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fischer frame fixing anchor DuoXpand 10 under fire exposure

Report No.: 21-010-3(1)

INDEPENDENT TECHNICAL ASSESSMENT

Product name:
DuoXpand 10

Product type:
Frame fixing anchor

Manufacturer:
fischerwerke GmbH & Co. KG

Validity:
5 Years

Assessment based on the documents:
fi540/01-21/37, ETA-21/0324 and 21-010-1(0)

19/04/2022

1 INTRODUCTION AND AIM

The company fischerwerke GmbH & Co. KG would like to have the characteristic fire resistance of the fischer DuoXpand 10 frame fixing tested and evaluated in concrete, calcium silicate masonry and solid clay brick masonry under 45° inclined tensile load and shear load.

The fire tests were carried out at the MPA of the University of Stuttgart to evaluate the DuoXpand frame anchor for size 10 (with a screw diameter of $d = 7$ mm) on the basis of EN 1992-4 and EAD 330284-00-0604. The test results are described in the test report fi540/01-21/37 dated 29.11.2021 and evaluated in the evaluation report 21-010-1(0) dated 07.02.2022.

The characteristic fire resistance values are valid for all head types of the anchor DuoXpand 10 as well as the versions with the associated special screws made of galvanised steel and stainless steel. The anchors shall be exposed to a standard fire defined by the standard temperature time curve (ETK) according to EN1363-1:2020.

2 DESCRIPTION OF THE PRODUCT

2.1 PRODUCT CHARACTERISTICS AND APPLICATION AREA

The fischer frame fixing DuoXpand 10 consists of a plastic sleeve and a special screw (Figure 2.1 and Figure 2.2). The special screws are available in two head versions: hexagonal head and countersunk head.

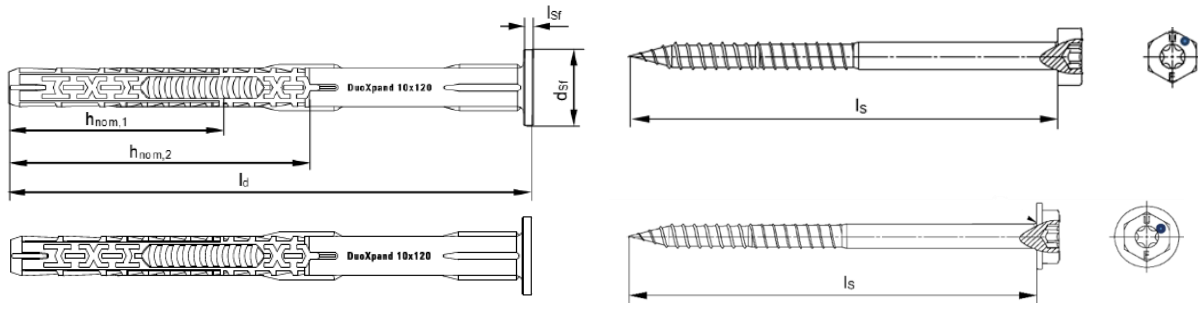


Figure 2.1: Technical drawings of the anchor sleeve and screw with hexagonal head (see right above) and hexagonal head with integrally formed washer (see right down)..

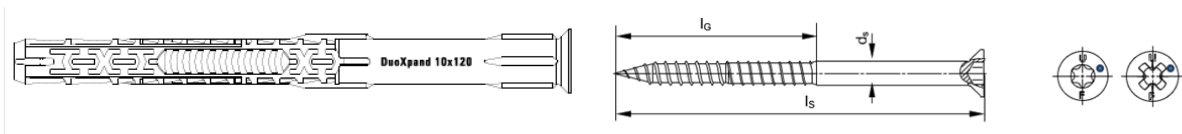


Figure 2.2: Technical drawings of the anchor sleeve and screw with countersunk head.

The dimensions and materials of both components are listed in Table 2.1 and Table 2.2.

Table 2.1: Dimensions and material of the anchor sleeve.

Anchor type	Anchor sleeve										Material
	$h_{nom,1}$ [mm]	$h_{nom,2}$ [mm]	$h_{nom,3}$ [mm]	$h_{nom,4}$ [mm]	d_{nom} [mm]	t_{fix} [mm]	min. l_d [mm]	max. l_d [mm]	l_{sf}^1 [mm]	d_{sf}^1 [mm]	
DuoXpand 10	50	70	140	160	10	≥ 1	80	230	2,2	18,5	Polyamide PA6 Colour grey + Polyoxymethylene POM Colour red

Table 2.2: Dimensions and materials of the special screw.

Anchor type	Special screw			Material
	d_s [mm]	l_G [mm]	l_s [mm]	
DuoXpand 10	7,0	≥ 77	$\geq l_d+7$	<ul style="list-style-type: none"> - Galvanised steel gvz with Zn5/Ag or Zn5/An in accordance with EN ISO 4042:2018 <u>or</u> - Galvanised steel gvz with Zn5/Ag or Zn5/An in accordance with EN ISO 4042:2018 with additional organic layer (Zn5/Ag/T7 or Zn5/An/T7, resp.) in three layers (total layer thickness $\geq 6 \mu\text{m}$) <u>or</u> - Stainless steel "A2" of corrosion resistance class CRC II in accordance with EN 1993-1-4:2006 + A1:2015 <u>or</u> - Stainless steel "A4" or "R" of corrosion resistance class CRC III in accordance with EN 1993-1-4:2006 + A1:2015

The frame fixing DuoXpand 10 has an European Technical Assessment. Detailed specifications of the intended use are given in ETA-21/0324. The resistances listed below for failure due to pull-out under fire are only valid for applications in normal non-cracked and cracked concrete C20/25 to C50/60 according to EN 206:2013+A2:2021 and for the mentioned solid calcium silicate and solid clay brick masonry.

2.2 CONDITIONS OF USE

The environmental conditions of the screws are as follows:

- Dry internal condition: special screw made of zinc coated steel or stainless steel suitable for corrosion resistance class CRC II or CRC III.
- External atmospheric exposure: the specific screw made of galvanised steel respectively galvanised steel with an additional organic coating, if the area of the head of the screw is protected against moisture and driving rain after mounting

¹ Only valid for flat collar version.

of the fixing unit in this way, that intrusion of moisture into the anchor shaft is prevented.

- External atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive condition exist: Special screw made of stainless steel of corrosion resistance class CRC III.

The allowed temperature range of the applications is between - 40 °C to + 80 °C for the design at ambient temperatures. The installation temperature ranges between - 20 °C to + 40 °C.

Exposure to UV due to solar radiation of the not protected anchor must not exceed 6 weeks.

For the design under fire conditions, the maximum temperatures should be lower than those of the ETK fire curve. The design load for the fire condition must not exceed the maximum design load for the "cold" design condition.

Other influences such as spalling of the concrete cover or larger cracks and/or overall frame anchor embedment depths (h_{nom}) smaller than 70 mm are not considered in the assessment.

Otherwise, the intended use specified in ETA-21/0324 applies.

2.3 INSTALLATION OF THE PRODUCT

The anchors are installed according to the manufacturer's installation instructions, considering the installation parameters given in Table 2.3.

Table 2.3: Installation parameter for fischer DuoXpand 10.

Anchor type			DuoXpand 10
Nominal drill hole diameter	$d_0 =$	[mm]	10
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	10,45
Total length of the frame fixing in the base material	$h_{nom,1} \geq$	[mm]	50 ²
	$h_{ef,1} \geq$	[mm]	23 ³
	$h_{nom,2} \geq$	[mm]	70
	$h_{ef,2} \geq$	[mm]	27
Depth of drill hole to deepest point	$h_{1,1} \geq$	[mm]	60 ²
	$h_{1,2} \geq$	[mm]	80
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	10,5

² Not allowed for fire exposure conditions.

³ Calculated using the equation for concrete cone failure and the measured failure load.

The drill hole must be drilled perpendicular to the surface of the anchoring base. The drill bits must comply with the requirements of the Technical Specifications. The dust must always be removed from the drill hole. The depth of the holes must be at least 10 mm deeper than the target overall plastic anchor embedment depths h_{nom} .

The plastic sleeve of the frame fixing DuoXpand 10 is to be driven into a predrilled hole together with the partially inserted screw. Then the screw is rotated inwards until the screw head touches the sleeve. Through this motion, the expansion part of the plastic sleeve expands against the wall of the drilled hole.

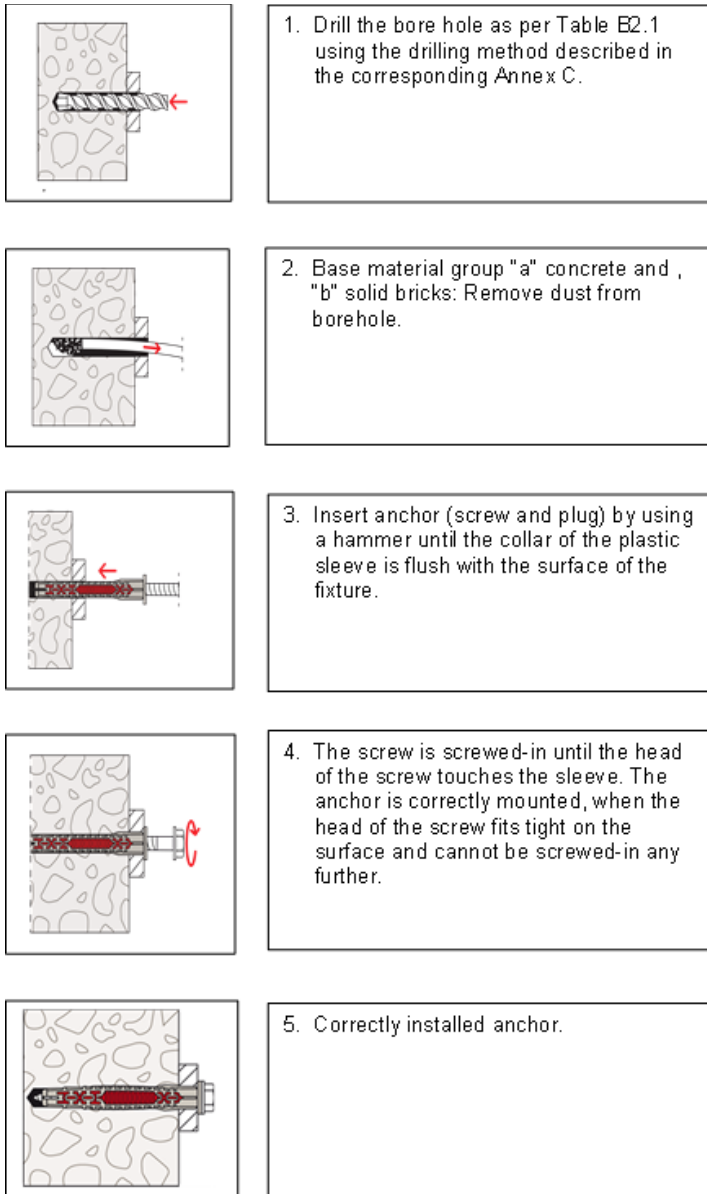


Figure 2.3: Installation instructions for the fischer DuoXpand frame fixing in concrete and solid masonry.

2.4 PROVISIONS FOR PLANNING AND DESIGNING

When installing anchors, a competent person entrusted with the installation of the anchors must be present on the construction site. This person must ensure that the work is carried out properly.

The requirements from ETA-21/0324 and the corresponding design in the cold state are a prerequisite for the design under fire exposure.

The transmission of the loads to be anchored in the structural member shall be additionally verified, also for the design under fire conditions. The anchorages shall be designed in such a way that the verification for the design under ambient temperature condition is fulfilled according to ETA-21/0324.

3 PERFORMANCE OF THE PRODUCT

The fischer frame fixing DuoXpand 10 is qualified for static loading in cracked and non-cracked concrete for normal ambient conditions. Fire tests were conducted with the fischer DuoXpand 10 to assess the characteristic fire resistance under fire conditions. The fire tests were carried out with the galvanised carbon steel variant. The results are summarised in the following tables and can be transferred to the stainless steel version.

3.1 CHARACTERISTIC FIRE RESISTANCE IN CONCRETE

Table 3.1 summarises the characteristic fire resistances under 90° shear loading for the frame fixing DuoXpand 10.

Table 3.1: Characteristic fire resistance under 90° shear load for the fischer frame fixing DuoXpand 10 in concrete.

Characteristic fire resistance under 90° shear load			DuoXpand 10	
			galvanised steel	stainless steel
Nominal embedment depth	$h_{nom} \geq$	[mm]	70	
Characteristic resistance under shear load without lever arm $V_{Rk,fi}$	R30	[kN]	2,30	
	R60		1,80	
	R90		1,30	
	R120		1,05	
Characteristic resistance under shear load with lever arm $M^0_{Rk,fi}$	R30	[Nm]	2,41	
	R60		1,89	
	R90		1,37	
	R120		1,10	

Table 3.2 summarises the characteristic fire resistances for the frame fixing DuoXpand 10 under 45 inclined load.

Table 3.2: Characteristic fire resistance under 45° inclined load for the fischer frame fixing DuoXpand 10 in concrete.

Characteristic fire resistance under 45° inclined load			DuoXpand 10	
			galvanised steel	stainless steel
Nominal embedment depth	$h_{nom} \geq$	[mm]	70	
Characteristic resistance under 45° inclined load without lever arm $F_{Rk,fi,45}$	R30	[kN]	0,51	
	R60		0,34	
	R90		0,17	
	R120		0,08	

3.1.1 Interaction of the fire values for application angles between 45° and 90°

The evaluation of the tests shows that with an increasing load angle, the characteristic resistance also increases. For a fire duration of 90 minutes a characteristic resistance of 0,8 kN can be assumed if the load angle is equal or larger than 70° (dominant shear load without lever arm).

According to EAD 330284-00-0604, a characteristic fire resistance R90 of 0,8 kN can be assumed for fastenings of facade elements with DuoXpand if no permanent centric tension load and shear load without lever arm is present.

The fire resistances R30 to R120 summarised in Table 3.3 are independent of the application, since the tests were carried out according to the general requirements of EAD 330284-00-0604. The fire resistance values for 60° and 75° inclined load were determined by interpolation so that the component of the tensile loading corresponded to the tested tensile loading in the test.

Table 3.3: Fire resistance as a function of the load angle in concrete.

Load angle [°]	Characteristic resistance under fire F_{Rk} [kN]			
	R30	R60	R90	R120
0	-	-	-	-
≥45	0,51	0,34	0,17	0,08
≥60	1,11	0,83	0,55	0,40
≥75	1,70	1,31	0,92	0,73
90	2,30	1,80	1,30	1,05

A loading between 45° and 90° is allowed if the characteristic load resistances given in Table 3.3 are considered. The resistances are therefore lower in some cases than the fire resistance R90 of 0,8 kN according to EAD 330284-00-0604 but are not necessarily limited to facade applications.

3.2 CHARACTERISTIC FIRE RESISTANCE IN MASONRY

Table 3.5 and Table 3.4 summaries the characteristic resistances under fire exposure for 90° shear loads and 45° inclined load for the frame fixing DuoXpand 10 in calcium silicate masonry and solid clay brick masonry.

Table 3.4: Characteristic fire resistance under 90°shear load for the frame fixing DuoXpand 10 in solid calcium silicate and solid clay brick masonry.

Characteristic fire resistance under 90° shear load			DuoXpand 10	
			galvanised steel	stainless steel
Nominal embedment depth	$h_{nom} \geq$	[mm]	70	
Characteristic resistance under shear load without lever arm $V_{Rk,fi}$	R30-R90	[kN]	1,30	
	R120		1,05	

Table 3.5: Characteristic fire resistance under 45° inclined load for the frame fixing DuoXpand 10 in solid calcium silicate and solid clay brick masonry.

Characteristic fire resistance under 45° inclined load			DuoXpand 10	
			galvanised steel	stainless steel
Nominal embedment depth	$h_{nom} \geq$	[mm]	70	
Characteristic resistance under 45° inclined load without lever arm $F_{Rk,fi,45}$	R30	[kN]	0,51	
	R60		0,34	
	R90		0,17	
	R120		0,08	

The R90 and R120 fire resistances summarised in Table 3.6 are independent of the application, as the tests were conducted in accordance with the general requirements of EAD 330284-00-0604. The fire resistance for 60° and 75° inclined loading were determined by interpolation so that the tensile force component corresponds to the tested one.

Table 3.6: Fire resistance as a function of the loading direction in solid calcium silicate and solid clay brick masonry.

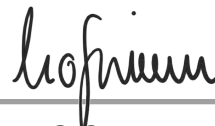
Load angle [°]	Resistance under fire F_{Rk} [kN]	
	R90	R120
	Non permanent	Non permanent
≥45	0,17	0,08
≥60	0,55	0,40
≥75	0,92	0,73
90	1,30	1,05

A loading direction between 45° und 90° is allowed if the characteristic resistances given in Table 3.3 are considered.

The calculated characteristic resistances for fixings in calcium silicate masonry and solid clay brick masonry are higher than the characteristic resistances assessed from the fire tests under 45° inclined and pure shear loading in concrete. This applies to all resistance classes R30 to R90 and R120. Therefore, the resistances in concrete can be also applied for fixings in calcium silicate masonry and solid clay brick masonry.



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