

Engineering Judgment

**120-year assessment of post-installed rebar
connections with improved bond-splitting
behaviour of
Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3
based on
EAD 332402-00-0601-v01**

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1. General

This document provides the relevant parameters ($sp1-sp4$, $lb1$, A_k , Ω_{cr}) for the calculation of the bond-splitting resistance, the bond strength values for uncracked concrete $\tau_{Rk,ucr}$ and the ψ^{ρ}_{sus} -factors for the injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 used for post-installed rebar connections with improved bond-splitting behaviour for a working life of 120 years.

The Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 injection system is intended for use in three temperature ranges, which include

- temperature range I (40°C short-term/24°C long-term),
- temperature range II (80°C short-term/50°C long-term) and
- temperature range III (120°C short-term/72°C long-term).

The assessed values expand on European Technical Assessment ETA-19/0665, dated from 29th June 2023, which includes the calculation parameters for the bond-splitting resistance, bond strength values and ψ^{ρ}_{sus} -factors for a working life of 100 years in accordance with European Assessment Document EAD 332402-00-0601-v01 for static and quasi-static tension loadings.

EAD 332402-00-0601-v01 (not yet published) provides assessment criteria to extend the working life up to 100 years based on the maximum Working Life Category 5 in Eurocode EN 1990. The provided 120-year calculation parameters $sp1-sp4$, $lb1$, A_k , Ω_{cr} for the bond-splitting resistance are based on the assessment for a working life of 100 years. There was no additional testing performed for the 120-year assessment.

The assessed values are based on the present state of knowledge about the long-term degradation behaviour of the used bonding material. Therefore, the long-term behaviour and robustness of the adhesive have to be guaranteed by the quality standards of the manufacturer!

There are no specific long-term tests prescribed in the EAD 332402-00-0601-v01 for the 100-year working life for the determination of the relevant parameters ($sp1-sp4$, $lb1$, A_k , Ω_{cr}) used for the calculation of the bond-splitting resistance. Therefore, the values of the parameters $sp1-sp4$, $lb1$, A_k , Ω_{cr} assessed for a working life of 100 years are considered to be also valid for 120 years. The proposed 120-year bond strength values for uncracked concrete $\tau_{Rk,ucr}$ and ψ^{ρ}_{sus} -factors provided in this document, are adopted from the bonded anchor assessment for a working life of 120 years (Engineering Judgment No. 01/2024 (18th March 2024) from the Bergmeister ZT GmbH) and based on the 100-year values from the valid ETA-19/0665, where the minimum value of these two is taken into consideration.

The injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for post-installed rebar connections with improved bond-splitting behaviour is assessed with reinforcing bars (rebars) for different sizes and drilling methods. The properties of the used rebars have to be in accordance with EN 1992-1-1, with classes B or C for the rebars.

The relevant parameters ($sp1$ - $sp4$, $lb1$, A_k , Ω_{cr}) for the calculation of the bond-splitting resistance, the bond strength values for uncracked concrete $\tau_{Rk,ucr}$ and the ψ_{sus}^0 -factors for a working life of 120 years expand on ETA-19/0665, which includes 50-year and 100-year values.

2. Assessment of bond strength values $\tau_{Rk,ucr}$, ψ_{sus}^0 -factors and relevant parameters for the calculation of the bond-splitting resistance for Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 for a working life of 120 years

The injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 is intended for use in non-carbonated, compacted reinforced or unreinforced normal weight concrete without fibers for concrete strength classes C20/25 to C50/60 according to EN 206 under static and quasi-static loading situations. The Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 injection system for post-installed rebar connections with improved bond-splitting behaviour is assessed with reinforcing bars of sizes $\emptyset 8$ to $\emptyset 32$ for the drilling methods hammer drilling (HD), hammer drilling with Hilti hollow drill bit TE-CD and TE-YD (HDB) and diamond coring with specific roughening using the Hilti roughening tool TE-YRT (RT). The installation is intended in dry or wet concrete, but not in flooded holes.

The 120-year bond strength values for uncracked concrete $\tau_{Rk,ucr}$ and ψ_{sus}^0 -factors separated for the different temperature ranges and the relevant parameters Ω_{cr} , $sp1$ - $sp4$, $lb1$ and A_k for the calculation of the bond-splitting resistance for a working life of 120 years are given in the following Table 1. The additional specifications (e.g., installation condition, minimum concrete cover, maximum embedment length, etc.) remain the same as already specified in ETA-19/0665.

Table 1: Essential characteristics for rebars under tension load for a working life of 120 years for Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3

Rebar		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø26	Ø28	Ø30	Ø32
Diameter of rebar	Ø [mm]	8	10	12	14	16	20	25	26	28	30	32
Pull-out resistance												
Characteristic bond resistance in uncracked concrete C20/25 – 120 years working life												
Temperature range I: 24°C/40°C	$\tau_{Rk,ucr}$ [N/mm ²]	10,8										
Temperature range II: 50°C/80°C	$\tau_{Rk,ucr}$ [N/mm ²]	9,4										
Temperature range III: 72°C/120°C	$\tau_{Rk,ucr}$ [N/mm ²]	7,9										
Influence of cracked concrete	Ω_{cr} [-]	0,53	0,58		0,61		0,64		0,73			
Bond -splitting resistance												
Product basic factor	A_k [-]	4,1										
Exponent for influence of concrete compressive strength	sp_1 [-]	0,31										
Exponent for influence of rebar diameter Ø	sp_2 [-]	0,32										
Exponent for influence of concrete cover c_d	sp_3 [-]	0,67										
Exponent for influence of side concrete cover (c_{max} / c_d)	sp_4 [-]	0,25										
Exponent for influence of anchorage length l_b	lb_1 [-]	0,45										
Influence factors ψ on bond resistance τ_{Rk}												
Cracked and uncracked concrete: Sustained load factor – 120 years	$\psi_{sus,120}^0$	24°C/40°C	0,71									
		50°C/80°C	0,86									
		72°C/120°C	0,72									

The provided 120-year calculation parameters for the bond-splitting resistance are based on the assessment for a working life for 100 years. The bond strength values for uncracked concrete $\tau_{Rk,ucr}$ and the ψ^{0}_{sus} -factors are adopted from the Engineering Judgment No. 01/2024 (18th March 2024) from the Bergmeister ZT GmbH for a working life of 120 years and based on the 100-year values from the valid ETA-19/0665, where the minimum value of these two factors is taken into consideration.

The assessed values are based on the present state of knowledge about the long-term degradation behaviour of the used bonding material. Therefore, the long-term behaviour and robustness of the adhesive have to be guaranteed by the quality standards of the manufacturer!

No additional tests have been performed for this 120-year assessment. The provided relevant parameters ($sp1-sp4$, $lb1$, A_k , Ω_{cr}) for the calculation of the bond-splitting resistance, the bond strength values for uncracked concrete $\tau_{Rk,ucr}$ and the ψ^{0}_{sus} -factors for the injection system Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3 used for post-installed rebar connections with improved bond-splitting behaviour for a working life of 120 years are valid for the specified rebar sizes, concrete strength classes and drilling methods. All values provided are only permissible for static and quasi-static tension loadings.

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