Deutsches Institut für Bautechnik

Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Member of EOTA
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Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment

ETA-11/0006 of 1 February 2016

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Hilti anchor channels (HAC) with channel bolts (HBC)
Product family to which the construction product belongs	Anchor channels
Manufacturer	Hilti AG Feldkircherstraße 100 9494 Schaan FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Werke
This European Technical Assessment contains	26 pages including 22 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	European Assessment Document (EAD) 330008-02-0601
This version replaces	ETA-11/0006 issued on 28 February 2012

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Specific Part

1 Technical description of the product

The Hilti anchor channel (HAC) with channel bolts (HBC) is a system consisting of V-shaped channel profile of carbon steel and at least two metal anchors non-detachably fixed to the channel back and channel bolts.

The anchor channel is embedded surface-flush in the concrete. Hilti channel bolts with appropriate hexagon nuts and washers are fixed to the channel.

The product description is given in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the anchor channel is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor channel of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistances under static and quasi-static loads and displacements	See Annex C1 to C6
Characteristic resistances under fatigue cyclic loads	See Annex C8 to C10

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for Class A1
Resistance to fire	See Annex C7

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with EAD No. 330008-02-0601, the applicable European legal act is: [2000/273/EC].

The system to be applied is: 1

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5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 1 February 2016 by Deutsches Institut für Bautechnik

Andreas Kummerow
p. p. Head of Department

beglaubigt:
Müller

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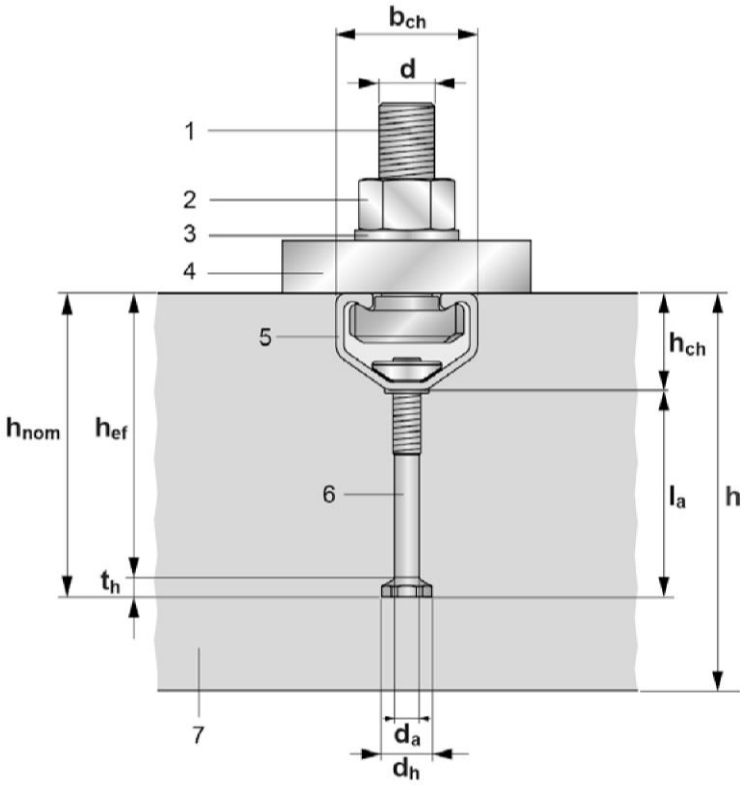
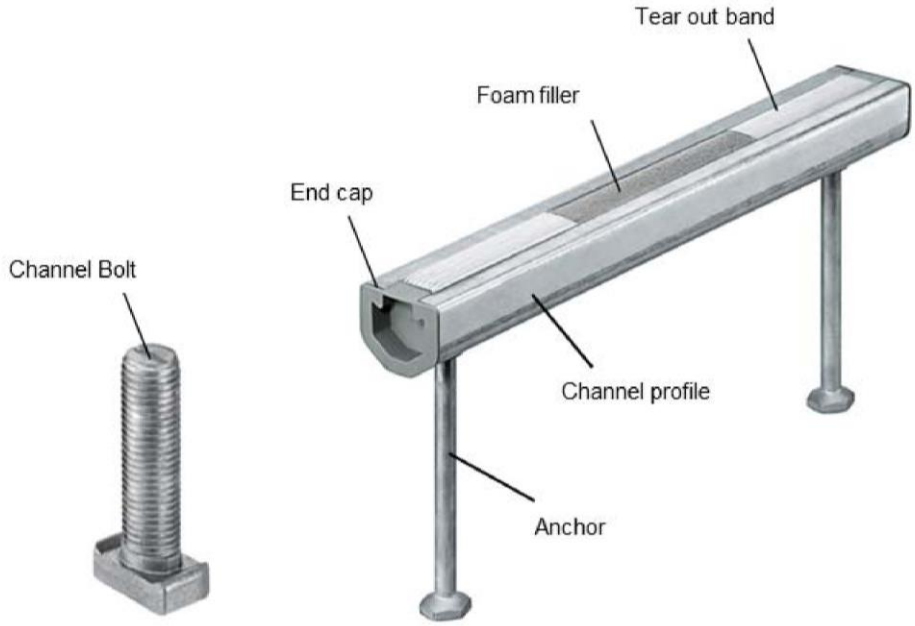
Product and installation condition



Key

1 channel bolt
2 hexagonal nut
3 washer
4 fixture
5 channel profile
6 anchor
7 concrete member



Hilti anchor channels (HAC) with channel bolts (HBC)

Product Description
Installed condition

Annex A1

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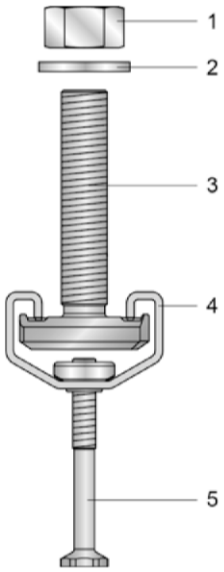
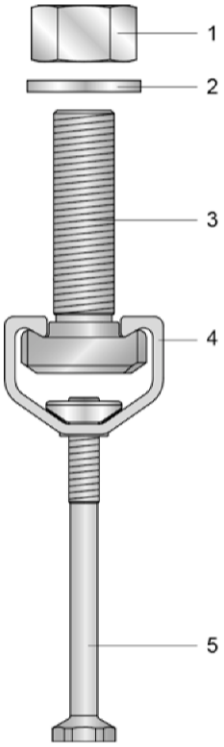
Anchor channel types



HAC-30F
with HBC-B



HAC-40F, HAC-50F, HAC-60F, HAC-70F
with HBC-C and HBC-C-N

Key

1 hexagonal nut
2 washer
3 channel bolt
4 channel profile
5 anchor

Marking of the Hilti anchor channel:
HAC-XZ

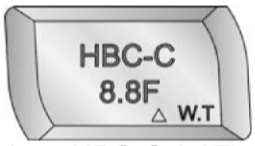
HAC = Identifying mark of the manufacturer (**H**ilti **A**nchor **C**hannel)
X = Size of the channel
Z = Corrosion class

(e.g. HAC-40F)

40 = Anchor channel size 40
F = hot-dip galvanized

Marking of the Hilti channel bolt:
HBC-X-(N) YZ

HBC = Identifying mark of the manufacturer (**H**ilti **B**olt **C**hannel)
X = Type of channel bolt
Y = Steel grade
Z = Corrosion class



(e.g. HBC-C 8.8F)

C = Channel bolt type in combination with HAC-40 to HAC-70
8.8 = Steel grade
F = hot-dip galvanized

Hilti anchor channels (HAC) with channel bolts (HBC)

Product Description
Anchor channel types and marking

Annex A2

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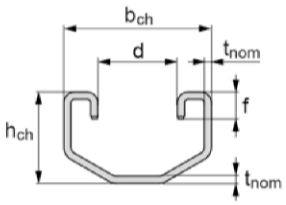
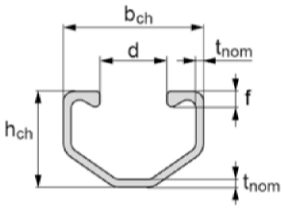
Anchor Channels



HAC-30



HAC-40, HAC-50, HAC-60, HAC-70

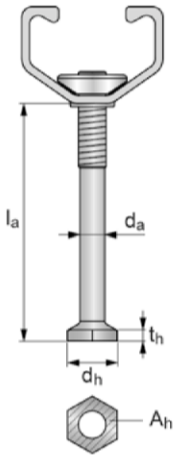
Table 1: Dimensions of channel profile

Anchor channel	b_{ch}	h_{ch}	t_{nom}	d	f	I_y
	[mm]					[mm^4]
HAC-30	41,3	25,6	2,00	22,3	7,5	15349
HAC-40	40,9	28,0	2,25	19,5	4,5	21463
HAC-50	41,9	31,0	2,75	19,5	5,3	33125
HAC-60	43,4	35,5	3,50	19,5	6,3	57930
HAC-70	45,4	40,0	4,50	19,5	7,4	95457

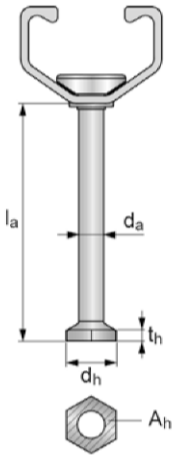
Table 2: Dimensions of anchor (welded or bolted to the channel profile)

Anchor channel	d_a	d_h	t_h	min l_a	Head area A_h
	[mm]				[mm^2]
HAC-30	5,35	11,5	2,0	44,4	89
HAC-40	7,19	17,5	3,0	66,0	209
HAC-50	9,03	19,5	3,5	78,5	258
HAC-60	9,03	19,5	4,5	117,0	258
HAC-70	10,86	23,0	5,0	140,0	356

bolted anchor



welded anchor



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Hilti anchor channels (HAC) with channel bolts (HBC)

Product Description
Anchor channels (HAC)

Annex A3

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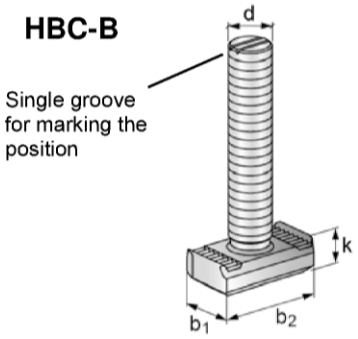
Channel bolts

Table 3: Dimensions of channel bolt

Anchor channel	Channel bolt type	Dimensions			
		b_1	b_2	k	d
		[mm]			
HAC-30	HBC-B	19,0	34,0	9,2	10
					12
HAC-40 HAC-50 HAC-60 HAC-70	HBC-C	14,0	33,0	10,4	10
					12
		18,5		11,4	16
				13,9	20
	HBC-C-N	18,5	33,0	11,4	16
				13,9	20

HBC-B



HBC-C

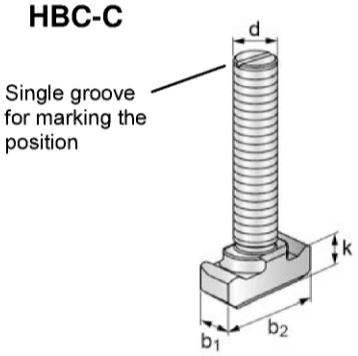
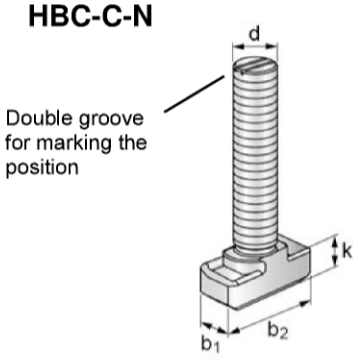


Table 4: Steel grade and corrosion class

Channel Bolt	Carbon steel [1]		Stainless steel [1]
Steel grade	4.6	8.8	A4-50
f_{uk} [N/mm^2]	400	800 / 830 [2]	500
f_{yk} [N/mm^2]	240	640 / 660 [2]	210
Corrosion class	G [3] F [4]		R

[1] Material properties according to Annex A5
[2] Material properties according to EN ISO 898-1
[3] Electroplated
[4] Hot-dip galvanized

HBC-C-N



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Hilti anchor channels (HAC) with channel bolts (HBC)

Product Description
Channel bolts (HBC)

Annex A4

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Table 5: Materials

Component	Carbon steel			Stainless steel
	Material properties	Coating		Material properties
1	2a	2b	2c	3
Channel Profile	Carbon steel according to EN 10025	Hot dip galvanized ≥ 55 µm [1)] Hot dip galvanized ≥ 70 µm [2)]		-
Rivet	Carbon steel	Hot dip galvanized ≥ 45 µm [5)]		-
Anchor	Carbon steel	Hot dip galvanized ≥ 45 µm [5)]		-
Channel bolt	Steel grade 4.6 and 8.8 according to EN ISO 898-1	Electroplated ≥ 8 µm	Hot-dip galvanized ≥ 45 µm [5)]	Steel grade 50 according to EN ISO 3506-1 1.4401 / 1.4404 / 1.4571 1.4362 / 1.4578 / 1.4439
Plain washer [3)] according to EN ISO 7089 and EN ISO 7093-1	Hardness class A ≥ 200 HV	Electroplated ≥ 8 µm	Hot-dip galvanized ≥ 45 µm [5)]	Hardness class A ≥ 200 HV 1.4401 / 1.4404 / 1.4571 1.4362 / 1.4578 / 1.4439
Hexagonal nut according to EN ISO 4032 or DIN 934 [4)]	Property class 8 according to EN ISO 898-2	Electroplated ≥ 8 µm	Hot-dip galvanized ≥ 45 µm [5)]	Property class 70 according to EN ISO 3506-2 1.4401 / 1.4404 / 1.4571 1.4362 / 1.4578 / 1.4439

[1)] For HAC-30F, HAC-40F and HAC-50F.
[2)] For HAC-60F and HAC-70F.
[3)] Not in scope of delivery.
[4)] Hexagonal nuts according to DIN 934 for channel bolts made from carbon steel (4.6) and stainless steel.
[5)] Hot-dip galvanized according to EN ISO 1461.

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Hilti anchor channels (HAC) with channel bolts (HBC)

Product Description
Materials

Annex A5

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Specifications of intended use

Anchor channels and channel bolts subject to:

- Static and quasi-static loads in tension and shear perpendicular to the longitudinal axis of the channel.
- Fatigue cyclic loads.
- Fire exposure: only for concrete class C20/25 to C50/60.

Base materials:

- Reinforced or unreinforced normal weight concrete according to EN 206.
- Strength classes C12/15 to C90/105 according to EN 206.
- Cracked or uncracked concrete.

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (e.g. accommodations, bureaus, schools, hospitals, shops, exceptional internal conditions with usual humidity)
  (anchor channels and channel bolts according to Annex A5, Table 5, column 2 and 3).
- Structures subject to internal conditions with usual humidity (e.g. kitchen, bath and laundry in residential buildings, exceptional permanent damp conditions and application under water)
  (anchor channels and channel bolts according to Annex A5, Table 5, column 2c and 3).
- The stainless steel Hilti channel bolts (HBC), washers and nuts may be used in structures subject to external atmospheric conditions (including industrial and marine environment) or exposure in permanently damp internal conditions, if no particular aggressive conditions (e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with chemical pollution e.g. desulphurization plants or road tunnels where de-icing materials are used) exist
  (channel bolts according to Annex A5, Table 5, column 3).

Design:

- Anchor channels are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor channel and channel bolts are indicated on the design drawings (e.g. position of the anchor channel relative to the reinforcement or to supports).
- For static and quasi-static loading as well as fire exposure the anchor channels are designed in accordance with EOTA TR 047 “Calculation Method for the Performance of Anchor Channels” or EN 1992-4.
- For fatigue loading the anchor channels are designed in accordance with EOTA TR 050 “Calculation Method for the Performance of Anchor Channels under Fatigue Loading”.
- The characteristic resistances are calculated with the minimum effective embedment depth.

Hilti anchor channels (HAC) with channel bolts (HBC)	Annex B1
Intended Use Specifications	

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Installation:

- The installation of anchor channels is carried out by appropriately qualified personnel under the supervision of the person responsible for the technical matters on site.
- Use of the anchor channels only as supplied by the manufacturer - without any manipulations, repositioning or exchanging of channel components.
- Cutting of anchor channels is allowed only if pieces according to Annex B3, Table 6 are generated including end spacing and minimum channel length and only to be used in dry internal conditions.
- Installation in accordance with the manufacturer's specifications given in Annexes B5, B6 and B7
- The anchor channels are fixed on the formwork, reinforcement or auxiliary construction such that no movement of the channels will occur during the time of laying the reinforcement and of placing and compacting the concrete.
- The concrete under the head of the anchors are properly compacted. The channels are protected from penetration of concrete into the internal space of the channels.
- Washer may be chosen according to Annex A5 and provided separately by the user.
- Orientating the channel bolt (groove according to Annex B6 and B7) rectangular to the channel axis.
- The required installation torques given in Annex B4 must be applied and must not be exceeded.

Hilti anchor channels (HAC) with channel bolts (HBC)	Annex B2
Intended Use Specifications	

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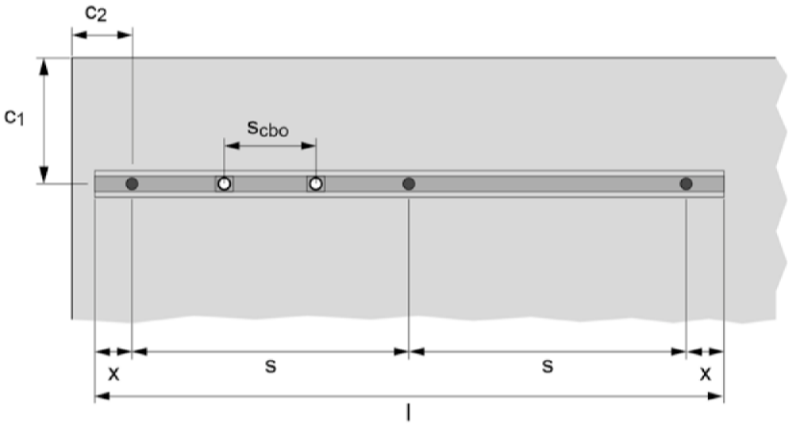
Table 6: Installation parameters for anchor channel

Anchor channel			HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Minimum effective embedment depth	$h_{ef,min}$	[mm]	68	91	106	148	175
Minimum spacing	s_{min}		50	100			
Maximum spacing	s_{max}		250				
End spacing	x		25				
Minimum channel length	l_{min}		100	150			
Minimum edge distance	c_{min}		50			75	
Minimum thickness of concrete member	h_{min}		80	105	125	168	196



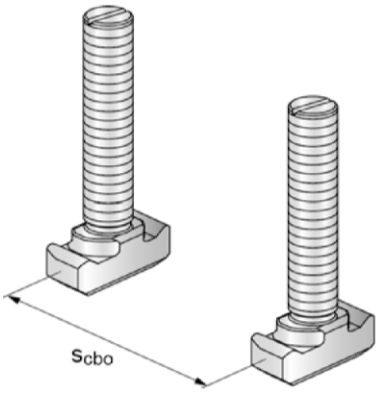


Table 7: Minimum spacing for channel bolts

Channel bolt			M10	M12	M16	M20
Minimum spacing between channel bolts	$s_{cbo,min}$	[mm]	50	60	80	100

s_{cbo} = center to center spacing between channel bolts ($s_{cbo,min}$ = 5d)

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Hilti anchor channels (HAC) with channel bolts (HBC)

Intended Use
Installation parameters for anchor channels (HAC)

Annex B3

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Table 8: Required installation torque T_{inst} for HBC-B

Channel bolt		T_{inst} [Nm] [1]	
		General	Steel-steel contact
		HAC-30	HAC-30
M10	4.6, A4-50	15	15
M12	4.6, A4-50	25	25

Table 9: Required installation torque T_{inst} for HBC-C

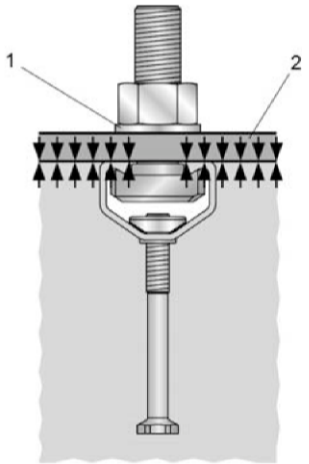
Channel bolt		T_{inst} [Nm] [1]							
		General				Steel-steel contact			
		HAC-40	HAC-50	HAC-60	HAC-70	HAC-40	HAC-50	HAC-60	HAC-70
M10	4.6, A4-50	15				15			
	8.8	15				48			
M12	4.6, A4-50	25				25			
	8.8	25				75			
M16	4.6, A4-50	60				60			
	8.8	60				185			
M20	4.6, A4-50	70	105	120		120			
	8.8	70	105	120		320			

Table 10: Required installation torque T_{inst} for HBC-C-N

Channel bolt		T_{inst} [Nm] [1]							
		General				Steel-steel contact			
		HAC-40	HAC-50	HAC-60	HAC-70	HAC-40	HAC-50	HAC-60	HAC-70
M16	8.8	-				185			
M20	8.8					320			

[1] T_{inst} must not be exceeded.

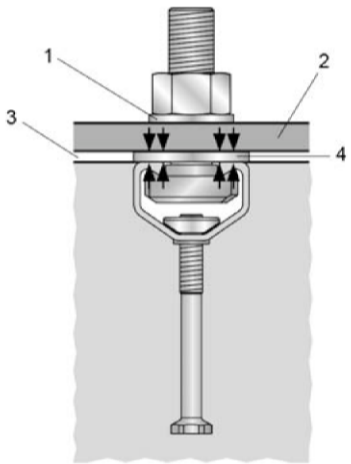
General: The fixture is in contact with the channel profile and the concrete surface.



Key

1 washer
2 fixture
3 gap
4 suitable steel part

Steel-steel contact: The fixture is fastened to the anchor channel by suitable steel part (e.g. washer). Fixture is in contact with the channel profile only.



Hilti anchor channels (HAC) with channel bolts (HBC)

Intended Use
Installation parameters for channel bolts (HBC)

Annex B4

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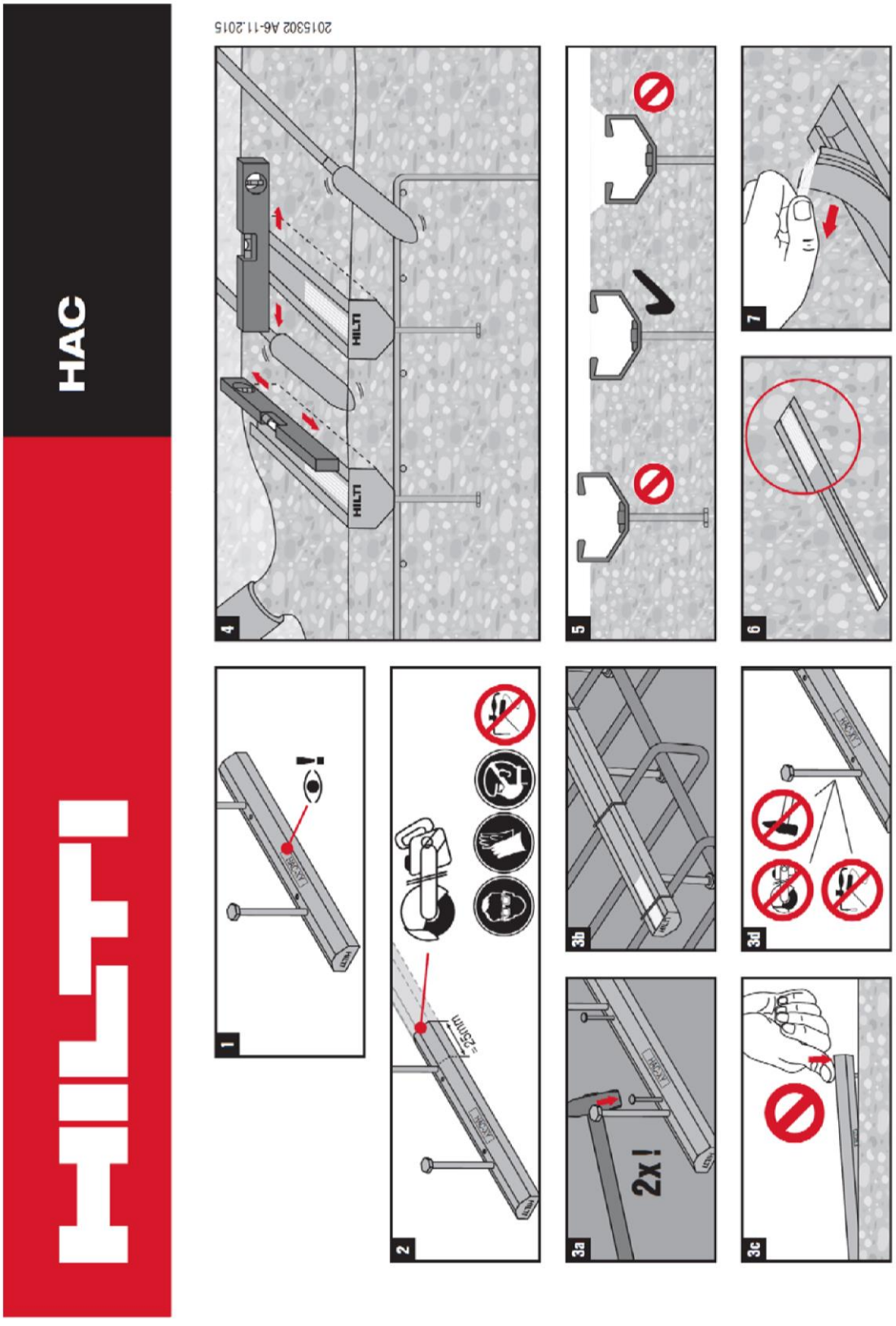

Hilti anchor channels (HAC) with channel bolts (HBC)

Intended Use
Installation instructions for anchor channels (HAC)

Annex B5

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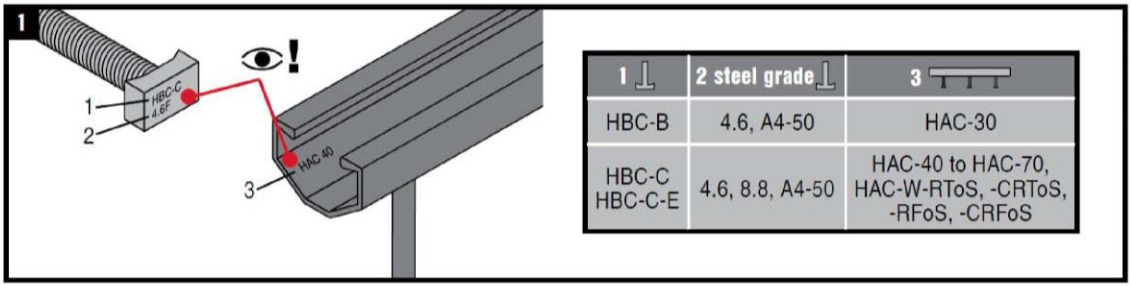
HILTI HBC



1	2 steel grade	3
HBC-B	4.6, A4-50	HAC-30
HBC-C HBC-C-E	4.6, 8.8, A4-50	HAC-40 to HAC-70, HAC-W-RToS, -CRToS, -RFoS, -CRFoS

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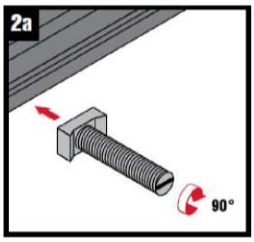

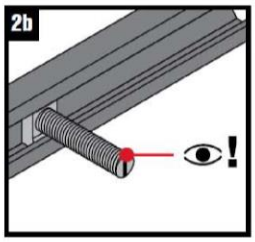

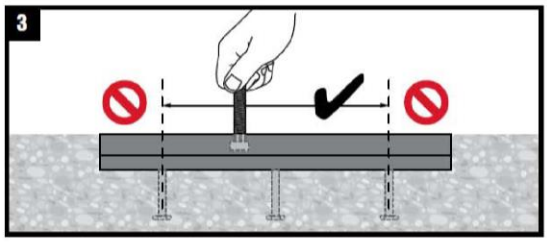

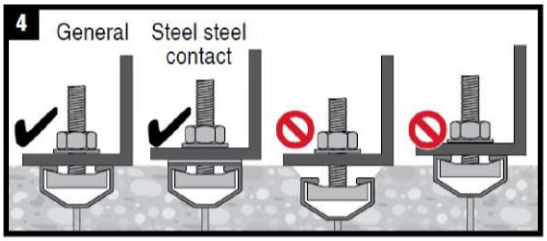

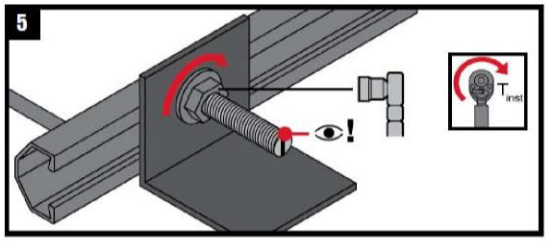

HBC-B

Required installation torque T_{inst} [Nm]1) for HBC-B			
Channel bolt		General	Steel steel contact
		HAC-30	HAC-30
M10	4.6, A4-50	15	15
M12	4.6, A4-50	25	25

HBC-C

Required installation torque T_{inst} [Nm] 1) for HBC-C									
Channel bolt		General				Steel steel contact			
		HAC-40	HAC-50	HAC-60	HAC-70	HAC-40	HAC-50	HAC-60	HAC-70
M10	4.6, A4-50	15				15			
	8.8	15				48			
M12	4.6, A4-50	25				25			
	8.8	25				75			
M16	4.6, A4-50	60				60			
	8.8	60				185			
M20	4.6, A4-50	70	105	120		120			
	8.8	70	105	120		320			

1) T_{inst} is the torque that shall be applied with a torque wrench and must not be exceeded.

Hilti anchor channels (HAC) with channel bolts (HBC)

Intended Use
Installation instructions for channel bolts (HBC-B and HBC-C)

Annex B6

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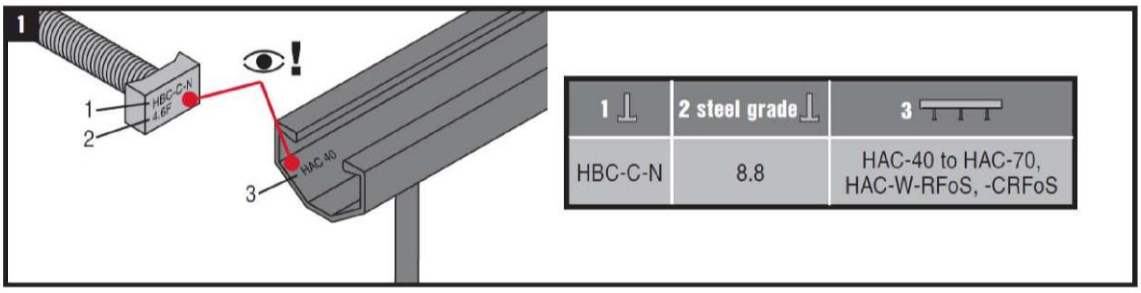
HILTI **HBC-C-N**



1 ⊥	2 steel grade ⊥	3 ⎍
HBC-C-N	8.8	HAC-40 to HAC-70, HAC-W-RFoS, -CRFoS

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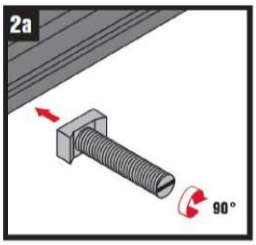

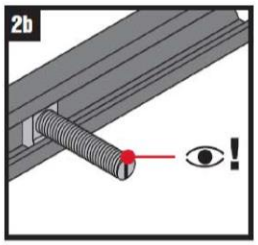

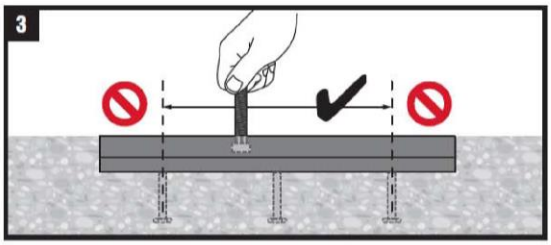

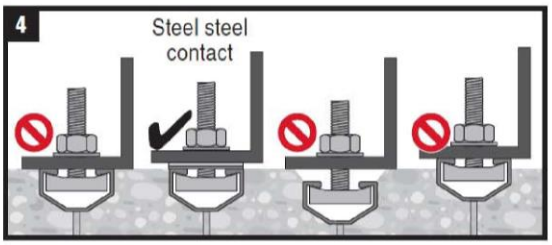

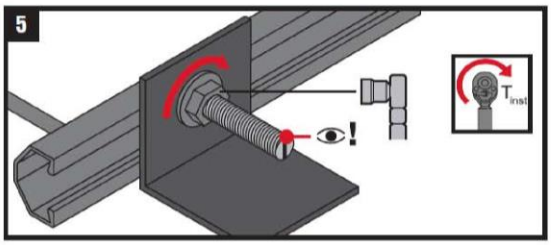

HBC-C-N [Nm]

Required Installation torque T_{inst} [Nm] 1) for HBC-C-N								
Channel bolt		General				Steel steel contact			
		HAC-40	HAC-50	HAC-60	HAC-70	HAC-40	HAC-50	HAC-60	HAC-70
M16	8.8	–				185			
M20	8.8					320			

1) T_{inst} is the torque that shall be applied with a torque wrench and must not be exceeded.

Hilti anchor channels (HAC) with channel bolts (HBC)

Intended Use
Installation instructions for channel bolts (HBC-C-N)

Annex B7

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Table 11: Characteristic resistances under tension load – steel failure of anchor channel

Anchor channel				**HAC-30**	**HAC-40**	**HAC-50**	**HAC-60**	**HAC-70**
Steel failure: Failure of anchor								
Characteristic resistance	$N_{Rk,s,a}$		[kN]	18,2	33,1	52,5	52,5	76,3
Partial safety factor	γ_{Ms} [1)]			1,8				
Steel failure: Failure of connection between anchor and channel								
Characteristic resistance	$N_{Rk,s,c}$		[kN]	18,2	25,0	35,0	50,1	71,0
Partial safety factor	$\gamma_{Ms,ca}$ [1)]			1,8				
Steel failure: Local failure by flexure of channel lips								
Characteristic spacing of channel bolts for $N_{Rk,s,l}$	$s_{l,N}$		[mm]	83	82	84	87	91
Characteristic resistance	$N^0_{Rk,s,l}$	HBC-B	[kN]	19,9	-	-	-	-
		HBC-C		-	25,0	35,0	50,1	71,0
		HBC-C-N		-	25,0	35,0	50,1	71,0
Partial safety factor	$\gamma_{Ms,l}$ [1)]			1,8				

[1)] In absence of other national regulations.

Table 12: Characteristic flexural resistance of channel under tension load

Anchor channel				**HAC-30**	**HAC-40**	**HAC-50**	**HAC-60**	**HAC-70**
Steel failure: Failure by flexure of channel								
Characteristic flexural resistance of channel	$M_{Rk,s,flex}$	HBC-B	[Nm]	755	-	-	-	-
		HBC-C		-	1136	1596	2187	3160
		HBC-C-N		-	980	1345	2156	3005
Partial safety factor	$\gamma_{Ms,flex}$ [1)]			1,15				

[1)] In absence of other national regulations.

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Hilti anchor channels (HAC) with channel bolts (HBC)

Performance
Characteristic resistances of anchor channels under tension load

Annex C1

Deutsches Institut für Bautechnik DIBt

Table 13: Characteristic resistances under tension load – concrete failure

Anchor channel				**HAC-30**	**HAC-40**	**HAC-50**	**HAC-60**	**HAC-70**
Pullout failure								
Characteristic resistance in cracked concrete C12/15		$N_{Rk,p}$	[kN]	8,0	18,8	23,2	23,2	32,0
Characteristic resistance in uncracked concrete C12/15			[kN]	11,2	26,3	32,5	32,5	44,9
Amplification factor of $N_{Rk,p}$	C16/20	ψ_c		1,33				
	C20/25			1,67				
	C25/30			2,08				
	C30/37			2,50				
	C35/45			2,92				
	C40/50			3,33				
	C45/55			3,75				
	C50/60			4,17				
	C55/67			4,58				
	≥ C60/75			5,00				
Partial safety factor		$\gamma_{Mp} = \gamma_{Mc}$ [1)]		1,5				
Concrete cone failure								
Product factor k_1	cracked concrete	$k_{cr,N}$		7,7	8,0	8,2	8,6	8,9
	uncracked concrete	$k_{ucr,N}$		11,0	11,5	11,7	12,3	12,7
Partial safety factor		γ_{Mc} [1)]		1,5				
Splitting								
Characteristic edge distance		$c_{cr,sp}$	[mm]	204	273	318	444	525
Partial safety factor		$\gamma_{Msp} = \gamma_{Mc}$ [1)]		1,5				

[1)] In absence of other national regulations.

Table 14: Displacements under tension load

Anchor channel			**HAC-30**	**HAC-40**	**HAC-50**	**HAC-60**	**HAC-70**
Tension load	N	[kN]	6,6	11,3	14,3	18,8	26,6
Short time displacement [1)]	δ_{N0}	[mm]	1,6	1,7	1,1	1,1	1,0
Long time displacement [1)]	$\delta_{N\infty}$	[mm]	3,2	3,4	2,2	2,2	2,0

[1)] Displacements in midspan of the anchor channel, including slip of channel bolt, deformation of channel lips, bending of the channel and slip of the anchor channel in concrete.

Hilti anchor channels (HAC) with channel bolts (HBC)

Performance
Characteristic resistances of anchor channels and displacements under tension load

Annex C2

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Table 15: Characteristic resistances under shear load – steel failure of anchor channel

Anchor channel				**HAC-30**	**HAC-40**	**HAC-50**	**HAC-60**	**HAC-70**
Steel failure: Failure of anchor								
Characteristic resistance	$V_{Rk,s,a}$		[kN]	23,7	34,9	47,5	72,2	95,8
Partial safety factor	γ_{Ms} [1)]			1,5				
Steel failure: Failure of connection between anchor and channel								
Characteristic resistance	$V_{Rk,s,c}$		[kN]	23,7	34,9	47,5	72,2	95,8
Partial safety factor	$\gamma_{Ms,ca}$ [1)]			1,8				
Steel failure: Local failure by flexure of channel lips								
Characteristic spacing of channel bolts for $V_{Rk,s,l}$	$s_{l,V}$		[mm]	83	82	84	87	91
Characteristic resistance	$V^0_{Rk,s,l}$	HBC-B	[kN]	23,7	-	-	-	-
		HBC-C		-	34,9	47,5	72,2	95,8
		HBC-C-N		-	34,9	47,5	72,2	95,8
Partial safety factor	$\gamma_{Ms,l}$ [1)]			1,8				

[1)] In absence of other national regulations.

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Table 16: Characteristic resistances under shear load – concrete failure

Anchor channel			**HAC-30**	**HAC-40**	**HAC-50**	**HAC-60**	**HAC-70**
Pry out failure							
Product factor		k_8	2,0				
Partial safety factor		γ_{Mc} [1)]	1,5				
Concrete edge failure							
Product factor k_{12}	cracked concrete	$k_{cr,V}$	7,5				
	uncracked concrete	$k_{ucr,V}$	10,5				
Partial safety factor		γ_{Mc} [1)]	1,5				

[1)] In absence of other national regulations

Table 17: Displacements under shear load

Anchor channel			**HAC-30**	**HAC-40**	**HAC-50**	**HAC-60**	**HAC-70**
Shear load	V	[kN]	8,0	13,9	18,9	29,0	38,0
Short time displacement [1)]	δ_{N0}	[mm]	1,0		1,5		
Long time displacement [1)]	$\delta_{N\infty}$	[mm]	1,5		2,3		

[1)] Displacements in midspan of the anchor channel, including slip of channel bolt, deformation of channel lips and slip of the anchor channel in concrete.

Table 18: Characteristic resistances under combined tension and shear load

Anchor channel	**HAC-30**	**HAC-40**	**HAC-50**	**HAC-60**	**HAC-70**
Steel failure: Local failure by flexure of channel lips and failure by flexure of channel					
Product factor	k_{13}	1,0 [1)]			
Steel failure: Failure of anchor and connection between anchor and channel					
Product factor	k_{14}	1,0 [2)]			

[1)] k_{13} can be taken as 2,0 if $V_{Rd,s,l}$ is limited to $N_{Rd,s,l}$.

[2)] k_{14} can be taken as 2,0 if max($V_{Rd,s,a}$; $V_{Rd,s,c}$) is limited to min($N_{Rd,s,a}$; $N_{Rd,s,c}$).

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Hilti anchor channels (HAC) with channel bolts (HBC)

Performance
Characteristic resistances of anchor channels and displacements under shear load
Characteristic resistances under combined tension and shear load

Annex C4

Table 19: Characteristic resistances under tension and shear load – steel failure of Hilti channel bolts HBC-B, HBC-C and HBC-C-N

Channel bolt					M10	M12	M16	M20
Steel failure								
Characteristic resistance	$N_{Rk,s}$ [2]	[kN]	HBC-B	4.6	23,2	33,7	-	-
				A4-50 [1]	29,0	42,2	-	-
			HBC-C	4.6	23,2	33,7	62,8	98,0
				8.8	46,4	67,4	125,6	174,3
				A4-50 [1]	29,0	42,2	78,5	122,5
			HBC-C-N	8.8	-	-	125,6	174,3
Partial safety factor		γ_{Ms} [3]		4.6	2,00			
				8.8	1,50			
				A4-50 [1]	2,86			
Characteristic resistance	$V_{Rk,s}$ [2]	[kN]	HBC-B	4.6	13,9	20,2	-	-
				A4-50 [1]	17,4	25,3	-	-
			HBC-C	4.6	13,9	20,2	37,7	58,8
				8.8	23,2	33,7	62,8	101,7
				A4-50 [1]	17,4	25,3	47,1	73,5
			HBC-C-N	8.8	-	-	62,8	101,7
Partial safety factor		γ_{Ms} [3]		4.6	1,67			
				8.8	1,25			
				A4-50 [1]	2,38			

[1] Materials according to Table 5, Annex A5.
[2] In conformity with EN ISO 898-1.
[3] In absence of other national regulations.

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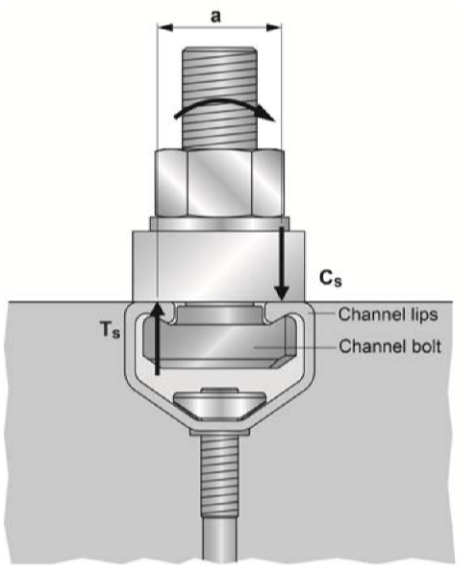
Table 20: Characteristic resistances under shear load with lever arm – steel failure of Hilti channel bolts HBC-B, HBC-C and HBC-C-N

Channel bolt					**M10**	**M12**	**M16**	**M20**
Steel failure								
Characteristic flexure resistance	$M^0_{Rk,s}$ 3)	[Nm]	HBC-B	4.6	29,9	52,4	-	-
				A4-50 1)	37,4	65,5	-	-
			HBC-C	4.6	29,9	52,4	133,2	259,6
				8.8	59,8	104,8	266,4	538,7
				A4-50 1)	37,4	65,5	166,5	324,5
			HBC-C-N	8.8	-	-	266,4	538,7
Partial safety factor		γ_{Ms} 2)		4.6	1,67			
				8.8	1,25			
				A4-50 1)	2,38			
Internal lever arm	a	[mm]	HBC-B	4.6, A4-50	25	27	-	-
			HBC-C	4.6, 8.8, A4-50	24	26	28	30
			HBC-C-N	8.8	-	-	28	30

1) Materials according to Table 5, Annex A5.
2) In absence of other national regulations.



3) The characteristic flexure resistance according to Table 20 is limited as follows:

$M^0_{Rk,s} \le 0{,}5 \cdot N_{Rk,s,l} \cdot a$ ($N_{Rk,s,l}$ according to Table 11) and

$M^0_{Rk,s} \le 0{,}5 \cdot N_{Rk,s} \cdot a$ ($N_{Rk,s}$ according to Table 19)

a = internal lever arm according Table 20

T_s = tension force acting on the channel lips

C_s = compression force acting on the channel lips

Hilti anchor channels (HAC) with channel bolts (HBC)

Performance
Characteristic flexural resistances of channel bolts under shear load

Annex C6

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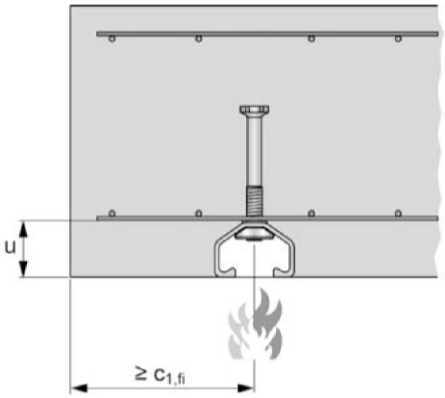
Table 21: Characteristic resistances of anchor channel under fire exposure

Anchor channel					**HAC-30**	**HAC-40**	**HAC-50**	**HAC-60**	**HAC-70**
Steel failure of anchor, connection between anchor and channel, local flexure of channel lip									
Characteristic resistance in cracked concrete C20/25	R30	$N_{Rk,s,fi}$ = $V_{Rk,s,fi}$	[kN]		2,5	2,8	5,7		
	R60				1,8	2,3	4,0		
	R90				1,1	1,7	2,3		
Partial safety factor		$\gamma_{Ms,fi}$ [1]	[-]		1,0				
Concrete cover	R30	u	[mm]		35		50		
	R60		[mm]		35		50		
	R90		[mm]		45		50		

[1] In absence of other national regulations.

Fire exposure from one side only



Fire exposure from more than one side

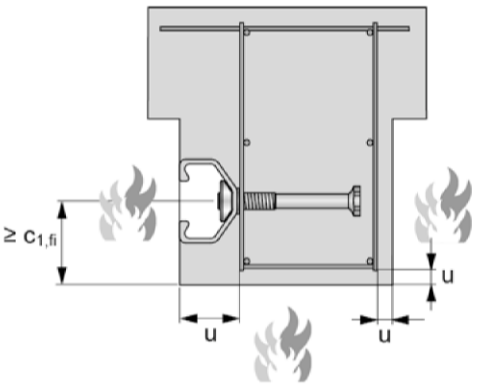


Table 22: Characteristic resistances of channel bolt under fire exposure

Channel bolt					**M8**	**M10**	**M12**	**M16**	**M20**
Steel failure without lever arm									
Characteristic resistance	HBC-B	R30	$N_{Rk,s,fi}$ = $V_{Rk,s,fi}$	[kN]	1,0	1,7	2,5	-	-
		R60			0,8	1,3	1,8	-	-
		R90			0,6	0,9	1,1	-	-
	HBC-C	R30			-	2,5	3,1	5,7	
		R60			-	1,9	2,5	4,0	
		R90			-	1,3	1,9	2,3	
Partial safety factor			$\gamma_{Ms,fi}$ [1]	[-]	1,0				

[1] In absence of other national regulations.

Hilti anchor channels (HAC) with channel bolts (HBC)

Performance
Characteristic resistances of anchor channels and channel bolts under fire exposure

Annex C7

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Table 23: Possible combination of anchor channels and channel bolts under fatigue load

Anchor channel	Channel bolt type	Diameter	Steel grade	Corrosion class
HAC-30	HBC-B	M10	4.6	G [1] F [2]
		M12		
HAC-40	HBC-C	M12	4.6	
		M16	8.8	
		M20		
HAC-50		M16	4.6	
		M20	8.8	
HAC-60		M16	4.6	
		M20	8.8	
HAC-70		M20	4.6	
			8.8	

[1] Electroplated
[2] Hot-dip galvanized

Table 24: Characteristic resistances under fatigue tension load - steel failure with n load cycles without static preload (N_{Ed} = 0) (Design method I according to EOTA TR 050)

Anchor channel		HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Steel failure	n	$\Delta N_{Rk,s,0,n}$ [kN]				
Characteristic resistances under fatigue tension load without static preload	$\leq 10^6$	1,76	1,57	2,66	3,54	6,44
	$\leq 3 \cdot 10^6$	1,60	1,50	2,60	3,50	6,40
	$\leq 10^7$					
	$\leq 3 \cdot 10^7$					
	$\leq 6 \cdot 10^7$					
	$> 6 \cdot 10^7$					

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Table 25: Characteristic resistances under fatigue tension load - pullout failure with n load cycles without static preload (N_{Ed} = 0) (Design method I according to EOTA TR 050)

Anchor channel			**HAC-30**	**HAC-40**	**HAC-50**	**HAC-60**	**HAC-70**
Pullout failure		n	$\Delta N_{Rk,p,0,n}$ [kN]				
Characteristic resistances under fatigue tension load in cracked concrete C12/15 without static preload		$\leq 10^6$	4,8	11,3	13,9		19,2
		$\leq 3 \cdot 10^6$	4,6	10,7	13,3		18,3
		$\leq 10^7$	4,3	10,2	12,6		17,4
		$\leq 3 \cdot 10^7$	4,1	9,7	12,0		16,5
		$\leq 6 \cdot 10^7$	4,0	9,4	11,6		16,0
		$> 6 \cdot 10^7$					
Amplification factor for $\Delta N_{Rk,p,0,n}$	C16/20	ψ_c	1,33				
	C20/25		1,67				
	C25/30		2,08				
	C30/37		2,50				
	C35/45		2,92				
	C40/50		3,33				
	C45/55		3,75				
	C50/60		4,17				
	C55/67		4,58				
	≥ C60/75		5,00				
Characteristic resistances under fatigue tension load in uncracked concrete C12/15 without static preload		$\Delta N_{Rk,p,0,n}$	= $\Delta N_{Rk,p,0,n}$ (cracked concrete) · 1,4				

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Hilti anchor channels (HAC) with channel bolts (HBC)

Performance
Characteristic resistances under fatigue cyclic tension load

Annex C9

Table 26: Reduction factor $\eta_{c,fat}$ with n load cycles without static preload (N_{Ed} = 0) (Design method I according to EOTA TR 050)

Anchor channel		HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Concrete cone failure	n	$\eta_{c,fat}$ [-]				
Reduction factor for $\Delta N_{Rk,c;0;n} = \eta_{c,fat} \cdot N_{Rk,c}$ with $N_{Rk,c}$ calculated according to EOTA TR 047 or EN 1992-4	$\leq 10^6$	0,600				
	$\leq 3 \cdot 10^6$	0,571				
	$\leq 10^7$	0,542				
	$\leq 3 \cdot 10^7$	0,516				
	$\leq 6 \cdot 10^7$	0,500				
	$> 6 \cdot 10^7$					

Table 27: Characteristic resistances under fatigue tension load with n → ∞ load cycles without static preload (N_{Ed} = 0) (Design method II according to EOTA TR 050)

Anchor channel		HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Steel failure						
$\Delta N_{Rk,s;0;\infty}$	[kN]	1,6	1,5	2,6	3,5	6,4
Concrete cone and pullout failure						
$\eta_{c,fat}$	[-]	0,5				

For the reduction of the characteristic resistances given in Tables 24, 25 and 26 in the transition zone from the static resistance to the fatigue limit resistance the partial safety factors are calculated as follows:

$$\gamma_{M,fat,n} = \gamma_{M,fat} + (\gamma_M - \gamma_{M,fat}) \cdot (\Delta N_{Rk,n} - \Delta N_{Rk,\infty}) / (N_{Rk} - \Delta N_{Rk,\infty})$$

In absence of other national regulations the following safety factors γ_M and $\gamma_{M,fat}$ are recommended for design method I according to EOTA TR 050:

γ_M = 1,8 (steel)

γ_M = 1,5 (concrete)

$\gamma_{M,fat}$ = 1,35

In absence of other national regulations the following safety factor $\gamma_{M,fat}$ is recommended for design method II (Table 27) according to EOTA TR 050:

$\gamma_{M,fat}$ = 1,35

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