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Object: Assessment of the load bearing behaviour of SPIT PULSA systems under tension load and one-sided fire loading according to the standard temperature-time curve for anchoring in concrete - abbreviated version

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This document covers 17 pages, including 0 appendix.

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1 Objective and request

MFPA Leipzig GmbH was ordered by SPIT SAS to assess the load bearing behaviour of SPIT PULSA systems under tension load and one-sided fire loading according to the standard temperature-time curve (STTC, see [N1]) for anchoring in concrete constructions. The assessment is carried out basing on the results of fire tests.
The present document includes a summary of the design concept for fire design and the associated characteristic load-bearing capacities. For a detailed derivation of the performance properties, please refer to [G1].

2 Description of the construction

2.1 Balistic nails HC6

SPIT HC6 are balistic nails, which are installed into the concrete substrate using a SPIT PULSA Gas actuated tool

- PULSA P40 P+ (for nails HC6-15 to HC6-32) or
- PULSA P65 (for nails HC6-15 to HC6-65).

SPIT HC6 balistic nails are produced in different lengths from 15mm (HC6-15) to 65mm (HC6-65) using the same steel type for each length (compare Appendix 1). The head and shaft diameters are identical for all nail types. In Figures 1 and 2, geometry information is given.

HC6 dimensions			HC6-15	HC6-17	HC6-22	HC6-27	HC6-32	HC6-50	HC6-57	HC6-65
Length	LT	[mm]	15	17	22	27	32	50	57	65
Shaft diameter	d	[mm]	3,0							
Effective anchorage depth	h_{ef}	[mm]	≥ 11,0			≥ 15				
Head diameter	D	[mm]	6,4							
Material nail		[-]	Steel, Hardeness ≥ 56 HRc							
Material collated strip		[-]	Polypropylene, orange color							
Zinc plating		[-]	Mechanical zinc plating, min. zinc 10υm							

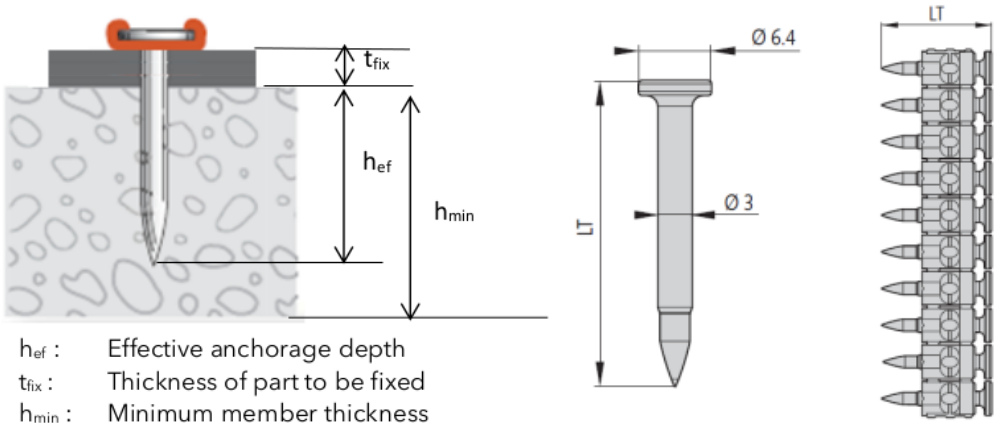

Figure 1: SPIT PULSA systems: Geometry information for SPIT HC6 balistic nails

HC6 dimensions			HC6-27	HC6-32	HC6-50	HC6-57	HC6-65
For use with tool			P40P+ P65	P40P+ P65	P65	P65	P65
Maximum concrete strength class	[-]		C50/60				
Maximum thickness of fixture	t_{fix}	[mm]	5	10	28	35	43
Effective anchorage depth	h_{ef}	[mm]	≥ 15				
Average anchorage depth when used in maximum concrete strength class	$h_{ef,m}$	[mm]	16,1				
Diameter of clearance hole in the fixture	d_f	[mm]	3,5				
Minimum member thickness	h_{min}	[mm]	80				
Minimum spacing	S_{min}	[mm]	200				
Minimum edge distance	C_{min}	[mm]	150				

Figure 2: SPIT PULSA systems: Installation parameters, from [P1]

With [P1] a current European Technical Assessment is available for SPIT HC6 balistic nails HC6-27 to HC6-65.
In connection with the performance characteristics of one individual fastener in case of fire, the nails

- HC6-27 to
- HC6-65

are considered.
The nails

- HC6-15 and
- HC6-17

are used to fasten the metal accessories described below.

2.2 Multiple fastening of drywall tracks with balistic nails HC6-15 and HC6-17

Using balistic nails HC6-15 or HC6-17, drywall tracks are fastened to the concrete substrate. The application corresponds to fastening system 4 according to [N2], Table 1.1. According to [N2], Table 1.1, the metal draywall track to be used must exhibit a sheet thickness of $0{,}6mm \leq t \leq 2{,}0mm$ and a tensile strength of $R_m \geq 260 \frac{N}{mm^2}$.
Experimental investigatons are carried out for a system cutout of a track of 900mm length using 3 nails with a spacing of 300mm. For both nail types, all the length of the nail below the head is embedded in the concrete substrate.
Figure 3 shows a prinziple drawing of the multiple fastening and the load introduction.

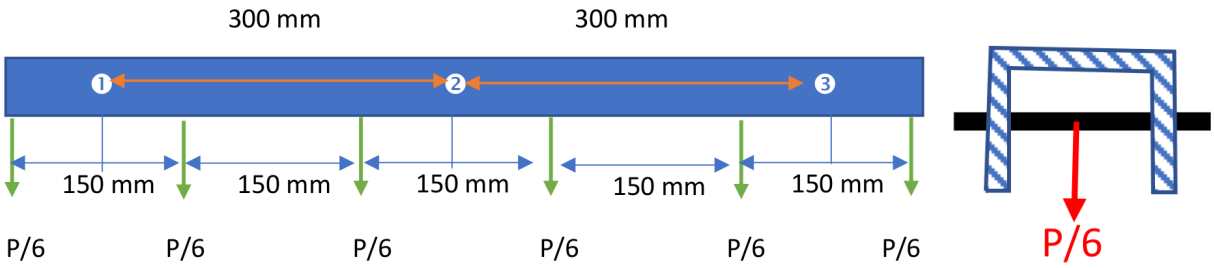

Figure 3: SPIT PULSA systems: Multiple fastening of drywall tracks with balistic nails HC6-15 and HC6-17 – prinziple drawing

2.3 Metal P-clip V2

The metal P-clip V2 is used in the field of technical building equipment to fix pipes or cables to the construction members. Metal P-clips V2 exhibit 1 rib and are produced in sizes 16, 20, 22, 24 and 25 using the same steel material DX51 Z275 MA-C for each size. With $b = 15mm$ and $t = 1{,}25mm$, the width and thickness of the metal sheet is identical for all sizes. The difference between the variants is only in the diameter of the bent area, which matches with the designation of the respective product size. Since the length of the straight section is also identical for all sizes with $L_1 = 30mm$, there is an increase in the total length of the product with increasing size.
In Figure 4, the metal P-clip V2 is shown.

Figure 4: SPIT PULSA systems: Metal P-clip V2

The metal P-clip V2 is fastened to the substrate using one nail HC6-17, which is placed within the center of the designated area of the metal P-clip. The metal P-clips V2 do not exhibit a pre-drilled hole, rather the balistic nail is shot through the metal sheet into the substrate. To ensure the correct position, a magnetic nose is used in combination with the SPIT PULSA Gas actuated tool. All the length of the nail below the head is embedded in the concrete substrate.

2.4 Perforated strip

The perforated strips 12x0,8 and 17x0,8 are used in the field of technical building equipment to fix pipes or cables to construction members. Using the same steel material DC01 for each size and exhibiting an identical sheet thickness $t = 0{,}8mm$, diameter of perforation $d = 5mm$ and distance between two perforations $e = 10mm$, both versions only differ in the width of the strip.
In Figure 5, geometry information as well as a joint using a perforated strip is shown.

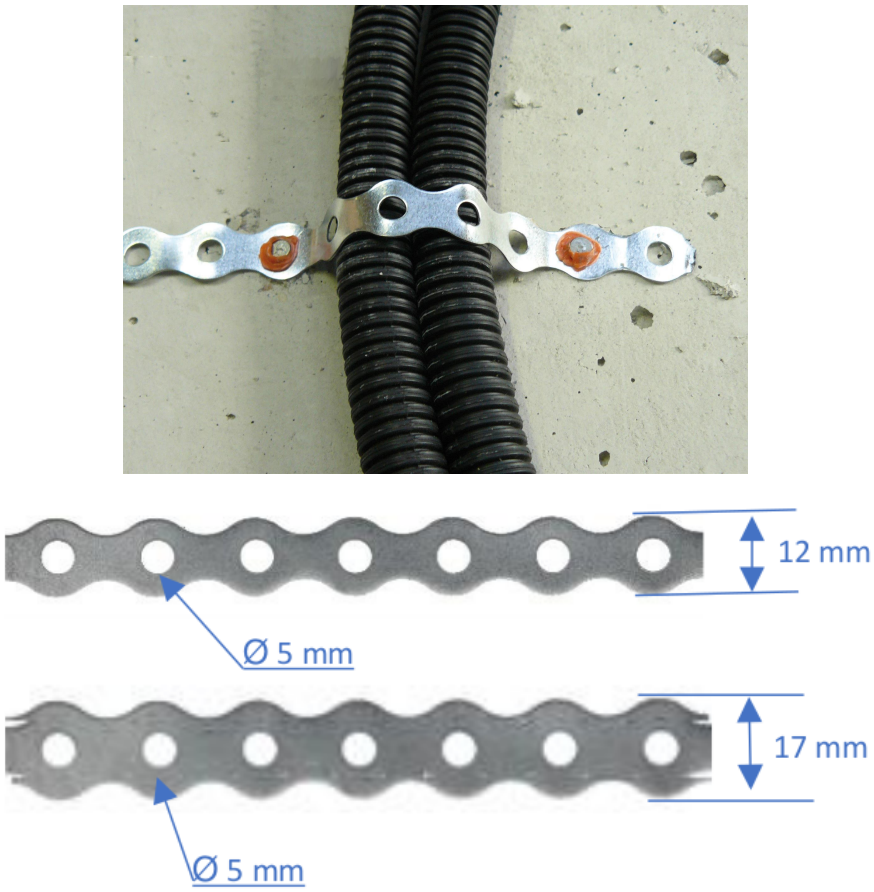

Figure 5: SPIT PULSA systems: Perforated strip

Perforated strips 12x0,8 and 17x0,8 are fastened to the substrate using two nails HC6-17 and having 4 free perforations between the two nails. All the length of the nails below the head is embedded in the concrete substrate.

2.5 Clip MCC-O

The clip MCC-O is used in the field of technical building equipment to fix cables (e.g. security cable for lightening) to the ceiling. In Figure 6, geometry information is given. The material S250GD is utilized.

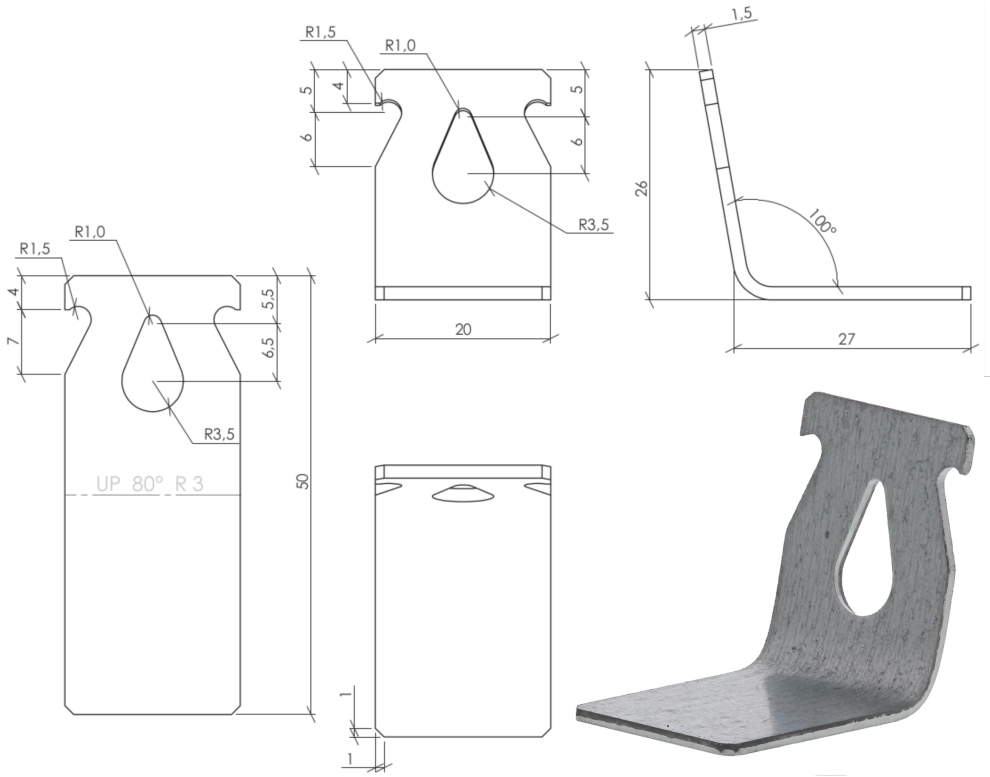

Figure 6: SPIT PULSA systems: Geometry information for clip MCC-O

The clip MCC-O is fastened to the substrate using one nail HC6-17, which is placed within the center of the designated area of the clip MCC-O. The clip MCC-O does not exhibit a pre-drilled hole, rather the balistic nail is shot through the metal sheet into the substrate. To ensure the correct position, a magnetic nose is used in combination with the SPIT PULSA Gas actuated tool. All the length of the nail below the head is embedded in the concrete substrate.

2.6 Cable support MBCH

The cable support MBCH is used in the field of technical building equipment to fix cable bundles to ceilings. Cable support MBCH is available in two sizes, which are able to hold 15 and 30 cables, respectively. While with $b = 38mm$ and $t = 1mm$ the width an thickness of the metal sheet is identical for both products, the overall size is lager for the 30 cables version. The same steel type is used for both sizes. In Figure 7, geometry information is given (also compare Appendix 1).

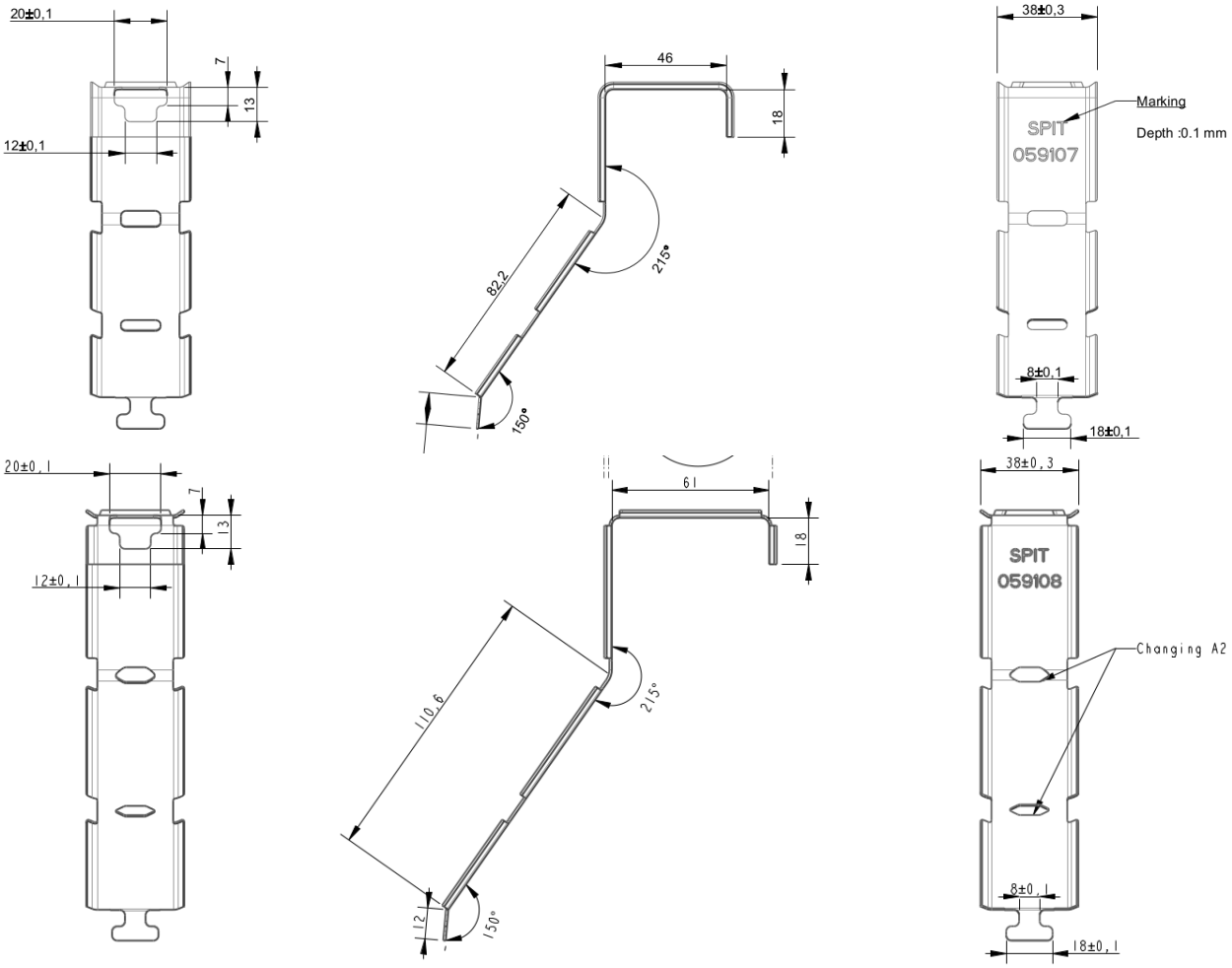

Figure 7: SPIT PULSA systems: Geometry information for cable support MBCH

The cable support MBCH is fastened to the substrate using one nail HC6-17, which is placed in the upper area of the product in the position marked in Figure 8. The cable support MBCH additionally exhibits a pre-drilled hole of $d = 7mm$ which is supposed to be used in combination with screws and anchors. In the present case, the balistic nail is shot through the metal sheet into the substrate. To ensure the correct position, a magnetic nose is used in combination with the SPIT PULSA Gas actuated tool. All the length of the nail below the head is embedded in the concrete substrate.

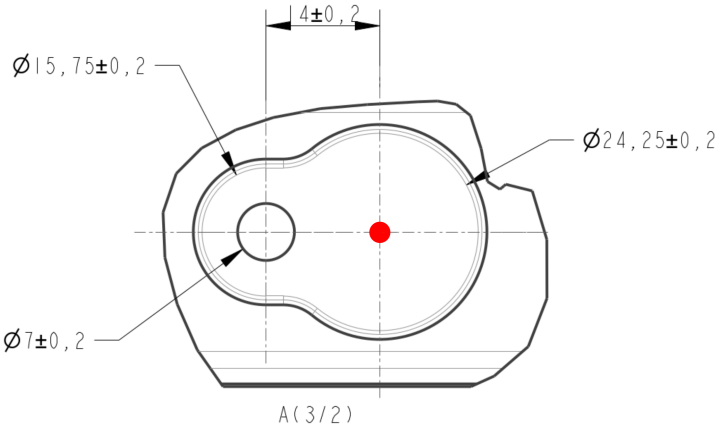

Figure 8: SPIT PULSA systems: Fastening of cable support MBCH

3 References

3.1 Utilized guidelines, rules and standards

The analyses are based on the following guidelines, rules and standards:

[N1] DIN EN 1363-1:2020-05: Fire resistance tests - Part 1: General requirements; German version EN 1363-1:2020

[N2] EAD 330083-04-0601: Power-actuated fastener in concrete for redundant non-structural applications; 03/2021

[N3] EAD 330232-01-0601: Mechanical fasteners for use in concrete; 12/2019

[N4] DIN EN 1992-4:2019-04: Eurocode 2 - Design of concrete structures - Part 4: Design of fastenings for use in concrete; German version EN 1992-4:2018

[N5] DIN EN 1993-1-8:2010-12: Eurocode 3: Design of steel structures - Part 1-8: Design of joints; German version EN 1993-1-8:2005 + AC:2009

[N6] DIN EN 1993-1-2:2010-12: Eurocode 3: Design of steel structures - Part 1-2: General rules - Structural fire design; German version EN 1993-1-2:2005 + AC:2009

[N7] DIN EN 206:2021-06: Concrete - Specification, performance, production and conformity; German version EN 206:2013+A2:2021

[N8] DIN EN 1992-1-2:2010-12: Eurocode 2: Design of concrete structures - Part 1-2: General rules - Structural fire design; German version EN 1992-1-2:2004 + AC:2008

3.2 Reference documents

The analyses are based on the following additional documents:

3.2.1 ETAs and verifications of applicability

[P1] ETA-22/0439: PULSA HC6 Nails, Power-actuated fastener for multiple use in concrete for non-structural applications – ETA-Danmark A/S, 25.07.2022

3.2.2 Assessment and test reports

[G1] Advisory Opinion No. GS 6.1/22-002-1: Assessment of the load bearing behaviour of SPIT PULSA systems under tension load and one-sided fire loading according to the standard temperature-time curve for anchoring in concrete – MFPA Leipzig GmbH; 20.09.2022

4 Assessment of the performance

4.1 Design concept

For the products described above, SPIT SAS aims to declare the performance characteristics in case of fire basing on the regulations of EAD 330083-04-0601 [N2]. With regard to the fire resistance of products made of steel, reference is made in [N2], Chapter 2.2.6 to EAD 330232-01-0601 [N3]. In [N3], Chapters 2.2.18, 2.2.19 and 2.2.20 the experimental determination of the fire resistance for

- tensile loading and steel failure,
- tensile loading and pull-out failure and
- shear loading and steel failure

is described.
In case of tensile loading and pull-out failure reference is made in [N3], Chapter 2.2.19 to EN 1992-4 [N4]: If the fire resistance for pull-out failure is calculated in accordance with [N4] on the basis of test results at ambient temperature, fire tests may be omitted.
The characteristic load bearing capacity of a system under tensile loading in case of fire is determined from the minimum value of the load bearing capacities for steel failure and pull-out failure

$$N_{Rk,fi}(t) = min\left[N_{Rk,s,fi}(t), \quad N_{Rk,p,fi}(t)\right]. \tag{1}$$

4.2 Summary

In the following, the performance characteristics are summarized.

4.2.1 Balistic nails HC6

		fire duration $[min]$			
		30	60	90	120
HC6-27	$h_{ef} \geq 18{,}8mm$	12,81	10,16	7,5	6,18
HC6-27 HC6-32 HC6-50 HC6-57 HC6-65	$h_{ef} \geq 15mm$	6,0			

Table 1: SPIT PULSA systems, SPIT HC6 balistic nails: Characteristic load bearing capacity $N_{Rk,s,fi}(t)$ $[kg]$ for steel failure (tensile and shear loading) and $\tilde{N}_{Rk,p,fi}(t)$ $[kg]$ for pull-out failure in non-cracked concrete

	fire duration $[min]$			
	30	60	90	120
HC6-15 HC6-17 HC6-22	-			
HC6-27 HC6-32 HC6-50 HC6-57 HC6-65	1,25			1,0

Table 2: SPIT PULSA systems, SPIT HC6 balistic nails: Characteristic tensile load bearing capacity $N_{Rk,p,fi}(t)$ $[kg]$ for pull-out failure in cracked concrete

The load bearing capacities summarized in Tables 1 and 2 are applicable to

- SPIT PULSA Gas actuated tools PULSA P40 P+ and PULSA P65.

4.2.2 Multiple fastening of drywall tracks

fire duration $[min]$			
30	60	90	120
26,80	19,86	12,92	9,48

Table 3: SPIT PULSA systems, multiple fastening of drywall tracks with balistic nails HC6-15 and HC6-17: Characteristic tensile load bearing capacity $N_{Rk,s,fi}(t)$ $\left[\frac{kg}{m}\right]$ for steel failure and $\tilde{N}_{Rk,p,fi}(t)$ $\left[\frac{kg}{m}\right]$ for pull-out failure in non-cracked concrete

The load bearing capacities summarized in Table 3 are applicable to

- drywall tracks UW, width = 50mm, height = 40mm, sheet thickness $0{,}6mm \leq t \leq 2{,}0mm$,
- nail spacings $\leq 300mm$,
- SPIT PULSA Gas actuated tools PULSA P40 P+ and PULSA P65.

4.2.3 SPIT PULSA systems with SPIT HC6 balistic nails

item	size	fire duration [min] 30	60	90	120
metal P-clip V2	16 20 22 24 25	2,02	1,68	1,34	1,17
perforated strip	12x0,8 17x0,8	7,31	5,89	4,46	3,75
clip MCC-O		10,16	8,71	7,25	6,52
MBCH	15 cables 30 cables	12,32 11,51	9,81 10,17	7,30 8,84	- 8,17

Table 4: SPIT PULSA systems with SPIT HC6 balistic nails: Characteristic tensile load bearing capacity $N_{Rk,s,fi}(t)$ $[kg]$ for steel failure and $\tilde{N}_{Rk,p,fi}(t)$ $[kg]$ for pull-out failure in non-cracked concrete

The load bearing capacities summarized in Table 4 are applicable to

- SPIT HC6-17 balistic nails,
- SPIT PULSA Gas actuated tools PULSA P40 P+ and PULSA P65,
- for perforated strip additionally:
  - 2 nails per item to be fastend, 4 free perforations between 2 nails.

5 Special notes

The advisory opinion at hand is valid for SPIT PULSA systems with SPIT HC6 balistic nails which are installed according to the manufacturer's instructions.

The load bearing capacities specified in the framework of the document at hand are determined for one-sided fire loading according to the standard temperature-time curve. According to [N4], Annex D.1(5) the values may also be used for multilateral fire loading when the edge distance of the fastener is $c \geq 300mm$ and $c \geq 2 \cdot h_{ef}$.

The load bearing capacity values shown in this document do not apply to the failure modes of the substrate under loads perpendicular and oblique to the nail axis.

The assessment at hand is valid for constructions of reinforced or unreinforced normal concrete of the strength class $\geq$ C20/25 and $\leq$ C50/60 according to [N7], which exhibit at least the same fire resistance class as the utilized systems. The design of the concrete construction has to be carried out according to [N8].

The load bearing capacities specified in the framework of the document at hand are determined assuming that no explosive concrete spalling occurs and are only valid under this condition. Evidence on the prevention of explosive concrete spalling is given in [N8], Chapter 4.5.

6 Signatures

This document does not replace a certificate of constancy of performance or suitability according to national and European building codes.

Leipzig, 24.01.2025

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