

Recommendations for fixing profiled metal floor decking with Direct Fastening Systems (including provision of composite connection when required).

General fixing advice:

- Metal floor decking **MUST** be suitably secured to limit transverse and vertical displacement during the construction process.
- Consideration should be given to weather / exposure conditions which may prevail during the construction process e.g. wind and thermal effects.
- Reference should be made to all relevant design documentation for details of specific fixing requirements including fastener spacing and fixing types.
- Particular consideration should be given to the loads caused by the placing of wet concrete during the construction phase.

Fixing & Securing:

- Steel decking panels can be easily and efficiently secured to structural steelwork beams using low velocity powder actuated fastening systems.
- From the information in provided in this data Sheet, the fastening type and frequency can be determined - **Hilti do not believe that Gas actuated tools and fixings are suitable for this application**, as the energy of the GX100/120 is not sufficient to perform a flush fixing and cater for the potential weather / exposure effects (wind, thermal...).
- Additional technical advice on this application is available from Hilti Technical Advisory Service on 0161 886 1144.

Site Testing

- Please refer to the **Fastening Inspection** and **Fastening Quality assurance** at the end of each product section in this Data Sheet.








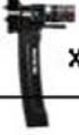




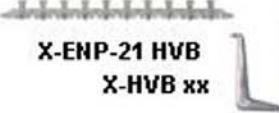
Health & Safety

- Cartridge Tools should only be used by suitably trained personnel in accordance with the manufacturers instructions. Please contact Hilti Customer Services 0800 886 100 to arrange training.
- Appropriate PPE must be worn at all times. For Cartridge Tools, Eye Protection to EN 166 Grade B is required by the HSE also Ear Defenders to EN 352-1 are strongly recommended.
- Risk Assessment Guidance is given on Page 17 of this document.
- For advice on other aspects of site safety when working with Direct Fastening tools e.g. safe zones, please contact Hilti Technical Advisory Service on 0161 886 1144.

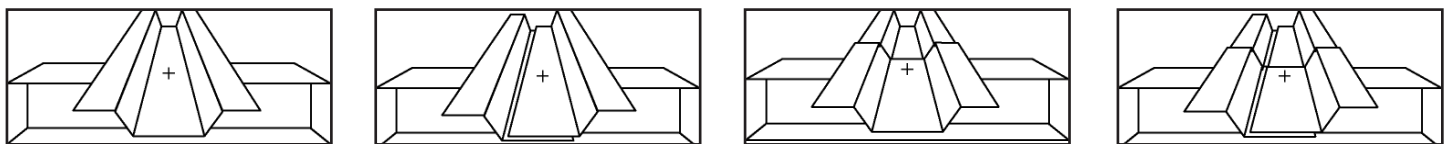
Further References:

- BCSA Code of Practice for Metal Decking & Stud Welding.
- Decking manufacturers Information Sheets and installation advice.

Fastening Systems covered in this Data Sheet.

Tool	Fastener Guide	Piston	Fastener	Item No.
 DX 460-F8	 X-460-F8	 X-460-P8	 X-U 15 P8 TH	237328 (100) 342215 (1000)
	 X-460-MX72		 X-U 15 MX SP	383466 (100) 342000 (1000)
 DX 76-PTR	 X-76-F-ENP PTR	 X-76-P-ENP-PTR	 X-ENP 19 L15	283507 (1000)
	 X-76-F-HVB PTR	 X-76-P-HVB PTR	 X-ENP-21 HVB X-HVB xx	283512 (100) Range 50 - 140

1. Typical Metal Floor Deck Applications (including ‘overlaps’, edge trim etc.)



2. Design Considerations

Before selecting a suitable fastening method, the following information must be considered:

1. The load requirement at the intended fastening points. **Note:** this loading MUST consider the worst case of:
 - a. Long term dead + Live load or
 - b. Construction live load
 - c. Thermal effect (differential expansion / contraction)
2. Is load requirement for the fastening ‘temporary’ through construction phase only or is it required to transfer loading into the structure as part of the structural design of the building e.g. transfer of lateral shear for composite action.
3. Base steel thickness range (see individual product data below for details).
4. Thickness of sheet to be fastened. **Note:** for the total thickness which can be fastened including overlaps, side trim etc, see individual product data below for details.

3. Fastener Selection

From the information in section 2. the fastening type and frequency can be determined.

Hilti do not believe that Gas actuated tools and fixings are suitable for this application, as the energy of the GX100/120 is not sufficient to perform a flush fixing.

3.1 Temporary Load Only

For fastenings which are required to take a 'temporary load' only during the construction phase, the following fasteners can be considered:

X-U 15 (previously X-DAK) in either single or magazine version. Suitable for use with DX 460 Fastening tool.

Material Specification

X-U 15 TH / MX SP (Hardness HRC 59)



Recommended loads

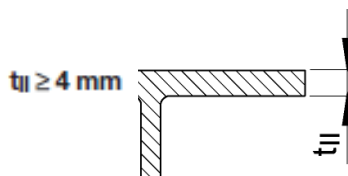
t_f [mm]	N_{rec} [kN]	V_{rec} [kN]
0.75-1.25	0.6	0.8

Design conditions:

- Recommended working loads valid for steel sheet with minimum tensile strength ≥ 360 N/mm².
- In case of a design based on the characteristic resistance, recommended values have to be multiplied by two: $\Rightarrow N_{Rk} = N_{rec} \cdot 2.0$ $V_{Rk} = V_{rec} \cdot 2.0$
- Redundancy (multiple fastening) must be provided.
- Valid for predominantly static loading

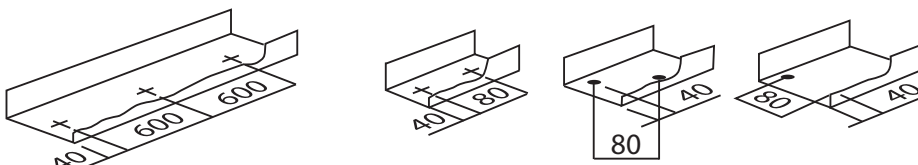
Application Requirements

Minimum steel thickness 4mm

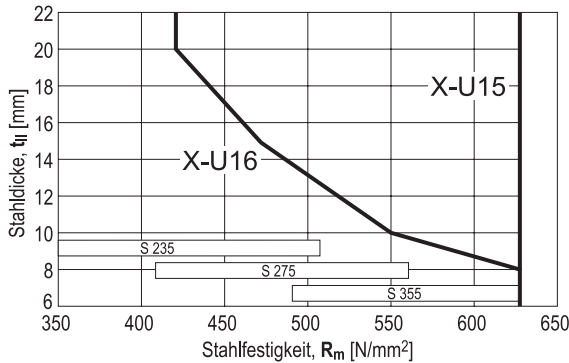


Spacing & Edge Distances

Minimum edge distance 40mm / Minimum spacing between fixings 80mm



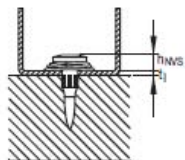
Recommended Setting Range for X-U 15



Cartridge selection and tool energy setting.
 Steel: 6.8/11M red cartridge
Note, a site trial is required to finally determine the correct tool energy.

Fastening Quality Assurance and Fastening Inspection

Fastening to steel



The head of the fixing should be between 3-6mm above the steel surface.

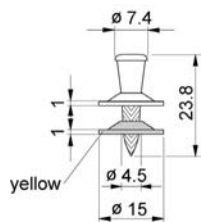
X-U 15: h_{nvs} = 4-6mm

3.2 Structural Load / transfer of shear load

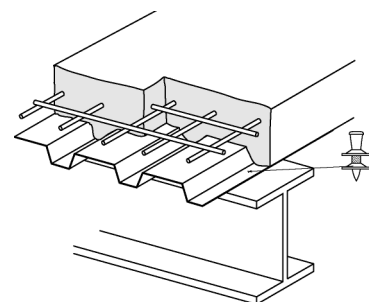
For fastenings which are designed to transfer 'shear' loading into the structure e.g. where decking is required to provide lateral restraint to the beams, the following fasteners can be considered:

X-ENP-19 L15 (single) or X-ENP-19 L15 MX (magazine type)

Approvals: ETA-04/0101 (Europe)



Application Examples



The intended use only comprises fastenings which are not directly exposed to external weather conditions or moist atmospheres.

Design Load Data

Characteristic loads – Steel sheeting

Sheeting thickness t_f [mm]	Trapezoidal profile (symmetric loading)		Liner trays ¹⁾ (asymmetric loading)	
	Char. resistance according to ETA-04/0101		Char. resistance keeping to ETA-04/0101	
nominal	Shear V_{Rk} [kN]	Tension N_{Rk} [kN]	Shear V_{Rk} [kN]	Tension N_{Rk} [kN]
0.63	4.00	4.10	2.80	2.90
0.75	4.70	6.30	3.30	4.40
0.88	5.40	7.20	3.80	5.00
1.00	6.00	8.00	4.20	5.60
1.13	7.00	8.40	4.90	5.90
1.25	8.00	8.80	5.60	6.20
1.50	8.60	8.80	6.00	6.20
1.75	8.60	8.80	6.00	6.20
2.00	8.60	8.80	6.00	6.20
2.50	8.60	8.80	6.00	6.20

- N_{Rk} and V_{Rk} are valid for steel sheet with minimum tensile strength ≥ 360 N/mm² (\geq S280 EN 10326).
- For intermediate sheet thicknesses, use recommended load for next smaller thickness or linear interpolation.
- ¹⁾ Required load reduction is taken into account in accordance with Eurocode 3-1-3, section 8.4 (9) and fig. 8.2. See also construction rules under spacings and edge distances.

Recommended loads – Steel sheeting

Sheeting thickness t_f [mm]	Trapezoidal profile (symmetric loading)		Liner trays ¹⁾ (asymmetric loading)	
	Recommended loads		Recommended loads	
nominal	Shear V_{rec} [kN]	Tension N_{rec} [kN]	Shear V_{rec} [kN]	Tension N_{rec} [kN]
0.63	2.10	2.20	1.50	1.55
0.75	2.50	3.35	1.75	2.35
0.88	2.90	3.85	2.00	2,70
1.00	3.20	4.25	2.25	3.00
1.13	3.75	4.50	2.65	3.15
1.25	4.25	4.70	3.00	3.30
1.50	4.60	4.70	3.20	3.30
1.75	4.60	4.70	3.20	3.30
2.00	4.60	4.70	3.20	3.30
2.50	4.60	4.70	3.20	3.30

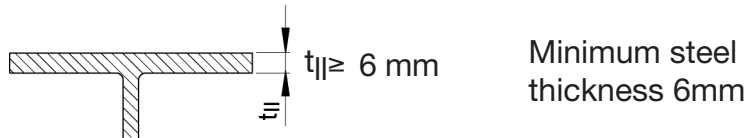
- N_{rec} and V_{rec} are valid for steel sheet with minimum tensile strength ≥ 360 N/mm² (\geq S280 EN 10326).
- For intermediate sheet thicknesses, use recommended load for next smaller thickness or linear interpolation.
- Recommended loads N_{rec} and V_{rec} are appropriate for Eurocode 1 wind loading design with a partial safety factor $\gamma_F = 1.5$ for wind load and a partial resistance factor $\gamma_M = 1.25$ for the fastening.
- ¹⁾ Required load reduction is taken into account in accordance with Eurocode 3-1-3, section 8.4 (9) and fig. 8.2. See also construction rules under spacings and edge distances.

Test Data

Testing and evaluation of design data have been done in accordance to European Technical Approval ETA-04/0101 which refers to Eurocode 3, part 1-3 (ENV 1993-1-3). The test procedure is described in detail in Section 2 of the **Hilti Direct Fastening Technology Manual**.

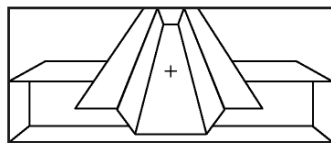
Application Requirements

Thickness of base material, Steel thickness t_{II}

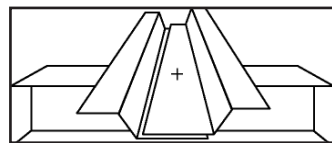


Thickness of fastened material

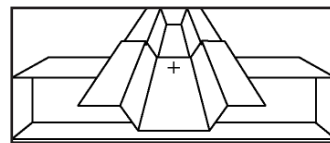
Sheet thicknesses and overlap types



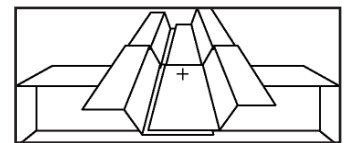
(a) single



(b) side lap



(c) end overlap



(d) side lap and end overlap

Nominal sheeting thickness t_I [mm]

Allowable overlap types

0.63-1.00

> 1.00-1.25

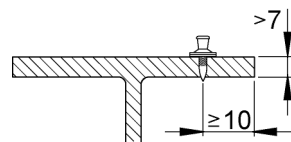
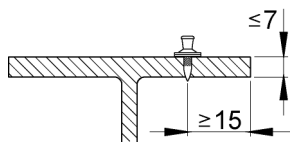
> 1.25-2.50

a, b, c, d

a, c

a

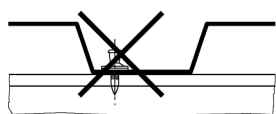
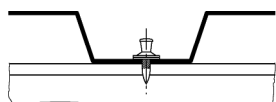
Spacing and Edge Distances (mm) for Steel Base Material



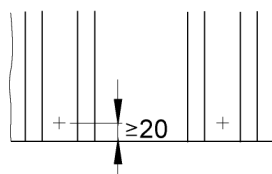
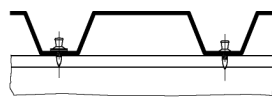
Steel thickness 6-7mm
minimum edge distance 15mm

Steel thickness greater than 7mm
minimum edge distance 10mm

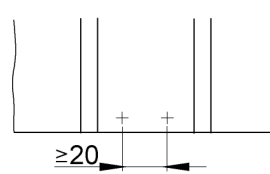
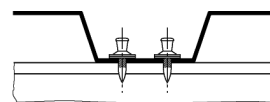
Trapezoidal Profiles



Center fastenings
in ribs

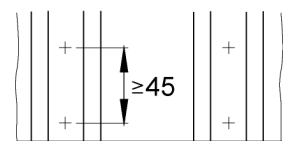
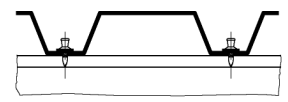


Clearance to
end of sheet



Double Fastenings (asymmetric)

Note: Reduced recommended load per fastening
Reduction depends on actual spacing and conditions
For further information contact Hilti.

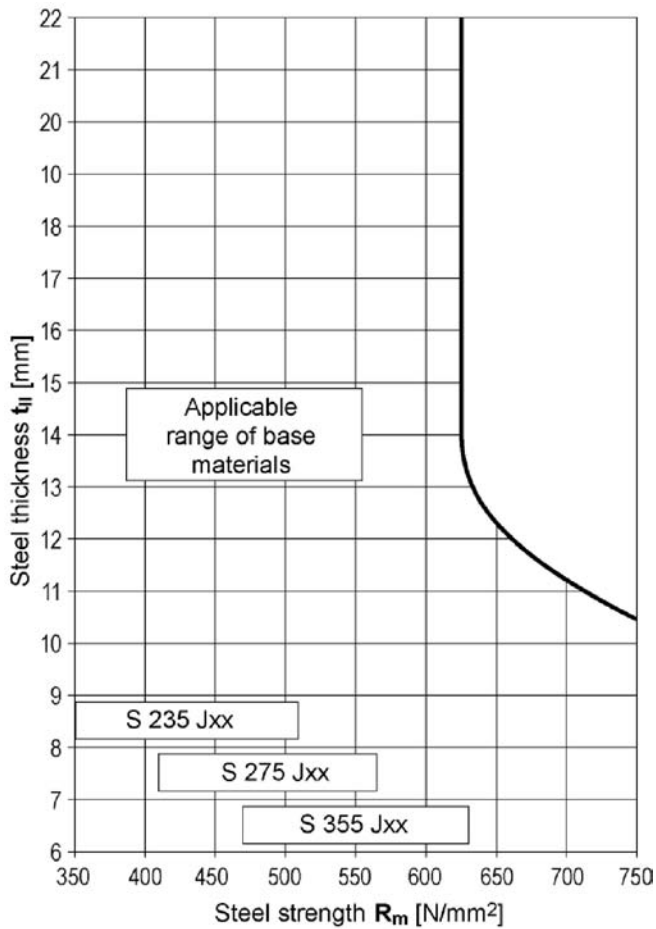


Corrosion information

The intended use only comprises fastenings which are not directly exposed to external weather conditions or moist atmospheres.

Recommended setting range

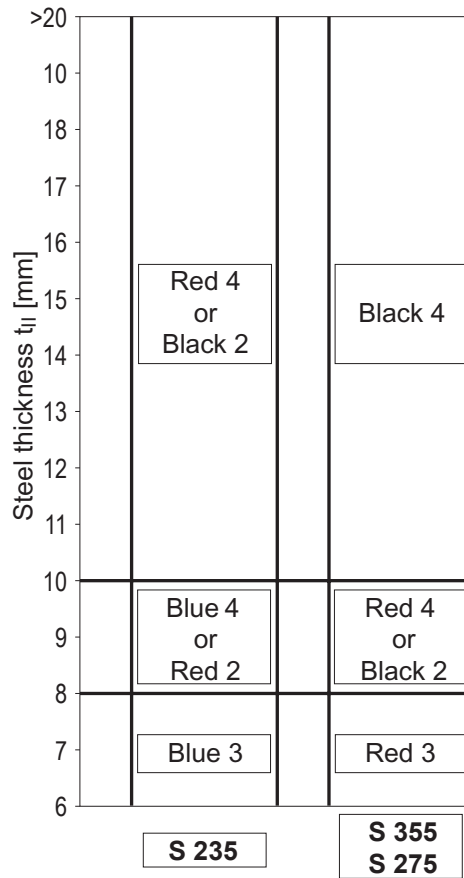
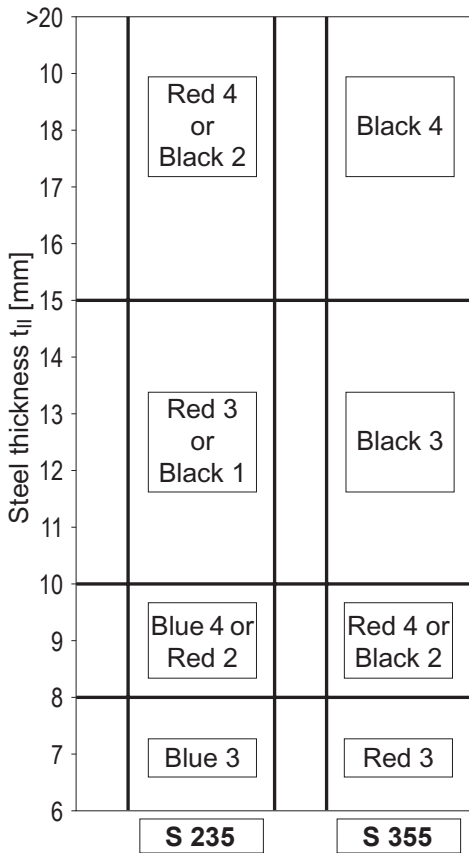
X-ENP-19 with DX 76 and DX 860-ENP



Fastener Selection and System Recommendation

	Designation	Item No.	Tools
Single nail:	X-ENP-19 L15	283506	DX 76 F15, DX 76 PTR
Collated nails:	X-ENP-19 L15 MX (white cartridge strip)	283507	DX 76 MX, DX 76 PTR
	X-ENP-19 L15 MXR (grey cartridge strip)	283508	DX 860-ENP

Cartridge Selection and tool energy setting

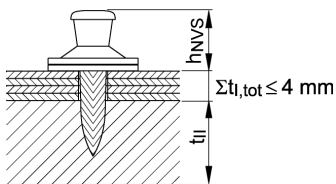


Fine Adjustment by Installation Tests on Site

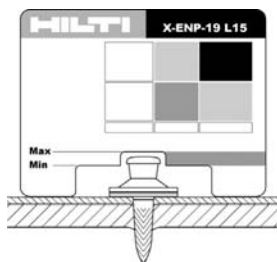
Note for S275:

Start with recommendation for S355. In case of too much energy: Reduction of tool energy setting or change of cartridge colour until correct nail head stand-offs h_{NVS} are achieved

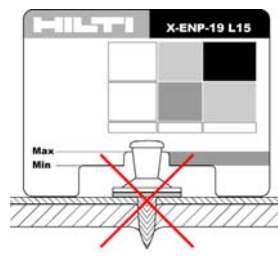
Fastening Inspection and Fastening Quality Assurance



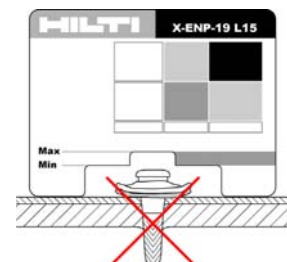
$$h_{NVS} = 8.2-9.8 \text{ mm for } t_{I,tot} \leq 4 \text{ mm}$$



h_{NVS} 8.2-9.8mm



h_{NVS} 8.2-9.8mm
(washers are not compressed)



h_{NVS} 8.2-9.8mm
(washers are strongly damaged by the tool piston)

Shear Connectors for Composite Design.

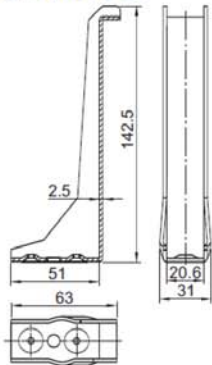
- Design in accordance with SCI / Corus BDES Design Software
- Contact Hilti Technical Advisory Service for further details (0161 886 1144)

X-HVB Shear Connectors

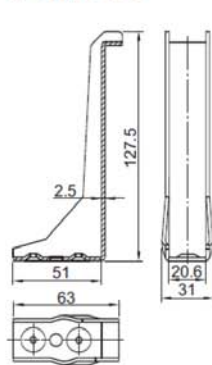
Product data

Dimensions

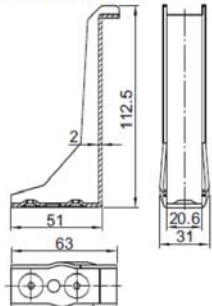
X-HVB 140



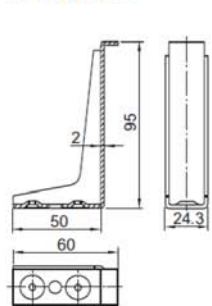
X-HVB 125



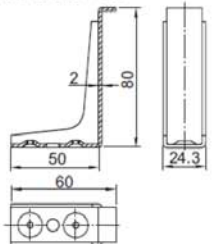
X-HVB 110



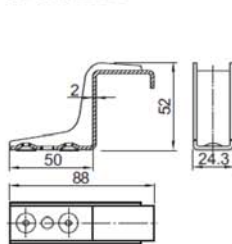
X-HVB 95



X-HVB 80

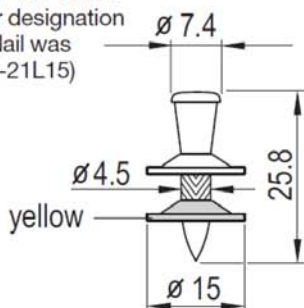


X-HVB 50



X-ENP-21 HVB

(Former designation of the Nail was ENPH2-21L15)



General information

Material specification

X-HVB

Carbon steel: $R_m = 295-350 \text{ N/mm}^2$

Zinc coating: $\geq 3 \mu\text{m}$

X-ENP-21 HVB

Carbon steel shank: HRC58

Zinc coating: $8-16 \mu\text{m}$

Fastening tools and equipment

Tool	DX 76
Fastener Guide	X-76-F-HVB
Piston	X-76-P-HVB
Cartridges	6.8/18 M black, red (details see application limit X-ENP-21 HVB)

See fastener selection for more details.

Approvals and design guidelines

SOCOTEC (France)

City of Vienna (Austria)

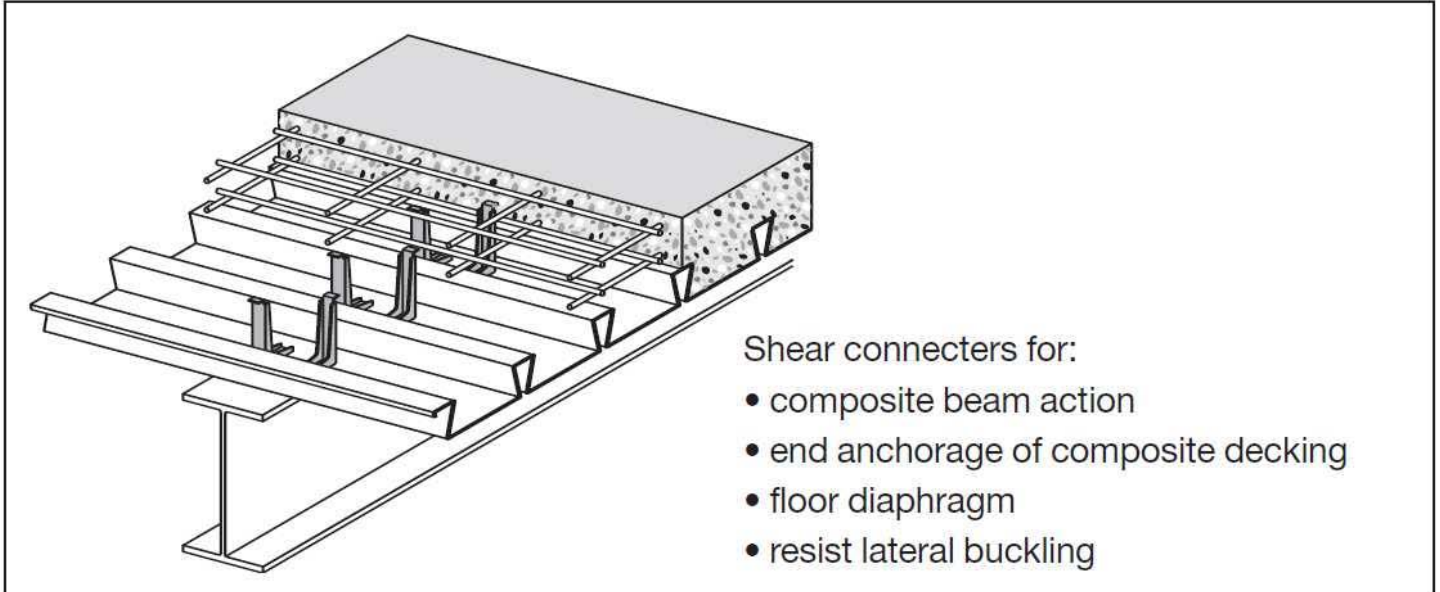
ÖNORM (Austria)

DIBt (Germany)

SCI (UK), TZÚS (Czech)

Note: Technical data presented in these approvals and design guidelines reflect specific local conditions and may differ from those published in this handbook. If the fastening is subject to an approval process or where a design guideline must be used, technical data in the approval or design guideline has precedence over data presented here. Approval copies are available from your Hilti technical advisory service.

Applications Examples



Shear connectors for:

- composite beam action
- end anchorage of composite decking
- floor diaphragm
- resist lateral buckling

Load Data

Design Data

Solid slabs

Nominal	Characteristic shear resistance P_{Rk} [kN] ¹⁾	Design shear resistance P_{Rd} [kN] ²⁾	Allowable horizontal shear q [kN] ³⁾	Allowable resistance (working load) R_D [kN] ⁴⁾
X-HVB 50	23	18	N.A	13
X-HVB 80	28	23	14	16
X-HVB 95	35	28	17.5	22
X-HVB 110	35	28	17.5	22
X-HVB 125	35	28	17.5	22
X-HVB 140	35	28	17.5	22

¹⁾ As defined in ENV 1994-1-1 (Nominal strength in AISC-LRFD; unfactored shear resistance in CISC, Q_k in BS 5950:3:3.1:1990)

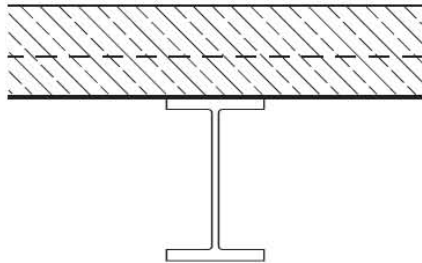
²⁾ As defined in ENV 1994-1-1 (Q_p in BS 5950:3:3.1:1990)

³⁾ Allowable shear in AISC-ASD

⁴⁾ Allowable shear for working load design (unfactored loads) per ENV 1994-1-1, SIA 161, and most other European codes

Reduction Factors for profile metal beams.

Ribs transverse to beams



Note: $k_t \leq 1.0$

$$k_t = \frac{K}{\sqrt{N_f}} \cdot \frac{b_0}{h_{ap}} \cdot \frac{h_{sc} - h_{ap}}{h_{ap}}$$

ENV 1994-1-1 designs:

$$K = 0.70$$

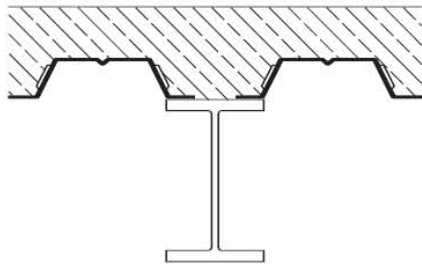
N_f = HVB's / rib (≤ 2 in the calculation even if 3 are placed in a rib)

AISC, CISC, BS 5950, other design codes:

$$K = 0.85$$

N_f = HVB's / rib (1, 2 or 3)

Ribs transverse to beams



Note: $k_p \leq 1.0$

$$\text{for } \frac{b_0}{h_{ap}} \geq 1.8 \Rightarrow k_p = 1.0$$

$$\text{for } \frac{b_0}{h_{ap}} < 1.8 \Rightarrow k_p = 0.6 \times \frac{b_0}{h_{ap}} \times \frac{h_{sc} - h_{ap}}{h_{ap}}$$

Engineering Advice

Connector placement along the beam

The HVB is a flexible connector and may be uniformly distributed between points where large changes in shear flow occur. These points are e.g. supporting points, points of application of point loads, areas with extreme values of bending moments.

Partial shear connection

Strength:

The minimum connection depends on the design code used:

- a) In **ENV 1994-1-1** and **BS 5950** designs, N/N_f , must be at least 0.4. This is increased depending on span length and decking geometry.
- b) In **AISC**, N/N_f must be at least 0.25.
- c) In **CISC**, N/N_f must be at least 0.50.

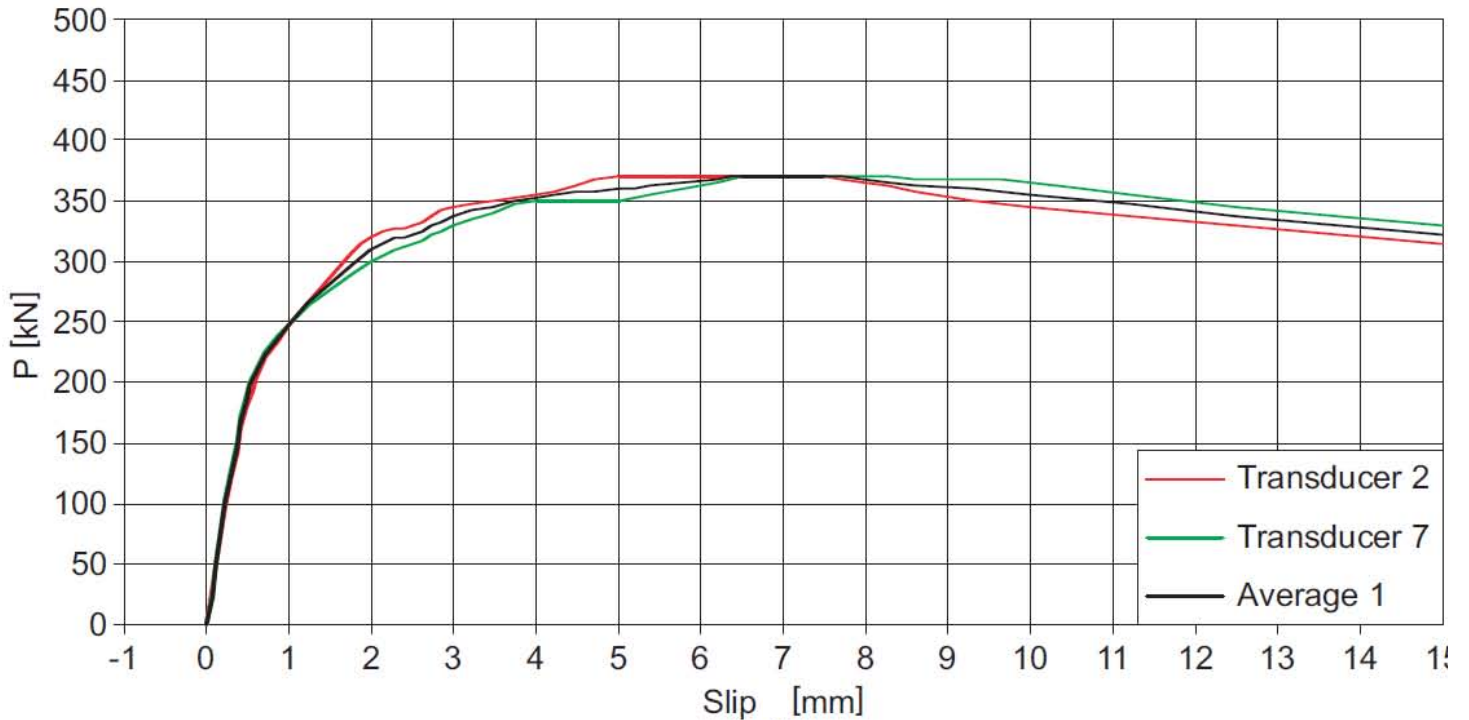
Deflection control only:

If the shear connection is needed for deflection control only, no minimum degree of connection, however, minimum allowable connector spacing applies and steel beam must have enough strength to carry the self-weight and all imposed loads.

Test Data

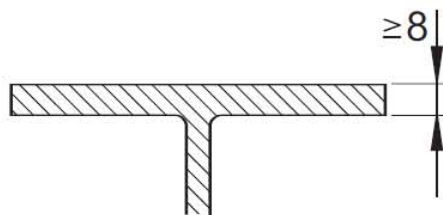
Important note: Test data are for information only and can't be used for design. These data are examples and not representing the whole range of applications and load cases. For more detailed information please contact Hilti.

Typical load displacement curve form Push-out test with 8 X-HVB 110



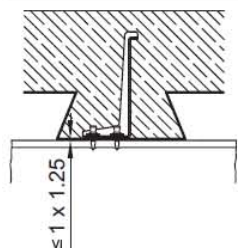
Application Requirements

Thickness of base material



Minimum thickness of steel base material **t_{II} = 8 mm**

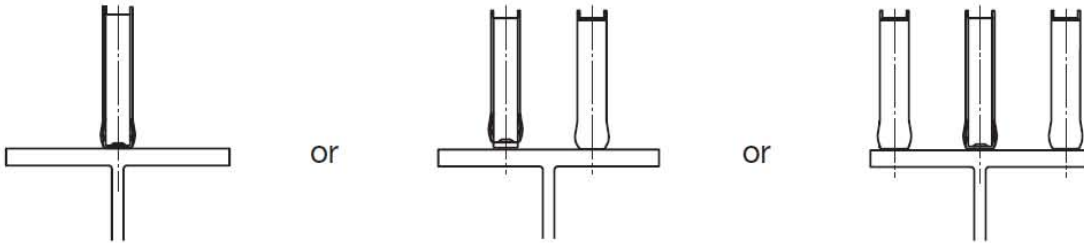
Thickness of fastened material



Maximum thickness of decking **t_I = 1.25 mm**

Connector Positioning spacing and edge distance

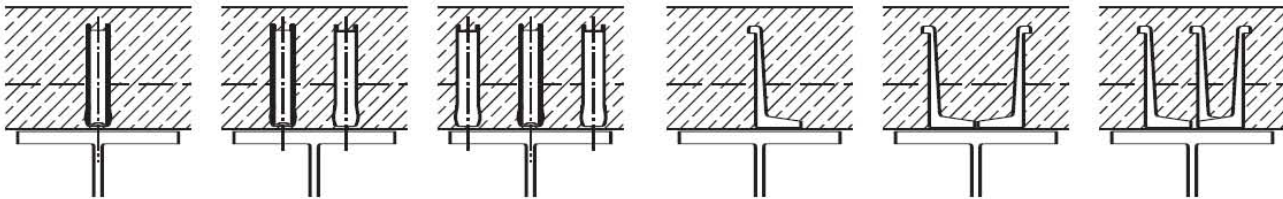
General positioning



Position the HVB's so that the shear force is transferred symmetrically to the beam. The HVB orientation parallel to the axis of the beam is preferred.

Positioning on metal decks - ribs transverse to beam

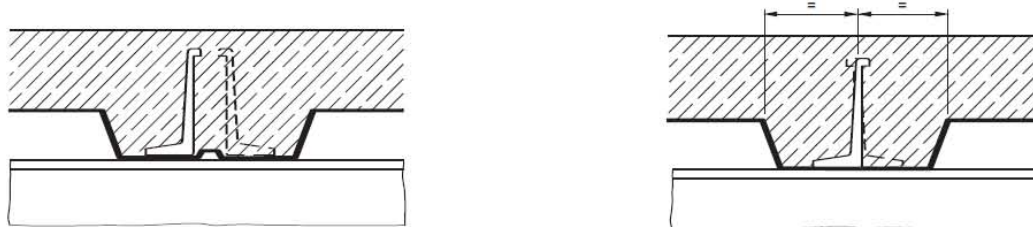
1) One, two or three HVB's per rib; \perp or \parallel to beam



2a) Position in the rib : 1 HVB per rib – leg centered in the rib or 40 mm clearance



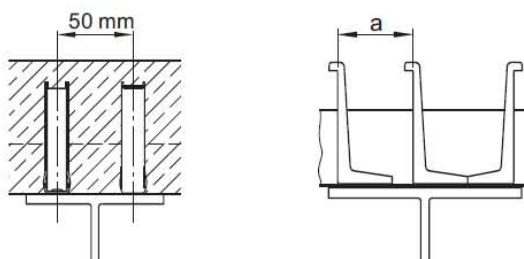
2b) With 2 or 3 HVB's per rib – Legs centered in the rib or alternated about the center



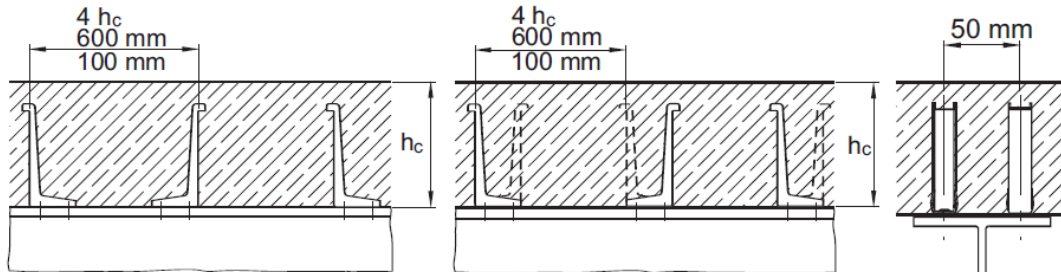
3) Spacing along the ribs

- basic minimum spacing, $a \geq 50$ mm
- $a \geq 100$ mm for:
 - $b_o/m < 0.7$ and $b_o/h_{ap} < 1.8$
 - SDI 3" composite decking (USA)

m = rib spacing

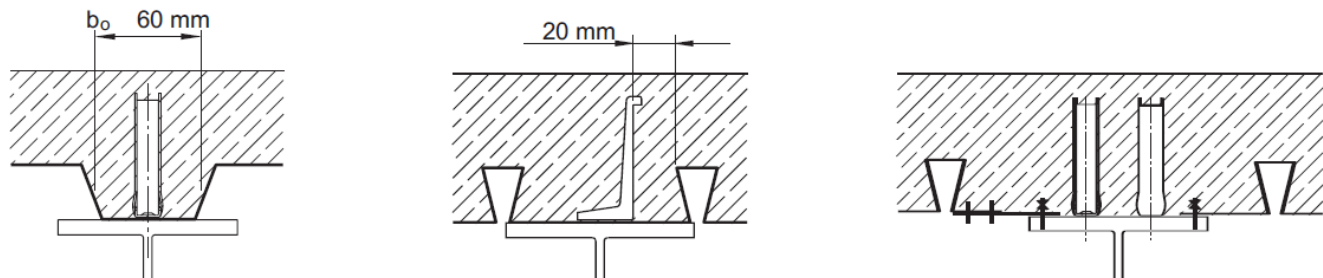


Positioning on Metal Decks
ribs parallel to beam and solid slabs



- With 1 connector per row, alternate direction of connectors from row to row.
- With 2 or 3 connectors per row, alternate direction of connectors inside of each row and from row to row.

Clearance to metal decking



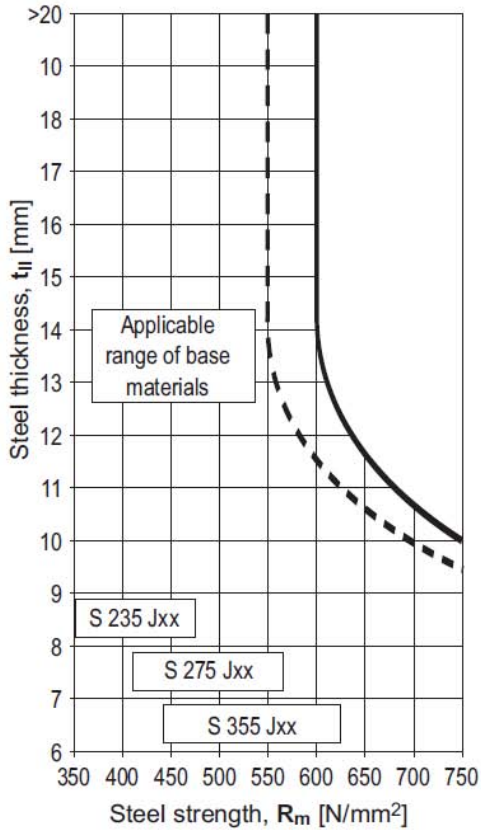
Split decking if necessary for spacing / clearance

Corrosion Information

The intended use only comprises fastenings which are not directly exposed to external weather conditions or moist atmospheres. For further detailed information on corrosion see corresponding chapter in The Hilti Direct Fastening Technology Manual.

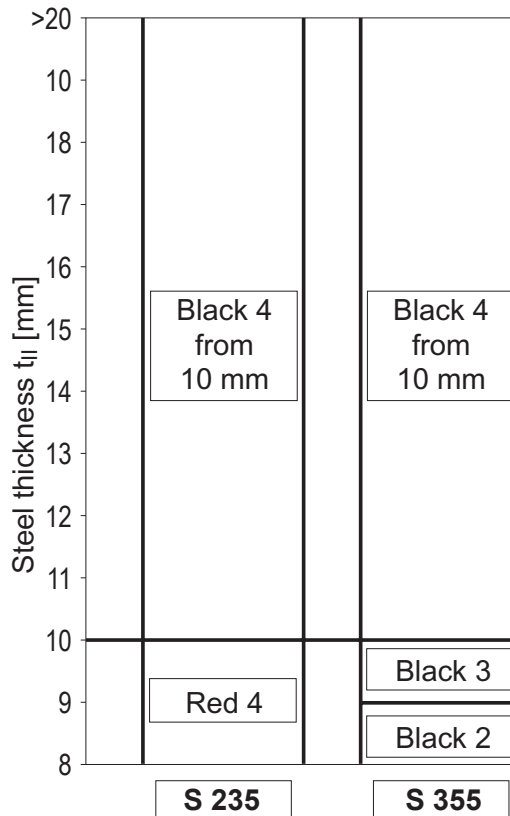
Recommended Setting Range
Application limits are valid only
if correct cartridge and power
setting are used!

Application limits X-ENP-21 HVB



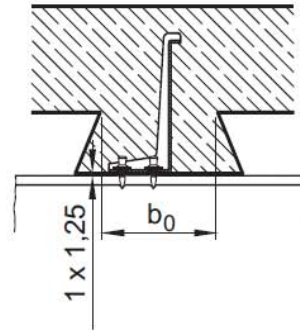
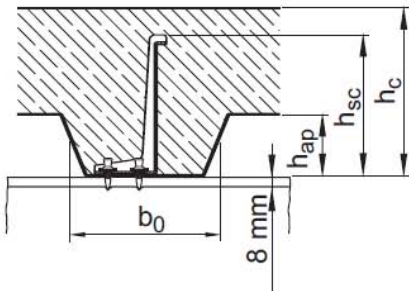
In thermo-mechanically rolled construction steel, e.g. S 355M per EN 10025-4 the application limit is reduced by 50N/mm²

Cartridge pre selection and power setting



Fine adjustment by setting tests on site

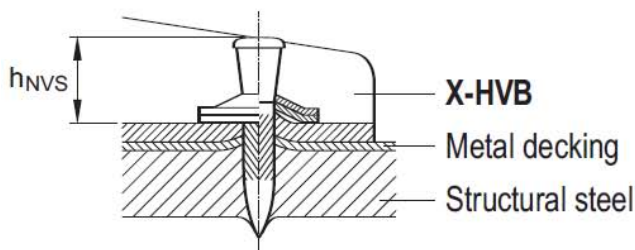
Fastener Selection



Connector

Designation	Item-Number	Maximum decking height h_{ap} [mm]	
		$b_0 / h_{ap} \geq 1.8$	$b_0 / h_{ap} < 1.8$
X-HVB 50	56467	Not for use with profiled decking	
X-HVB 80	239357	45	45
X-HVB 95	239358	60	57
X-HVB 110	239359	75	66
X-HVB 125	239360	80	75
X-HVB 140	239361	80	80
all connectors with two nails			
X-ENP-21 HVB	283512		

Fastening Quality Assurance and Fastening Inspection



X-ENP-21 HVB $h_{NVS} = 8.2-9.8$ mm

Risk Assessment Guidance - DX

Should a risk assessment be required (CDM, HSE requirements), for a task involving the use of Hilti DX tools (cartridge tools), we offer the following guidance. The final column of the table illustrates the fact that risks also exist when considering alternative fixing methods. Clearly, any assessment must consider all risks involved when that particular task is being carried out. Therefore this is not an exhaustive list and should be used in conjunction with current legislation or good practice, such as the HSE publication “Five steps to risk assessment”. (Rev1) 4/02. www.hse.gov.uk/pubns/indg163.pdf.

Eliminate your risk of hand arm vibration by using DX for lightweight fixings

Risk	Potential problem	Measures to avoid problem	Parallel risks for other fixing methods
Spalling of base material	Fragments entering eyes or hitting skin	Eye protection to BS EN 166 code B Observe spacing and edge distance recommendations.	<i>Swarf or concrete chips and dust drilling.</i>
Noise	a) Hearing damage b) Occupied buildings	a) Ear defenders to BS EN 352, e.g. “Bilson Viking”.	a) <i>Applicable most other fixing methods.</i> b) <i>Cartridge tools may be preferred for work in occupied buildings when compared with hammer drilling.</i>
Tool recoil	Injury to hand / arm Loss of foothold causing fall	Hold tool firmly with bent arms to absorb recoil. User should stand on a firm base take suitable precautions to prevent a fall.	<i>Torque reaction from drilling machine or screw gun.</i>
Exhaust gases	Effects on respiratory system	Insignificant volume of harmful gases produced in normal use. For many fixes in a confined space, ensure adequate ventilation. CoSHH data available on request.	<i>Dust from drilling, fumes from certain chemical anchors.</i>
Tool misuse	Damage resulting from irresponsible use	Only trained, certificated personnel should use the system. Training available from Hilti (GB) Ltd.	<i>Applicable to all other fixing methods.</i>
Misfire	Unexpected ignition of mis-fired cartridge	Follow misfire procedure (as covered in training).	<i>None.</i>
Free-flight of fastener	Fastener injuries worker or bystanders	Use only low velocity, indirect acting tools. All standard Hilti DX tools are low velocity..	<i>None.</i>
Fixing failure	Failure under load	Follow correct procedure (see instructions and training). Observe Hilti technical data for the correct selection and number of fixings. Carry out site testing if data s unavailable or if the application is critical.	<i>Applicable to all other fixing methods.</i>

For cartridges we can provide a product data sheet and CoSHH data (Material safety Data Sheet). We can also assist with method statements for many applications. If you have any queries, please contact us and we will be pleased to offer further, specific advice.

HILTI TECHNICAL ADVISORY SERVICE
TELEPHONE 0161 886 1144

IMPORTANT NOTES

1. The information and recommendations given herein are believed to be correct at the time of writing. The data has been obtained from tests done under laboratory, or other controlled, conditions and it is the users' responsibility to use the data given in the light of conditions on site and taking account of the intended use of the products concerned. Whilst Hilti (Gt. Britain) Limited can give general guidance and advice, the nature of Hilti products means that the ultimate responsibility for selecting the correct product for a particular application must lie with the customer.
2. All products must be used, handled and applied in accordance with current instructions for use published by Hilti (Gt. Britain) Limited.
3. All products are supplied, and advice given, subject to Hilti (Gt. Britain) Limited terms of business.
4. Hilti's policy is one of continuous development. We therefore reserve the right to alter specifications etc. without notice.
5. Construction materials and conditions vary on different sites. If it is suspected that the base material has insufficient strength to achieve a suitable fixing, contact the Hilti Technical Advisory Service.



Hilti (Gt. Britain) Ltd is a member of The Construction Fixing Association.