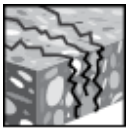
Hilti HIT-RE 500 V3 mortar with rebar (as post-installed connection)

Injection mortar system	Benefits
 Hilti HIT-RE 500 V3 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)  Statik mixer  Rebar	- **SAFEset** technology: Hilti hollow drill bit for hammer drilling and roughening tool for diamond coring - suitable for concrete C 12/15 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - for rebar diameters up to 40 mm - non corrosive to rebar elements - long working time at elevated temperatures - suitable for embedment length till 3200 mm - fire time exposure up to 4h

Base material


Concrete (uncracked)


Concrete (cracked)


Dry concrete


Wet concrete

Load conditions


Static/ quasi-static


Fire resistance

Installation conditions


Hammer drilling


Diamond coring

SAFEset
Hilti SAFEset technology with hollow drill bit and roughening tool

Other informations


European Technical Approval


CE conformity


PROFIS Rebar design Software

SGK
Corossion tested

Service temperature range

Temperature range: -40°C to +80°C (max. long term temperature +50°C, max. short term temperature +80°C).

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical assessment	CSTB, Marne la Vallée	ETA-16/0142 / 2016-04-18
European technical assessment	CSTB, Marne la Vallée	ETA-16/0143 / 2016-04-18
Fire evaluation	CSTB, Marne la Vallée	MRF 1526054277/B / 2016-04-12

a) All data given in this section according to the approvals mentioned above ETA-16/0142 issue 2016-04-18 and ETA-16/0143 issue 2016-03-29.

Materials

Reinforcmenent bars according to EC2 Annex C Table C.1 and C.2N.

Properties of reinforcement

Product form		**Bars and de-coiled rods**	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ (MPa)		400 to 600	
Minimum value of k = $(f_t/f_y)_k$		≥ 1,08	≥ 1,15 < 1,35
Characteristic strain at maximum force, ε_{uk} (%)		≥ 5,0	≥ 7,5
Bendability		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar) (%)	Nominal bar size (mm) ≤ 8 > 8	± 6,0 ± 4,5	
Bond: Minimum relative rib area, $f_{R,min}$	Nominal bar size (mm) 8 to 12 > 12	0,040 0,056	

Setting details

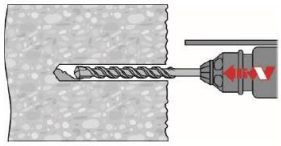
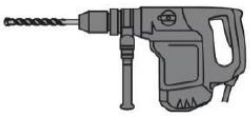
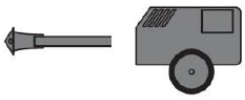
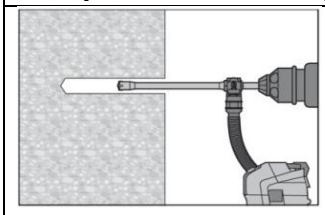
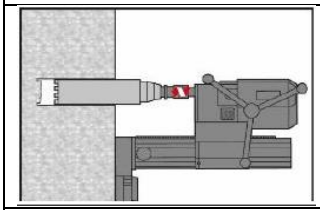
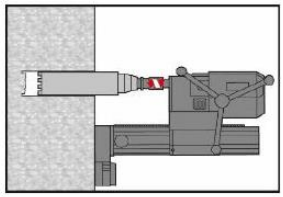
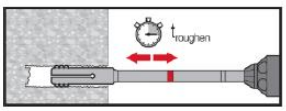
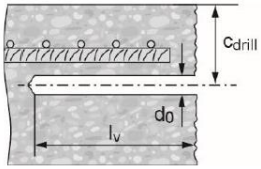
For detailed information on installation see instruction for use given with the package of the product.

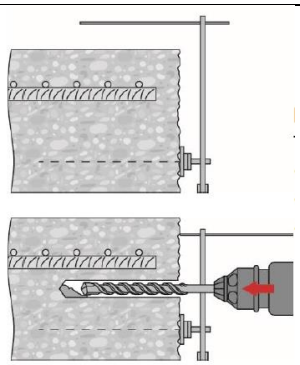
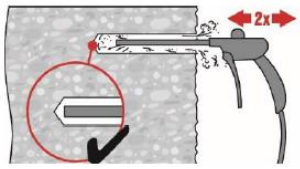
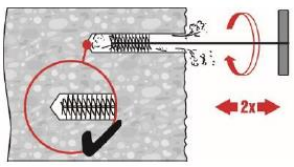
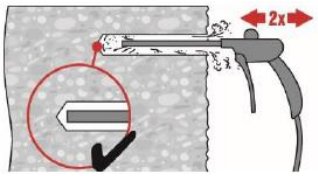
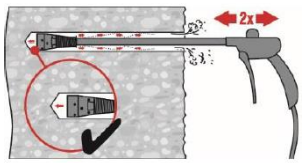
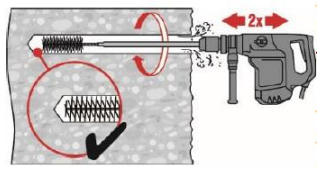
Curing time for general conditions[1)]

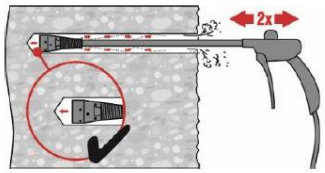
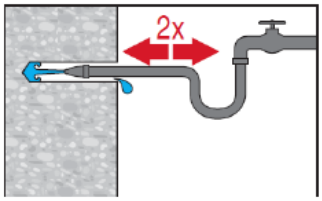
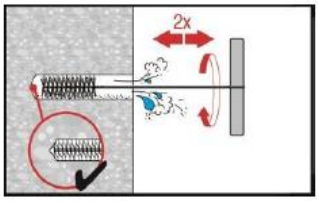
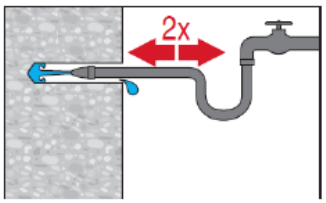
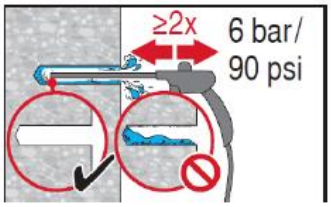
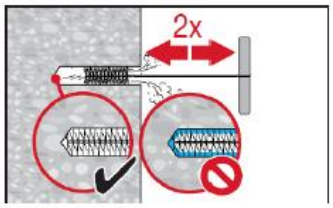
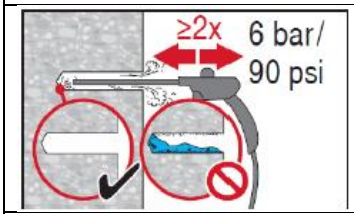
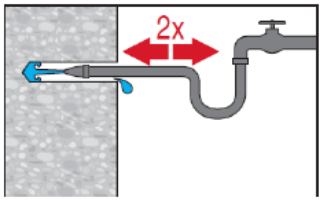
Data according ETA-16/0142, issue 2016-04-18			
Temperature of the base material	**Working time in which rebar can be inserted and adjusted t_{gel}**	**Initial curing time $t_{cure,ini}$**	**Curing time before rebar can be fully loaded t_{cure}**
5 °C ≤ T_{BM} < -1 °C	2 h	48 h	168 h
0 °C ≤ T_{BM} < 4 °C	2 h	24 h	48 h
5 °C ≤ T_{BM} < 9 °C	2 h	16 h	24 h
10 °C ≤ T_{BM} < 14 °C	1,5 h	12 h	16 h
15 °C ≤ T_{BM} < 19 °C	1 h	8 h	16 h
20 °C ≤ T_{BM} < 24 °C	30 min	4 h	7 h
25 °C ≤ T_{BM} < 29 °C	20 min	3,5 h	6 h
30 °C ≤ T_{BM} < 34 °C	15 min	3 h	5 h
35 °C ≤ T_{BM} < 39 °C	12 min	2 h	4,5 h
T_{BM} = 40 °C	10 min	2 h	4 h

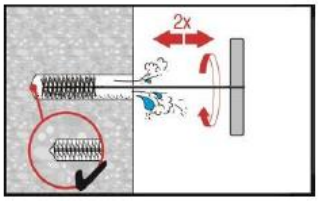
[1)] The curing time data are valid for dry base material only. In wet base material the curing times must be doubled.

Setting instruction

Safety Regulations: 	Review the Material Safety Data Sheet (MSDS) before use for proper and safe handling! Wear well-fitting protective goggles and protective gloves when working with Hilti HIT-RE 500 V3. Important: Observe the installation instruction of the manufacturer provided with each foil pack.
Hole drilling	Note: Before drilling, remove carbonized concrete; clean contact areas In case of aborted drill hole the drill hole shall be filled with mortar.
a) Hammer drilling	
	Drill hole to the required embedment depth with a hammer drill set in rotation-hammer mode or a compressed air drill using an appropriately sized carbide drill bit. Hammer drill (HD)  Compressed air drill (CA) 
b) Hammer drilling with Hilti hollow drill bit: for dry and wet concrete only.	
	Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment. This drilling system removes the dust and cleans the drill hole during drilling when used in accordance with the user's manual. After drilling is complete, proceed to the "injection preparation" step in the installation instruction.
c) Diamond coring: for dry and wet concrete only.	
	Diamond coring is permissible when suitable diamond core drilling machines and the corresponding core bits are used.
d) Diamond coring followed by roughening with Hilti Roughening tool: for dry and wet concrete only.	
 	Diamond coring is permissible when suitable diamond core drilling machines and the corresponding core bits are used. For the use in combination with Hilti roughening tool TE-YRT. Before roughening the borehole needs to be dry. Check usability of the roughening tool with the wear gauge RTG. Roughen the borehole over the whole length to the required h_{ef}.
Splicing applications	
	Measure and control concrete cover c. $c_{drill} = c + d_0/2$ Drill parallel to surface edge and to existing rebar. Wher applicable use Hilti drilling aid HIT-BH.

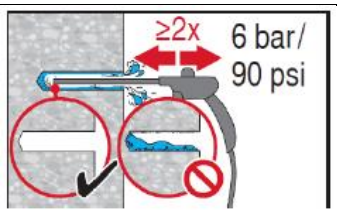
Drilling aid	
	Ensure that the drill hole is parallel to the existing rebar. Three different options can be considered: • Hilti drilling aid HIT-BH • Lath or spirit level • Visual check
Drill hole cleaning	Just before setting the bar, the drill hole must be free of dust and debris by one of two cleaning methods described below. Inadequate hole cleaning = poor load values.
Compressed air cleaning (CAC) For all drill diameters d_0 and all drill hole depths $h_0 \leq 20 \cdot d$	
	Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m^3/h) until return air stream is free of noticeable dust.
	Brush 2 times with the specified brush HIT-RB size (brush Ø ≥ borehole Ø) by inserting the round steel brush to the back of the hole (if needed with nozzle extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the drill hole. If this is not the case, please use a new brush or a brush with a larger diameter.
	Blow 2 times again with compressed air until return air stream is free of noticeable dust. If required use additional accessories and extensions for air nozzle and brush to reach back of hole.
Compressed Air Cleaning (CAC)	For drill holes deeper than 250 mm (for ϕ 8 to ϕ 12) or deeper than 20·ϕ (for ϕ > 12 mm)
	Use the appropriate air nozzle Hilti HIT-DL. Blow two times from the back of the hole over the hole length with oil-free compressed air until return air stream is free of noticeable dust. Safety tip: Do not inhale concrete dust. Use of the dust collector Hilti HIT-DRS is recommended.
	Screw the round steel brush HIT-RB in one end of the brush extension HIT-RBS, so that the overall length of the brush is sufficient to reach the base of the drill hole. Attach the other end of the extension to the TE-C/TE-Y chuck. Safety tip: Start machine brushing operation slowly Start brushing operation once the brush is inserted in the borehole.

	Use the appropriate air nozzle Hilti HIT-DL. Blow two times from back of the hole over the hole length with oil-free compressed air until return air stream is free of noticeable dust. Safety tip: Do not inhale the concrete dust. Use of the dust collector Hilti HIT-DRS is recommended.
Cleaning of diamond cored holes: For all drill hole diameters d_0 and all drill hole depths h_0	
	Flush 2 times by inserting a water hose (water-line-pressure) to the back of the hole until water runs clear.
	Brush 2 times with the specified brush by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø). If this is not the case, please use a new brush or a brush with a larger diameter.
	Flush 2 times by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.
	Blow 2 times from the back of the hole (if needed woth nozzle extension) over the whole length with oil-free compressed air (min. 6 bat at 6 m^3/h) until return air stream is free of noticeable dust and water. For drill hole diameters ≥ 32 mm the compressor has to supply a minimum air flow of 140 m^3/h.
	Brush 2 times with the specified brush size (brush Ø ≥ drill hole Ø) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a teisitng motion snd removing it. The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø). If this is not the case, please use a new brush or a brush with a larger diameter
	Blow 2 times with compressed air until return air stream is free of noticeable dust and water.
Cleaning of diamond cored holes followe by roughening: For all drill hole diameters d_0 and all drill hole depths h_0	
	Flush 2 times by inserting a water hose (water-line-pressure) to the back of the hole until water runs clear.



Brush 2 times with the specified brush by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.

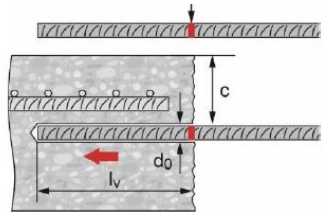
The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø). If this is not the case, please use a new brush or a brush with a larger diameter.



Blow 2 times from the back of the hole (if needed woth nozzle extension) over the whole length with oil-free compressed air (min. 6 bat at 6 m^3/h) until return air stream is free of noticeable dust and water.

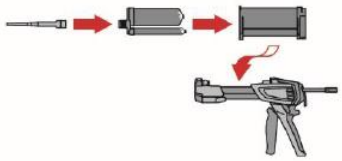
For drill hole diameters ≥ 32 mm the compressor has to supply a minimum air flow of 140 m^3/h.

Rebar preparation

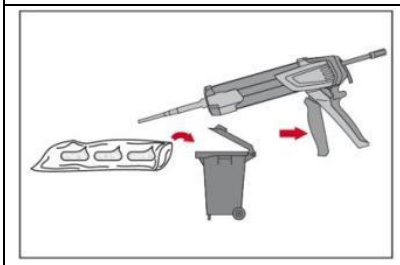


Before use, make sure the rebar is dry and free of oil or other residue.
Mark the embedment depth on the rebar. (e.g. with tapte) **,** ℓ_v
Insert rebar in borehole, to verify hole and setting depth ℓ_v.

Injection preparation

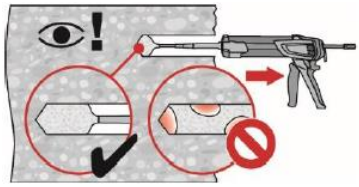
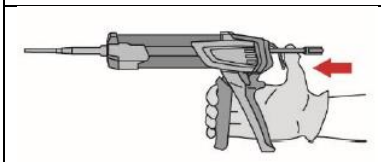
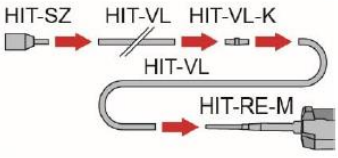
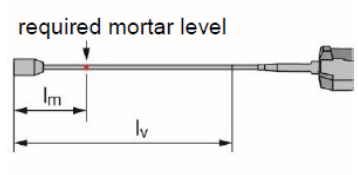
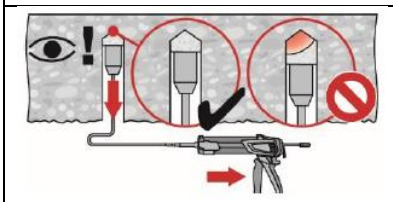
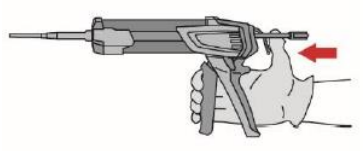


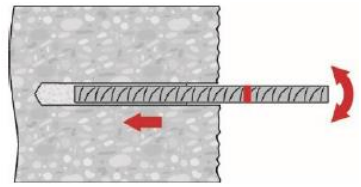
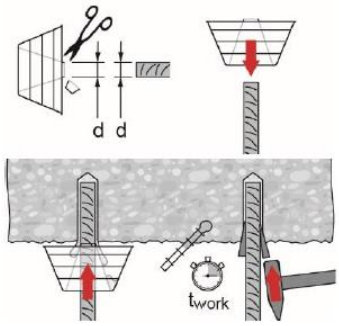
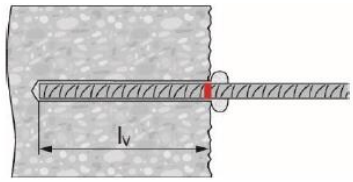
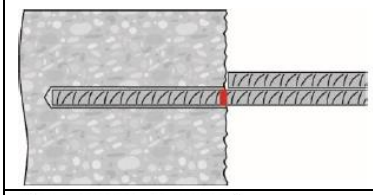
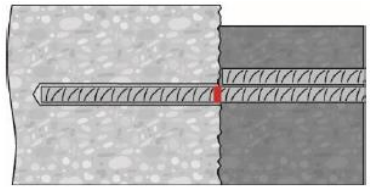
Tightly attach Hilti mixing nozzle HIT-RE-M to foil pack manifold. Do not modify the nixing nozzle.
Observe the instruction for use of the dispenser.
Check foil pack holder for proper function. Insert foil pack into foil pack holder and put holder into dispenser.



The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
After changing a mixing nozzle, the first few trigger pulls must be discarded as decribed above. For each new foil pack a new mixing nozzle must be used.
Discard quantities are

- 3 strokes for 330 ml foil pack,
- 4 strokes for 500 ml foil pack,
- 65 ml for 1400 ml foil pack.

Inject adhesive	Injecz adhesive form the back of the drill hole without forming air voids.
Injection method for drill hole depth ≤ 250 mm (without overhead applications)	
	Inject the adhesive from the back of the hole towards the front and slowly withdraw the mixing nozzle step by step after each trigger pull. Fill holes approximately 2/3 full to ensure that the annular gap between the rebar and the concrete is completely filled with adhesive over the embedment length.
	After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle.
Injection method for drill hole depth > 250 mm or overhead application	
	Assemble mixing nozzle HIT-RE-M, extension(s) and piston plug HIT-SZ. For combinations of several injection extansions use coupler HIT-VL K. A substitution of the injection extansion for a plastic hose or a combination of both is permitted. The combination of HIT-SZ piston plug with HIT-VL 16 pipe and then HIT-VL 16 tube support proper injection.
	Mark the required mortar level ℓ_m and embedment depth ℓ_v with tape or marker on the injection extension. estimation: $l_m = 1/3 \cdot l_v$ precise formula for optimum mortar volume: $l_m = l_v \cdot (1{,}2 \cdot (\phi^2 / d_0^2) - 0{,}2)$
	For overhead installationthe injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug. Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the drill hole by the adhesive pressure.
	After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle.

Setting the element	Before use verify that the element is dry and free of oil and other contaminants.
	For easy installation insert the rebar slowly twisted into the drill hole until the embedment mark is at the concrete surface level.
	For overhead application: During insertion of the rebar, mortar might flow out of the borehole. For collection of the flowing mortar, HIT-OHC may be used. Support the rebar and secure it from falling till mortar started to harden, e.g. using wedges HIT-OHW. For overhead installation use piston plugs and fix embedded parts with e.g. wedges.
	After installing the rebar the annular gap must be completely filled with mortar. Proper installation: • desired anchoring embedment l_v is reached: embedment mark at concrete surface. • excess mortar flows out of the drill hole after the rebar has been fully inserted until the embedment mark.
	Observe the working time t_{work}, which varies according to temperature of base material. Minor adjustments to the rebar position may be performed during the working time.
	Full load may be applied only after the curing time t_{cure} has elapsed.

Fitness for use

Some creep tests have been conducted in accordance with EAD 330087-00-0601 in the following conditions : in dry environnement at 50 °C during 90 days.
These tests show an excellent behaviour of the post-installed connection made with HIT-RE 500 V3: low displacements with long term stability, failure load after exposure above reference load.

Resistance to chemical substances

Categories	Chemical substances	Resistant	Non resistant
Alkaline products	Drilling dust slurry pH = 12,6	+	
	Potassium hydroxide solution (10%) pH = 14	+	
Acids	Acetic acid (10%)		+
	Nitric acid (10%)		+
	Hydrochloric acid (10%)		+
	Sulfuric acid (10%)		+
Solvents	Benzyl alcohol		+
	Ethanol		+
	Ethyl acetate		+
	Methyl ethyl keton (MEK)		+
	Trichlor ethylene		+
	Xylol (mixture)	+	
Products from job site	Concrete plasticizer	+	
	Diesel	+	
	Engine oil	+	
	Petrol	+	
	Oil for form work	+	
Environnement	Sslt water	+	
	De-mineralised water	+	
	Sulphurous atmosphere (80 cycles)	+	

Electrical Conductivity

HIT-RE 500 V3 in the hardened state **is not conductive electrically**. Its electric resistivity is $66 \cdot 10^{12}\ \Omega.m$ (DIN IEC 93 – 12.93). It is adapted well to realize electrically insulating anchorings (ex: railway applications, subway).

Drilling diameters

Rebar [mm]	Drill bit diameters d_0 [mm]					
	Hammer drill (HD)	Hollow Drill Bit (HDB)	Compressed air drill (CA)	Diamond coring		
				Dry (PCC)	Wet (DD)	With roughening tool (RT)
10	14 (12 a))	14 (12 a))	-	-	14 (12 a))	-
12	16 (14 a))	16 (14 a))	17	-	16 (14 a))	-
14	18	18	17	-	18	18
16	20	20	20	-	20	20
18	22	22	22	-	22	22
20	25	25	26	-	25	25
22	28	28	28	-	28	28
24	32	32	32	-	32	32
25	32	32	32	-	32	32
26	35	35	35	35	35	35
28	35	35	35	35	35	35
30	37	-	35 / 37	35	37	-
32	40	-	40	47	40	-
34	45	-	42	47	45	-
36	45	-	45	47	47	-
40	55	-	57	52	52	-

a) Max. installation length l = 250 mm.

Basic design data for rebar design according to rebar ETA

Bond strength in N/mm² according to ETA 16/0142 for hammer drilling, hammer drilling with hollow drill bit TE-CD, TE-YD, compressed air drilling, dimond coring dry and diamond coring wet followed by roughening with Hilti roughening tool TE-YRT

Rebar [mm]	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
10 - 40	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3

Bond strength in N/mm² according to ETA 16/0142 for diamond coring wet

Rebar [mm]	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
10 - 12	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,0
14 - 16	1,6	2,0	2,3	2,7	3,0	3,4	3,7	3,7	3,7
20 - 36	1,6	2,0	2,3	2,7	3,0	3,4	3,4	3,4	3,4
40	1,6	2,0	2,3	2,7	3,0	3,0	3,0	3,0	3,0

Pullout design bond strength for Hit Rebar design Method

Design bond strength [$f_{bd,po} = \tau_{Rk}/\gamma_{Mp}$] in N/mm² according to ETA-16/0143 for uncracked concrete C20/25

Temperaure range	Dilling method	Rebar [mm]								
		10	12	14	16	20	25	28	30	32
I: 40°C/24° C	Hammer drilled holes	9,3	9,3	9,3	9,3	9,3	8,7	8,7	8,7	8,7
	Hammer drilled holes with hollow drill bit	-	9,3	9,3	9,3	9,3	8,7	8,7	-	-
	Diamond cored holes with roughening tool	-	-	9,3	9,3	9,3	8,7	8,7	-	-
	Diamond cored holes	5,0	5,0	5,0	4,3	4,3	4,3	4,5	4,5	4,5
	Hammer drilled holes in water filled holes	5,7	5,7	5,7	5,7	5,7	5,2	5,2	5,2	5,2
I: 70°C/43° C	Hammer drilled holes	7,3	7,3	7,3	6,7	6,7	6,7	6,3	6,3	6,3
	Hammer drilled holes with hollow drill bit	-	7,3	7,3	6,7	6,7	6,7	6,3	-	-
	Diamond cored holes with roughening tool	-	-	7,3	6,7	6,7	6,7	6,3	-	-
	Diamond cored holes	3,6	3,6	3,6	3,1	3,3	3,3	3,3	3,3	3,3
	Hammer drilled holes in water filled holes	4,3	4,3	4,3	4,3	4,0	4,0	4,0	3,8	3,8

Design bond strength [$f_{bd,po} = \tau_{Rk}/\gamma_{Mp}$] in N/mm² according to ETA-16/0143 for cracked concrete C20/25

Temperaure range	Dilling method	Rebar [mm]								
		10	12	14	16	20	25	28	30	32
I: 40°C/24° C	Hammer drilled holes	5,7	6,3	6,3	6,3	6,7	6,7	7,3	7,3	7,3
	Hammer drilled holes with hollow drill bit	-	6,3	6,3	6,3	6,7	6,7	7,3	-	-
	diamond cored holes with roughening tool	-	-	6,3	6,3	6,7	6,7	7,3	-	-
II: 70°C/43° C	Hammer drilled holes	4,7	5,3	5,3	5,3	5,3	5,3	5,3	5,3	5,3
	Hammer drilled holes with hollow drill bit	-	5,3	5,3	5,3	5,3	5,3	5,3	-	-
	diamond cored holes with roughening tool	-	-	5,3	5,3	5,3	5,3	5,3	-	-

Increasing factors in concrete for $f_{bd,po}$ according to ETA-16/0143 for uncracked and cracked concrete

Dilling method	Concrete class	Rebar [mm]								
		10	12	14	16	20	25	28	30	32
Hammer drilled holes Hammer drilled holes with hollow drill bit Diamond cored holes	C 30/37	1,04								
	C40/50	1,07								
	C50/60	1,09								
Diamond cored holes with roughening tool	C 30/37 - C50/60	1,0								

Additional Hilti Technical Data:

Reduction factor for splitting with large concrete cover: δ = 0,306 (Hilti additional data)

Amplification factor α_{lb} for the minimum anchorage length and minimum lap length according to EN 1992-1-1

For Hammer drilling, Hammer drilling with Hilti Hollow Drill Bit, Compressed air drilling, Diamond coring followed by roughening with Hilti roughwning tool									
Rebar [mm]	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
10 - 40	1,0								

For diamond coring dry and wet									
Rebar [mm]	**Concrete class**								
	C12/15	**C16/20**	**C20/25**	**C25/30**	**C30/37**	**C35/45**	**C40/50**	**C45/55**	**C50/60**
10 - 12	1,0								
14 - 36	Linear interpolation between diameter								
40	1,0	1,0	1,0	1,0	1,2	1,3	1,4	1,4	1,4

Pre-calculated values of anchorage length for characteristic steel strength f_{yk}= 500 N/mm^2

For Hammer drilling, Hammer drilling with Hilti Hollow Drill Bit, Compressed air drilling, Diamond coring followed by roughening with Hilti roughening tool

Rebar [mm]	Concrete class	f_{bd} [N/mm^2]	$f_{bd,p}$ [N/mm^2]	Yielding load [kN]	$l_{0,min}$ [mm] 1)	$l_{b,min}$ [mm] 2)	$l_{bd,y,\alpha2=1}$ [mm] 3)	$l_{bd,y,\alpha2=0.7}$ [mm] 4)	$l_{bd,y,HRM,\alpha2<0.7}$ [mm] 5)
10	C20/25	2,3	9,3	34,1	200	142	473	331	116
10	C50/60	4,3	10,2	34,1	200	100	253	177	107
12	C20/25	2,3	9,3	49,2	200	170	567	397	140
12	C50/60	4,3	10,2	49,2	200	120	303	212	128
14	C20/25	2,3	9,3	66,9	210	198	662	463	163
14	C50/60	4,3	10,2	66,9	210	140	354	248	150
16	C20/25	2,3	9,3	87,4	240	227	756	529	186
16	C50/60	4,3	10,2	87,4	240	160	404	283	171
20	C20/25	2,3	9,3	136,6	300	284	945	662	233
20	C50/60	4,3	10,2	136,6	300	200	506	354	214
25	C20/25	2,3	8,7	213,4	375	354	1181	827	314
25	C50/60	4,3	9,4	213,4	375	250	632	442	288
28	C20/25	2,3	8,7	267,7	420	397	1323	926	351
28	C50/60	4,3	9,4	267,7	420	280	708	495	322
30	C20/25	2,3	8,7	307,3	450	425	1418	992	376
30	C50/60	4,3	9,4	307,3	450	300	758	531	345
32	C20/25	2,3	8,7	349,7	480	454	1512	1059	401
32	C50/60	4,3	9,4	349,7	480	320	809	566	368

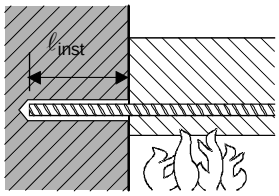
1): Minimum anchorage length for overlap joint
2): Minimum anchorage length for simply supported connections
3): Anchorage length for simply supported connections in case of: α_1= α_2= α_3= α_4= α_5= 1
4): Anchorage length for simply supported connections in case of: α_1= α_3= α_4= α_5= 1; α_2= 0.7
5): Anchorage length with HIT Rebar design Method (HRM) for simply supported connections in case of: α_1= α_3= α_4= α_5= 1; α_2< 0.7. An adequate concrete cover must be applied.

Fire Resistance

According to MRF 1526054277 / B

a) Anchoring application

a) Anchoring application beam-wall connection with a concrete cover of 20 mm



Maximum force in rebar in conjunction with HIT-RE 500 V3 as a function of embedment depth for the fire resistance classes F30 to F240 (yield strength f_{yk} = 500 N/mm² and concrete class C20/25) according EC2[a)].

Rebar	Max. $F_{s,T}$	ℓ_{inst}	Fire resistance of bar in [kN]					
[mm]	[kN]	[mm]	R30	R60	R90	R120	R180	R240
10	26,2	110	5,8	2,4	1,1	0,6	0,0	0,0
		150	10,1	6,5	3,8	2,5	1,2	0,5
		190	14,5	10,8	8,1	6,0	3,3	2,0
		230	18,8	15,1	12,4	10,3	6,7	4,4
		300	26,2	22,7	20,0	17,9	14,3	11,2
		340		26,2	24,3	22,2	18,6	15,6
		360			26,2	24,4	20,8	17,7
		380				26,2	23,0	19,9
		410					26,2	23,1
		440						26,2
12	37,7	140	10,9	6,5	3,5	2,3	1,0	0,3
		200	18,7	14,3	11,0	8,5	4,8	3,0
		260	26,5	22,1	18,8	16,3	12,0	8,3
		320	34,3	29,9	26,6	24,1	19,8	16,1
		350	37,7	33,8	30,5	28,0	23,7	20,0
		390		37,7	35,7	33,2	28,9	25,2
		410			37,7	35,8	31,5	27,8
		430				37,7	34,1	30,4
		460					37,7	34,3
		490						37,7
14	51,3	160	15,7	10,6	6,7	4,4	2,3	1,1
		220	24,8	19,7	15,8	12,9	8,0	5,1
		280	33,9	28,8	24,9	22,0	17,0	12,7
		340	43,0	37,9	34,1	31,1	26,1	21,8
		400	51,3	47,0	43,2	40,2	35,2	30,9
		430		51,3	47,7	44,8	39,7	35,4
		460			51,3	49,3	44,3	40,0
		480				51,3	47,3	43,0
		510					51,3	47,6
		540						51,3

Rebar	Max. $F_{s,T}$	ℓ_{inst}	Fire resistance of bar in [kN]					
[mm]	[kN]	[mm]	R30	R60	R90	R120	R180	R240
16	67	180	21,4	15,5	11,2	7,8	4,3	2,5
		240	31,8	25,9	21,6	18,2	12,5	8,2
		300	42,2	36,3	32,0	28,6	22,9	18,0
		360	52,6	46,8	42,4	39,0	33,3	28,4
		450	67,0	62,4	58,0	54,6	48,9	44,0
		480		67,0	63,2	59,8	54,1	49,2
		510			67,0	65,1	59,3	54,4
		530				67,0	62,8	57,8
		560					67,0	63,0
		590						67,0
20	104,7	220	35,5	28,1	22,6	18,5	11,4	7,3
		280	48,5	41,1	35,6	31,5	24,3	18,1
		340	61,5	54,1	48,6	44,5	37,3	31,1
		400	74,5	67,1	61,7	57,5	50,3	44,1
		460	87,5	80,1	74,7	70,5	63,3	57,1
		540	104,7	97,5	92,0	87,8	80,6	74,5
		580		104,7	100,7	96,5	89,3	83,1
		600			104,7	100,8	93,6	87,5
		620				104,7	98,0	91,8
		660					104,7	100,5
		680						104,7

b) anchoring application beam-wall connection with a concrete cover of 40 mm

Rebar	Max. $F_{s,T}$	ℓ_{inst}	Fire resistance of bar in [kN]					
[mm]	[kN]	[mm]	R30	R60	R90	R120	R180	R240
10	26,2	110	7,3	3,1	1,5	0,9	0,0	0,0
		150	11,6	7,3	4,5	3,0	1,3	0,6
		190	15,9	11,7	8,9	6,7	3,5	2,1
		230	20,3	16,0	13,2	11,0	7,2	4,6
		290	26,2	22,5	19,7	17,5	13,7	10,5
		330		26,2	24,0	21,9	18,0	14,9
		350			26,2	24,0	20,2	17,0
		370				26,2	22,3	19,2
		410					26,2	23,6
		440						26,2
12	37,7	140	12,6	7,5	4,3	2,8	1,1	0,3
		200	20,4	15,3	11,9	9,3	5,2	3,2
		260	28,2	23,1	19,7	17,1	12,5	8,8
		320	36,0	30,9	27,6	25,0	20,3	16,6
		340	37,7	33,5	30,2	27,6	22,9	19,2
		380		37,7	35,4	32,8	28,1	24,4
		400			37,7	35,4	30,7	27,0
		420				37,7	33,3	29,6
		460					37,7	34,8
		490						37,7
14	51,3	160	17,8	11,8	7,9	5,2	2,5	1,2
		220	26,9	20,9	17,0	13,9	8,5	5,5
		280	36,0	30,0	26,1	23,0	17,6	13,2
		340	45,1	39,1	35,2	32,1	26,7	22,4
		390	51,3	46,7	42,8	39,7	34,3	29,9
		430		51,3	48,8	45,8	40,4	36,0
		450			51,3	48,8	43,4	39,0
		470				51,3	46,4	42,1
		510					51,3	48,1
		540						51,3

Rebar	Max. $F_{s,T}$	ℓ_{inst}	Fire resistance of bar in [kN]					
[mm]	[kN]	[mm]	R30	R60	R90	R120	R180	R240
16	67	180	23,8	16,9	12,5	9,0	4,6	2,7
		240	34,2	27,3	22,9	19,4	13,2	8,7
		300	44,6	37,7	33,3	29,8	23,6	18,6
		360	55,0	48,2	43,7	40,2	34,0	29,0
		430	67,0	60,3	55,8	52,3	46,1	41,2
		470		67,0	62,7	59,3	53,1	48,1
		500			67,0	64,5	58,3	53,3
		520				67,0	61,7	56,8
		560					67,0	63,7
		580						67,0
20	104,7	220	38,4	29,8	24,2	19,9	12,2	7,8
		300	55,7	47,2	41,6	37,3	29,5	23,3
		380	73,1	64,5	58,9	54,6	46,8	40,6
		460	90,4	81,9	76,3	71,9	64,2	57,9
		530	104,7	97,0	91,4	87,1	79,3	73,1
		570		104,7	100,1	95,8	88,0	81,8
		600			104,7	102,3	94,5	88,3
		620				104,7	98,9	92,6
		650					104,7	99,1
		680						104,7
25	163,6	280	64,2	53,6	46,6	41,1	31,4	23,7
		370	88,6	77,9	70,9	65,5	55,8	48,0
		460	113,0	102,3	95,3	89,9	80,2	72,4
		550	137,4	126,7	119,7	114,3	104,6	96,8
		650	163,6	153,8	146,8	141,4	131,7	123,9
		690		163,6	157,7	152,2	142,5	134,7
		720			163,6	160,4	150,7	142,9
		740				163,6	156,1	148,3
		770					163,6	156,4
		800						163,6
28	205,3	310	81,1	69,1	61,3	55,2	44,3	35,6
		370	99,3	87,3	79,5	73,4	62,5	53,8
		430	117,5	105,5	97,7	91,6	80,7	72,0
		490	135,7	123,7	115,9	109,8	98,9	90,2
		550	153,9	141,9	134,1	128,0	117,2	108,4
		610	172,1	160,1	152,3	146,2	135,4	126,6
		670	190,3	178,3	170,5	164,4	153,6	144,8
		720	205,3	193,5	185,7	179,6	168,7	160,0
		760		205,3	197,8	191,8	180,9	172,2
		790			205,3	200,9	190,0	181,3
		810				205,3	196,1	187,3
		850					205,3	199,5
		870						205,3
32	268,1	350	106,5	92,8	83,9	76,9	64,5	54,6
		410	127,3	113,6	104,7	97,8	85,3	75,4
		470	148,1	134,5	125,5	118,6	106,1	96,2
		530	168,9	155,3	146,3	139,4	127,0	117,0
		590	189,7	176,1	167,1	160,2	147,8	137,8
		650	210,6	196,9	187,9	181,0	168,6	158,6
		710	231,4	217,7	208,7	201,8	189,4	179,4
		820	268,1	255,8	246,9	240,0	227,5	217,6
		860		268,1	260,8	253,8	241,4	231,4
		890			268,1	264,2	251,8	241,8
		910				268,1	258,7	248,8
		940					268,1	259,2
		970						268,1

b) Overlap joint application

Max. bond stress, $f_{bd,FIRE}$, depending on actual clear concrete cover for classifying the fire resistance.

It must be verified that the actual force in the bar during a fire, $F_{s,T}$, can be taken up by the bar connection of the selected length, ℓ_{inst}. Note: Cold design for ULS is mandatory.

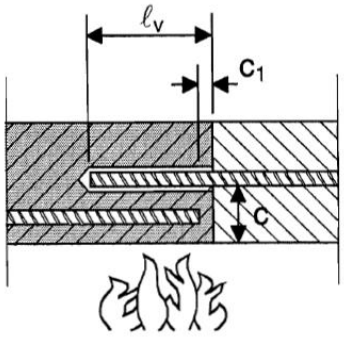
$F_{s,T} \leq (\ell_{inst} - c_f) \cdot \phi \cdot \pi \cdot f_{bd,FIRE}$ where: $(\ell_{inst} - c_f) \geq \ell_s$;

ℓ_s = lap length

ϕ = nominal diameter of bar

$\ell_{inst} - c_f$ = selected overlap joint length; this must be at least ℓ_s, but may not be assumed to be more than 80 ϕ

$f_{bd,FIRE}$ = bond stress when exposed to fire



Critical temperature-dependent bond stress, $f_{bd,FIRE}$, concerning "overlap joint" for Hilti HIT-RE 500 V3 injection adhesive in relation to fire resistance class and required minimum concrete coverage c.

Clear concrete cover c	Max. bond stress, τ_c [N/mm²]					
[mm]	R30	R60	R90	R120	R180	R240
30						
40	0,8					
50	1,1					
60	1,5					
70	2,1	0,9				
80	2,9	1,2				
90	3,5	1,5	0,9			
100		1,8	1,1	0,8		
110		2,3	1,4	1,0		
120		2,8	1,6	1,2		
130		3,4	2,0	1,4	0,9	
140		3,5	2,3	1,6	1,0	
150			2,8	1,9	1,1	0,8
160			3,3	2,2	1,3	0,9
170			3,5	2,5	1,5	1,1
180				2,9	1,7	1,2
190				3,4	1,9	1,4
200				3,5	2,2	1,5
210					2,5	1,7
220					2,8	1,9
230					3,1	2,1
240					3,5	2,3
250						2,6
260						2,9
270						3,2
280						3,5
290						