

Expert Opinion

– Translation –

Document number: (2104/017/22) – CM dated 10/11/2022

Client: MKT GmbH & Co. KG
Auf dem Immel 2
67685 Weilerbach

Order date: 14/10/2022

Order ref.: Order no. 856/22

Order received: 14/10/2022

Subject: Fire safety assessment of loaded BZ plus A4 / HCR wedge anchors installed in solid structural elements under one-side exposure to fire along the tunnel-furnace curve according to ZTV-ING Part 7 (Section 10.2, clause (1))

Basis for assessment: See Section 1

This expert opinion comprises 5 pages including cover sheet and 3 annexes



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1 General

With letter of 14/10/2022, MKT GmbH & Co. KG, 67685 Weilerbach, ordered the preparation of an Expert Opinion on BZ plus A4 / HCR wedge anchors combined with solid structural elements (reinforced concrete) when exposed to fire.

The following documents serve as basis for the Expert Opinion of the constructions to be assessed:

- [1] DIN 4102-2 : 1977-09, Fire Behaviour of Building Materials and Building Components: Building Components; Definitions, Requirements and Tests,
- [2] ZTV-ING Part 7, Issue 2022/01,
- [3] Test report no. 2102/400/19 dated 13/10/2020 issued by MPA Braunschweig,
- [4] Letter dated 28/09/2022 issued by MKT GmbH & Co. KG, 67685 Weilerbach,
- [5] BZ plus A4 / HCR wedge anchor, ETA-99/0010 dated 23/07/2018 issued by DIBt, Berlin

The BZ plus A4 / HCR wedge anchors are assessed on the basis of the fire tests carried out with the anchors installed in solid structural elements (reinforced concrete grounds) in accordance with ZTV-ING Part 7. Currently, the existing technical directives and specifications, which regulate above all mechanical fasteners for cracked concrete combined with reinforced concrete elements when exposed to fire, provide no complete concept for assessment for these fastening systems combined with reinforced concrete grounds in accordance with ZTV-ING Part 7. According to MKT GmbH & Co. KG, 67685 Weilerbach, there is currently no complete construction supervisory authority certificate for BZ plus A4 / HCR wedge anchors combined with reinforced concrete that lays down the regulations to be met by the execution described here in the event of fire in accordance with ZTV-ING Part 7.

2 Description of the constructions

The BZ plus A4 / HCR wedge anchor is an anchor made of stainless or high corrosion-resistant steel that is installed in a drill hole and anchored by force control. The loads applied are transferred into the anchoring base via the anchor.

For the normal purpose of use, the related technical specifications for BZ plus A4 / HCR wedge anchors can be taken from [5].

The fire-safety-related assessment is limited to mainly static (dead) loads combined with solid structural elements, which must also have been proven for a fire load along tunnel-furnace curve according to ZTV-ING Part 7 (Section 10.2, clause (1)).

The following table and the annexes summarize the design data (from the manufacturer [5]) for BZ plus A4 / HCR wedge anchors. Further information on the wedge anchor can be taken from [5] from MKT GmbH & Co. KG, 67685 Weilerbach.

Table 1: BZ plus A4 / HCR wedge anchors

Wedge anchors BZ plus A4 / HCR	Dimension	Minimum embedment depth $h_{ef\ min}$ [mm]	Material
BZ plus A4 wedge anchor with nut and washer	M8	35	Stainless steel (material no. 1.4401)
	M10	40	
	M12	50	
	M16	65	
BZ plus A4 wedge anchor with nut and washer	M8	45	High corrosion-resistant steel (material no. 1.4529)
	M10	45	
	M12	50	
	M16	65	

For a more detailed description of the construction, reference is made to the annexes and [5] for BZ plus A4 / HCR wedge anchors.

3 Assessment of the wedge anchors combined with solid structural elements

The subject matter of this fire-safety-related assessment is the load-bearing behaviour of BZ plus A4 / HCR wedge anchors combined with reinforced concrete grounds (strength class $\geq C20/25 \leq C50/60$) when exposed to fire along the tunnel-furnace curve according to ZTV-ING Part 7 (Section 10.2, clause (1)).

If smaller loads apply for the normal purpose of use according to [5], these shall be binding. The suitability of the anchors must be certified – independently of the fire-safety-related assessment – for the ground and application, also for the cold as-installed state.

With regard to the load-bearing capacity under exposure to fire, steel failure and ground failure can be distinguished.

For the anchors assessed here, the failure of BZ plus A4 / HCR wedge anchors (steel failure) was decisive. In terms of fire safety, it may be assumed with sufficient reliability that a failure of the ground examined here will not be decisive in case of fire.

The centre distance to be applied for the BZ plus A4 / HCR wedge anchors under one-side exposure to fire is the distance ($a \geq 5h_{ef \min}$ according to Table 1; however, at least 250 mm) that excludes a failure of the ground, which means the steel failure of the fastening system will be decisive. Moreover, the centre distances must comply at least with the distances required for the cold as-installed state (see also [5]). Further parameters (geometry, moisture, formwork spalling, eccentricity, position in the structural element, and other influencing variables) must be considered separately, if required.

The load-bearing capacity (steel failure) under exposure to fire of the systems described above was determined on the basis of the fire tests conducted in solid structural elements (reinforced concrete).

$F_{ZTV\text{-fire}}$ \Rightarrow Maximum load under one-side exposure to fire along the tunnel-furnace curve according to ZTV-ING Part 7 (Section 10.2, clause (1))

The load on the anchors can be applied as centric tensile load (N), shear load (V) or as a combination of both (oblique tension).


The design proposals for BZ plus A4 / HCR wedge anchors under tensile load and exposure to fire on one side along the tunnel-furnace curve according to ZTV-ING Part 7 (Section 10.2, clause (1)) can be taken from Annexes 2 and 3.

4 Special notes


4.1 This Expert Opinion applies only with regard to fire safety. Further requirements may arise from the technical building regulations and the respective State Building Code, or the regulations for special constructions – for example, with regard to structural physics, statics, electrical engineering, ventilation engineering, or similar.

- 4.2 This Expert Opinion is no certificate of suitability for use in the building control procedure. The furnishing of a related proof is up to the manufacturer/constructor of the construction.
- 4.3 The assessment above applies only for BZ plus A4 / HCR wedge anchors combined with solid structural elements under exposure to fire on one side along the tunnel-furnace curve according to ZTV-ING Part 7. The ground/anchoring base must have a fire resistance for a fire load along the tunnel-furnace curve according to ZTV-ING Part 7 (Section 10.2, clause (1)).
- 4.4 The validity of this Expert Opinion ends on 12/11/2025.
- 4.5 The validity of this Expert Opinion can be extended upon request and as a function of the state of the art.

*This document is the translated version of Expert Opinion No. 2104/017/22 – CM dated 10/11/2022 .
The legally binding text is the aforementioned German Expert Opinion.*


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Technical data of the wedge anchor

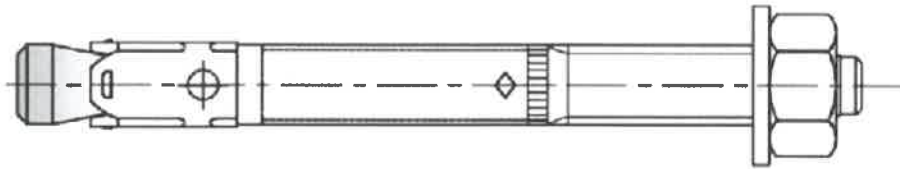


Table 2: Material data¹⁾

Execution		Material
BZ plus A4	M8 M10 M12 M16	Stainless steel (material no. 1.4401), elongation at fracture $A_5 \geq 8\%$
BZ plus HCR		High corrosion-resistant steel (material no. 1.4529), elongation at fracture $A_5 \geq 8\%$

Table 3: Characteristics for installation of the wedge anchors¹⁾

Wedge anchor			Reinforced concrete (strength class $\geq C20/25 \leq C50/60$) ²⁾					
Size			M8 A4	-	M10 A4	-	M12 A4	M16 A4
			-	M8 HCR	-	M10 HCR	M12 HCR	M16 HCR
Drilling diameter	d_0	[mm]	8	8	10	10	12	16
Drill hole depth	$h_1 \geq$	[mm]	60	60	75	75	90	110
Effective embedment depth	$h_{nef} \geq$	[mm]	46	46	60	60	70	85
Installation torque	T_{inst}	[Nm]	20	20	35	35	50	110

¹⁾ Manufacturer data

²⁾ Fastening must be carried out in a load-bearing ground. Attention must be paid when installing the wedge anchors that the individual minimum embedment depths and installation torques are observed.

Design proposal for BZ plus A4 wedge anchors under one-side exposure to fire along the tunnel-furnace curve according to ZTV-ING Part 7 (Section 10.2, clause (1))

Table 4: Maximum load under exposure to fire along the tunnel-furnace curve according to ZTV-ING Part 7 (Section 10.2, clause (1)) for BZ plus A4 wedge anchors in reinforced concrete grounds (strength class $\geq C20/25 \leq C50/60$)

Designation	Maximum load under exposure to fire in accordance with the tunnel-furnace curve according to ZTV-ING Part 7 (Section 10.2, clause (1))
BZ plus A4 wedge anchor	$F_{ZTV-fire}^{1)2)}$ [kN]
M8 A4	0.40
M10 A4	0.55
M12 A4	0.90
M16 A4	3.40

- 1) If smaller loads apply for the normal purpose of use (see also [5]), these shall be binding. The suitability of the anchors must be certified – independently of the fire-safety-related assessment – for the ground and application, also for the cold as-installed state.
- 2) The maximum tensile/shear load can be applied as centric tensile load (N), shear load (V) or as a combination of both (oblique tension).

Design proposal for BZ plus HCR wedge anchors under one-side exposure to fire along the tunnel-furnace curve according to ZTV-ING Part 7 (Section 10.2, clause (1))

Table 5: Maximum load under exposure to fire along the tunnel-furnace curve according to ZTV-ING Part 7 (Section 10.2, clause (1)) for BZ plus HCR in reinforced concrete grounds (strength class $\geq C20/25 \leq C50/60$)

Designation	Maximum load under exposure to fire along the tunnel-furnace curve according to ZTV-ING Part 7 (Section 10.2, clause (1))
BZ plus HCR wedge anchor	$F_{ZTV-fire}^{1)2)}$ [kN]
M8 HCR	0.60
M10 HCR	0.85
M12 HCR	1.35
M16 HCR	5.50

- 1) If smaller loads apply for the normal purpose of use (see also [5]), these shall be binding. The suitability of the anchors must be certified – independently of the fire-safety-related assessment – for the ground and application, also for the cold as-installed state.
- 2) The maximum tensile/shear load can be applied as centric tensile load (N), shear load (V) or as a combination of both (oblique tension).