post-installed rebar connections" and shall also have a valid suitability certificate for this type of work.

Training of the construction site personnel shall be provided by the originator under the supervision of a body appointed by the Deutsches Institut für Bautechnik.

Should this body determine that the training has been successfully completed, it will issue the construction site personnel with a certificate as evidence of suitability for the installation of the rebar connection with the MKT Injection System VME.

Should this body determine that the requirements specified in Annex 10 through 12 for the company for installing the post-installed rebar connections are fulfilled, it will issue a suitability certificate for this. The suitability certificate will be issued for three years and may be revoked. Upon request, the validity period of the suitability certificate can be extended for three years at a time. Before each extension, it shall be demonstrated to the testing body that the requirements for the company installing the post-installed rebar connections have been observed. The responsible manager of the company shall indicate to the testing body any change of responsible expert personnel.

The rebar connection shall be installed according to the construction drawings as well as the installation instructions of the originator. When creating drilled holes, cleaning and injecting the adhesive, only devices that are intended for that purpose shall be used.

For each rebar connection, an installation report shall be prepared according to the requirements of Annex 9.

4.2 Controlling the concrete member

Before drilling the hole, the concrete strength class should be determined. The concrete strength class shall not be below the strength classes specified in the construction drawings according to 3.1 or above C50/60 or B 55.

If the position of the existing rebars is not apparent, this shall be determined using appropriate reinforcement detection equipment based upon the construction documentation and marked on the component for the overlap joint.

For installing the bonded-in rebars, the component temperature shall not be below +5°C or above +40°C.

4.3 Installation

The anchorages (drilling, cleaning of the drilled hole, preparation of the rebar, injection of the adhesive and installing the rebar) should be performed according to the manufacturers installation instruction given in ETA-07/0299.

4.4 Control of installation

Installation should be controlled according to Annex 9, Table 6. When installing the rebar connections, a construction manager of the contracted company or its expert representative shall be present on the construction site. This person shall ensure proper implementation of the work and document the controlling (installation report). The records shall be present at the construction site throughout the construction project and should be presented to those responsible for controlling upon request. Like the delivery notes, these shall also be retained by the company for 5 years after completion of the work.

Referatsleiter
Kummerow

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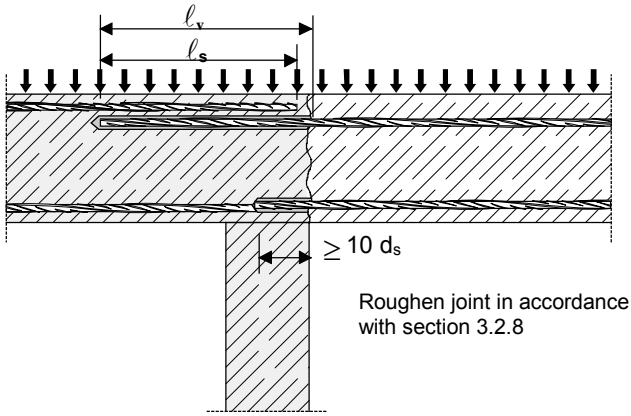


Figure 1: Overlap joint in slabs and beams

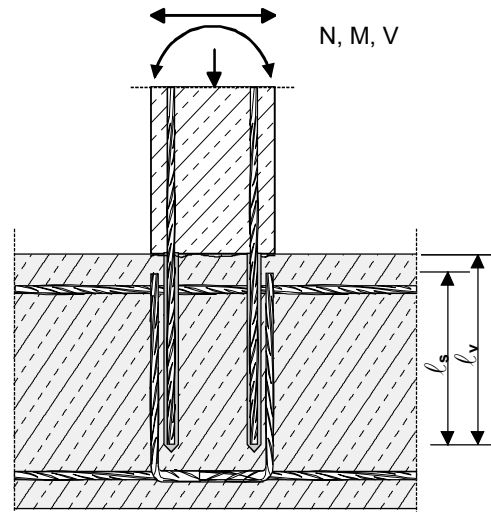


Figure 2: Overlap joint in foundation of a column or wall where the rebar are stressed in tension

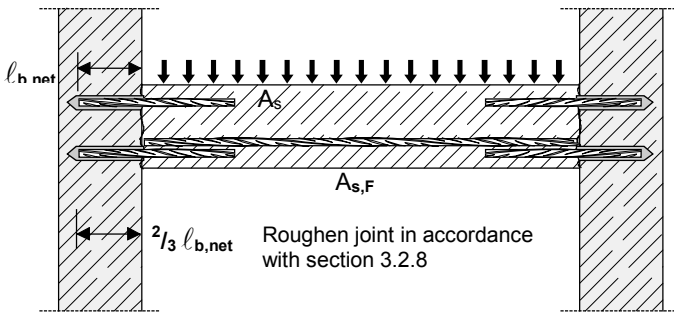


Figure 3: End anchoring of slabs or beams, designed as simply supported.

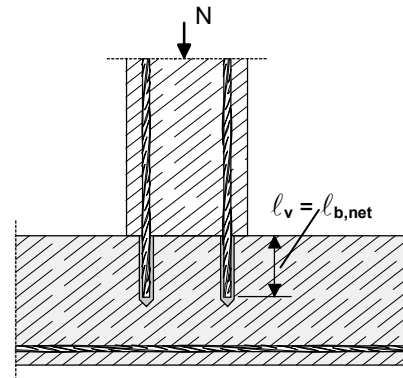


Figure 4: Rebar connection of components stressed primarily in compression. The rebar are stressed in compression.

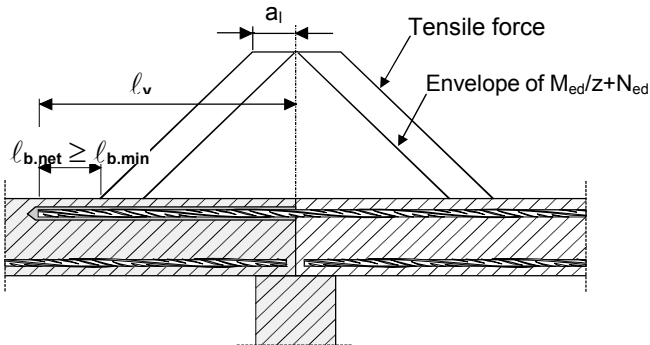


Figure 5: Anchoring of reinforcement to cover the line of acting tensile force

Comments on figures 1 to 5:

The images do not show any transverse reinforcement. The transverse reinforcement required in DIN 1045-1 shall be present. The transverse load transfer between old and new concrete shall be demonstrated in accordance with DIN 1045-1.

Components of the attachment:

- Normal weight concrete C12/15 – C50/60 according to DIN EN 206-1:2001-07
- Normal weight concrete B15 – B55 in accordance with DIN 1045:1988-07
- Rebar BSt 500 S, $d_s = 8 - 28$ mm, in accordance with DIN 488 or pursuant to national technical approval
- MKT Injection Adhesive VME in accordance with ETA-07/0299

MKT Injection System VME

Application examples of post-installed rebar

Annex 1

of "Allgemeine bauaufsichtliche Zulassung"

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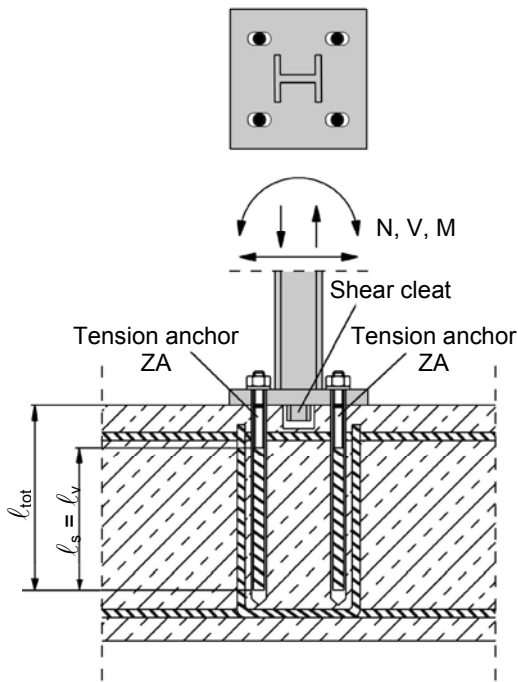


Figure 6: Overlap joint at the foundations of columns

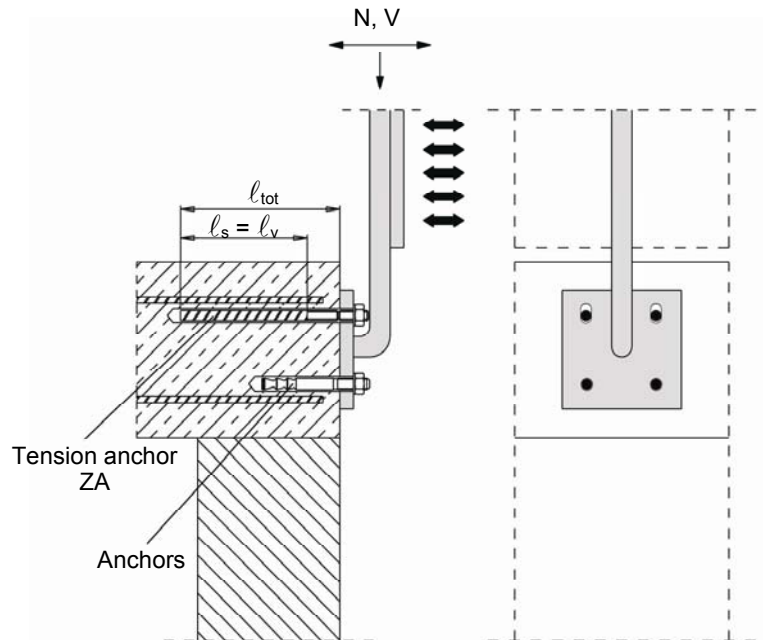


Figure 7: Overlap joint for anchoring guardrail posts

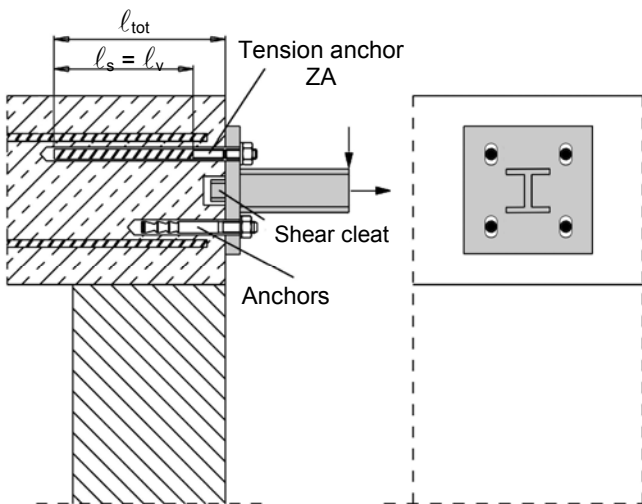


Figure 8: Overlap joint for anchoring Cantilevered beams

Components of the attachment:

- normal weight concrete C12/15 – C50/60 acc. to DIN EN 206-1:2001-07
- normal weight concrete B15 – B55 in accordance to DIN 1045:1988-07
- MKT Tension Anchor ZA M12, M16, M20
- MKT Injection Adhesive VME in accordance with ETA-07/0299

Comments on figures 6 to 8:

The transverse reinforcement required in DIN 1045-1 is not shown.

The MKT Tension Anchor ZA may transfer only forces in direction of the rebar axis.

The tensile force shall be transferred by an overlap joint into cast in place reinforcement of the member. The transmission of shear forces shall be ensured by additional measures, e.g. shear cleats or anchors with a European technical approval (ETA). Holes in the anchor plate for the tension anchors should be designed as slotted holes in the direction of the shear force.

MKT Injection System VME

Application examples of MKT Tension Anchor ZA

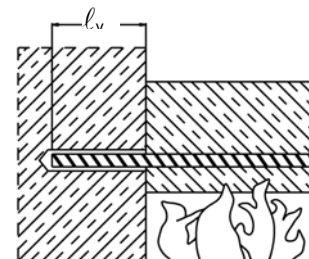
Annex 2

of "Allgemeine bauaufsichtliche Zulassung"

Z-21.8-1872

of 15-07-2008

Table 1a: Maximum rebar load $F_{s,T}$ for proof in accordance with section 3.2.9 for classification in fire resistance ratings; rebar connection perpendicular to the component surface with the fire exposure in slabs and walls



Rebar diameter	Max. adm. rebar load	Setting depth	Fire-resistance rating				
			F 30	F60	F90	F120	F180
d_s	max $F_{s,T}$	l_v	$F_{s,T}$				
mm	kN	in cm	kN	kN	kN	kN	kN
8	16,2	8,0	1,7	0,5	0,1	0	0
		12,0	7,5	2,3	1,1	0,6	0,1
		17,0	16,2	9,1	5,3	3,1	1,1
		21,5		16,2	13,2	9,9	3,7
		23,5			16,2	13,4	6,5
		25,5				16,2	10
		29,5					16,2
10	25,3	10,0	5,0	1,5	0,6	0,2	0
		15,0	16,0	6,9	3,6	2,2	0,7
		19,5	25,3	16,9	12,1	7,9	2,7
		23,5		25,3	20,9	16,7	8,1
		26,0			25,3	22,2	13,6
		27,5				25,3	16,9
		31,5					25,3
12	36,4	12,0	11,3	3,5	1,6	0,9	0,2
		18,0	27,2	16,3	10,6	6,2	2,2
		22,0	36,4	26,8	21,1	16,1	6,4
		26,0		36,4	31,7	26,7	16,4
		28,0			36,4	31,9	21,6
		30,0				36,4	26,9
		34,0					36,4
14	49,6	14,0	19,4	7,3	3,7	2,2	0,7
		20,0	37,8	25,1	18,5	12,6	4,4
		24,0	49,6	37,4	30,8	25,0	12,9
		28,0		49,6	43,1	37,3	25,2
		30,5			49,6	45,0	32,9
		32,5				49,6	39,1
		36,0					49,6

Comments: Intermediate values may be linearly interpolated. Extrapolation is not permitted. The setting depth should be dimensioned in accordance with section 3.2.2. Designing in accordance with DIN 1045-1:2001-07

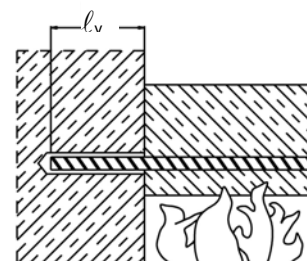
MKT Injection System VME

Annex 3

of "Allgemeine bauaufsichtliche Zulassung" **Z-21.8-1872** of 15-07-2008

Fire protection
Proof in accordance with section 3.2.9, rebar connection perpendicular to the component surface with the fire exposure

Table 1b: Maximum rebar load $F_{s,T}$ for proof in accordance with section 3.2.9 for classification in fire resistance ratings; rebar connection perpendicular to the component surface with the fire exposure in slabs and walls



Rebar diameter	Max. adm. rebar load	Setting depth	Fire-resistance rating				
			F 30	F60	F90	F120	F180
d_s	max $F_{s,T}$	l_v	$F_{s,T}$				
mm	kN	in cm	kN	kN	kN	kN	kN
16	64,8	16,0	29,2	14,6	7,9	4,7	1,6
		21,0	46,8	32,2	24,6	18,0	6,5
		26,5	64,8	51,6	44,0	37,3	23,6
		30,5		64,8	58,1	51,4	37,6
		32,5			64,8	58,4	44,7
		34,5				64,8	51,7
		38,5					64,8
20	101,2	20,0	54,0	35,9	26,4	18,1	6,2
		25,0	76,0	57,9	48,4	40,0	22,8
		31,0	101,2	84,3	74,8	66,4	49,2
		35,0		101,2	92,4	84,0	66,8
		37,5			101,2	95,0	77,8
		39,0				101,2	84,4
		43,0					101,2
25	158,1	25,0	95,0	72,4	60,5	50,1	28,6
		30,0	122,5	99,9	88,0	77,5	56,0
		36,5	158,1	135,6	123,7	113,3	91,8
		41,0		158,1	148,4	138,0	116,5
		43,0			158,1	149,0	127,5
		45,0				158,1	138,5
		49,0					158,1
28	198,3	28,0	124,9	99,5	86,2	74,5	50,5
		34,0	161,9	136,5	123,2	111,5	87,4
		40,0	198,3	173,4	160,1	148,4	124,3
		44,5		198,3	187,8	176,1	152,1
		46,5			198,3	188,4	164,4
		48,5				198,3	176,7
		52,5					198,3

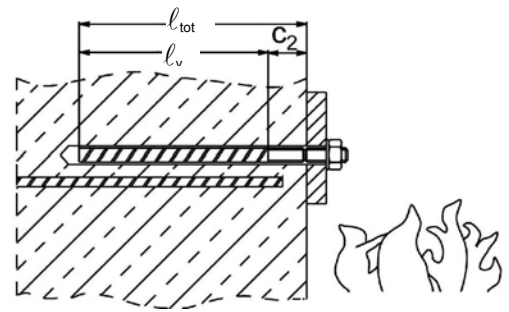
Comments: Intermediate values may be linearly interpolated. Extrapolation is not permitted. The setting depth should be dimensioned in accordance with section 3.2.2. Designing in accordance with DIN 1045-1:2001-07

MKT Injection System VME

Annex 4
of "Allgemeine
bauaufsichtliche Zulassung"
Z-21.8-1872
of 15-07-2008

Fire protection
Proof in accordance with section 3.2.9, rebar connection perpendicular to
the component surface with the fire exposure

Table 2: Maximum rebar load $F_{s,T}$ for proof in accordance with section 3.2.9 for classification in fire resistance ratings; connection with MKT Tension Anchor ZA perpendicular to the component surface with the fire exposure in slabs and walls



Tension anchor	Setting depth	Fire-resistance rating				
		F30	F60	F90	F120	F180
	l_v in cm	$F_{s,T}$				
		kN	kN	kN	kN	kN
ZA M12 $d_s = 12 \text{ mm}$	12,0	9,0	2,9	1,3	0,7	0,1
	14,0	14,2	6,3	2,9	1,7	0,5
	16,0	19,5	11,5	5,0	3,0	1,0
	16,5	20,8	12,0			1,2
	18,5	26,1				2,1
	20,0	30,0				
ZA M16 $d_s = 16 \text{ mm}$	16,0	26,0	15,0	7,5	4,6	1,3
	17,0	29,5			6,0	1,8
	18,0	33,1				2,5
	19,0	36,6				3,4
	20,0	40,0				4,7
ZA M20 $d_s = 20 \text{ mm}$	20,0	50,1	35,0	15,0	10,0	5,7
	21,0	54,5				7,3
	22,5	60,0				

Comments: Intermediate values may be linearly interpolated. Extrapolation is not permitted. The setting depth should be dimensioned in accordance with section 3.2.2.
Designing in accordance with DIN 1045-1:2001-07

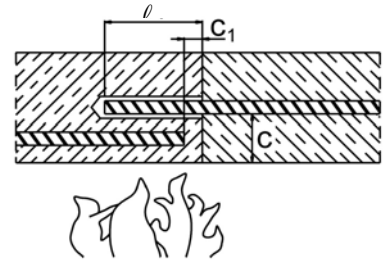
MKT Injection System VME

Fire protection
Proof in accordance with section 3.2.9,
connection with MKT Tension Anchor ZA
perpendicular to the component surface
with the fire exposure

Annex 5

of "Allgemeine
bauaufsichtliche Zulassung"
Z-21.8-1872
of 15-07-2008

Table 3: Maximum bond stress τ_T depending on existing concrete coverage for classification in fire resistance ratings; Rebar connection parallel to the component surface with the fire exposure in slabs and walls



Fire-resistance rating					Concrete cover for bonded-in reinforcement c
F30	F60	F90	F120	F180	
Maximum bond stress τ_T					mm
N/mm ²	N/mm ²	N/mm ²	N/mm ²	N/mm ²	
0,32					30
0,40	0				35
0,50					40
0,62		0			45
0,79	0,31				50
0,95	0,37		0		55
1,16	0,44				60
1,50	0,53			0	65
2,20	0,65	0,32			70
	0,78	0,36			75
	0,94	0,42			80
	1,06	0,49	0,30		85
	1,20	0,58	0,36		90
	1,40	0,68	0,41		95
	2,20	0,82	0,48		100
		0,94	0,57		105
		1,09	0,68	0,30	110
		1,28	0,80	0,33	115
		2,20	0,94	0,38	120
			1,08	0,43	125
			1,25	0,50	130
			1,47	0,55	135
			2,20	0,60	140
				0,67	145
				0,71	150
				0,80	155
				0,89	160
				1,02	165
				1,19	170
				1,40	175
				1,67	180
				2,20	185

It shall be shown, that the existing rebar load $F_{s,T}$ under fire exposure in the rebar connection can be transferred with the selected length l_v :

$$F_{s,T} \leq (l_v - c_1) \cdot d_s \cdot \pi \cdot \tau_T \text{ with } (l_v - c_1) \geq l_s(l_u) \leq 80 d_s$$

The following meanings apply:

$F_{s,T}$ rebar load under fire exposure

$l_s(l_u)$ lap length of overlap joint acc. to section 3.2.2. or 3.2.3.

d_s nominal diameter of the rebar

$(l_v - c_1)$ selected lap length. This shall be set at a minimum of $l_s(l_u)$, and a maximum of $80d_s$.

τ_T bond stress under fire exposure

MKT Injection System VME

Fire protection
Proof in accordance with section 3.2.9,
rebar connection parallel to the
component surface with the fire exposure

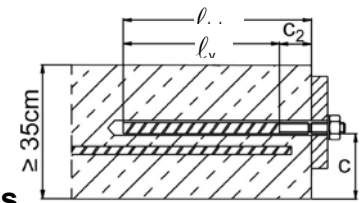
Annex 6

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Table 4: Maximum bond stress τ_T depending on existing concrete coverage for classification in fire resistance ratings; connection of MKT Tension Anchor ZA M12, M16, M20 with the fire exposure from three sides in slabs and walls



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Fire-resistance rating				Concrete coverage for bonded-in reinforcement c
F30	F60	F90	F120	
Maximum bond stress τ_T				mm
N/mm ²	N/mm ²	N/mm ²	N/mm ²	
				10
0				20
				25
0,2	0			30
0,3				35
0,4		0		40
0,5			0	45
0,6				50
0,7	0,3			55
0,9	0,3			60
1,1	0,4			65
1,3	0,5	0,2		70
1,6	0,6	0,3		75
2,0	0,7	0,3		80
2,2	0,8	0,4	0,3	85
	0,9	0,5	0,3	90
	1,1	0,6	0,4	95
	1,4	0,7	0,4	100
	1,6	0,8	0,5	105
	1,9	0,9	0,6	110
	2,2	1,1	0,7	115
		1,3	0,8	120
		1,6	0,9	125
		1,8	1,1	130
		2,2	1,3	135
			1,5	140
			1,8	145
			2,1	150
			2,2	155

The following definitions apply:

- l_{tot} Setting depth
- l_v effective setting depth
- l_s lap length of the overlap joint in accordance with section 3.2.4.
- d_s diameter of the bonded-in tension anchor
- c concrete cover of the bonded-in tension anchor
- c_2 length of the bonded-in thread ≥ 100 mm
- h_{vorh} existing thickness of concrete slab
- $F_{s,T}$ rebar load under fire exposure
- τ_T bond stress under fire exposure

It shall be shown that the existing rebar load $F_{s,T}$ under fire exposure in the rebar connection can be transferred with the selected length l_v : $F_{s,T} < l_v \cdot d_s \cdot \pi \cdot \tau_T < F_{s,thread}$ (Annex 8, Table 5) with $l_s < l_v < 80 d_s$

The data in Annex 7, Table 4 apply for concrete with a thickness of concrete slab of $h_{vorh} > 35$ cm. If the thickness of concrete slab falls below of this minimum thickness by 35 cm – h_{vorh} , this can be compensated by fire protection plates with a total thickness of at least $0.5 \cdot (35 \text{ cm} - h_{vorh})$.

MKT Injection System VME

Fire protection proof in accordance with section 3.2.9, connection with MKT Tension Anchor ZA with the fire exposure from three sides

Annex 7

of "Allgemeine bauaufsichtliche Zulassung" **Z-21.8-1872** of 15-07-2008

Table 5: Maximum rebar load $F_{s,thread}$ depending on fire-resistance rating

Tension anchor	Fire-resistance rating				
	F30	F60	F90	F120	F180
	kN	kN	kN	kN	kN
ZA M12	30	12	5,0	3,0	2,1
ZA M16	40	15	7,5	6,0	4,7
ZA M20	60	35	15,0	10,0	7,3

MKT Injection System VME

Fire protection
max. rebar load $F_{s, thread}$

Annex 8
of "Allgemeine
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Table 6: Control of installation

No.	Item to check	Type of check	Requirements	Frequency, time
Concrete				
1	concrete concrete strength	visual inspection from construction documentation	suitability for planned works in accordance with specifications of the structural engineer	before beginning of work every component, before beginning of work
2	existing reinforcement	checking the location and distances	no reinforcement hits during drilling; Mark existing reinforcement on concrete surface.	every component, before beginning of work
Base materials				
3	adhesive cartridge VME	packaging imprint visual inspection storage conditions	Expiration date not passed no noticeable changes installation instructions of the manufacturer	each delivery continuous during storage and removal
4	processing equipment	function controls	correct functioning	during beginning and daily
5	work plan	instructions for manufacturing and processing	adherence to work instructions	before beginning of work
Processing				
6	weather	temperature protection of the drilled hole from water entry	adherence to work instructions no water in the drilled hole	3 times per working day before injecting the drilled hole
7	creating the drilled hole	Overlap, edge distances	adherence to work instructions	every drilled hole
8	cleaning the drilled hole	visual inspection and blow-out check	dust-free, clean, rough surface; not wet (glossy)	every drilled hole before injecting
9	rebar or MKT Tension Anchor ZA	condition marking clearance in drilled hole	only surface rust setting depth marked no rebar interference with drilled hole	every rebar before injecting the drilled hole
10	safety at work	personal protection equipment	suitable protective clothing, protective gloves and protective goggles / face protection should be worn	always when working with the injection adhesive
11	injection	filling marking on the mixer extension without hollow spaces	mark length in accordance with equation 1 (ETA-07/0299) no spring back of the rebar, no adhesive splash	every rebar during setting
12	bonded-in rebar connections	setting depth injection	Setting mark at the drilled hole mouth adhesive visible at the drilled hole mouth	every rebar after setting

MKT Injection System VME

Control of installation

Annex 9

of "Allgemeine bauaufsichtliche Zulassung"

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Requirements for the company installing post-installed rebar connections and MKT Tension Anchors ZA

1 General

Rebar connections with post-installed rebar or MKT Tension Anchors ZA shall be installed, monitored and checked by companies with a qualified manager, a construction manager and expert construction site personnel who are specially trained for making the rebar connection and have a valid certification for this type of work.

Training of the expert construction site personnel shall be provided by the originator supervised by a body appointed by the Deutsches Institut für Bautechnik.

Should this body determine that the requirements specified for the company in Section 4.1 are fulfilled, it will issue a suitability certificate for this. The suitability certificate will be issued for three years and may be revoked. Upon request, the validity period of the suitability certificate can be extended for three years at a time. Before each extension, it shall be demonstrated to this body that the requirements for the company have been observed. The responsible operations manager shall indicate to the body any change of responsible personnel. Should this body determine that the training has been successfully completed in accordance with section 4.1, it will issue the construction site personnel with a certificate as evidence of suitability for the installing of rebar connections with post-installed rebar or MKT Tension Anchors ZA.

2 Requirements of the personnel and equipment of the company

2.1 Qualified manager

The company shall have a qualified manager with adequate knowledge of reinforced concrete construction and experience in the installation of rebar connections with post-installed rebar or MKT Tension Anchors ZA. This person shall at least be qualified to work independently doing reinforced concrete work and the management of a company in this field.

The responsibilities of the qualified manager include:

- Assess construction drawings with regard to completeness of specifications for post-installed rebar or MKT Tension Anchors ZA
- Compiling and checking performance specifications and evaluating the feasibility of the rebar connections
- Compiling work plans
- Assess the specialist qualification of the expert construction site personnel employed.
- Signing off the installation report and evaluating the results.

2.2 Construction manager

For work in accordance with this approval, the construction manager or expert representative of the construction manager shall monitor the construction site to ensure that the rebar connections with post-installed rebar or MKT Tension Anchors ZA are installed in accordance with the conditions of this national technical approval.

MKT Injection System VME

Requirements for the company installing rebar connections with post-installed rebar and MKT Tension Anchors ZA

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2.3 Expert construction site personnel

The works on the construction site shall be carried out by a trained and, in particular, technically qualified person, with knowledge, skills and practical experience of concrete technology and other material technologies. Capability to perform the works shall be demonstrated by appropriate certification in accordance with section 3.

The responsibilities of the construction site personnel include:

- Practical performance of drilling, cleaning, injecting and fixing work in accordance with verified construction documentation. In case of deviations, the construction manager shall be informed.
- Defining, instructing and monitoring the work transferred to other construction site personnel and carried out in his/her presence.
- Maintaining the installation report.

2.4 Equipment

For the installation of rebar connections with post-installed rebar and MKT Tension Anchors ZA, equipment and devices shall be present on the site and maintained in accordance with the manufacturer's installation instructions to facilitate professional performance of this works. All devices and equipment should be inspected on the construction site before beginning first use and, thereafter, at appropriate intervals for trouble-free function.

The devices and equipment include

- Devices for accurate performance of the drilling (drilling aids), drilling stands for diamond core drills
- Devices for cleaning the drilled holes,
- Equipment for proper storage of the injection adhesive at the correct temperature,
- Fully functional dispenser and mixer extensions,
- Compressor for oil-free compressed air of at least 6 bar.

3 Training of expert construction site personnel

The company shall ensure that the expert construction site personnel employed for installing the rebar connection with post-installed rebar are trained and have valid certification.

The suitability certificate for the expert construction site personnel includes the following work:

1. Implementation of a complete overlap joint near to the edge $d_s = 12 \text{ mm}$, $\ell_v = 1.15 \text{ m}$ in reinforced concrete according to construction drawings with an installation report:
 - Locate and mark anchoring base and existing reinforcement and mark
 - Drill hole using drilling aid
 - Clean the drilled hole in accordance with this approval
 - Injection using manually or pneumatically operated dispenser
 - Insert the rebar
 - Final control and self-assessment
2. Installing of a rebar $d_s = 12 \text{ mm}$ in a covered, transparent inspection tube with $\ell_v = 60 \text{ cm}$

The required time for the injection of the adhesive and insertion of the rebar should be measured each time.

MKT Injection System VME

Requirements for the company installing rebar connections with post-installed rebar and MKT Tension Anchors ZA

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3.2 Evaluation of the works

The testing body will evaluate the work using the following questions:

- Is there a sufficient understanding of the work to be implemented before work starts?
- Does the equipment used conform to the regulatory requirements and is this equipment handled safely?
- Has the anchoring base been inspected?
- Is the drilled hole set in the correct position?
- Where holes are drilled near to the edge, is the drilling aid handled safely?
- Does the angular deviation during drilling conform to the permissible tolerances?
- Are drilled holes cleaned in accordance with the installation instructions?
- Is the embedment length of the rebar correctly marked and the free movement in the drilled hole checked?
- Have the cartridges been inspected for storage temperature and expiration date?
- Have the cartridges been correctly opened and prepared for the cartridge change?
- Is the dispenser handled in accordance with the installation instructions? Is the filling mark correctly marked on the mixer extension?
- Is the marked rebar or MKT Tension Anchor ZA located close at hand before injection starts?
- Are the first two strokes of a new cartridge (or 10 cm of adhesive) being discarded?
- Does the injection of the adhesive conform to the specifications of the installation instructions for a complete filling without voids?
- Is the rebar or MKT Tension Anchor ZA properly set up to the marking of the embedment depth?
- Does adhesive exit from the drill hole mouth?
- Is the maximum working time from the start of the injection to the setting of the rebar or MKT Tension Anchor ZA adhered to?
- Are defects identified and rectified professionally during or after installing of the rebar?
- Is the installation report maintained completely and accurately?

MKT Injection System VME

Requirements for the company installing rebar connections with post-installed rebar and MKT Tension Anchors ZA

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