Rail anchoring systems

Introduction
Bottom-up – post-installed method
Top-down – cast-in method

Introduction to Hilti rail anchoring systems

1 The Hilti direct fixation (DFF) generation for bottom-up, top-down, elastic and rigid applications

Hilti offers solution for both construction methods, Top-down (cast-in) and bottom up (post-installed) construction method.

Bottom–up is described as the concrete slab is poured first. The rail is set in position while all associated components are clipped to the rail besides Hilti DFF. The holes for anchors are cored in the top of the slab while the holes in the baseplates are used as drilling pattern (high accuracy). Afterwards the borehole is filled with Hilti injection mortar and Hilti DFF are inserted into the mortar filled borehole
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Bottom-up construction method

Hilti direct fixation fastener

Top down is described as the rail is set and supported on props in the correct position. Baseplates and all associated components (clips, Hilti rail anchors, etc.) are clipped to the rail while the concrete is then poured up to a given level or the underside of the baseplate.

Top down construction method

Clipped components before concrete pouring

Support after concrete pouring

Hilti provides elastic fasteners if elastomeric pads are situated between rib plate and concrete surface. The necessary movement of the baseplate is ensured by Hilti DFF adapted with compression springs (9) which will be pre-tensioned during installation.

Hilti provides rigid systems if no elastomeric pads are situated between rib plate and concrete surface (tram washes, depots) where the baseplate will not move up and down in the area of the anchors. Hilti rigid rail anchors are also used if **sandwich base-plates or so called floating plates** should be fastened.

This boundary condition is taken into account by equipping Hilti rail anchors with spring washers (rigid) (10)

2 Hilti direct fixation fasteners ensure that major components of a modular baseplate support works

1 **Rail** to provide guide way for rolling stocks

2 To secure the rail to the baseplate in general two pieces of **elastic clips** fitted with electrical insulation are used. The elastic clips ensure sufficient force transfer to the rail to retrain longitudinal movement of the rail. These are attached to the baseplate via T-bolts including nut and washer.

3 The **rail pad** is located between the rail and baseplate to reduce abrasion as the rail moves with temperature.

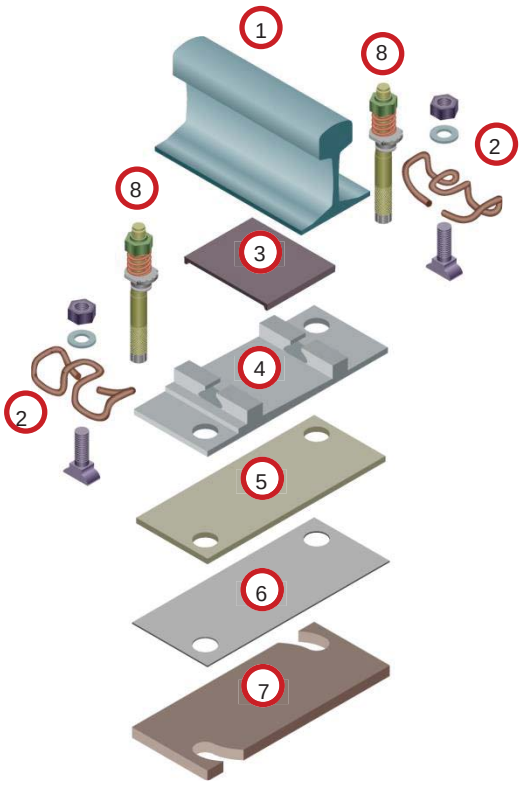
4 The **baseplate/rib plate** may be steel iron plates which seat the rail foot and provide anchoring points for the Hilti rail anchors and clips. The baseplate also incline the rail towards the center of the track either by an angle of 1:20 or 1:40 due to the conical wheel thread of the wheels on the rail.

5 The **elastic pad** is providing the necessary elasticity between the baseplate and concrete slab and manages resilience in terms of noise and vibration.

6 7 **Shims** are packing pieces of varying thickness to accommodate variations in the concrete surface located between the elastic pad and concrete surface.

Additional **non-shrink Hilti epoxy grout** (Hilti CB-G EG) can be used to accommodate concrete surface irregularities.

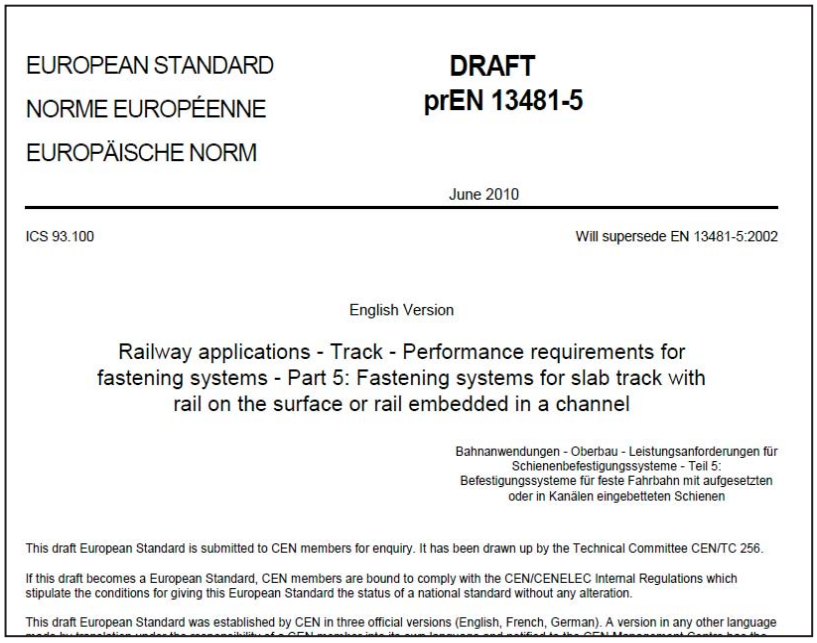
8 **Hilti direct fixation fasteners (2 or 4 pics. per baseplate) to provide a reliable load transfer from the support into the slab (concrete sleepers)**



3 State-of-the art testing while Hilti direct fixation fasteners are going beyond

Hilti Rail anchors are tested by third party according to the new European standard DIN EN 13481-5 and the former standards[1)] .Therefore Hilti rail anchors provide:

- **Sufficient fatigue resistant** (repeated loading) to ensure that the horizontal guidance forces are transferred from the rail to the base material, see section 4
- **Sufficient electrical resistance** to avoid stray current, see section 5
- the possibility of **dismantling the complete support after exposure** to severe environmental conditions
- **Sufficient tension resistance**, see section 6



EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

DRAFT
prEN 13481-5

June 2010

ICS 93.100

Will supersede EN 13481-5:2002

English Version

Railway applications - Track - Performance requirements for fastening systems - Part 5: Fastening systems for slab track with rail on the surface or rail embedded in a channel

Bahnanwendungen - Oberbau - Leistungsanforderungen für Schienenbefestigungssysteme - Teil 5: Befestigungssysteme für feste Fahrbahn mit aufgesetzten oder in Kanälen eingebetteten Schienen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 256.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language

European standard for performance requirements for fastening systems – Part 5: Fastening systems for slab track with rail on the surface or rail embedded in channel

Hilti rail anchors go beyond the scope and requirements of DIN EN 13481-5 by means of tested under not expected concrete conditions (cracks in slab track), installation safety, electrical insulation and highest loads.

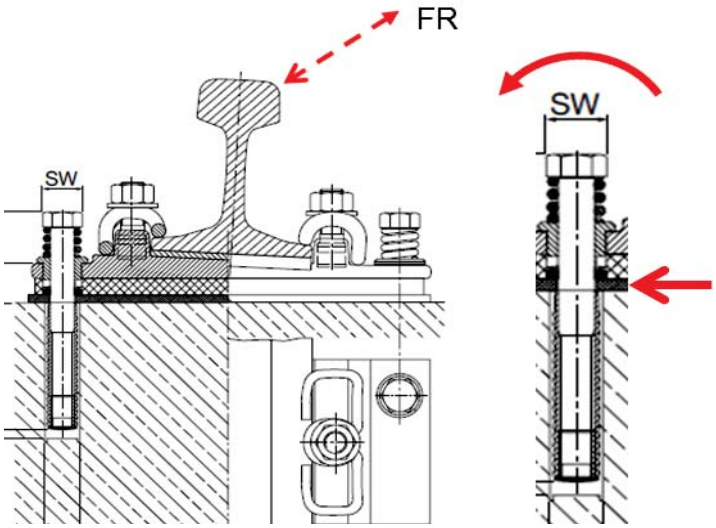
1) Testing recommended by the Research and Test Establishment of the International Railway association ORE or ERRI (see also CEN/TC, Part 4 «Railway applications – permanent way, test methods for fastening systems/biaxial load test, June 1996).

4 Hilti DFF keep position even under high fatigue loading

Forces acting on the rail (F_R) by rolling stock are loading Hilti direct fixation fastners under shear by means of cantilever bending. The orientation and value of the forces are taken account by the DIN EN 13481-5 and the former standards[1)] in a realistic way based on axle load of the rolling stock, maximum speed and curve radii.

All Hilti rail anchor resist more than 3x10^6 load cycles under the tested boundary conditions without showing any damage.

Due to High steel strength and manufacturing quality Hilti direct fixation fasteners cover the largest lever arm possible to provide you the most flexible solution concerning load and fixing height. In general only 2 anchors per baseplate are needed (straight track). This results in less installation time and costs in combination with a reliable solution.



a) b)

a) Cross section and inclined load F_R by rolling stock
b) Cantilever bending of Hilti direct fixation fasteners by means of shear force and moment

Hilti rail anchor goes beyond !

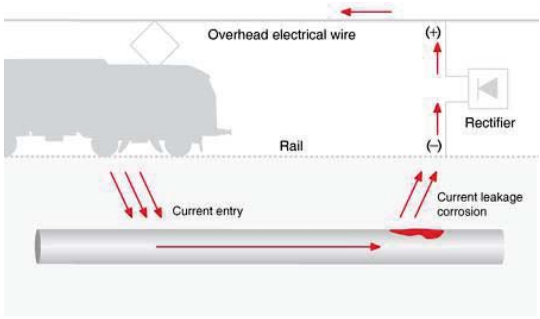
While the axle load of DIN EN 13481-5 is limited to 250 kN (25tons), Hilti showed that the HRC rail anchor family resists axle loads up to 390 kN (39tons) without showing any damage.

We do not believe in plastic if it comes to load transfer

All parts of Hilti rail anchors which are taking up tension load and/or bending moment are made out of high strength steel to ensure a reliable load transfer mechanism.

5 Hilti rail anchors brings electrical current to the intended path

Stray currents can be described as electrical current which do not follow the intended path. Effectively stray currents are electrical charges leaking into the ground while the hazard of stray currents emerges whenever this rogue DC charge comes into contact with anything metallic, whereupon it will begin the corrosion process (e.g. pipes).

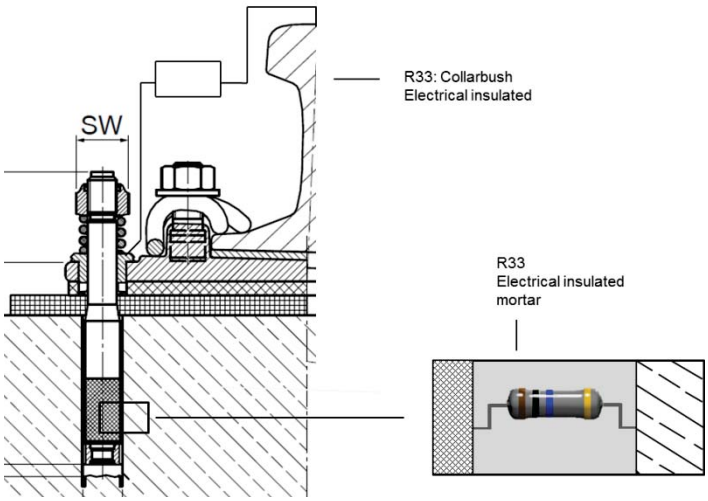


Stray current acting on a metallic pipe

One part of reducing stray current such as rail-to-earth resistance can be controlled via Hilti rail anchors by combining Hilti electrical resistance mortar (HIT RE 500 & HIT RE 500 SD) with Hilti electrical resistance collar bushes.

The European standard is measuring the electrical insulation during test, the minimum required resistance value is R_{33}= 5.0kΩ (wet conditions),

With Hilti rail anchors always 5.0kΩ < R_{33} ≤ 33 kΩ were achieved based on the used system.



6 The state-of the art testing standard DIN EN 13481-5

According to DIN EN 13481-5 “Railway applications – Track – Performance requirements for fastening systems – Part 5: Fastening systems for slab track with rail on surface or rail embedded in a channel”, direct fixation fasteners should in addition resist a tension load of 60 kN for 3 minutes. However it is not clearly stated if these pullout tests should be performed after or before the fatigue tests by means of 3 Mio. load cycles.

This is clear for us. Providing top quality direct fixation fasteners Hilti performs the discussed pullout test after and with the already fatigue loaded anchor to take account of all conditions in a realistic way

With Hilti direct fixation fasteners pullout loads of up to 150 kN after fatigue loading are measured.

HRT-WH Rail anchor with Hilti HVU or Hilti HIT-RE 500

Fastening system		Benefits
	Hilti HRT-WH	- for fastening rails to concrete slab track - for bottom-up (post-installed) construction method - verified for axle loads up to 250 kN - high electrical insulation values concerning stray currency - corrosion resistance -- additional sizes and accessoiries available - chisel point - setting through rib plate possible - different support stiffness - complete installation and system portfolio - 2 and 4 anchor configuration
	Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	
	Hilti HVU foil capsule	

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Rail anchor testing	Technical University of Munich	Report no. 1893 / 2001-05-06

Application field covered

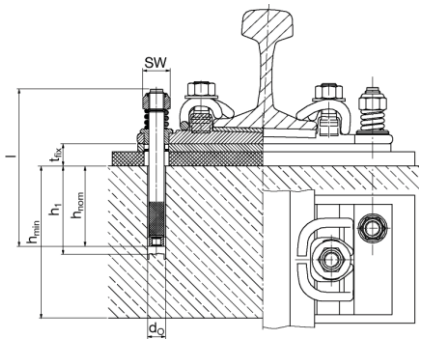
Selection of Hilti rail anchors for fastening rails to concrete track slab, based on axle load (A), stiffness (c) and thickness (t) of elastic pad

Anchor *	Elastic pad, t (mm)**	Tramway A = 100 kN	Metro A = 135 kN	Commuter A = 170 kN	Full Size A = 250 kN
HRT-WH M22x200	10				
	20				
Criteria	V_{max}	60 km/h	80 km/h	120 km/h	≥ 250 km/h
	$R_{min}(V_{max})$***	70 m (25 km/h)	200 m (60 km/h)	350 m (80 km/h)	3000 m
	Support spacing	750 mm	750 mm	700 mm	650 mm

* Configuration of base plate (support):  -> = Anchors per support

** Stiffness of elastic pad: t = 10mm -> c = 20-30 kN/mm
t = 20mm -> c = 10-20 kN/mm

*** Indicative value: V_{max} is a function of the existing superelevation (cant) and the lateral acceleration.

Setting details	HRT WH 22x200		
	**Hilti mortar type**	**HVU M20x110**	**HIT-RE 500**
	Nominal diameter of drill bit d_0 [mm]	25	
	Nominal drilling depth h_1 [mm]	120	110
	Embedment depth h_{nom} [mm]	110	
	Minimum member thickness h_{min} [mm]	200	
	Length of anchor l [mm]	200	
	Maximum fixing height t_{fix} [mm]	35	
	Spring deflection S_{inst} [mm]	5	
	Spring length L_{st} [mm]	22	
	Wrench size S_{inst} [mm]	32	

Curing time for general conditions HVU capsule

Temperature of the base material	Curing time before anchor can be fully loaded t_{cure}
20 °C to 40 °C	20 min
10 °C to 19 °C	30 min
0 °C to 9 °C	1 h
-5 °C to - 1 °C	5 h

Curing time for general conditions HIT-RE 500

Temperature of the base material	Curing time before anchor can be fully loaded t_{cure}
40 °C	4h
30 °C to 39 °C	8h
20 °C to 29 °C	12h
15 °C to19 °C	24h
10 °C to 14 °C	48h
5 °C to 9 °C	72h

Specification

HRT-WH Rail Anchor	
	**Stopnut (M22-SW32)** Material: 5S (DIN 985,EN ISO 7040,DIN 267), blue zinc plated: Fe/Zn 5B (DIN 50961) Fixing device: Nylon, torque force 68 Nm Service temperature: -50°C up to 120°C **Washer (24/39/3 mm)** Material: Steel grade 4.6 (DIN 126), blue zinc plated: Fe/Zn 5B (DIN 50961) **Double coilSpring Fe 6** Material: Spring steel, Int. Ø= 24 mm, Ext. Ø= 44 mm, original height: 22 mm, compressed height: 17 mm, cathaphoretic coating 7 µ **Collar Bush (Sealing Lip)** Material: Plastic, int. Ø= 22 mm, ext. Ø= 36 mm Volume resitivity: 1.2 x 10^{12} Ω cm Flexible lower portion of collar bush to prevent any excess injection mortar HIT-RE or foilcapsule (HVU) from restricting managed system compression **Anchor Body (Ø 22 mm)** High grade steel (DIN/ISO 898/1) Blue zinc plated: Fe/Zn 10B (DIN 50961) Designed to withstand high axle loads of 250 kN, cone heads fits setting tool TE-Y-E M20 to set the anchor with the HVU foil capsule **Thread (M22)** To provide adequate bonding with foil capsule HVU or HIT-RE 500 mortar and transfer tension loading to the lower part of the concrete slab **Chisel Point** To provide adequate mixing of the HVU foil capsule and to transfer the torsionloading via the mortar to the concrete

HRT Rail anchor with Hilti HIT-RE 500

Fastening system	Benefits
 Hilti HRT  Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- for fastening rails to concrete slab track - for bottom-up (post-installed) construction method - verified for axle loads up to 170 kN - high electrical insulation values concerning stray currency - corrosion resistance - for diamond core drilled holes with roughening - additional sizes and accessoiries available - setting through rib plate possible - different support stiffness - complete installation and system portfolio - 2 and 4 anchor configuration

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Rail anchor testing	Technical University of Munich	Report no. 1584a / 1995-08-15
		Report no. 1726 / 1998-04-04

Application field covered

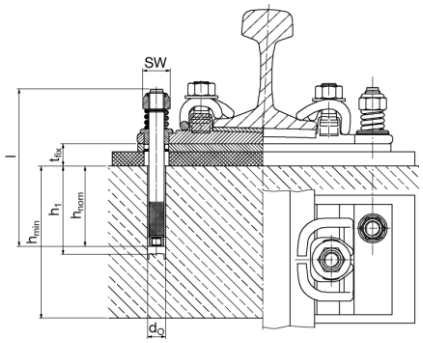
Selection of Hilti rail anchors for fastening rails to concrete track slab, based on axle load (A), stiffness (c) and thickness (t) of elastic pad

Anchor *	Elastic pad, t (mm)**	Tramway A = 100 kN	Metro A = 135 kN	Commuter A = 170 kN	Full Size A = 250 kN
HRT M22x215	10				
	20				
	30				
Criteria	V_{max}	60 km/h	80 km/h	120 km/h	≥ 250 km/h
	$R_{min}(V_{max})$***	70 m (25 km/h)	200 m (60 km/h)	350 m (80 km/h)	3000 m
	Support spacing	750 mm	750 mm	700 mm	650 mm

* Configuration of base plate (support):  -> = Anchors per support

** Stiffness of elastic pad: t = 10mm -> c = 20-30 kN/mm
t = 20mm -> c = 10-20 kN/mm
t = 30mm -> c = 5-10 kN/mm

*** Indicative value: V_{max} is a function of the existing superelevation (cant) and the lateral acceleration.

Setting details	HRT WH 22x200	
	**Anchor size**	**M22**
	Hilti mortar type	**HIT-RE 500**
	Nominal diameter of drill bit d_0 [mm]	25
	Nominal drilling depth h_1 [mm]	110
	Embedment depth h_{nom} [mm]	106
	Minimum member thickness h_{min} [mm]	160
	Length of anchor l [mm]	215
	Maximum fixing height t_{fix} [mm]	40
	Spring deflection S_{inst} [mm]	8
	Spring length L_{st} [mm]	35
	Wrench size S_{inst} [mm]	38

Curing time for general conditions HIT-RE 500

Temperature of the base material	Curing time before anchor can be fully loaded t_{cure}
40 °C	4h
30 °C to 39 °C	8h
20 °C to 29 °C	12h
15 °C to19 °C	24h
10 °C to 14 °C	48h
5 °C to 9 °C	72h

Specification

	Hilti HRT Rail Anchor
	**Stopnut (M22-SW32)** Material: 5S (DIN 985,EN ISO 7040,DIN 267), blue zinc plated: Fe/Zn 5B (DIN 50961) Fixing device : Nylon, torque force 68 Nm Service temperature: -50°C up to 120°C **Spring 35mm** Wire grade: C7 (DIN 2076), yellow zinc plated: Fe/Zn 7C (DIN 50961) Spring rate: 373 N/mm Deformation: 8mm ➔ 3.0 kN compression **Collar Bush (Sealing Lip)** Material: Plastic, int. Ø= 22 mm, ext. Ø= 36 mm Volume resitivity: 1.2 x 10^{12} Ω cm Flexible lower portion of collar bush to prevent any excess injection mortar from restricting managed system compression **Anchor Body (Ø 22 mm)** Material: High grade carbon steel (DIN/ISO 898/1) Yellow zinc plated: Fe/Zn 10C (DIN 50961) Designed to withstand high dynamic loads resulting from train axle loads up to 170 kN **Knurling** To provide adequate bonding with HIT-RE 500 mortar and transfer tension and torsion loadings to the lower part of the concrete slab **Centering Bush** To centrally locate the anchor within the cored hole to provide an uniforme wrapping of the anchor rod with the injection mortar. To avoid the contact between the concrete slab reinforcement and the anchor body

HRC / HRC-DB Rail anchor with Hilti HIT-RE 500

Fastening system		Benefits
	Hilti HRC	- for fastening rails to concrete slab track - for bottom-up (post-installed) construction method - verified for axle loads up to 250 kN - high electrical insulation values concerning stray currency - corrosion resistance - additional sizes and accessoiries available - horizontal adjustment when used with ex-center collar bush - different support stiffness - complete installation and system portfolio - 2 and 4 anchor configuration
	Hilti HRC-DB	
	Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	

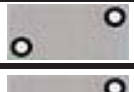
Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Rail anchor testing	Technical University of Munich	Report no. 1584b / 1995-08-15
		Report no. 1584d / 1995-08-15
		Report no. 1609 / 1995-12-06
EBA approval [a)]	German Federal Railway Office	21.62 lozb (561/00) / 2001-05-29

a) EBA approval (HRC-DB), shimming up to 25mm to take account of settlement

Application field covered

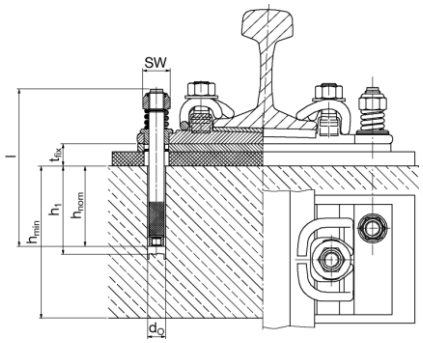
Selection of Hilti rail anchors for fastening rails to concrete track slab, based on axle load (A), stiffness (c) and thickness (t) of elastic pad

Anchor *	Elastic pad, t (mm)**	Tramway A = 100 kN	Metro A = 135 kN	Commuter A = 170 kN	Full Size A = 250 kN
HRC M22x215	10				
	20				
	30				
HRC-DB M22x225	10 +26mm shim				
Criteria	V_{max}	60 km/h	80 km/h	120 km/h	≥ 250 km/h
	R_{min} (V_{max})***	70 m (25 km/h)	200 m (60 km/h)	350 m (80 km/h)	3000 m
	Support spacing	750 mm	750 mm	700 mm	650 mm

* Configuration of base plate (support):  -> = Anchors per support

** Stiffness of elastic pad: t = 10mm -> c = 20-30 kN/mm
t = 20mm -> c = 10-20 kN/mm
t = 30mm -> c = 5-10 kN/mm

*** Indicative value: V_{max} is a function of the existing superelevation (cant) and the lateral acceleration.

Setting details	HRC M22x215 / HRC-DB M22x225		
	**Anchor**	**HRC M22**	**HRC-DB M22**
	Hilti mortar type	**HIT-RE 500**	
	Nominal diameter of drill bit d_0 [mm]	30	
	Nominal drilling depth h_1 [mm]	110	
	Embedment depth h_{nom} [mm]	106	
	Minimum member thickness h_{min} [mm]	160	
	Length of anchor l [mm]	215	225
	Maximum fixing height t_{fix} [mm]	40	50
	Spring deflection S_{inst} [mm]	8	
	Spring length L_{st} [mm]	35	
	Wrench size S_{inst} [mm]	38	

Curing time for general conditions HIT-RE 500

Temperature of the base material	Curing time before anchor can be fully loaded t_{cure}
40 °C	4h
30 °C to 39 °C	8h
20 °C to 29 °C	12h
15 °C to19 °C	24h
10 °C to 14 °C	48h
5 °C to 9 °C	72h

Specification

Hilti HRC Rail Anchor	
	**Stopnut (M22-SW32)** Material: 5S (DIN 985,EN ISO 7040,DIN 267), blue zinc plated: Fe/Zn 5B (DIN 50961) Fixing device : Nylon, torque force 68 Nm Service temperature: -50°C up to 120°C **Spring 35mm** Wire Grade: C7 (DIN 2076), Yellow Zinc Plated: Fe/Zn 7C (DIN 50961) Spring Rate: 373 N/mm Deformation: 8mm ➔ 3.0 kN compression **Collar Bush (Sealing Lip)** Material: Plastic, int. Ø= 22 mm, ext. Ø= 36 mm Volume Resitivity: 1.2 x 10^{12} Ω cm Flexible lower portion of collar bush to prevent any excess injection mortar from restricting managed system compression **Anchor Body (Ø 22 mm)** Material: High grade carbon steel (DIN/ISO 898/1), yellow zinc plated: Fe/Zn 10C (DIN 50961) Designed to withstand high dynamic loads resulting from train axle loads up to 250 kN **Knurling** To provide adequate bonding with HIT-RE/HY mortar and transfer tension and torsion loadings to the lower part of the concrete slab **Centering Bush** To centrally locate the anchor within the cored hole to provide an uniforme wrapping of the anchor rod with the injection mortar. To avoid the contact between the concrete slab reinforcement and the anchor body

HRA Rail anchor with Hilti HIT-RE 500 or HVU-G/EA glass capsule

Fastening system		Benefits
	Hilti HRA, type a	- for fastening rails to concrete slab track - for bottom-up (post-installed) construction method - verified for axle loads up to 250 kN - high electrical insulation values concerning stray currency - corrosion resistance -- with spring or double coil spring - additional sizes and accessoiries available - different support stiffness - complete installation and system portfolio - 2 and 4 anchor configuration
	Hilti HRA, type b	
	Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	
	Hilti HVU-G/EA glass capsule	

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Rail anchor testing	Technical University of Munich	Report no. 1584c / 1995-08-15
		Report no. 1584d / 1995-08-15

Application field covered

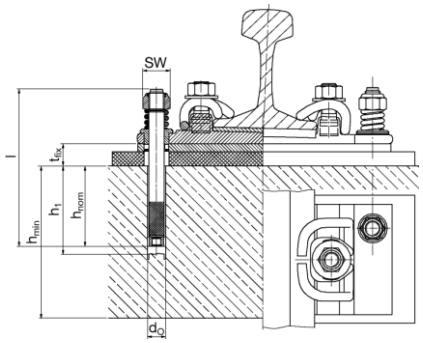
Selection of Hilti rail anchors for fastening rails to concrete track slab, based on axle load (A), stiffness (c) and thickness (t) of elastic pad

Anchor *	Elastic pad, t (mm)**	Tramway A = 100 kN	Metro A = 135 kN	Commuter A = 170 kN	Full Size A = 250 kN
HRA M22x220a M22x220b M22x270 M22x310	10				
	20				
	30				
Criteria	V_{max}	60 km/h	80 km/h	120 km/h	≥ 250 km/h
	R_{min} (V_{max})***	70 m (25 km/h)	200 m (60 km/h)	350 m (80 km/h)	3000 m
	Support spacing	750 mm	750 mm	700 mm	650 mm

* Configuration of base plate (support):  -> = Anchors per support

** Stiffness of elastic pad: t = 10mm -> c = 20-30 kN/mm
t = 20mm -> c = 10-20 kN/mm
t = 30mm -> c = 5-10 kN/mm

*** Indicative value: V_{max} is a function of the existing superelevation (cant) and the lateral acceleration.

Setting details	HRA M22				
	**Anchor**	**HRA M22**			
		220a	**220b**	**270**	**310**
	Hilti mortar type	**HIT-RE 500 HVU-G/EA glass capsule**			
	Nominal diameter of drill bit d_0 [mm]	35			
	Nominal drilling depth h_1 [mm]	120	120	130	130
	Embedment depth h_{nom} [mm]	110	110	125	125
	Minimum member thickness h_{min} [mm]	160			
	Length of anchor l [mm]	220	220	270	310
	Maximum fixing height t_{fix} [mm]	50	40	65	105
	Spring deflection S_{inst} [mm]	5	8	12	12
	Spring length L_{st} [mm]	22	35	55	55
	Wrench size S_{inst} [mm]	38			

Curing time for dry conditions HVU-G/EA glass capsule

Temperature of the base material	Curing time before anchor can be fully loaded t_{cure}
30 °C	20 min
20 °C to 29 °C	30 min
10 °C to19 °C	1,5 h
-5 °C to 9 °C	6 h

The curing time data for water satutated anchorage bases must be doubled

Curing time for general conditions HIT-RE 500

Temperature of the base material	Curing time before anchor can be fully loaded t_{cure}
40 °C	4h
30 °C to 39 °C	8h
20 °C to 29 °C	12h
15 °C to19 °C	24h
10 °C to 14 °C	48h
5 °C to 9 °C	72h

Specification

	Hilti HRA Rail Anchor, type a
	**Stopnut (M22-SW38)** Material; 5S (DIN 982), Zinc plated Fe/Zn 7C (DIN 50961) **Spring (35mm/55mm)** Wire Grade: C7 (DIN 2076), yellow zinc plated: Fe/Zn 7C (DIN 50961) Spring Rate: 373 N/mm **Washer (W 24 x39 x 3 mm)** Zinc plated Fe/ZN 5B (DIN 50961) **Collar Bush** Material; Plastic, int Ø= 28 mm, ext Ø= 35.5 mm Electrical Insulation; 3.5 x 10^{12} Ω **Plastic Wrapping** Designed to eliminate stray current loss. Ext Ø= 32 mm **Anchor Body** High grade carbon steel. Designed to withstand high dynamic loads resulting from train axle loads up to 250 kN **Bonding Ribs** To provide adequate bonding with injection mortar HIT-RE 500 mortar and HVU-G/EA capsule **Chisel Point** To provide torsional resistance and ensure mixing of HVU-G/EA capsule

Hilti HRA Rail Anchor, type b	
Stopnut (M22-SW38) Material; 5S (DIN 982), Zinc plated Fe/Zn 7C (DIN 50961) **Double coilSpring Fe 6 (22 mm)** Spring steel, Int ∅= 24mm, Ext ∅= 44 mm, Original Heigth: 22mm Compressed Heigth: 17mm, Cathaphoretic coatings 7 µ **Washer (W 24 x39 x 3 mm)** Zinc plated Fe/ZN 5B (DIN 50961) **Collar Bush** Material; Plastic, int Ø= 28 mm, ext Ø= 35.5 mm Electrical Insulation; 3.5 x 10^{12} Ω **Plastic Wrapping** Designed to eliminate stray current loss. Ext Ø= 32 mm **Anchor Body** High grade carbon steel. Designed to withstand high dynamic loads resulting from train axle loads up to 250 kN **Bonding Ribs** To provide adequate bonding with injection mortar HIT-RE 500 mortar and HVU-G/EA capsule **Chisel Point** To provide torsional resistance and ensure mixing of HVU-G/EA capsule	

HRT-I Rail anchor with Hilti HIT-RE 500

Fastening system	Benefits
 Hilti HRT-I (rigid)  Hilti HRT-I (elastic)  Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- for fastening rails to concrete slab track - for bottom-up (post-installed) construction method - verified for axle loads up to 250 kN - high electrical insulation values concerning stray currency - corrosion resistance - with spring (elastic) or spring washer (rigid) - additional sizes and accessoiries available - bolt removable - different support stiffness - complete installation and system portfolio - 2 and 4 anchor configuration

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Rail anchor testing	Technical University of Munich	Report no. 2824 / 2011-12-21
		Report no. 2883 / 2012-05-21

Application field covered

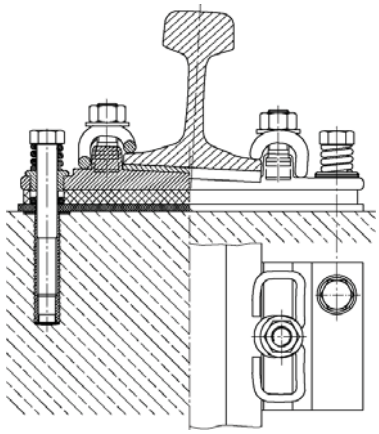
Selection of Hilti rail anchors for fastening rails to concrete track slab, based on axle load (A), stiffness (c) and thickness (t) of elastic pad

Anchor *	Elastic pad, t (mm)**	Tramway A = 100 kN	Metro A = 135 kN	Commuter A = 180 kN	Full Size A = 250 kN
HRT- I M22	15				-
	25				-
HRT- I M27	10				
	20				
	30				-
Criteria	V_{max}	60 km/h	80 km/h	120 km/h	≥ 250 km/h
	R_{min} (V_{max})***	70 m (25 km/h)	200 m (60 km/h)	300 m (80 km/h)	3000 m
	Support spacing	750 mm	750 mm	700 mm	650 mm

* Configuration of base plate (support):  -> = Anchors per support

** Stiffness of elastic pad: t = 10mm -> c = 20-30 kN/mm
t = 20mm -> c = 10-20 kN/mm
t = 30mm -> c = 5-10 kN/mm

*** Indicative value: V_{max} is a function of the existing superelevation (cant) and the lateral acceleration.

Setting details	HRT-I-M22x190/HRT-I M27x240		
	**Anchor**	**HRT–I M22**	**HRT–I M27**
	Hilti mortar type	**HIT-RE 500**	
	Nominal diameter of drill bit d_0 [mm]	32	35
	Nominal drilling depth h_1 [mm]	125	155
	Embedment depth h_{nom} [mm]	120	150
	Minimum member thickness h_{min} [mm]	-	
	Length of anchor l [mm]	160	200
	Maximum fixing height t_{fix} [mm]	-	-
	Spring deflection S_{inst} [mm]	8	10
	Spring length L_{st} [mm]	35	40
	Wrench size S_{inst} [mm]	32	41

Curing time for general conditions HIT-RE 500

Temperature of the base material	Curing time before anchor can be fully loaded t_{cure}
40 °C	4h
30 °C to 39 °C	8h
20 °C to 29 °C	12h
15 °C to19 °C	24h
10 °C to 14 °C	48h
5 °C to 9 °C	72h

Specification

Hilti HRT-I (elastic) Rail Anchor		
	**Bolt (M22, SW32)** Material: 10.9 (DIN 931,EN ISO 4014,), hot dipped galvanized Head: Hexagonal **Spring (35 mm)** Wire Grade: C7 (DIN 2076), Yellow Zinc Plated: Fe/Zn 7C (DIN 50961), spring Rate: 373 N/mm, deformation: 8mm **Collar Bush (Sealing Lip)** Material: Plastic , Int. Ø= 23 mm, Ext. Ø= 36 mm Volume resitivity: 1.2 x 10^{12} Ω cm Flexible lower portion of collar bush to prevent any excess injection mortar HIT-RE on the anchor shaft **Sealingwasher (22.0/36.0/5.0)** To prevent any excess injection mortar HIT-RE on the anchor shaft. **Insert Body Ø 28 mm** Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 120 mm	**Bolt (M27, SW41)** Material: 8.8 (DIN 931,EN ISO 4014), blue zinc plated: Fe/Zn 10B (DIN 50961) Head: Hexagonal **Spring (40 mm)** Wire Grade: C7 (DIN 2076), yellow zinc plated: Fe/Zn 7C (DIN 50961), spring Rate: 300 N/mm, deformation: 10mm ➔ 3.0 kN compression **Collar Bush (Sealing Lip)** Material: Plastic , int. Ø= 28 mm, ext. Ø= 36 mm Volume Resitivity: 1.2 x 10^{12} Ω cm Flexible lower portion of collar bush to prevent any excess injection mortar HIT-RE on the anchor shaft **Sealingwasher (27.0/36.0/5.0)** To prevent any excess injection mortar HIT-RE on the anchor shaft. **Insert Body Ø 33 mm** Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 150 mm

Hilti HRT-I (rigid) Rail Anchor		
Bolt (M22, SW32) Material: 10.9 (DIN 931,EN ISO 4014,), hot dipped galvanized Head: Hexgonal **Spring washer (22.5/35.9/4.0)** Wire Grade: C7 (DIN 2076), blue zinc plated: Fe/Zn 10B (DIN 50961), deformation: 4mm **Washer (23.0/44.0/4.0)** Material: 4.8 (DIN 125), blue zinc plated: Fe/Zn 10B (DIN 50961) Int. Ø= 23 mm, Ext. Ø= 44 mm **Collar Bush** Material: Plastic, int. Ø: 22.2 mm, ext. Ø: 24.2 mm; collar Ø: 44 mm, height: 2/12/14 mm to provide insulation against stray current. **Sealingwasher (22.0/36.0/5.0)** PE-Hard foam LD29, black**,** to prevent any excess injection mortar HIT-RE on the anchor shaft. **Insert Body (Ø 28 mm)** Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 120 mm	**Bolt (M27, SW41)** Material: 8.8 (DIN 931,EN ISO 4014), blue zinc plated: Fe/Zn 10B (DIN 50961) Head: Hexgonal **Spring washer (27.5/41.5/5.0)** Wire Grade: C7 (DIN 2076), blue zinc plated: Fe/Zn 10B (DIN 50961), deformation: 4mm **Washer (28.0/49.0/4.0)** Material: 4.8 (DIN 125), blue zinc plated: Fe/Zn 10B (DIN 50961) Int. Ø= 28 mm, Ext. Ø= 49 mm **Collar Bush** Material: Plastic, int. Ø: 27.2 mm, ext. Ø: 30.5 mm; collar Ø: 49 mm, height: 2/12/14 mm to provide insulation against stray current. **Sealingwasher (27.0/36.0/5.0)** PE-Hard foam LD29, black**,** to prevent any excess injection mortar HIT-RE on the anchor shaft. **Insert Body (Ø 33 mm)** Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 150 mm	

HRT-IP Rail Anchor for cast-in/top down construction method

Fastening system	Benefits
 Hilti HRT–IP (elastic)  Hilti HRT-IP (rigid)	- for fastening rails to concrete slab track - for top-down (cast-in) construction method - verified for axle loads up to 250 kN - high electrical insulation values concerning stray currency - corrosion resistance - with spring (elastic) or spring washer (rigid) - additional accessoiries available different support stiffness - fixing plate to support assembling - bolt removable - identical system for post-installed/bottom up construction method available (HRT-I) → Rehabilitation - 2 and 4 anchor configuration

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Rail anchor testing	Technical University of Munich	Report no. 2824 / 2011-12-21
		Report no. 2883 / 2012-05-21

Application field covered

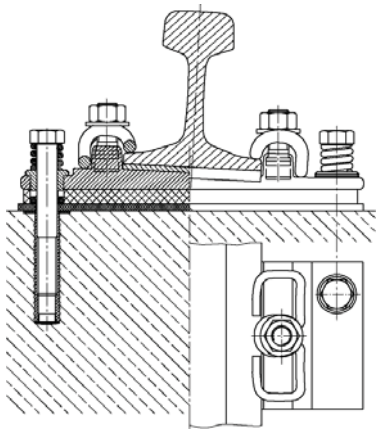
Selection of Hilti rail anchors for fastening rails to concrete track slab, based on axle load (A), stiffness (c) and thickness (t) of elastic pad

Anchor *	Elastic pad, t (mm)**	Tramway A = 100 kN	Metro A = 135 kN	Commuter A = 180 kN	Full Size A = 250 kN
HRT- IP M22	15				-
	25				-
HRT – IP M27	10				
	20				
	30				-
Criteria	V_{max}	60 km/h	80 km/h	120 km/h	≥ 250 km/h
	R_{min} (V_{max})***	70 m (25 km/h)	200 m (60 km/h)	300 m (80 km/h)	3000 m
	Support spacing	750 mm	750 mm	700 mm	650 mm

* Configuration of base plate (support):  -> = Anchors per support

** Stiffness of elastic pad: t = 10mm -> c = 20-30 kN/mm
t = 20mm -> c = 10-20 kN/mm
t = 30mm -> c = 5-10 kN/mm

*** Indicative value: V_{max} is a function of the existing superelevation (cant) and the lateral acceleration.

Setting details	HRT-IP M22x190/HRT-IP M27x240		
	**Anchor**	**HRT–IP M22**	**HRT–IP M27**
	Embedment depth h_{nom} [mm]	*120*	*150*
	Minimum member thickness h_{min} [mm]	-	
	Length of anchor l [mm]	*160*	*200*
	Maximum fixing height t_{fix} [mm]	-	-
	Spring deflection S_{inst} [mm]	*8*	*10*
	Spring length L_{st} [mm]	*35*	*40*
	Wrench size S_{inst} [mm]	*38*	*41*

Specification

Hilti HRT-IP (elastic) Rail Anchor		
	**Bolt (M22, SW32)** Material: 10.9 (DIN 931,EN ISO 4014,), hot dipped galvanized Head: Hexgonal **Spring (35 mm)** Wire Grade: C7 (DIN 2076), yellow zinc plated: Fe/Zn 7C (DIN 50961), Spring rate: 373 N/mm, deformation: 8mm **Collar Bush** Material: Plastic , int. Ø= 27 mm, ext. Ø= 36 mm Volume resitivity: 1.2 x 10^{12} Ω cm **Sealingwasher (22.0/36.0/5.0)** To prevent any excess concrete on the anchor shaft **Fixing plate (26.2/50.0/2.0)** To fix the rigid pad (HDPE) and elastic pad to the support assembling during concrete slab pouring. **Insert Body (Ø 28 mm)** Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 120 mm	**Bolt (M27, SW41)** Material: 8.8 (DIN 931,EN ISO 4014), Blue Zinc Plated: Fe/Zn 10B (DIN 50961) Head: Hexgonal **Spring (40 mm)** Wire Grade: C7 (DIN 2076), Yellow Zinc Plated: Fe/Zn 7C (DIN 50961), spring Rate: 300 N/mm, deformation: 10mm ➔ 3.0 kN compression **Collar Bush** Material: Plastic , int. Ø= 28 mm, ext. Ø= 36 mm Volume resitivity: 1.2 x 10^{12} Ω cm **Sealingwasher (27.0/36.0/5.0)** To prevent any excess concrete on the anchor shaft **Fixing plate (31.2/50.0/2.0)** To fix the rigid pad (HDPE) and elastic pad to the support assembling during concrete slab pouring. **Insert Body (Ø 33 mm)** Material: Carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 150 mm

Hilti HRT-IP (rigid) Rail Anchor		
Bolt (M22, SW32) Material: 10.9 (DIN 931,EN ISO 4014,), hot dipped galvanized Head: Hexgonal	**or** **Bolt (M27, SW41)** Material: 8.8 (DIN 931,EN ISO 4014), Blue Zinc Plated: Fe/Zn 10B (DIN 50961) Head: Hexgonal	
Spring washer (22.5/35.9/4.0) Wire Grade: C7 (DIN 2076), blue zinc plated: Fe/Zn 10B (DIN 50961), deformation: 4mm	**Spring washer (27.5/41.5/5.0)** Wire Grade: C7 (DIN 2076), blue zinc plated: Fe/Zn 10B (DIN 50961), deformation: 4mm	
Washer (23.0/44.0/4.0) Material: 4.8 (DIN 125), blue zinc plated: Fe/Zn 10B (DIN 50961) Int. Ø= 23 mm, Ext. Ø= 44 mm	**Washer (28.0/49.0/4.0)** Material: 4.8 (DIN 125), blue zinc plated: Fe/Zn 10B (DIN 50961) Int. Ø= 28 mm, Ext. Ø= 49 mm	
Collar Bush Material: Plastic, int. Ø: 22.2 mm, ext. Ø: 24.2 mm; collar Ø: 44 mm, height: 2/12/14 mm to provide insulation against stray current.	**Collar Bush** Material: Plastic, int. Ø: 27.2 mm, ext. Ø: 30.5 mm; collar Ø: 49 mm, height: 2/12/14 mm to provide insulation against stray current.	
Sealingwasher (22.0/36.0/5.0) PE-Hard foam LD29, black**,** to prevent any excess injection mortar HIT-RE on the anchor shaft.	**Sealingwasher (27.0/36.0/5.0)** PE-Hard foam LD29, black**,** to prevent any excess injection mortar HIT-RE on the anchor shaft.	
Fixing plate (26.2/50.0/2.0) To fix the rigid pad (HDPE) and elastic pad to the support assembling during concrete slab pouring.	**Fixing plate (31.2/55.0/2.0)** To fix the rigid pad (HDPE) and elastic pad to the support assembling during concrete slab pouring.	
Insert Body (Ø 28 mm) Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 120 mm	**Insert Body (Ø 33 mm)** Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 150 mm	