EN

DECLARATION OF PERFORMANCE

according to Annex III of the Regulation (EU) Nr. 305/2011 (Construction Products Regulation)

Hilti nailed shear connector HVB with powder-actuated fastener X-ENP-21 HVB
No. Hilti-DX-DoP-014

1. Unique identification code of the product-type:

Hilti nailed shear connector X-HVB 40, X-HVB 50, X-HVB 80, X-HVB 95, X-HVB 110, X-HVB 125 and X-HVB 140 with powder-actuated fastener X-ENP-21 HVB in combination with Hilti powder-actuated fastening tool DX 76 or DX 76 PTR

2. Type, batch or serial number or any other element allowing identification of the construction product as required pursuant to Article 11(4): Type and lot number are displayed on the packaging

3. Intended use or uses of the construction product, in accordance with the applicable harmonized technical specification, as foreseen by the manufacturer:

Intended use	Nailed shear connector in composite beams and composite decks according to EN 1994-1-1 in building construction. Nailed shear connector can be used either in new construction or for renovation of existing buildings.
Base material	New construction: Structural steel S235, S275 and S355 in qualities JR, J0, J2, K2 according to EN 10025-2. Renovation: In addition old steels which cannot be classified accordingly are still applicable provided these are made of unalloyed carbon steel with minimum yield strength f_y of 170 N/mm².
Concrete	Normal weight concrete C20/25 – C50/60 according to EN 206. Light weight concrete LC 20/22 – LC 50/55 according to EN 206 with a raw density $\rho \geq 1750$ kg/m³.
Composite decking	Steel for profiled sheeting follows EN 1993-1-3 and the material codes given there.
Loading	Static and quasi-static loads in building construction. Seismic loading is covered if the X-HVB is used as shear connector in composite beams used as secondary seismic member in dissipative as well as non-dissipative structures according to EN 1998-1

4. Name, registered trade name or registered trade mark and contact address of the manufacturer as required pursuant to Article 11(5):

Hilti Aktiengesellschaft, Business Unit Direct Fastening, 9494 Schaan, Fürstentum Liechtenstein

5. Where applicable, name and contact address of the authorised representative whose mandate covers the tasks specified in Article 12(2): n.a.

6. System or systems of assessment and verification of constancy of performance of the construction product as set out in Annex V: System 2+

7. In case of the declaration of performance concerning a construction product covered by a harmonised standard: n.a.

8. In case of the declaration of performance concerning a construction product for which a European Technical Assessment has been issued:

DIBt, Deutsches Institut für Bautechnik issued ETA-15/0876 on the basis of EAD 200033-00-0602. The notified body MPA-Stuttgart 0672 performed third party tasks under system 2+ and issued the certificate of conformity of the factory production control 0672-CPR-0622.

9. Declared performance:

Essential characteristics	Performance
Characteristic resistance in solid concrete decks, shear connector orientation parallel to beam axis	See Annex C1 of ETA-15/0876
Characteristic resistance in composite decks – decking ribs perpendicular to beam axis – shear connector orientation parallel to beam axis	See Annex C1 of ETA-15/0876
Characteristic resistance in composite decks – decking ribs perpendicular to beam axis – shear connector orientation perpendicular to beam axis	See Annex C1, C3 and C4 of ETA-15/0876
Characteristic resistance in composite decks – decking ribs parallel to beam axis – shear connector orientation parallel to beam axis	See Annex C2 of ETA-15/0876
Characteristic resistance of end anchorage of composite decks	See Annex C6 of ETA-15/0876
Characteristic resistance for use in seismic areas under seismic actions according to EN 1998-1	See Item 3 of DoP and annex B1 of ETA-15/0876
Characteristic resistance in solid concrete decks in renovation application with old metallic iron or steel material with an actual yield strength less than 235 MPa	See Annex C5 of ETA-15/0876
Application limit	See Annex B3 of ETA-15/0876
Reaction to fire	Class A1 according to EN 13501-1:2007+A1:2009
Resistance to fire	See Annex C7 of ETA-15/0876

The relevant annexes from ETA-15/0876 as referenced above are summarized below:

Annex C1 of ETA-15/0876

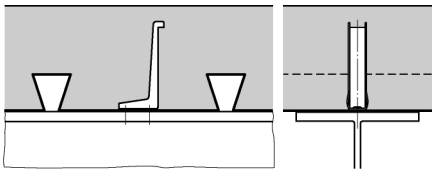
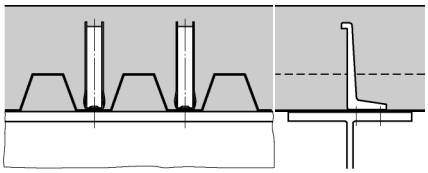
Table 3: Characteristic and design[1] resistance in composite beams with solid slabs

Shear Connector	Characteristic Resistance P_{Rk} [kN]	Minimum base material thickness [mm]	X-HVB positioning[3]	Ductility assessment
X-HVB 40	29.0	6	"duckwalk"	Ductile according to EN 1994-1-1: 2004/AC:2009
X-HVB 50	29.0	6		
X-HVB 80	32.5	8 [2]	parallel with beam	
X-HVB 95	35.0			
X-HVB 110	35.0			
X-HVB 125	37.5			
X-HVB 140	37.5			

1) In the absence of other national regulations, a recommended partial factor γ_V = 1.25 can be used
2) Reduction to 6 mm minimum base material thickness possible, see Annex C5 of ETA-15/0876
3) "Duckwalk" positioning according to Annex C5 of ETA-15/0876, positioning "parallel with beam" according to Annex B5 of ETA-15/0876

Conditions:
- Normal weight concrete C20/25 to C50/60
- Light weight concrete LC20/22 to LC50/55 with a minimum density ρ = 1750 kg/m³
- Observation of positioning rules according to Annex B5 and Annex C5

Table 4: Characteristic and design[1] resistance in composite beams with decking ribs transverse to beam axis

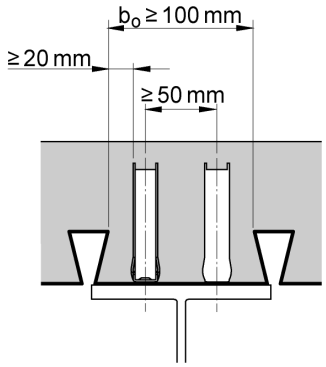
X-HVB positioning	Characteristic Resistance $P_{Rk,t}$	Ductility assessment
 X-HVB positioning longitudinal with the beam	$P_{Rk,t,l} = k_{t,l} \cdot P_{Rk}$ $k_{t,l} = \frac{0.66}{\sqrt{n_r}} \cdot \frac{b_0}{h_p} \cdot \left(\frac{h_{SC}}{h_p} - 1\right) \leq 1.0$	Ductile according to EN 1994-1-1: 2004/AC:2009
 X-HVB positioning transverse with the beam	$P_{Rk,t,t} = 0.89 \cdot k_{t,t} \cdot P_{Rk}$ $k_{t,t} = \frac{1.18}{\sqrt{n_r}} \cdot \frac{b_0}{h_p} \cdot \left(\frac{h_{SC}}{h_p} - 1\right) \leq 1.0$	

1) In the absence of other national regulations, a recommended partial factor γ_V = 1.25 can be used

Conditions:
- Characteristic resistance P_{Rk} for solid concrete slabs according to Table 3
- Normal weight concrete C20/25 to C50/60
- Light weight concrete LC20/22 to LC50/55 with a minimum raw density ρ = 1750 kg/m³
- Geometric parameters b_0, h_p and h_{SC} according to Annex B4, n_r corresponds to the number of X-HVBs per rib
- Observation of positioning rules according to Annex B6 and Annex B7 of ETA-15/0876
- Applicable for X-HVB 80, X-HVB 95, X-HVB 110, X-HVB 125, X-HVB 140

Annex C2 of ETA-15/0876

Table 5: Charcteristic and design[1)] resistance in composite beams with decking ribs parallel to beam axis

X-HVB positioning	Characteristic Resistance $P_{Rk,l}$	Ductility assessment
 X-HVB positioning longitudinal with the beam	$P_{Rk,l} = k_l \cdot P_{Rk}$ $k_l = 0.6 \cdot \frac{b_0}{h_p} \cdot \left(\frac{h_{SC}}{h_p} - 1\right) \leq 1.0$	Ductile according to EN 1994-1-1: 2004/AC:2009

1) In the absence of other national regulations, a recommended partial factor γ_V = 1.25 can be used

Conditions:

- Characteristic resistance P_{Rk} for solid concrete slabs according to Annex C1 of ETA-15/0876, Table 3
- X-HVB are to be positioned parallel with beam
- Normal weight concrete C20/25 to C50/60
- Light weight concrete LC20/22 to LC50/55 with a minimum density ρ = 1750 kg/m³
- Geometric parameters b_0, h_p and h_{SC} according to Annex B4 of ETA-15/0876
- Observation of positioning rules according to Annex B8 of ETA-15/0876
- Applicable for X-HVB 80, X-HVB 95, X-HVB 110, X-HVB 125, X-HVB 140

Annex C3 of ETA-15/0876

Annex C3 gives supplemental characteristic and design resistances for specific geometric conditions beyond the scope of application of Annex C1:

Conditions:

- Narrow rib decking transverse to beam used on narrow beams
- X-HVB are to be positioned transverse to beam
- Performances and geometric conditions see Annex C3 of ETA-15/0876
- Applicable for X-HVB 95, X-HVB 110, X-HVB 125, X-HVB 140

Annex C4 of ETA-15/0876

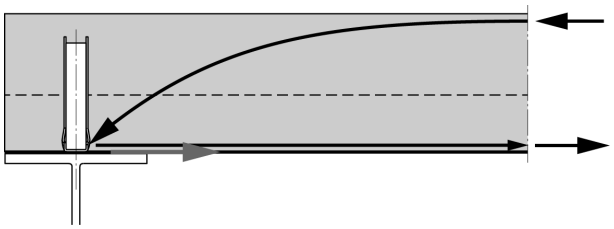
Annex C4 gives supplemental characteristic and design resistances for X-HVB 140 for 80 mm deep decking with 15 mm deep re-entrant stiffener

Conditions:

- X-HVB are to be positioned transverse to beam
- Performances and geometric conditions see Annex C4 of ETA-15/0876
- Applicable for X-HVB 140

Annex C6 of ETA-15/0876

End anchorage in composite slabs



Characteristic and design[1)] resistance:

$$V_{Rk,EA} = 50 \cdot t \cdot f_{u,k}$$

1) In the absence of other national regulations, a recommended partial factor γ_V = 1.25 can be used

with:

$V_{Rk,EA}$ …. characteristic strength of X-HVB 80 to X-HVB 140 for end anchorage of composite decking.

t ……. design core thickness of composite sheet

$f_{u,k}$ …. characteristic strength of steel composite decking. Independent on the applied steel grade, $f_{u,k}$ used in the formula shall not exceed 360 N/mm².

Annex C5 of ETA-15/0876

Characteristic resistance: Effect of reduced base material thickness for X-HVB 80 to X-HVB 140

Reduction of characteristic resistance P_{Rk} with the factor ($t_{II,act}$ / 8) is required in case the actual base material thickness is less than 8 mm.

$$P_{Rk,red} = \frac{t_{II,act}}{8} \cdot P_{Rk}$$

with:

$P_{Rk,red}$ … reduced characteristic resistance of X-HVB 80 to X-HVB 140 for actual base material thickness $t_{II,act}$ < 8 mm and a minimum thickness of 6 mm.

P_{Rk} …. Characteristic resistances in solid and composite slabs for X-HVB 80 to X-HVB 140 according to Annex C1 (Table 3 and 4) and Annex C2 of ETA-15/0876

For solid concrete slabs $P_{Rk,red} \geq 29{,}0\ kN$ applies.

Notes: Corresponding values can also be applied in new construction.
No extrapolation of above formula for base material thickness t_{II} > 8 mm

Characteristic resistance: Effect of reduced base material strength

Reduction of characteristic resistance P_{Rk} with the factor $\alpha_{BM.red}$ is required in case the actual base material strength f_u of the old construction steel is less than 360 N/mm².

Minimum ultimate strength $f_{u,min}$ = 300 N/mm² (with a minimum yield strength f_y = 170 N/mm²)

$$P_{Rk,red} = \alpha_{BM,red} \cdot P_{Rk}$$

$$\alpha_{BM,red} = 0.95$$

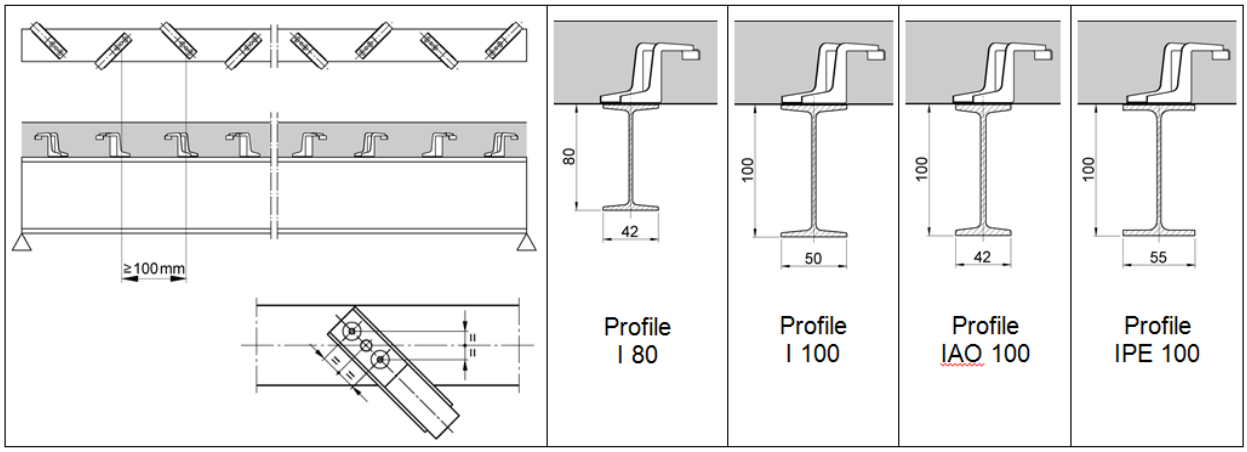
with:

$P_{Rk,red}$ …. reduced characteristic strength of X-HVB for base material strength between 300 and 360 N/mm²

P_{Rk} ……. Characteristic resistance of X-HVB according to Annex C1 to Annex C4 of ETA-15/0876

$\alpha_{BM,red}$…. base material strength reduction factor

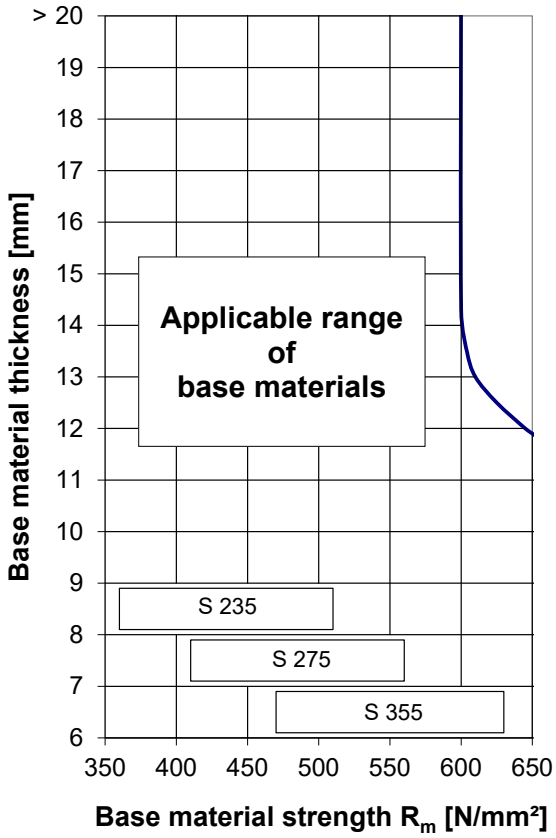
"Duckwalk" positioning of X-HVB 40 and 50 in combination with thin solid slabs:



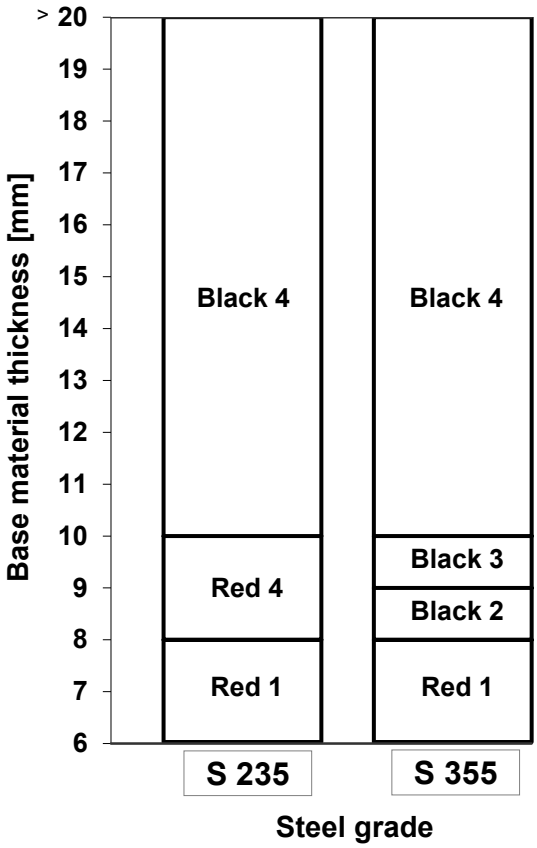
Minimum section width = 40 mm (e.g. old section IAO 100),
Minimum centre distance of steel sections = 400 mm

Annex B3 of ETA-15/0876

Application limit and tool energy setting

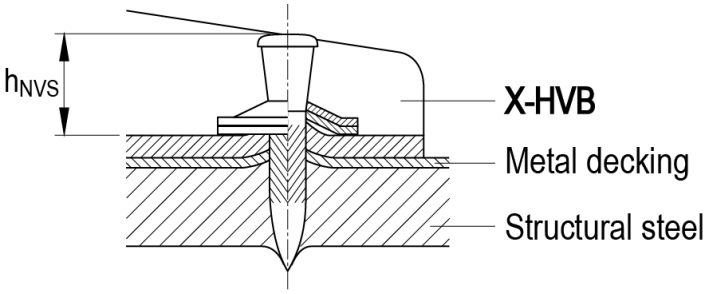


Notes:
Minimum section covered: IPE 100 (see annex C5)



Notes:
In case of thin base materials, the blue cartridge is possible to be used. Blue 3 corresponds to Red 1.
Fine adjustment on the energy based on job site trials.

Fastener inspection



Clearly visible piston mark on top washer

8.2 mm ≤ h_{NVS} ≤ 9.8 mm

Extract of Annex C7 of ETA-15/0876
Characteristic and design resistance in case of a fire.

Table 8: Temperature dependent strength reduction factor

Temperature of top flange $\Theta_{X\text{-}HVB}$ [°C]	$k_{u,\Theta,X\text{-}HVB}$
20	1.00
100	1.00
200	0.95
300	0.77
400	0.42
500	0.24
600	0.12
≥ 700	0

The design of the X-HVB shear connector in case of a fire is done according to EN 1994-1-2:2005/A1:2014. The reduction factor $k_{u,\Theta,X\text{-}HVB}$ shall be determined with the temperature of the steel top flange to which the X-HVB is connected.

The characteristic resistance of the X-HVB nailed shear connector at elevated temperature is calculated:

In case of solid concrete slabs:

$$P_{fi,Rk} = k_{u,\theta,X-HVB} \cdot P_{Rk}$$

with:

$P_{fi,Rk}$ …. characteristic resistance of X-HVB shear connector at elevated temperature.
P_{Rk} …. characteristic resistance of X-HVB shear connector according to Annex C1 of ETA-15/0876, Table 3.

In the absence of other national regulations a recommended partial factor $\gamma_{M,fi,V}$ = 1.0 can be used

Further formulas for composite beams with composite slabs in case of a fire: see ETA-15/0876, Annex C7.

10. The performance of the product identified in points 1 and 2 is in conformity with the declared performance in point 9. This declaration of performance is issued under the sole responsibility of the manufacturer identified in point 4.

Signed for and on behalf of the manufacturer by:

Mario Grazioli
Head of Quality Direct Fastening

Hilti Aktiengesellschaft, Schaan: October 31, 2021