

## Expert Opinion

– Translation –

Document number: (2101/173/18) – CM dated 13/08/2018

Client: Adolf Würth GmbH & Co. KG  
Reinhold-Würth-Straße 12-17  
  
74653 Künzelszau

Order date: 20/06/2018

Order ref: Mr Röger

Order received: 20/06/2018

Subject: Assessment of Würth W-BS/S und W-BS/A4 concrete screws regarding their behaviour on exposure to fire according to the standard temperature-time curve (ETK) in accordance with DIN EN 1363-1, in order to determine the fire resistance

Basis for assessment: See Section 1

This expert opinion comprises 6 pages including cover sheet and 6 annexes.



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## 1 General

An expert opinion on the Würth concrete screws combined with solid structural elements (masonry) under exposure to fire on one side was commissioned by Adolf Würth GmbH & Co. KG, Künzelsau on 20/06/2018.

The documents serving as basis for the expert opinion for the constructions to be assessed are listed below:

- [1] DIN EN 1363-1, Fire resistance tests - Part 1: General Requirements,
- [2] DIN 4102-4, Fire Behaviour of Building Materials and Components,
- [3] Test Report No. 2101/713/17 dated 13/08/2018 issued by MPA Braunschweig, and
- [4] Würth W-BS/S and W-BS/A4 concrete screws, Technical Data Sheets from Adolf Würth GmbH & Co. KG, Künzelsau.

The assessment for the Würth concrete screws was conducted on the basis of the fire tests carried out when installed in solid structural elements (reinforced concrete/masonry). Existing technical regulations and technical specifications, which regulate above all mechanical fasteners for cracked concrete combined with reinforced concrete elements when exposed to fire, currently provide no complete design concept for these fastening systems combined with reinforced concrete/masonry. According to Adolf Würth GmbH & Co. KG, Künzelsau, there is currently no complete construction supervisory authority certificate (e.g. ETA) for Würth concrete screws combined with reinforced concrete/masonry that lays down the regulations to be met by the execution described here in the event of fire.

## 2 Description of the constructions

The Würth W-BS/S and W-BS/A4 concrete screws consist of a screw shaft with special thread and are made in one piece. The loads are applied via the screw shaft and the thread pitches into the anchoring base. Following preparation of the borehole, the Würth concrete screws are installed with the admissible tightening torque in the ground and fastened there by self-tapping.

According to the client, the related technical specifications for Würth concrete screws installed in reinforced concrete/masonry – for the normal purpose of use – can be taken from the respective technical data sheets (e.g. installation instructions) of Adolf Würth GmbH & Co. KG, Künzelsau.

The fire-safety-related assessment is limited to mainly static (dead) loads combined with solid structural elements, which have to be classified in the fire resistance class at least corresponding to the one of the fastening systems.

The following table and the annexes summarize the design data (from the manufacturer) for Würth W-BS/S and W-BS/A4 concrete screws. Further information on Würth concrete screws can be taken from the technical data sheets (e.g. installation instructions) and approvals of Adolf Würth GmbH & Co. KG, Künzelsau.

Table 1: Würth W-BS/S concrete screws

Würth W-BS/S concrete screw	Size	Connection thread	Ground
W-BS/S 5 type S with hexagon head	5	-	Reinforced concrete Masonry (perforated sand-lime brick, sand-lime brick, clay brick)
W-BS/S 5 type P with pan head		-	
W-BS/S 5 type P with large pan head		-	
W-BS/S 5 type SK with countersunk head		-	
W-BS/S 6 type S with hexagon head	6	-	Masonry (perforated sand-lime brick, sand-lime brick, clay brick)
W-BS/S 6 type P with pan head		-	
W-BS/S 6 type P with large pan head		-	
W-BS/S 6 type SK with countersunk head		-	
W-BS/S 6 type I with female thread <sup>1)</sup>	6	IG M8/M10	
W-BS/S 6 type ST, hanger bolt with hexagon drive	6	M8	

<sup>1)</sup> Connection combined with nuts (strength class  $\geq 8$ ) und threaded rods (strength class  $\geq 4.8$ )

Table 2: Würth W-BS/A4 concrete screws

Würth W-BS/A4 concrete screw	Size	Connection thread	Ground
W-BS/A4 6 type S with hexagon head	6	-	Masonry (perforated sand-lime brick, sand-lime brick, clay brick)
W-BS/A4 6 type P with pan head		-	
W-BS/A4 6 type SK with countersunk head		-	

For a more detailed description of the construction, reference is made to the annexes and the technical data sheets for Würth W-BS/S and W-BS/A4 concrete screws from Adolf Würth GmbH & Co. KG, Künzelsau.

### 3 Assessment of Würth W-BS/S and W-BS/A4 concrete screws combined with solid structural elements

The subject matter of this fire-safety-related assessment is the load-bearing behaviour of Würth concrete screws combined with undergrounds such as masonry made of sand-lime bricks  $\geq$  KS 12-1.4-NF (in accordance with DIN V 106 (DIN EN 771-2)) or clay bricks  $\geq$  Mz 12-2.0-2DF (in accordance with DIN 105-100 (DIN EN 771-1)) or perforated sand-lime bricks  $\geq$  KSL 12-1.4-2 DF (in accordance with DIN V 106-100 (DIN EN 771-2)) or undergrounds made of reinforced concrete (strength class  $\geq$  C20/25  $\leq$  C50/60) when exposed to fire in accordance with DIN EN 1363-1.

If smaller loads apply for the normal purpose of use according to the technical data sheets [4] of Adolf Würth GmbH & Co. KG, Künzelsau, these shall be binding. Independent of the fire-safety-related assessment, the suitability of the anchors has to be certified for the ground and application, also for the cold as-installed state.

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

For the anchors assessed here, the failure of the Würth concrete screws (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 Würth concrete screws under exposure to fire is the distance that excludes a failure of the ground, which means the steel failure of the fastening system will be decisive. Moreover, the centre distances have to comply at least with the distances required for the cold as-installed state as per technical data sheets [4] of Adolf Würth GmbH & Co. KG, Künzelsau.

Further parameters (geometry, moisture, formwork spalling, eccentricity, position in the structural element and other influencing variables) have to be considered separately, if required.

The load-bearing behaviour (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 (masonry).

$F_{\text{fire}(t)}$  ⇒ design value for Würth concrete screw

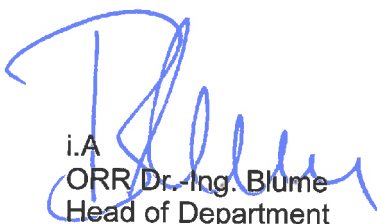
The load on the anchors can be applied as centric tensile load (N), shear load (V) or as a combination of both (oblique tension).

The design proposals for Würth concrete screws under tensile load and exposure to fire on one side in accordance with DIN EN 1363-1 can be taken from Annexes 4 to 6.


#### 4 Special notes

- 4.1 This Expert Opinion is no substitute for the building authority certificate (abP, abZ, ETA).
- 4.2 This Expert Opinion applies only to Würth W-BS/S and W-BS/A4 concrete screws combined with solid structural elements (reinforced concrete / solid masonry according to Section 3) taking the constraints of the technical data sheets [4] of Adolf Würth GmbH & Co. KG, Künzelsau, into account.
- 4.3 The assessment of the Würth W-BS/S and W-BS/A4 concrete screws refers to the fastener combined with solid structural elements (reinforced concrete / solid masonry according to Section 3) under exposure to fire on one side according to the standard temperature-time curve in accordance with DIN EN 1363-1.
- 4.4 The validity of this Expert Opinion ends on 13/08/2023.
- 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. 2101/173/18 – CM dated 13/08/2018. The legally binding text is the aforementioned German Expert Opinion.*

  
i.A.  
ORR/Dr.-Ing. Blume  
Head of Department



  
i.A.  
Dipl.-Ing. Maertins  
Engineer/official in charge

## Technical data of Würth W-BS/S 5 concrete screws





Anchor type		
	Würth concrete screw	W-BS/S 5 type S with hexagon head
		W-BS/S 5 type P with pan head
		W-BS/S 5 type P with large pan head
		W-BS/S 5 type SK with countersunk head

Table 3: Material data

Anchor type	Material
Würth concrete screw W-BS/S	Steel in accordance with manufacturer spec, galvanized min. 5 µm

Table 4: Installation parameters for Würth W-BS/S concrete screws

Würth W-BS/S concrete screws			Reinforced concrete (strength class $\geq$ C20/25 $\leq$ C50/60)	Clay brick $\geq$ Mz 12-2.0-2DF acc.to DIN 105 / DIN 105-100 (EN 771-1) Sand-lime brick $\geq$ KS 12-1.4- NF acc. to DIN V 106 (DIN EN 771-2)	Perforated sand-lime brick $\geq$ KSL 12-1.4-2 DF acc. to DIN V 106-100 (DIN EN 771-2) <sup>2)</sup>
Min. embedment depth	$h_{nom}$	[mm]	35		
Nominal drilling diameter	$d_o$	[mm]	5		
Cutting bit diameter	$d_{cut} \leq$	[mm]	5.4		
Borehole depth	$h_1 \geq$	[mm]	40		
Through-borehole in attachment part	$d_f \leq$	[mm]	7		
Max. fastening height	$t_{fix}$	[mm]	$l_s - h_{nom}$		
Max. tightening torque <sup>1)</sup>	$T_{inst}$	[Nm]	10	8	4

1) As an alternative, the maximum tightening torque may be applied using a torque-controlled screwdriver (e.g. tangential screwdriver).

2) In perforated brick masonry, boreholes may only be prepared by rotation.

Fastening must be executed in load-bearing brick/reinforced concrete.

## Technical data of Würth W-BS/S 6 concrete screws







Anchor type		
	Würth concrete screw	W-BS/S 6 type S with hexagon head
		W-BS/S 6 type P with pan head
		W-BS/S 6 type P with large pan head
		W-BS/S 6 type SK with countersunk head
		W-BS/S 6 type I with female thread
		W-BS/S 6 type ST, hanger bolt with hexagon drive

Table 5: Material data

Anchor type		Material
Würth concrete screw	W-BS/S	Steel in accordance with manufacturer spec, galvanized min. 5 µm
Threaded rod with nut and washer	M8	Steel; galvanized min. 5 µm; (strength class 4.8)

Table 6: Installation parameters for Würth W-BS/S concrete screws

Würth W-BS/S concrete screws			Clay brick ≥ Mz 12-2.0-2DF acc.to DIN 105 / DIN 105-100 (EN 771-1) Sand-lime brick ≥ KS 12-1.4- NF acc.to DIN V 106 (DIN EN 771-2)	Perforated sand-lime brick ≥ KSL 12-1.4-2 DF acc.to DIN V 106-100 (DIN EN 771-2) <sup>2)</sup>
Min. embedment depth	$h_{nom}$	[mm]	35	
Nominal drilling diameter	$d_o$	[mm]	6	
Cutting bit diameter	$d_{cut} \leq$	[mm]	6.4	
Borehole depth	$h_1 \geq$	[mm]	40	
Through-borehole in attachment part	$d_r \leq$	[mm]	8	
Max. fastening height	$t_{fix}$	[mm]	$l_s - h_{nom}$	
Max. tightening torque <sup>1)</sup>	$T_{inst}$	[Nm]	8	4

1) As an alternative, the maximum tightening torque may be applied using a torque-controlled screwdriver (e.g. tangential screwdriver).

2) In perforated brick masonry, boreholes may only be prepared by rotation.

Fastening must be executed in load-bearing brick/reinforced concrete.

## Technical data of Würth W-BS/A4 6 concrete screws (stainless steel)




Anchor type		
	Würth concrete screw	W-BS/A4 6 type S with hexagon head
		W-BS/A4 6 type P with pan head
		W-BS/A4 6 type SK with countersunk head

Table 7: Material data

Anchor type	Material
Würth concrete screw W-BS/A4	Stainless steel: material nos. 1.4401, 1.4404, 1.4571, 1.4578

Table 8: Installation parameters for Würth W-BS/A4 concrete screws

Würth W-BS/A4 concrete screws			Clay brick $\geq$ Mz 12-2.0-2DF acc.to DIN 105 / DIN 105-100 (EN 771-1) Sand-lime brick $\geq$ KS 12-1.4- NF acc.to DIN V 106 (DIN EN 771-2)	Perforated sand-lime brick $\geq$ KSL 12-1.4-2 DF) acc.to DIN V 106-100 (DIN EN 771-2) <sup>2)</sup>
Min. embedment depth	$h_{nom}$	[mm]	35	
Nominal drilling diameter	$d_o$	[mm]	6	
Cutting bit diameter	$d_{cut} \leq$	[mm]	6.4	
Borehole depth	$h_1 \geq$	[mm]	40	
Through-borehole in attachment part	$d_f \leq$	[mm]	8	
Max. fastening height	$t_{fix}$	[mm]	$l_s - h_{nom}$	
Max. tightening torque <sup>1)</sup>	$T_{inst}$	[Nm]	8	4

1) As an alternative, the maximum tightening torque may be applied using a torque-controlled screwdriver (e.g. tangential screwdriver).

2) In perforated brick masonry, boreholes may only be prepared by rotation.

Fastening must be executed in load-bearing brick/reinforced concrete.



**Design proposal for Würth W-BS/S concrete screws under tensile load and exposure to fire in accordance with DIN EN 1363-1 in reinforced concrete**

Table 9: Design proposal for Würth W-BS/S concrete screws in undergrounds made of reinforced concrete (strength class  $\geq C20/25 \leq C50/60$ )

Würth W-BS/S concrete screw	
Fire resistance time in minutes [min]	Maximum tensile/shear loads – max. F <sup>1)</sup> [kN]
	W-BS/S 5 type S W-BS/S 5 type P W-BS/S 5 type SK
30	0.84
60	0.62
90	0.40
120	0.29

<sup>1)</sup> It is to be checked, whether the admissible cold loads are binding; moreover, attachment parts always have to be proved separately.

## Design proposal for Würth W-BS/S and W-BS/A4 concrete screws under tensile load and exposure to fire in accordance with DIN EN 1363-1 in masonry

Table 10: Design proposal for Würth W-BS/S and W-BS/A4 concrete screws in undergrounds made of  $\geq$  KS 12-1.4- NF (acc.to DIN V 106 (DIN EN 771-2)) and clay brick  $\geq$  Mz 12-2.0-2DF) acc.to DIN 105 / DIN 105-100 (EN 771-1)

Würth W-BS/S und W-BS/A4 concrete screws			
Fire resistance time in minutes  [min]	Maximum tensile/shear loads – max. F <sup>1)</sup>  [kN]		
	W-BS/S 5 type S W-BS/S 5 type P W-BS/S 5 type SK	W-BS/S 6 type S W-BS/S 6 type P W-BS/S 6 type SK	W-BS/A4 6 type S W-BS/A4 6 type P W-BS/A4 6 type SK
30	0.64	0.94	
60	0.49	0.72	
90	0.34	0.50	
120	0.27	0.39	

<sup>1)</sup> It is to be checked, whether the admissible cold loads are binding; moreover, attachment parts always have to be proved separately.

Table 11: Design proposal for Würth W-BS/S and W-BS/A4 concrete screws in undergrounds made of perforated sand-lime brick  $\geq$  KSL 12-1.4-2 DF acc.to DIN V 106-100 (DIN EN 771-2)

Würth W-BS/S and W-BS/A4 concrete screws			
Fire resistance time in minutes  [min]	Maximum tensile/shear loads – max. F <sup>1)</sup>  [kN]		
	W-BS/S 5 type S W-BS/S 5 type P W-BS/S 5 type SK	W-BS/S 6 type S W-BS/S 6 type P W-BS/S 6 type SK	W-BS/A4 6 type S W-BS/A4 6 type P W-BS/A4 6 type SK
30	0.57	0.83	
60	0.43	0.64	
90	0.30	0.44	
120	0.23	0.34	

<sup>1)</sup> It is to be checked, whether the admissible cold loads are binding; moreover, attachment parts always have to be proved separately.

Table 12: Design proposal for Würth W-BS/S 6 type I and W-BS/S 6 type ST concrete screws in undergrounds made of sand-lime brick  $\geq$  KS 12-1.4- NF (acc.to DIN V 106 (DIN EN 771-2)) and clay brick  $\geq$  Mz 12-2.0-2DF) acc.to DIN 105 / DIN 105-100 (EN 771-1) and perforated sand-lime brick  $\geq$  KSL 12-1.4-2 DF acc.to DIN V 106-100 (DIN EN 771-2)

Würth W-BS/S 6 type I and W-BS/S 6 type ST concrete screws		
Fire resistance time in minutes [min]	Maximum tensile/shear loads – max. F <sup>1)</sup> [kN]	
	W-BS/S 6 type I	W-BS/S 6 type ST
30	0.67	0.37
60	0.55	0.33
90	0.43	0.26
120	0.34	0.18

<sup>1)</sup> It is to be checked, whether the admissible cold loads are binding; moreover, attachment parts always have to be proved separately.