NORTH AMERICAN PRODUCT TECHNICAL GUIDE

Volume 1:
Direct Fastening Technical Guide, Edition 24

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CONTENTS

1.0 INTRODUCTION

1.1 ABOUT PUBLISHED LOAD VALUES

The Direct Fastening Technical Guide is intended to supplement Hilti Online with technical information for the designer or specifier. Technical data presented herein was current as of the date of publication (see back cover). Load values are based on testing and analytical calculations by Hilti or by contracted testing laboratories using testing procedures and construction materials representative of current practice in North America. Load values obtained from testing represent the average results of multiple identical samples. Variations in base materials such as concrete and local site conditions require on-site testing to determine actual performance at any specific site. Data may also be based on national standards or professional research and analysis.

For information regarding updates and changes, please contact Hilti, Inc. (U.S.) Technical Support at 1-877-749-6337 or at www.us.hilti.com or Hilti (Canada) Corporation at 1-800-363-4458 or www.hilti.com.

1.2 Approvals/Listings

Many Hilti direct fastening products have listings or approvals such as International Code Council Evaluation Services Reports (ICC-ES ESR's) or Underwriters Laboratory (UL) listings. Listings and approvals are provided by independent third parties who evaluate products based on model building codes or various jurisdictional requirements. Product listings and approvals indicate that a product has been tested and evaluated based on a specific acceptance or test criteria.

Not all technical data contained in this document is based on a published approval or listing. Hilti may publish additional data beyond that contained in a report, i.e. for applications outside the scope of an available test criteria.

Approvals and listings have been indicated in the Direct Fastening Technical Guide for reference. Acceptance of the product listings or approvals is subject to the authority having jurisdiction over the project. It is important to review the approval or listing to determine if the application or conditions expected for the project are included in the scope of the approval or listing.

1.3 UNITS

Technical data is provided in both fractional (Imperial) and metric units. Metric values are provided using the International System of units (SI) in observance the Metric Conversion Act of 1975 as amended by the Omnibus Trade and Competitiveness Act of 1988. Data is commonly provided in Imperial engineering units with the SI metric conversions shown in parentheses. Additional information may be found in Section 4.3.1 Metric Conversions and Equivalents, provided in this Product Technical Guide.

1.4 OUR QUALITY SYSTEM

Hilti is one of a select group of North American companies to receive both the ISO 9001 and the ISO 14001 Certifications. This recognition of our commitment to quality and the environment ensures our customers that Hilti has the systems and procedures in place to maintain our position as the world market leader and to continually evaluate and improve our performance.

For Technical Support, contact

Hilti, Inc. (U.S.) at 1-877-749-6337

or

Hilti (Canada) Corporation at 1-800-363-4458.

2.0 DIRECT FASTENING TECHNOLOGY

2.1 BASE MATERIALS

2.1.1 BASE MATERIALS FOR FASTENING

The design of modern buildings requires fastenings to be made in a variety of base materials. To meet this challenge, fastener manufacturers have developed many products specifically targeting certain types of base materials. The properties of the base material play a decisive role in the suitability and performance of a fastener. The designer must carefully match the type of fastener with the base material to obtain the desired results.

2.1.2 CONCRETE

Concrete is a mineral building material that is made from three basic ingredients: cement, aggregate and water. Special additives are also used to influence or change certain properties. Concrete has a relatively high compressive strength compared to its tensile strength. Thus, steel reinforcing bars are cast in concrete to carry the tensile forces, and this combination is referred to as reinforced concrete.

Cement is the binding agent that combines with water and aggregate and hardens through the process of hydration to form concrete. Portland cement is the most common cement and is available in several different types, as outlined in ASTM C150, to meet specific design requirements.

The aggregates used in concrete consist of both fine aggregate (usually sand) and coarse aggregate graded by particle size. Different types of aggregates can be used to create concrete with specific characteristics. Normal weight concrete is generally made from crushed stone or gravel. Lightweight concrete is used when it is desirable to reduce the dead load on a structure or to achieve a superior fire rating for a floor structure. Lightweight aggregates are made from expanded clay, shale, slate or blast-furnace slag. Lightweight insulating concrete is used when thermal insulating properties are a prime consideration. Lightweight insulating aggregates are manufactured from perlite, vermiculite, blast-furnace slag, clay or shale. Sand lightweight concrete is made from lightweight aggregate and natural sand. All concrete with a unit weight between 85 and 115 pcf is considered structural lightweight concrete. The ASTM specification and unit weight for each of these concretes is summarized as follows:

ASTM		
Concrete	**Aggregate grading**	**Concrete unit**
Type	**Specification**	**Weight pcf**
Normal Weight	ASTM C33	145-155
Sand Lightweight	ASTM C330	105-115
All Lightweight	ASTM C 330	85-110
Lightweight Insulating Concrete	ASTM C 332	15-90

A nail penetrating concrete needs to create a hole for the shaft by crushing and compacting the concrete. It also needs to withstand hard aggregates while penetrating the concrete matrix without bending excessively or fracturing. When installed properly the fastener achieves a certain embedment depth which is directly linked to the holding values of the fastener.

Values for the ultimate strength of fasteners in concrete are traditionally given in relation to the 28-day uniaxial compressive strength of the concrete (actual, not specified). Concrete which has cured for less than 28 days is referred to as green concrete. Aggregate type, cement replacements such as fly ash, and admixtures could have an effect on the capacity of some fasteners, and this may not be reflected in the concrete strength as measured in a uniaxial compression test. Generally, Hilti data reflects testing with common aggregates and cement types in plain, unreinforced concrete. In questionable cases, consult with Hilti Technical Support.

In view of the significantly lower strength of green concrete (less than 28-day cure), it is recommended that power-actuated fastenings not be made in cast-in-place concrete which has cured for less than 7 days, unless site testing is performed to verify the fastening capacity. Power-actuated fastening capacity should be based on the concrete strength at the time of installation.

2.1.3 MASONRY MATERIALS

Masonry is a heterogeneous building material consisting of brick, block or clay tile bonded together using joint mortar. The primary application for masonry is the construction of walls which are made by placing masonry components in horizontal rows (course) and vertical rows (wythe). Masonry components are manufactured in a wide variety of shapes, sizes, materials and both hollow and solid configurations. These variations require that the selection of a fastening system be carefully matched to the application and type of masonry material being used. As a base material, masonry generally has a much

lower strength than concrete. The behavior of the masonry components, as well as the geometry of their cavities and webs, has a considerable influence on the ultimate load capacity of the fastening.

2.1.3.1 CONCRETE BLOCK

Concrete block is the term which is commonly used to refer to concrete masonry units (CMU) made from Portland cement, water and mineral aggregates. CMUs are manufactured in a variety of shapes and sizes using normal weight and lightweight aggregates. Both hollow and solid load bearing CMUs are produced in accordance with ASTM C90.

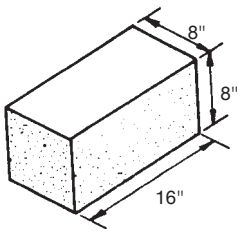
Nominal width of unit **in.** (mm)	**Minimum face-shell thickness**[A] **in.** (mm)	**Minimum web thickness**[A] **in.** (mm)
3 (76) and **4** (102)	**3/4** (19)	**3/4** (19)
6 (152)	**1** (25)	**1** (25)
8 (203)	**1-1/4** (32)	**1** (25)
10 (254)	**1-3/8** (35)	**1-1/8** (29)
	1-1/4 (32)[B]	
≥12 (305)	**1-1/2** (38)	**1-1/8** (29)
	1-1/4 (32)[B]	

Adapted from ASTM C90.

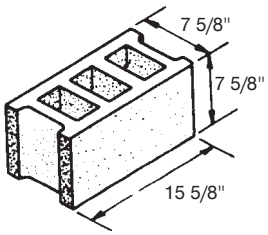
A Average of measurements on three units taken at the thinnest point.

B This face-shell thickness is applicable where the allowable design load is reduced in proportion to the reduction in thickness from the basic face-shell thickness shown.

CMU sizes generally refer to the nominal width of the unit (6-, 8-, 10-inch, etc.). Actual dimensions are nominal dimensions reduced by the thickness of the mortar joint.



Nominal size
(usually fictitious)



Modular size
(actual)

Concrete block construction can be reinforced, whereby reinforcing bars are placed vertically in the cells and those cells are filled with grout to create a composite section analogous to reinforced concrete. If all cells, both unreinforced and reinforced, are filled with grout, the construction is referred to as fully grouted. If only the reinforced cells are grouted, the construction is referred to as partially grouted. Horizontal reinforcing may be placed in the wall via a bond beam, which is always grouted. Ladder reinforcement may also be placed in the mortar bed between courses. Grout typically conforms to ASTM C476 and has a compressive strength of at least 2,000 psi. Concrete masonry units have a compressive strength that may range from 1,250 to over 4,800 psi, although the maximum specified compressive strength of the assembled masonry will generally not exceed 3,000 psi.

2.1.3.2 MORTAR

Mortar is the product that is used in the construction of reinforced and non-reinforced unit masonry structures. The role of mortar when hardened in the finished structure is to transfer the compressive, tensile and shear stresses between the units. Mortar consists of a mixture of cementitious material, aggregate and water combined in accordance with ASTM C270. Either a cement/lime mortar or a masonry mortar, each in four types, can be used under this specification.

Mortar	**Type**	**Average compressive strength at 28 days, min psi** (MPa)
Cement-lime	**M**	**2500** (17.2)
	S	**1800** (12.4)
	N	**750** (5.2)
	O	**350** (2.4)
Masonry cement	**M**	**2500** (17.2)
	S	**1800** (12.4)
	N	**750** (5.2)
	O	**350** (2.4)

Since mortar plays a significant role in the structural integrity of the masonry wall, it is important to understand how power-actuated fasteners interact with the structure. Within a masonry structure there are designated joint locations. The proximity of a power-actuated fastener to one of these locations must be considered in the design of the fastening. Product specific guidelines are provided within this manual.

2.1.3.3 GROUT

ACI defines grout as “a mixture of cementitious material and water, with or without aggregate, proportioned to produce a pourable consistency without segregation of the constituents”.

The terms grout and mortar are frequently used interchangeably but are, in actuality, not the same. Grout need not contain aggregate (mortar contains fine aggregate). Grout is supplied in a pourable consistency where mortar is not. Grout fills voids while mortar bonds elements together.

Grout is used to fill space or cavities and provide continuity between building elements. In some applications, grout will act in a structural capacity, such as in unreinforced masonry construction.

Grout, in regards to power-actuated fastenings, is specified by the design professional. When power-actuated fasteners are tested for the development of design values, the grout is specified according to applicable ASTM standards. Design engineers are encouraged to become familiar with the characteristics of the grout used in performance testing to better understand the applicability of the design loads published in this guide to the actual jobsite

2.1.4 GYPSUM WALLBOARD

Gypsum wallboard consists of an incombustible core, essentially gypsum, surfaced with paper firmly bonded to the core. It is made in flat sheets 4 feet by 8 feet or larger, and from 1/4 inch to 5/8 inch thick in accordance with ASTM C1396/C1396M.

Gypsum wallboard is attached to the wall studs and ceiling joints in residential and commercial building to form the base for the finished wall or ceiling treatment.

Gypsum wallboard does not have the capacity to accept high loads. Hilti offers several screw fasteners designed for attachment of gypsum wallboard to cold-formed steel framing. Gypsum wallboard is not a suitable material for use with power-actuated fasteners.

2.1.5 COLD-FORMED STEEL FRAMING

Cold-formed steel framing uses cold-formed steel sections for the construction of walls, floors and roofs. The framing members have industry standard dimensions similar to wood framing studs. There are a large variety of shapes and sizes available for both residential and commercial markets. Framing members are generally produced in C-sections with thicknesses of 12 to 25 GA (97 to 18 mils) and varying widths. Other specialized shapes and connection components are also available from a variety of manufacturers. Design of cold-formed steel framing is done in accordance with the American Iron and Steel Institute (AISI) Cold-Formed Steel Design Manual.

Power-actuated fasteners and self-drilling screws are commonly used in cold-formed steel construction. Power-actuated fasteners are used to attach the cold-formed steel to concrete and steel base materials. Self-drilling screws are used to attach cold-formed steel components as part of larger assemblies or systems.

Fasteners are typically evaluated without the steel elements. The elements should be evaluated separately based on applicable AISI design requirements. In some instances, such as steel deck diaphragms, shear walls, deflection slip clips and perimeter wall track at edge of slab, power-actuated fasteners have been tested with the cold-formed steel components as a system assembly and the corresponding data is provided in this Product Technical Guide.

For specific applications, Cold-formed steel framing can act as the base material for Power-actuated fastenings; for example, fastening of wood structural panels to CFS framing to create a shear wall or diaphragm. Design values for specific fasteners tested for this specific application are included in this Product Technical Guide.

2.1.6 STEEL

Structural steel is a critical building component which serves as the main structural support in many structures. Iron ore is processed and combined with other elements to produce different types of steel. Reference to a particular type of steel is usually made by ASTM standard. For example, ASTM A36 is the specification for what is usually referred to as A36 steel. Steel is hot-rolled into structural shapes that are available in different grades, with the grade corresponding to the yield strength. Common grades of structural steel include ASTM A36, which has a minimum yield strength of 36 ksi and ASTM A572, which is available in grades 42, 50, 55, 60 and 65. ASTM A992 is a high strength steel used extensively for wide flanged shapes.

The strength of steel is very important when selecting a power-actuated fastener. The strength and thickness determine the resistance that must be overcome when setting the fastener. The power required to drive a fastener must be greater than the resistance. If the power and resistance are too high, the fastener could be damaged during the setting process. This is referred to as exceeding the application limit for the fastener. For a given fastener, the application limit is determined by its length, diameter, material strength and hardness.

2.1.7 WOOD STRUCTURAL PANELS

The wood structural panels are structural wood materials, plywood or OSB (Oriented Strand Board) used as part of shear walls with cold-formed steel framing members. Plywood is the original structural wood panel composed of thin sheets of veneer or plies which form the plywood in layers. OSB is manufactured through compressed strands arranged in layers of generally three or five. American Plywood Association performance standards set the minimum requirements for the manufacturing of the wood structural panels for the end use. Common thicknesses of the wood structural panels for shear wall sheathing are 3/8, 7/16, 15/32, 1/2, 19/32, 5/8, 23/32 and 3/4 inch. Wood structural panels shall comply with a national product standard such as DOC (US Department of Commerce) PS-1 or PS-2. Wood structural panels are available in different sizes and the most common size is 4 feet by 8 feet.

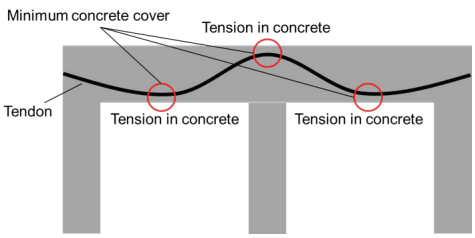
2.1.8 PRE-FABRICATED PRE-TENSIONED / PRESTRESSED CONCRETE

Pre-tensioned / prestressed concrete is typically cast around tensioned tendons or strands. This method produces a good bond between the tendon and concrete, which both protects the tendon from corrosion and allows for direct transfer of tension. The cured concrete adheres and bonds to the bars and when the tension is released it is transferred to the concrete as compression by static friction and keying. Most pre-tensioned / prestressed concrete elements are pre-fabricated in a factory and must be transported to the construction site, which limits their size. Often, pre-stressed concrete is realized as hollow core concrete slabs. Load data for X-U fasteners installed into hollow core concrete can be found in section 3.2.6 of the Hilti Product Technical Guide Vol 1.

Pre-tensioned / prestressed concrete requires special consideration for the installation of power-actuated fasteners. ACI 318-14, chapter 20 specifies for tendons and strands a minimum concrete cover of ¾ in. to 3 in.for prefabricated prestressed concrete. Installing fasteners with a deeper embedment than the clear concrete cover into this type of concrete is typically not recommended unless the precise location of the tendons is known.

Locating steel reinforcement or tendons can be realized using Hilti Detection Systems. Please refer to http://www.us.hilti.com, www.hilti.com, or www.hilti.ca for guidance. If the location and clear cover over the tendons is known, power-actuated fasteners with embedments of less than the clear cover distance typically are not expected to interfere with the tendons or strands.

Bonded post-tensioned concrete is a term used for a method of applying compression after pouring concrete, and completion of the curing process, through tension tendons. This method is commonly used to create monolithic slabs. Slabs are created in-situ versus being manufactured at a plant. The same considerations as described in section 2.1.8 for avoiding fastener installation damaging post-tensioning tendons should be considered when using power-actuated fasteners.



Hilti offers fasteners with various low embedments and pre-mounted washers (for example, X-U 22 P8 S15). The pre-mounted washers help avoid installation beyond the target embedment in case of excess energy. Testing has shown that the embedment of the X-U 22 P8 S15, when installed at the highest power level, will penetrate no more than 3/4" in the concrete.

When Power-Actuated fasteners are properly installed in Post-tensioned concrete, the load capacities published for normal cast-in-place concrete of equivalent compressive strength may be utilized.

2.2 EVALUATION OF TEST DATA

2.2.1 DEVELOPING FASTENER PERFORMANCE DATA

Power-actuated fastener testing at Hilti is conducted in accordance with ASTM E1190 Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members, unless otherwise noted in the corresponding load tables. Because of the wide variation in possible concrete reinforcing configurations found in construction, testing is typically performed in unreinforced concrete, which gives conservative results.

There are two methods of developing allowable loads;
(1) apply an appropriate safety factor to the mean ultimate load as determined from a given number of individual tests, or
(2) apply a statistical method to the test data which relates the allowable working load to the performance variability of the fastening.

2.2.2 ALLOWABLE LOADS

Historically, allowable loads for power-actuated fasteners were derived by applying a safety factor to the average ultimate value of test results. This approach is characterized by Eq. 2.2.2.

Eq. 2.2.2 $F_{all} = \frac{\overline{F}}{v}$

Where:

$\overline{F}$ = mean of test data (population sample)
v = safety factor

Statistical safety factors for power-actuated fasteners are generally calculated using ICC-ES AC70. The statistical safety factor is assumed to cover expected variations in field installation conditions and variation in power-actuated fastener performance from laboratory tests.

Note that statistical safety factors calculated per ICC-ES AC70 account for test data coefficient of variation, (i.e., each data point has its own safety factor based on the variability in the test data).

2.3 CORROSION

Refer to the Hilti Corrosion Handbook for information regarding sources of potential corrosion and corrosion protection of fasteners.

2.4. SEISMIC CONSIDERATIONS

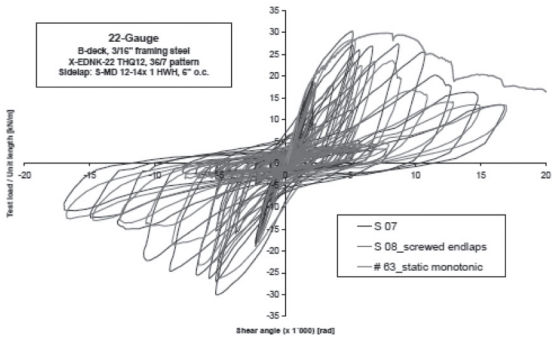
2.4.1 STRUCTURAL SYSTEMS

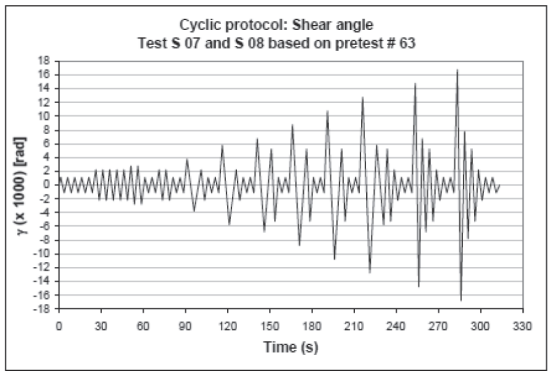
Historically, power-actuated fasteners (Hilti DX and GX fastening systems) have been used in seismic and non-seismic regions for structural and nonstructural applications. Reference Section 3.1.3 of this Product Technical Guide for an overview on typical direct fastening applications.

Structural system applications may involve construction of lateral force resisting systems such as shear walls and untopped and concrete filled steel deck roof and floor diaphragms as described in this Product Technical Guide Sections 3.2.8 and 3.5 respectively. Lateral force resisting systems are designed to resist the controlling load combinations involving wind and seismic forces and are a critical component of the overall building structure. Power-actuated fastening systems are used for steel deck roof and floor diaphragm frame attachments and shear wall sheathing attachments to cold-formed steel framing members. Screw fasteners are also an integral part of the lateral force resisting systems when used as structural frame and sidelap connections in diaphragms, as well as framing connections for cold-formed steel stud and track wall components. The American Iron and Steel Institute (AISI) S100 North American Cold-Formed Steel Specification; AISI S213 North American Standard for Cold-Formed Steel Framing – Lateral Design; and AISI S310 North American Standard for the Design of Profiled Steel Diaphragms provide design provisions and safety and resistance factors for these structural systems used to resist wind and seismic forces. These structural systems involve redundant fastenings in orthogonal directions and are qualified by large scale diaphragm and shear wall assembly tests using either quasi-static or cyclic loading protocols.

Extensive seismic research into untopped steel deck diaphragms has been conducted at McGill University and Ecole Polytechnique by Tremblay, Rogers, et al. and was supplemented by Hilti with additional testing. This research has proven that mechanical fasteners, such as power-actuated fasteners and screws, provide improved seismic ductility and energy dissipation when compared to traditional arc spot puddle welds.

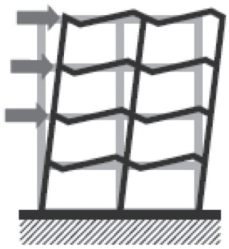
The following graphs allow for a comparison between the cyclic behavior and the static monotonic reference test.





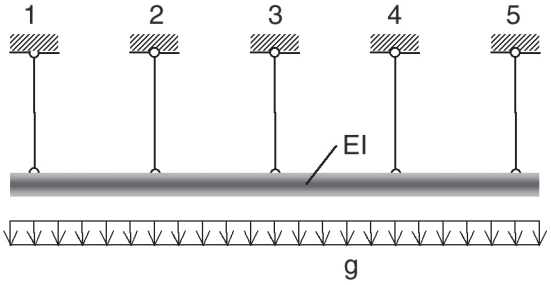
Structural system seismic research investigating shear walls has been conducted by AISI, the American Plywood Association (APA) and university researchers. This research was codified in the International Building Code (IBC) and National Building Code of Canada (NBCC) in AISI S213. ICC-ES AC230 Acceptance Criteria for Power-Driven Pins for Shear Wall Assemblies with Cold-Formed Steel Framing and Wood Structural Panels further establishes the seismic load test requirements for power-actuated fasteners used as alternatives to screw fasteners for attachment of wood structural panel sheathing to cold-formed steel framing. Cyclic load tests following the CUREE protocol, are used to simulate the seismic forces. Safety and resistance factors for wind and seismic loading are then applied to the cyclic load test results to develop the design shear loads. Energy dissipation of the shear wall assembly and a predictable post peak behavior were demonstrated through qualification testing and are critical to shear wall performance in a seismic event.

Test protocol and evaluation methods for individual fasteners installed in steel base materials have been established by ICC-ES in Acceptance Criteria 70, Acceptance Criteria for Power Actuated Fasteners, Annex A. Successful completion of this test protocol allows for the fastener to achieve a published seismic load up to the static load level, in both tension and shear.



2.4.2 NONSTRUCTURAL SYSTEMS

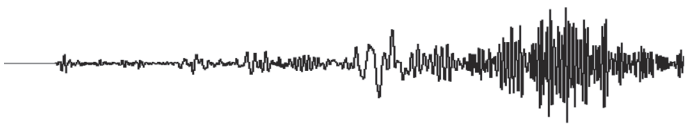
Nonstructural systems are separate from structural systems and a clear distinction is made in the building codes and standards. These applications may involve suspended ceilings, conduit attachments, mechanical, plumbing, electrical and communications equipment, doors, windows, wood sill plates, cold-formed steel track attachments, architectural components and other applications that are not part of the structural systems.



ASCE 7-10 Minimum Design Loads for Building and Other Structures, which is referenced in the IBC 2015 and 2018, clarified language pertaining to the use of power-actuated fasteners for nonstructural component fastenings including suspended ceilings and distributed systems. A distributed system includes multiple fastening points for redundancy and load distribution across linear or grid like arrangements of fasteners. ASCE 7-10 Section 13.4.5 further establishes conservative baseline limiting load capacities for power-actuated fasteners at 90 lb (400 N) for concrete base materials and 250 lb (1,112 N) for steel base materials in typical applications, unless otherwise tested and approved for other load capacities. This clarified language pertaining to power-actuated fastening applications in all seismic design categories, including use as part of distributed systems in higher Seismic Design Categories D through F, is incorporated into the latest ICC-ES AC70 Acceptance Criteria for Fasteners Power-Driven into Concrete, Steel and Masonry Elements. In addition, ICC-ES AC70 Annex A provides testing and acceptance criteria for power-driven fasteners in steel base materials to allow development of allowable load values greater than 250 lb (1,112 N). All Hilti power-driven fasteners intended for steel applications have been successfully tested per the ICC-ES AC70 Annex A seismic testing requirements. Reference Hilti power-actuated fastener evaluation reports ESR-2269, ESR-1663, ESR-1752, ESR-2347 and ESR-2795 for more detailed information.

Additional seismic research is being conducted to evaluate the performance of power-actuated fasteners in both structural and nonstructural applications. In 2012, the University of California San Diego (UCSD) Building Nonstructural Component and System (BNCS) seismic research project sponsored by the National Science Foundation (NSF) and Network for Earthquake Engineering Simulation (NEES) involved the use of power-actuated fasteners for many common nonstructural applications including lay-in acoustical ceilings, cold-formed steel interior partition walls, exterior balloon framing walls and electrical conduit attachments. The initial results are promising and provide additional confirmation that power-actuated fasteners are reliable attachment methods for these typical applications in seismic events. Further research is being conducted by Hilti to extend the load capacities and applications of power-actuated fastenings in steel base materials as part of diaphragms, shear walls and nonstructural component fastenings.

In 2012, AISI also established design provisions for power-actuated fastenings in steel base materials and these are now codified in Section J5 of AISI S100. These provisions formally recognize power-actuated fasteners consistent with an extensive historical use in cold-formed steel framing applications and provide a rational basis for the determination of safety and resistance factors consistent with screws, bolts and welds. The development of LRFD and LSD design provisions with the corresponding safety and resistance factors for steel fastenings is a significant development for power-actuated fastening technology in North America, as previously, only ASD design was used based on a minimum safety factor of 5:1. The data contained herein this Product Technical Guide is still presented in the traditional ASD format for steel base materials, with the ICC-ES AC70 minimum safety factor of 5:1 applied, but alternative safety and resistance factors are provided in the AISI S100 specification for a more optimized and statistically justified design approach.



3.0 DIRECT FASTENING SYSTEMS

3.1 DIRECT FASTENING TERMINOLOGY AND APPLICATIONS

3.1.1 DIRECT FASTENING TERMINOLOGY

DX = Hilti Powder-Actuated Direct Fastening Systems

GX = Hilti Gas-Actuated Direct Fastening Systems

BX = Hilti Battery-Actuated Direct Fastening Systems

Characteristics of steel and other metals

F_u = specified minimum ultimate tensile strength of metals, ksi (MPa)

F_y = specified minimum yield strength of metals, ksi (MPa)

Characteristics of concrete and masonry

f_c = concrete compressive strength as measured by testing of cylinder, psi (MPa)

f'_c = specified concrete compressive strength, psi (MPa)

Fastening details

c_{min} = minimum edge distance, in. (mm)

d_{nom} = nominal fastener shank diameter, in. (mm)

D = thread diameter for threaded studs, in. (mm)

h_{ET} = penetration of the fastener point below the top surface of the base material, in. (mm)

h_{NVS} = nailhead stand-off above the surface fastened into. For nails, this is the surface of the fastened material. For threaded studs, the surface of the base material, in. (mm)

L_s = shank length of fastener, in. (mm)

s_{min} = minimum fastener spacing, in. (mm)

t_I = thickness of the fastened material, in. (mm)

Σt_I = total thickness of the fastened material, where more than one layer fastened, in. (mm)

t_{II} = thickness of the base material, in. (mm)

T_{max} = maximum tightening torque, ft-lb (Nm)

Steel deck fastening systems[1]

t_f = flange thickness of beam or bar joist for steel deck fastening applications, in. (mm)

F = diaphragm flexibility factor, in./lb (mm x 10^{-6}/N)

G' = diaphragm shear stiffness lb/in. (N/mm x 10^{-6})

q = allowable diaphragm shear, plf (N/mm)

Q_f = fastener strength, panel to frame, lb (kN)

S_f = fastener flexibility factor, panel to frame, in./kip (mm/kN)

X-HVB Shear Connector

h_r = nominal rib height, in. (mm)

H_s = connector height, in. (mm)

N_r = number of connectors in one rib

q = allowable shear strength, lb (kN)

Q_n = nominal shear strength, lb (kN)

R_g = coefficient to account for group effect

w_r = average width of rib, in. (mm)

Y_{con} = distance from top of steel beam to top of concrete slab, in. (mm)

Screw fastening systems[2]

L = length of screw, in. (mm)

MT = maximum thickness of all attachments to be fastened, including the base material, in. (mm)

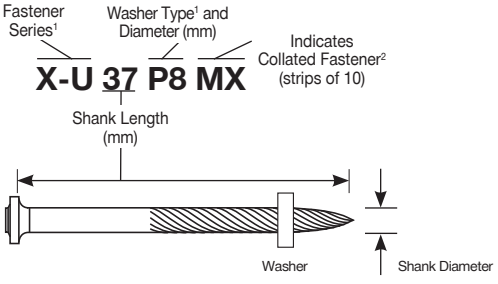
P_{ss} = nominal shear strength (resistance) of screw, lb (kN)

P_{ts} = nominal tension strength (resistance) of screw, lb (kN)

1 More detailed definitions for Steel Deck Fastening Systems can be found on page 147.

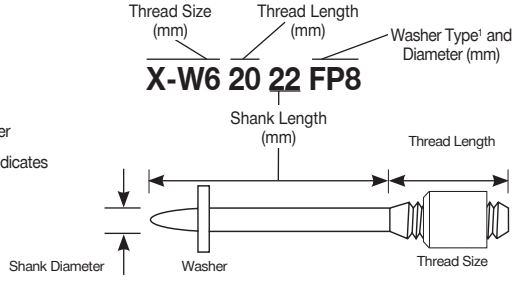
2 Terminology for screw fastener head styles (e.g. hex washer head (HWH)) can be found on page 209.

Fastener nomenclature



1. **P** = Plastic washer
   S = Steel washer
   D = Double washer (1 plastic, 1 steel)
   L = Double washer (both steel)
   DP = Double washer (both plastic)
   FP = Plastic ferrule and guide washer
2. **"MX"** at the end of fastener name indicates fasteners collated in strips of 10

Stud nomenclature



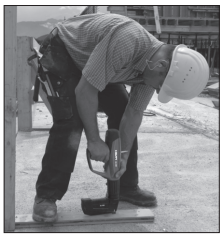
3.1.2 BENEFITS OF DIRECT FASTENING SYSTEMS

Power-actuated fastening systems are recognized as a safer, acceptable and more cost effective method of making instantaneous fastenings into various construction base materials such as concrete, steel and masonry. Power-actuated fastening technology uses either powder cartridges (blank cartridges), compressed gas canisters, or battery energy. Without the need for external power sources, it is portable, faster and lightweight allowing for more reliable fastenings in difficult access areas on today's construction sites.

Screw fastening systems are commonly used for the attachment to cold-formed steel members. Self-drilling screws allow for direct attachment without the need for additional equipment such as a drill bit or welding machine making screw fastening portable, faster and lightweight.

A key benefit to using direct fastening systems is increased productivity for the end user due to the speed of making fastenings vs. drilling and anchoring, bolting or welding. Fastenings are more easily inspected and suitable for all trades in a variety of applications.

3.1.3 COMMON DIRECT FASTENING APPLICATIONS



General fastenings to concrete

Reference sections 3.2.5, 3.2.6 and 3.2.10

General fastenings to steel

Reference sections 3.2.5, 3.2.6 and 3.2.12

Perimeter wall applications
- **Deflection slip clips**
- **Steel framing Track**

Reference section 3.2.6.4

Structural wood panel sheathing

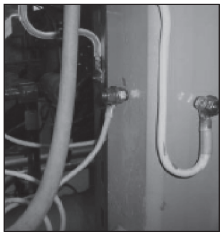
Reference section 3.2.8

Interior partition walls (Drywall track attachment)

Reference section 3.2.9

Wood sill plate attachment

Reference section 3.2.10



Electrical grounding

Reference section 3.2.14.7 and 3.2.15.6

Pipe hangers

Reference sections 3.2.11, 3.2.12 and 3.2.16

Cable and conduit attachment

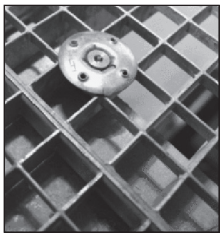
Reference section 3.2.16

Thermal insulation attachment

Reference section 3.2.17

Ceiling hangers

Reference section 3.3



Grating and checkerplate attachment

Reference section 3.4

Steel deck attachment

Reference section 3.5

Steel deck sidelap attachment

Reference sections 3.5.6 and 3.6

Cold-formed steel framing connections

Reference section 3.6

3.2 GENERAL CONSTRUCTION FASTENER DESIGN AND SELECTION

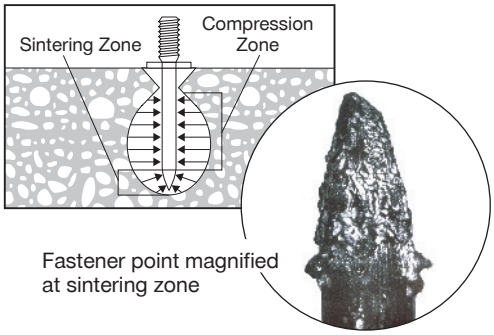
3.2.1 FASTENING TO CONCRETE

3.2.1.1 GENERAL SUITABILITY

When a powder, battery or gas-actuated fastener is driven into concrete, the concrete around the fastener shank is displaced. This displaced concrete compresses against the shank creating a friction hold. In addition, heat generated during the driving process causes a sintering of the concrete to the fastener.

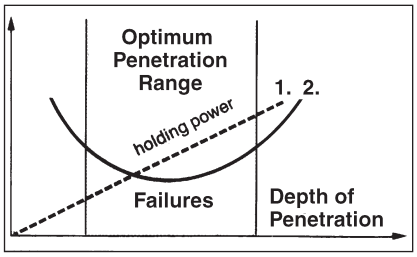
A fastener driven into concrete is influenced by the following factors:

- Depth of penetration
- Compressive strength of the concrete
- Fastener spacing and edge distance
- Fastener shank diameter
- Concrete aggregate



3.2.1.2 DEPTH OF PENETRATION INTO CONCRETE

Generally, as the fastener penetration increases, so does the load capacity (1) See chart at right. However, a penetration depth which is too shallow or too deep may cause an increase in fastening failure.



Depth of Penetration Guide[1]

Material	Typical	Sprinkler installations with W10 stud only
Concrete block and joints	**3/4" to 1"** (19 to 25 mm)	–
Average concrete (2000-4000 psi)	**3/4" to 1-1/4"** (19 to 32 mm)	**1" to 1-5/8"** (25 to 41 mm)
Precast or prestressed concrete (5000 psi +)	**3/4" to 1"** (19 to 25 mm)	**1" to 1-1/4"** (25 to 32 mm)

1 For allowable load capacities at specific embedment depths refer to specific product sections.

3.2.1.3 COMPRESSIVE STRENGTH OF CONCRETE/AGGREGATE HARDNESS

Generally, as the concrete compressive strength increases, so does the fastener's load capacity. However, the characteristics of the fastener, and additional concrete properties aside from compressive strength influence the fastener holding power and potential for making a successful fastening. Fastener properties include the shape of the tip, the diameter, and the hardness. Concrete properties include aggregate size, hardness, and density. For these reasons, it is always recommended that test fastenings under jobsite conditions are carried out, in order to verify the fastener selection. In general, concrete compressive strength is an indicator as follows:.

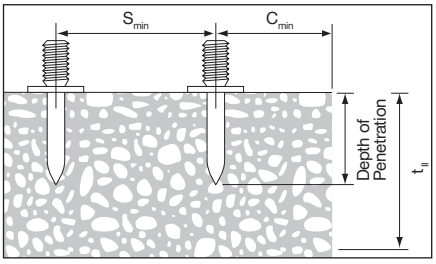
Concrete compressive strength

Optimum	2000 – 6000 psi (14-41 MPa)
Maximum	8500 psi (55 MPa)*

* May require pre-drilling with DX KWIK System (Section 3.2.1.10)

3.2.1.4 FASTENER SPACING, EDGE DISTANCE AND BASE MATERIAL THICKNESS REQUIREMENTS FOR CONCRETE NAIL SHANK DIAMETER

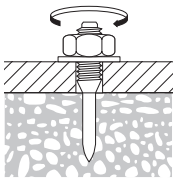
d_{nom} in.	(mm)	C_{min} in.	(mm)	S_{min} in.	(mm)
0.118	(3.0) X-C G2, G3	**2-3/8**	(60)	**2-3/8**	(60)
0.138	(3.5) X-C	**2-3/4**	(70)	**2-3/4**	(70)
0.145	(3.7) X-CR	**2-3/4**	(70)	**2-3/4**	(70)
0.157	(4.0) X-P, X-U	**3**	(76)	**4**	(102)
0.177	(4.5) DS	**3**	(76)	**4**	(104)
0.205	(5.2) W10	**4**	(104)	**4**	(104)



C_{min} = Min. edge distance[1]
S_{min} = Min. fastener spacing[2]
t_{II} = Min. concrete thickness = 3 x fastener penetration depth[3]

1 Unless otherwise noted in corresponding load tables (e.g. sill plate application).
2 Unless otherwise noted in corresponding load tables (e.g. perimeter wall applications).
3 Unless otherwise noted in corresponding load tables (e.g. lightweight concrete over metal deck applications).

3.2.1.5 MAXIMUM TIGHTENING TORQUE



Maximum tightening torque, T_{max}, for threaded studs driven into concrete, ft-lb (Nm)

Stud type	
X-W6	**W10**
3.0 (4.0)	**4.5** (6.0)

3.2.1.6 FASTENER LOCATIONS WHEN INSTALLING INTO LIGHTWEIGHT CONCRETE OVER METAL DECK

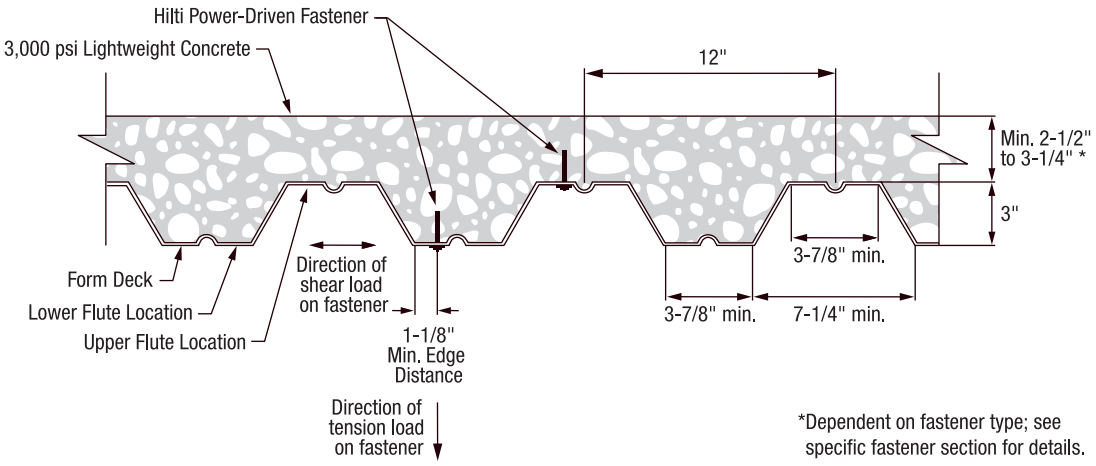


Figure 1: Hilti fastener location in 3" deep composite floor deck normal deck profile orientation

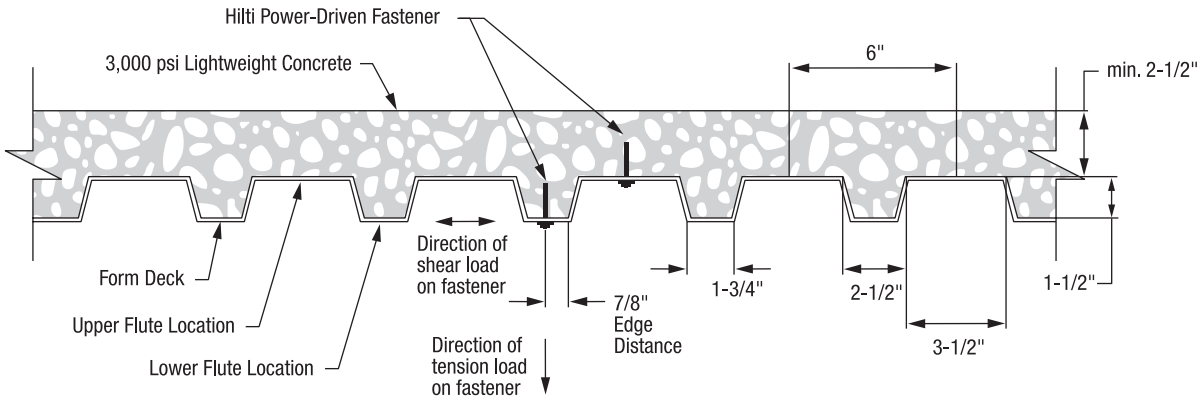


Figure 2: Hilti fastener location in 1-1/2" deep composite floor deck normal deck profile orientation

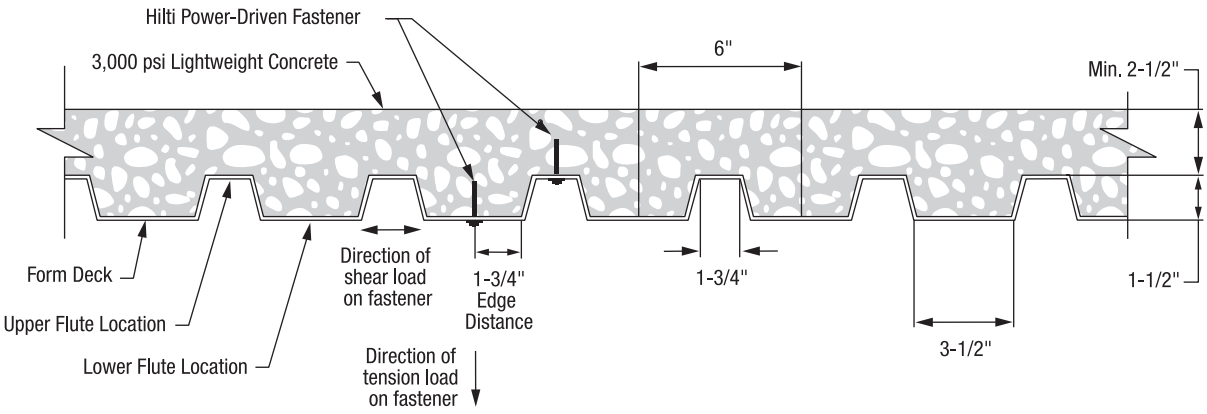


Figure 3: Hilti fastener location in 1-1/2" deep composite floor deck inverted deck profile orientation

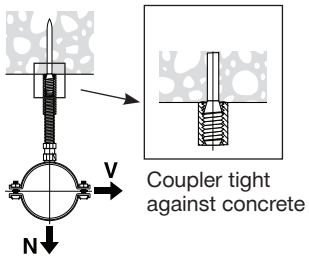
3.2.1.7 BENDING MOMENTS ON POWER-ACTUATED FASTENERS IN CONCRETE

Bending moments on power-actuated fasteners installed in concrete and masonry base materials can be minimized through proper design detailing and installation practice. Proper design should include redundancy with multiple fastening points instead of single-point fastenings, in order to distribute bending moment effects among multiple fasteners. Installation of threaded rod coupler hangers on powder-actuated threaded studs should be done with the coupler run down over the stud shank and in contact with the concrete or masonry base material as depicted in the figure below. Care should be taken not to exceed the maximum torque discussed in Section 3.2.1.5.

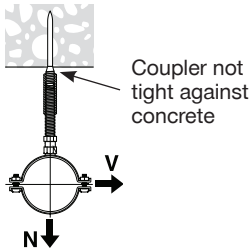
Although no design equations are provided for determining equivalent bending moment loads on power-actuated fasteners, recommended allowable bending moments for threaded stud fasteners are provided in Section 3.2.11 based on testing with a safety factor of 2:1 for static loading.

Relatively small bending moments can contribute to a significant reduction in the overall fastening capacity and must be checked by the design engineer.

Arrangements to reduce or prevent moment on shank:

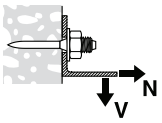


Arrangement causing moment to act on shank:



Non-symmetric arrangement:

- Moment on fastened part
- Prying effect must be considered in determining loads acting on fastener



3.2.1.8 COMBINED LOADING OF POWER-ACTUATED FASTENERS IN CONCRETE

Combined loading of power-actuated fasteners installed in concrete can be treated with exponent α = 1 unless otherwise provided for the specific application (e.g. ceiling clips with power-actuated fasteners subjected to 45° loading).

$$(N_s / N_{rec})^{\alpha} + (V_s / V_{rec})^{\alpha} \leq 1.0$$

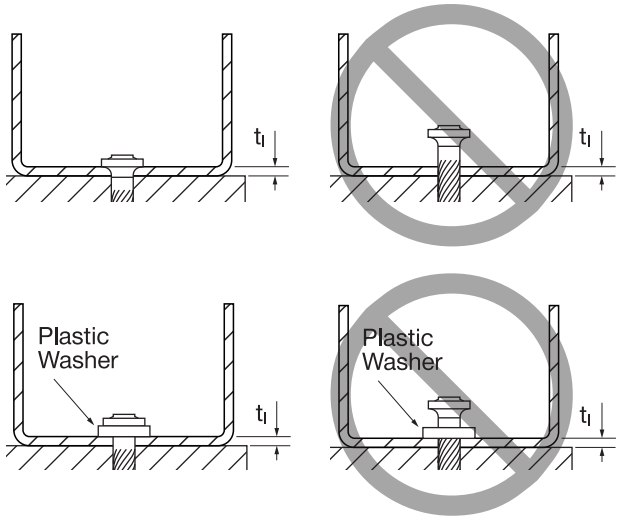
where:

N_s = Applied tension load
N_{rec} = Allowable tension load
V_s = Applied shear load
V_{rec} = Allowable shear load

3.2.1.9 FASTENER CLAMPING AND NAILHEAD STAND-OFF

Power-actuated fastenings must be thought of in terms of a fastening system consisting of the power-actuated tool, cartridges, battery or gas canister energy source and the fastener itself. Not all power-actuated fastening systems can achieve adequate embedment and proper clamping of the fastened part to the base material. The installer should start with the lowest power regulation and cartridge and work up until tight clamping is achieved. During installation of the fastener, the plastic guidance washer may be removed completely, partially or remain intact. Any of these scenarios would be considered acceptable, provided the attached material is clamped tightly to the base material and the specified embedment is achieved.

Installers should never “double-shoot” fastenings with excessive nail head stand-off in order to drive them deeper. This can create a safety hazard and break the bond or sintering between the fastener shank and the base material.



3.2.1.10 DX KWIK SYSTEM

3.2.1.10.1 Product description

DX KWIK is a method of fastening into concrete that combines the speed and portability of powder-actuated fastenings with the performance and consistency of anchors.

The DX KWIK system requires a shallow, small diameter hole to be drilled into the concrete, then a powder-actuated fastener is driven through the hole into the concrete.

Product features:

Two very important fastening principles are achieved by using the DX KWIK system:

- The fastener obtains its holding power in the concrete deeper than standard powder-actuated fastenings without pre-drilling
- Concrete stresses are distributed deeper below the concrete surface

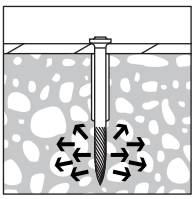
DX KWIK System advantages

- Higher allowable loads
- Ability to fasten into high-strength concrete
- Virtually eliminates concrete surface spalls
- More consistent fastening

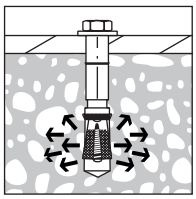
DX KWIK fasteners

Rotary hammer drill

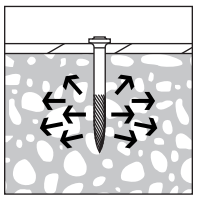
DX 5
powder-actuated fastening tool



DX KWIK

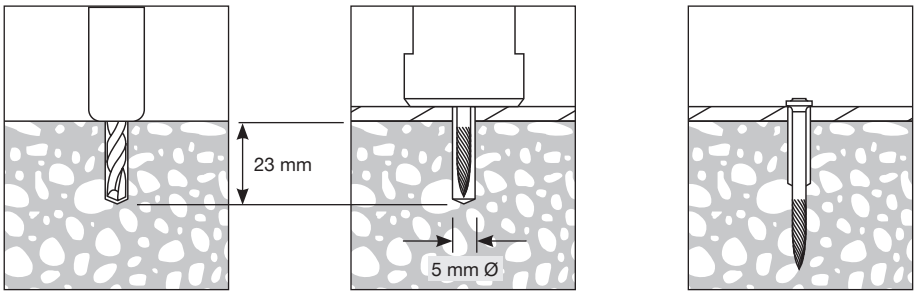


Anchor



Standard DX

3.2.1.10.2 Installation Instructions*



1. Drill a hole into the concrete using a TX-C 5/23 special DX KWIK bit.

2. Insert the special high strength fastener into the DX tool leaving the fastener point protruding out.

Note:

- Typically, DX KWIK fasteners are 47 mm minimum in length.
- As of publication date, only X-U series fasteners have been tested. Reference Section 3.2.6.3 for allowable load capacity table.

3. Using the required cartridge power drive the fastener into the concrete.

* These are abbreviated instructions which may vary by application. **ALWAYS** review/follow the instructions accompanying the product.

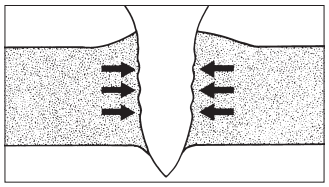
3.2.2 FASTENING TO STEEL

3.2.2.1 GENERAL SUITABILITY

When a powder, battery, or gas-actuated fastener is driven into steel, the steel around the fastener shank is displaced. This displaced steel flows back around the shank and into the knurling creating a keying hold or, in the case of smooth shank fasteners, a friction hold. In addition, the local heat generated during the driving process causes partial fusion of the fastener to the steel.

A fastener driven into steel is influenced by the following factors:

- Base steel thickness
- Tensile strength of base steel
- Fastener spacing and edge distance
- Fastener shank diameter
- Fastener shank knurling



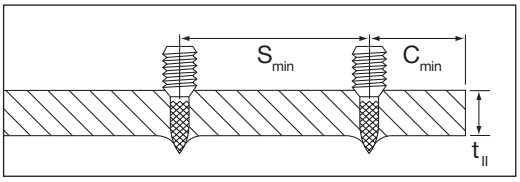
3.2.2.2 FASTENER SPACING, EDGE DISTANCE AND BASE MATERIAL THICKNESS REQUIREMENTS FOR STEEL

C_{min} = Min. Edge Distance = 1/2" (12 mm)[1]

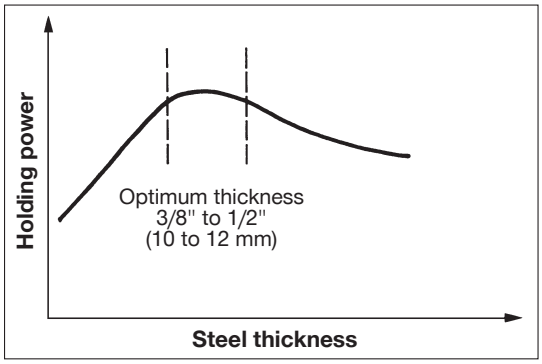
S_{min} = Min. Fastener Spacing without reduction in performance = 1" (25 mm)[1]

t_{II} = Min. Base Steel Thickness = 1/8" (3 mm)[2]

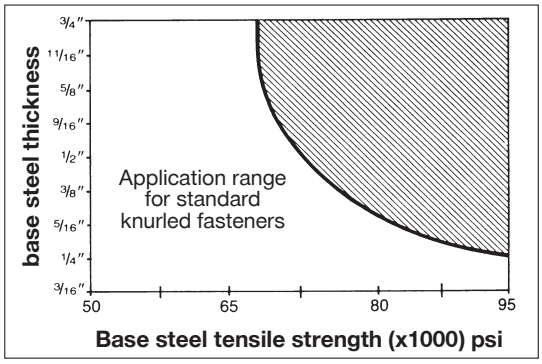
1 Unless otherwise noted (e.g. X-BT-MR and X-BT-GR fastener)
2 Some fasteners require thicker base steel (e.g. X-EW10H, X-BT-MR and X-BT-GR)



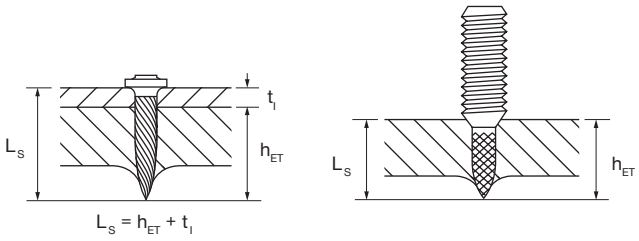
3.2.2.3 BASE STEEL THICKNESS AND FASTENER DRIVING DISTANCE REQUIREMENTS



Optimal holding power is obtained when fastener point is driven to distance h_{ET}.



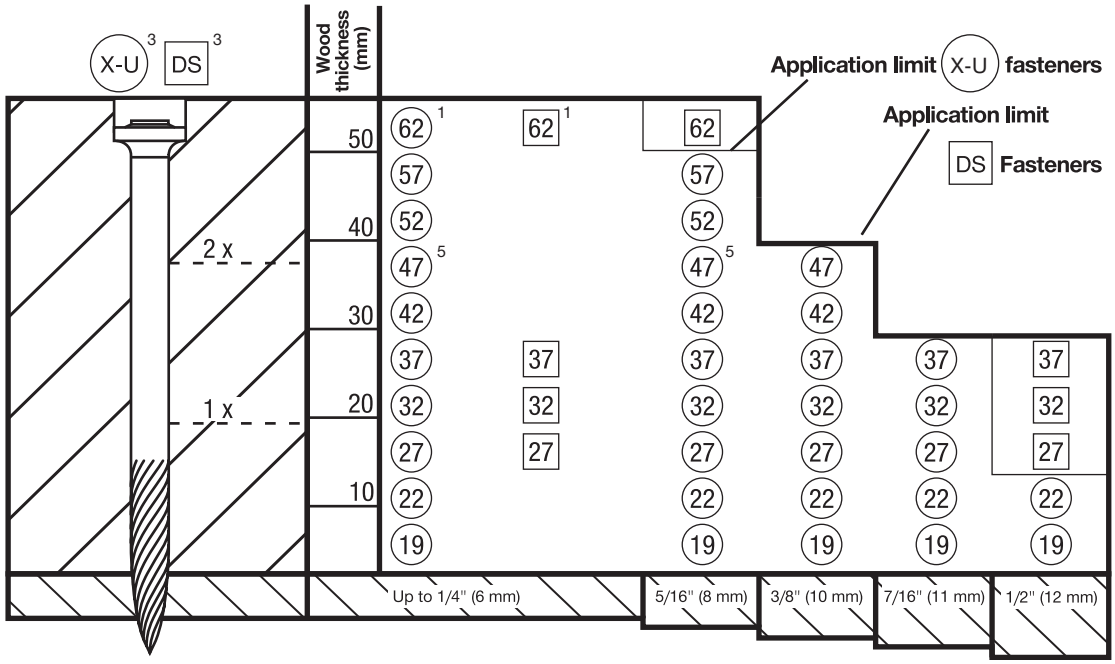
As the tensile strength of the base steel increases, the thickness of the base steel suitable for DX/GX fastenings decreases.



Fastener type	Recommended driving distance to achieve optimal tension capacity, h_{ET}*	
	in.	mm
X-U	0.394 - 0.551	10 - 14
X-U 15	0.433 - 0.551	11 - 14
X-EW6H-xx-9	0.315 - 0.433	8 - 11
EDS	0.472 - 0.669	12 - 17
X-S 14 B3, G3	0.315 - 0.433	8 -11
X-P B3, G3	0.315 - 0.630	8-16
X-EW10H-xx-14	0.512 - 0.630	13 - 16
DS	0.669 - 1.063	17 - 27
X-S13 P8THP	0.394 - 0.472	10 -12
X-S16 P8TH	> 0.433	> 11
X-R	> 0.394	> 10

* The objective of this table is to ensure adequate through-penetration of the base steel. For load capacity of fasteners without through-penetration, refer to corresponding allowable load tables and applicable footnotes for more details. AISI S100, Section J5, provides additional information regarding point penetration of PAF's in steel.

3.2.2.4 RECOMMENDED FASTENER LENGTHS FOR ATTACHING WOOD TO STEEL BASE MATERIAL [2,4]



Notes:

1 X-U or DS up to 62 mm long may be used in base steel up to 1/4" (6 mm) thick.

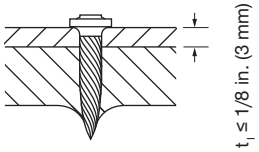
2 If the application limit is exceeded, shank buckling can occur.

3 Numbers in ○ and □ represent fastener shank length in mm.

4 Based upon a base steel tensile strength (F_u) of less than or equal to 70 ksi.

5 For installation of 2 x 4 to steel (1/4" - 3/8"), the X-U 47 is the most appropriate choice.

3.2.2.5 RECOMMENDATIONS FOR ATTACHING STEEL TO STEEL BASE MATERIAL



Directly fastened material ≤ 1/8" thick usually deforms with the displaced base material. This allows a tight fit between the fastened steel and base material without the need for pre-drilling. Thicker fastened materials may need to be pre-drilled.

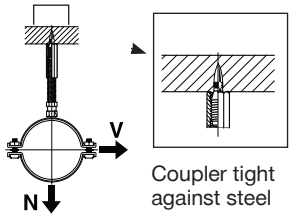
3.2.2.6 BENDING MOMENTS ON POWER-ACTUATED FASTENERS IN STEEL

As with welded studs, bending moments on power-actuated fasteners installed in steel can be minimized through proper design detailing and installation practice. Proper design should include redundancy with multiple fastening points instead of single-point fastenings, in order to distribute bending moment effects among multiple fasteners. Installation of threaded rod coupler hangers on powder-actuated threaded studs should be done with the coupler run down over the stud shank and in contact with the steel base material as depicted in the figure below. Care should be taken not to exceed the maximum torque discussed in Section 3.2.2.6.

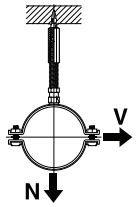
Although no design equations are provided for determining equivalent bending moment loads on power-actuated fasteners, recommended allowable bending moments for threaded stud fasteners are provided in Section 3.2.12, 3.2.13, and 3.2.14 based on testing with a safety factor of 2:1 for static loading.

Relatively small bending moments can contribute to a significant reduction in the overall fastening capacity and must be checked by the design engineer.

Arrangements to reduce or prevent moment on shank:



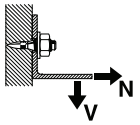
Arrangement causing moment to act on shank:



Coupler not tight against steel

Non-symmetric arrangement:

- Moment on fastened part
- Prying effect must be considered in determining loads acting on fastener



3.2.2.7 COMBINED LOADING OF POWER-ACTUATED FASTENERS IN STEEL

Combined loading of power-actuated fasteners installed in steel can be treated with exponent α = 1 unless otherwise provided for the specific application (e.g. powder-actuated fasteners for steel deck applications with diaphragm shear and tension uplift).

$$(N_s / N_{rec})^{\alpha} + (V_s / V_{rec})^{\alpha} \leq 1.0$$

where:

N_s = Applied Tension Load N_{rec} = Allowable Tension Load

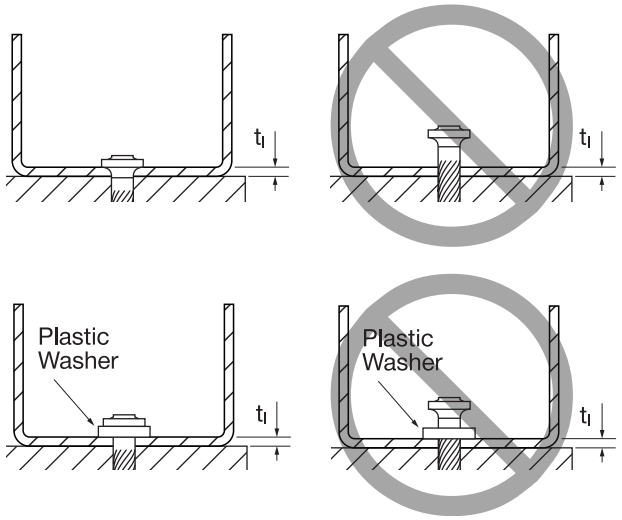
V_s = Applied Shear Load V_{rec} = Allowable Shear Load

Hilti powder-actuated fasteners for attachment of steel decks (X-ENP-19 L15, and X-HSN 24) have separate design equations for combined loading in the SDI Deck Diaphragm Design Manual, 4th Edition (2015); and referenced in AISI S310-16, “North American Standard for the Design of Profiled Steel Diaphragm Panels.”

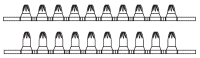
3.2.2.8 FASTENER CLAMPING AND NAILHEAD STAND-OFF

Power-actuated fastenings must be thought of in terms of a fastening system consisting of the power-actuated tool, cartridges, battery or gas canister energy source and the fastener itself. Not all power-actuated fastening systems can achieve adequate embedment and proper clamping of the fastened part to the base material. The installer should start with the lowest power regulation and cartridge and work up until tight clamping is achieved. During installation of the fastener, the plastic guidance washer may be removed completely, partially or remain intact. Any of these scenarios would be considered acceptable, provided the attached material is clamped tightly to the base material and the recommended h_{ET} as found in Section 3.2.2.3 is achieved.

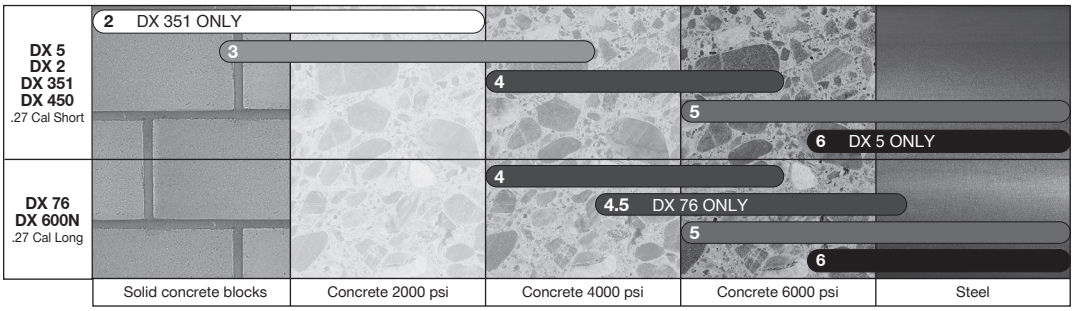
Installers should never “double-shoot” fastenings with excessive nail head stand-off in order to drive them deeper. This can create a safety hazard and break the fusion bond between the fastener shank and the steel base material.



3.2.3 POWDER-ACTUATED CARTRIDGE SELECTION GUIDE[1]

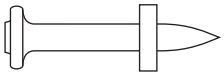
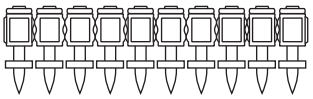
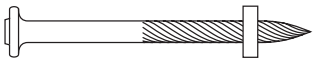
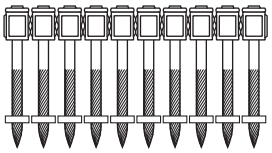
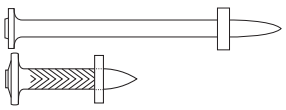
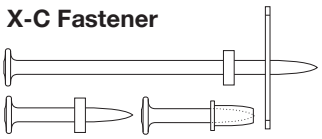
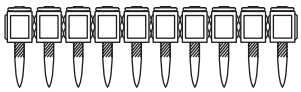
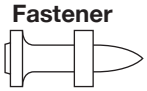
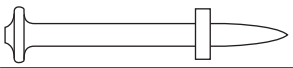


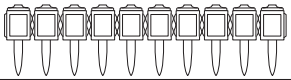
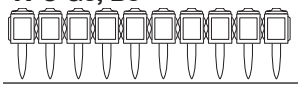
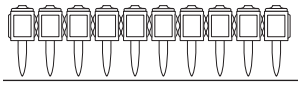
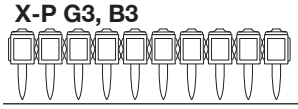
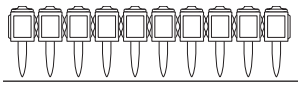
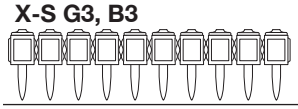
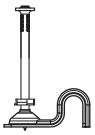
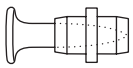
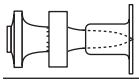
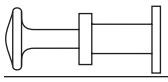
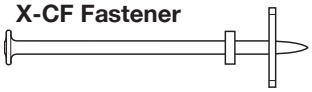
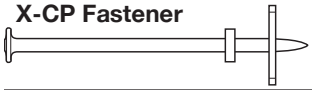
1 This chart is presented as a guide only. Start with the lightest cartridge recommended and work up in strength if necessary. Product recommendations may not be suitable for all types of concrete aggregates. Please contact your Hilti Sales Representative or Hilti Customer Service if you have questions.

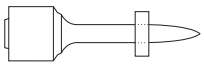
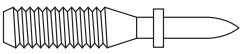
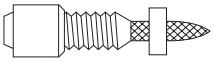
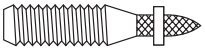
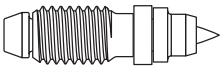
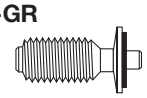
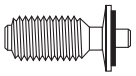
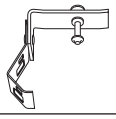
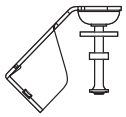
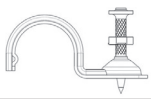
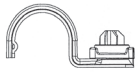


3.2.4 POWER-ACTUATED FASTENER AND TOOL SELECTION GUIDE

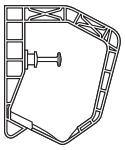
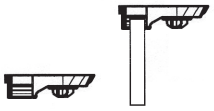
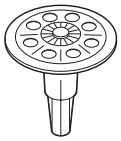
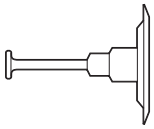
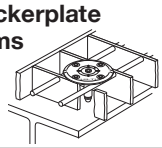
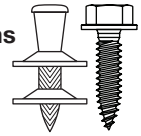
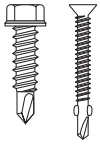
Fastener notes:
● = Single
M = Collated fasteners (magazine required)
P8 = 8 mm fastener guide required
P10 = 10 mm fastener guide required

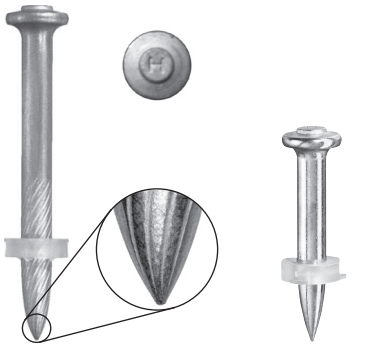
Fastener	Application	DX 351	DX 2	DX 5/ DX 460	DX 76	DX 600N	DX 450	2024 Direct Fastening Technical Guide: Section numbers	2024 Direct Fastening Technical Guide: Page numbers
X-P Fastener 	For high-quality fastenings in concrete, including concrete with compressive strength as high as 8,000 psi. Perimeter wall fastening, drywall track for load bearing interior walls, brackets and angles to concrete.	●	●	●				3.2.5 3.2.6	30–35 36–45
X-P MX Collated Fastener 	High volume, quality fastening to concrete base materials.	**M**		**M**				3.2.5 3.2.6	30–35 36–45
X-U Fastener 	For universal, high quality fastenings to concrete and steel: perimeter wall applications, forming, underfloor, thin metal brackets, angles, etc.	●	●	●				3.2.5 3.2.6	30–35 36–45
X-U MX Collated Fastener 	High-volume, repetitive fastenings to concrete and steel: perimeter wall applications, forminginstallation, etc.	**M**		**M**				3.2.5 3.2.6	30–35 36–45
DS/EDS Fastener 	For fastening to concrete (DS)and steel (EDS): perimeter wall applications, forming, underfloor, installation straps, thin metal brackets, angles, etc.			**P10**	●	●	●	3.2.5	30–35
X-C Fastener 	A standard quality fastener for fastenings to concrete and CMU block	●	●	●				3.2.5 3.2.9	30–35 56–62
X-C MX Collated Fastener 	High volume repetitive fastenings to concrete and CMU block	**M**		**M**				3.2.5 3.2.9	30–35 56–62
X-R Corrosion Resistant Fastener 	High hardness fastener with increased application limit for fastenings to steel base materials for outdoor environments in corrosive conditions	●	●	●				3.2.5 3.2.7	30–35 46–48
X-CR Corrosion Resistant Fastener 	Concrete fastener with resistance equivalent to SAE 316 stainless steel for exterior or corrosive environments	●	●	●				3.2.5	30–35

Fastener notes: ● = Single M = Collated fasteners (magazine required) P8 = 8 mm fastener guide required		DX 351	DX 2	DX 5/ DX 460	GX 2	GX 3/ BX 3	2024 Direct Fastening Technical Guide	
Fastener	**Application**						**Section numbers**	**Page numbers**
X-C G2 	Standard Gas-actuated fastener for fastening drywall track and other thin materials to concrete and CMU.				●		3.2.9	56–62
X-C G3, B3 	Standard Gas- or battery-actuated fastener for fastening drywall track and other thin materials to concrete and CMU.					●	3.2.9	56–62
X-P G2 	Premium Gas-actuated fastener for fastening drywall track and other thin materials to concrete and CMU.				●		3.2.9	56–62
X-P G3, B3 	Premium Gas- or battery-actuated fastener for fastening drywall track and other thin materials to concrete and CMU.					●	3.2.9	56–62
X-S G2 	Premium Gas-actuated fastener for fastening drywall track and other thin materials to steel				●		3.2.9	56–62
X-S G3, B3 	Premium Gas-actuated fastener for fastening drywall track and other thin materials to steel					●	3.2.9	56–62
X-CT Fastener Single and Collated 	Removable fastenings for forming (concrete formwork, shuttering, etc)		●	●			3.2.5	30–35
BC Rebar Basket Clip 	Rebar basket clip with pre-mounted fastener	●	●				3.2.5	30–35
X-PN 37 G3 MX 	Gas actuated fastener for attaching wood structural panels to cold-formed steel framing.					●	3.2.8	49–55
X-S13 THP Fastener 	Fastening of drywall track to steel	●	●	●			3.2.5 3.2.9	30–35 56–62
X-U 15 Stepped-Shank Fastener 	Fastening of cold-formed steel to high strength steel. Available with or without collapsible metal top hat washer. Collated magazine version is also available.	●	P8	●			3.2.5 3.2.6 3.2.9	30–35 36–45 56–62
X-S16 Fastener 	Fastening of drywall track to steel	●	●	●			3.2.5 3.2.9	30–35 56–62
X-CF Fastener 	An economical fastener made specifically for repetitive 2x4 fastenings to concrete		●	●			3.2.10	63–64
X-CP Fastener 	Thick mechanically plated fastener made specifically for fastening treated wood sill plates to concrete		●	●			3.2.10	63–64

Fastener notes: ● = Single M = Collated fasteners (magazine required) P8 = 8 mm fastener guide required P10 = 10 mm fastener guide required		DX 351	DX 2	DX 5/ DX460	GX 120 ME	DX 600N	2021 Direct Fastening Technical Guide	
Fastener	**Application**						**Section numbers**	**Page numbers**
X-W6 – 1/4" Threaded Stud 	Installation of electrical clips and clamps, lamps and lighting as well as switch boxes and control cabinets Available in stainless steel	**P8**	**P8**	**P8**			3.2.11	65–67
W10 – 3/8" Threaded Stud 	Holder brackets, pipe hangers and cable trays, to concrete			**P10**		●	3.2.11	65–67
X-EW6H – 1/4" Threaded Stud 	Fastening of light brackets, electrical clamps, rings and channels to steel	**P8**	**P8**	**P8**			3.2.12	68–70
X-EW10H – 3/8" Threaded Stud 	Fastening pipe hangers, cable trays, air ducts, brackets and channels to steel			**P10**		●	3.2.12	68–70
X-ST-GR Threaded Stud 	High hardness threaded stud with increased application limit for fastenings to steel base materials for outdoor environments in mildly corrosive conditions			●			3.2.13	71–73
X-BT-MR/X-BT-GR Threaded Stud 	Fastening pipe hangers, cable trays, air ducts, brackets and channels to steel. Also used as electrical grounding stud.	● **BT Tool**					3.2.12 3.2.14	68–70 74–82
X-BT ER Threaded Stud 	Stainless stud assembly for electrical connection under permanent current, short-circuit current, or lightning current conditions	● **BT Tool**					3.2.14.7	79–82
X-RH Rod Hanger 	For suspending electrical metal tubing (EMT) from concrete or steel	●	●	●			3.2.17	102–111
X-HS Threaded Rod Hanger 	For suspending ceilings, sprinkler pipes, mechanical (HVAC) and electrical components with 1/4" and 3/8" threaded rods	●	●	●			3.2.17	102–111
X-HS MX Threaded Rod Hanger 	Hanger system using 1/4" threaded rod for light cable trays, etc.	●		●	●		3.2.17	102–111
X-EMTC/BX Conduit and Cable Clip 	Thin wall conduit and armored cable clips with pre-mounted fasteners	●	●	●			3.2.17	102–111
X-EMTC/BX MX Conduit and Cable Clip 	Thin wall conduit and armored cable clips for use with magazine tools	●		●	●		3.2.17	102–111

* S-BT does not require powder-actuated tool for installation; see product section for specific installation tools.

Fastener notes: ● = Single M = Collated fasteners (magazine required) P8 = 8 mm fastener guide required		DX 351	DX 2	DX 5 / DX 460	GX 3 / BX 3	2021 Direct Fastening Technical Guide	
Fastener	**Application**					**Section numbers**	**Page numbers**
X-EMTSC MX Stand-Off Conduit Clip 	For stand-off conduit applications	●		●	●	3.2.17	102–111
X-ECH/F Cable Holder 	For suspending cable from concrete or steel Note: Requires ECH adapter.	●		●		3.2.17	102–111
X-EKB MX Cable Clamp 	For clamping cable to concrete or steel	●		●	●	3.2.17	102–111
X-ECT MX Cable Tie Fastener 	For cable tie applications. To be used with magazine tools and non-Hilti supplied cable tie.	●		●	●	3.2.17	102–111
X-IE Insulation Fastener Family 	For attaching mineral wool, EPS, XPS, PIR, PUR, wood-wool and fiber-cement faced boards to concrete or steel. Note: Requires X-IE Conversion Kit, DX-5 IE or GX-IE / GX-IE-XL.			●		3.2.18 3.2.19 3.2.20	112–117 118–121 122–125
X-SW Soft Washer 	For fastening thin or easily damaged materials to concrete or steel	●	●	●		3.2.18	112–117
Ceiling Fastenin Systems 	For hanging lay-in panel or acoustical suspended ceilings	Reference individual section for tool information.					130–138
Grating and Checkerplate Fastening Systems 	For fastening grating and checkerplate for marine and industrial environments	Reference individual section for tool information.					139–148
Steel Deck Fastening Systems 	For fastening steel deck panels to bar joists and structural steel, as well as steel deck panel to panel at the sidelap	Reference individual section for tool information.					149–204
Self-Drilling Screw Fasteners 	For cold-formed steel connections and gypsum, wood and other materials to cold-formed steel	Reference individual section for tool information.					205–232


X-U

X-P


X-C


DS


X-CR, X-R


X-S


EDS


X-U 15

Listings/Approvals

ICC-ES (International Code Council)
ESR-2269 with LABC/LARC Supplement (X-P, X-U and X-U 15)
ESR-1663 with LABC/LARC Supplement (DS, EDS, X-CR, X-R, X-C)
ESR-1752 with LABC/LARC Supplement (X-C, Gas- & Battery-Actuated Fasteners)

3.2.5 GENERAL APPLICATION FASTENERS

3.2.5.1 PRODUCT DESCRIPTION

X-U Universal Series This universal high performance fastener is designed for applications in concrete and high strength or standard strength steel. The shank diameter is consistent through the fastener offering at 0.157". X-U fastener lengths range from 5/8" through 2-7/8" and are available as single fasteners (P8) or collated (MX) in strips of 10. All X-U fasteners have a unique twist knurling reaching 7/8" from the tip up the shank.

X-P Premium Concrete Fastener The X-P fastener is optimized for high performance in concrete base materials. With a shank diameter of 0.157”, an optimized conical tip design, and high steel hardness, the X-P is designed for demanding concrete applications, in base materials up to 8,000 psi in strength. The X-P fastener is available in lengths ranging from 5/8” to 1-9/16”, making it ideal for drywall track to concrete applications. X-P fasteners are available as single fasteners (P8) or collated (MX) in strips of 10.

X-C Standard Series The X-C series of fasteners is a cost effective solution for applications in concrete and masonry. This fastener is not suited for fastening to steel base materials. Fastener lengths range from 3/4" through 2-7/8" with a shank diameter of 0.138". X-C fasteners are offered in a single (P8) fastener version as well as in collated (MX) strips of 10.

X-CR and X-R Fastener Series The X-CR is a high performance, corrosion resistant fastener equivalent to SAE 316 stainless steel. This fastener is ideally suited for applications where corrosion is a concern whether on concrete or steel base materials. The X-CR is designed mainly for concrete applications and is offered as a single (P8) fastener in lengths from 5/8" through 2-1/8". The X-R fastener is intended for steel applications and is offered in 1/2” shank length. Shank diameter for these fasteners is 0.145" for shank lengths less than 1-1/2" and 0.157" for longer fasteners.

X-S Steel Fastener The X-S is an economical fastener for steel. It has a 0.145" smooth shank diameter and is offered in a 1/2" and 5/8" length. The X-S13 comes collated (MX) in strips of 10 or individually with a plastic “tophat” (THP). The X-S16 comes singly with a metal "tophat" (TH). This fastener is ideally suited for fastening drywall track to standard strength steel and is discussed further in Section 3.2.9.

Gas and Battery Series Specialized series of fasteners are designed for compatibility with Hilti GX 2 and GX 3 gas-actuated and BX 3 and BX 4 battery-actuated tools. These collated fastener lines are designed for applications in interior finishing and mechanical/electrical trades. X-C G2/G3/B3/B4 fasteners are used for fastening to concrete and masonry. The X-P G2/G3/B3/B4 premium fasteners are capable of fastening to masonry, concrete, and steel materials. The X-S G2/G3/B3/B4 is designed for fastening to steel and provides and economical option with the shortest length. For more details refer to Section 3.2.9.

DS/EDS Fastener Series The DS series fastener is a high performance fastener of 0.177" shank diameter suitable for both concrete and steel applications. It is offered in a single fastener version only with a 10 mm dome head design and a 10 mm guidance washer. Available lengths are 3/4" through 2-1/2". Knurling is offered on 3/4" and 7/8" lengths; designated as EDS and ideally suited for steel applications.

X-U 15 Steel Fastener The X-U 15 is a premium, high performance fastener designed specifically for attachments to steel (e.g. drywall track, tagging, etc.). It is offered in a 0.145" shank diameter and 5/8" length with a unique step shank design as either single fasteners with metal tophat or collated in strips of 10.

3.2.5.2 MATERIAL SPECIFICATIONS

Fastener designation	Fastener material	Fastener plating[1]	Steel washer or clip material[1,2]	Washer or clip plating[1,2]
X-P	Carbon Steel	5 µm Zinc	N/A	N/A
X-U	Carbon Steel	5 µm Zinc	Carbon Steel	5 µm Zinc
DS/EDS	Carbon Steel	5 µm Zinc	N/A	N/A
X-C	Carbon Steel	5 µm Zinc	Carbon Steel	5 µm Zinc
X-R, X-CR[3]	SAE 316	N/A	SAE 316	N/A
X-C/ X-P/ X-S: G2/G3/B3/B4	Carbon Steel	2-10 µm Zinc	N/A	N/A
X-CT Forming Nail	Carbon Steel	5 µm Zinc	N/A	N/A
BC X-C	Carbon Steel	5 µm Zinc	Carbon Steel	5 µm Zinc

1 The 5 µm zinc coating is in accordance with ASTM B 633, SC 1, Type III. Refer to Section 2.3.3.1 for more information.
2 Most fasteners have a plastic washer for guidance when installing. Not all fastener lengths have a pre-mounted steel washer. Refer to Section 3.2.2.4 for more information on available fasteners.
3. The X-CR and X-R fastener material is a proprietary material, which provides a corrosion resistance equivalent to SAE 316 stainless steel. The steel washer material is SAE 316 stainless steel.

* More details about the innovative X-P and X-U fasteners can be found in Section 3.2.6.

3.2.5.3 TECHNICAL DATA

Allowable loads in normal weight concrete [1,2]

Fastener description	Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Concrete compressive strength							
				2000 psi		4000 psi		6000 psi		8000 psi	
				Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
Premium Concrete Fastener	X-P	**0.157** (4.0)	**3/4** (19)	**100** (0.44)	**155** (0.69)	**100** (0.44)	**175** (0.78)	**105** (0.47)	**205** (0.91)	**135** (0.60)	**205** (0.91)
			1 (25)	**165** (0.73)	**220** (0.98)	**180** (0.80)	**225** (1.00)	**150** (0.67)	**300** (1.33)	**150** (0.67)	**215** (0.96)
			1-1/4 (32)	**240** (1.07)	**310** (1.38)	**280** (1.25)	**310** (1.38)	**180** (0.80)	**425** (1.89)	–	–
			1-1/2 (38)	**310** (1.38)	**420** (1.87)	–	–	–	–	–	–
Universal Knurled Shank Fasteners	X-U	**0.157** (4.0)	**3/4** (19)	**100** (0.44)	**125** (0.57)	**100** (0.44)	**125** (0.57)	**105** (0.47)	**205** (0.91)	–	–
			1 (25)	**165** (0.73)	**190** (0.85)	**170** (0.76)	**225** (1.00)	**110** (0.49)	**280** (1.25)	–	–
			1-1/4 (32)	**240** (1.07)	**310** (1.38)	**280** (1.25)	**310** (1.38)	**180** (0.80)	**425** (1.89)	–	–
			1-1/2 (38)	**275** (1.22)	**420** (1.87)	**325** (1.45)	**420** (1.87)	–	–	–	–
Standard Fastener	X-C	**0.138** (3.5)	**3/4** (19)	**45** (0.20)	**75** (0.33)	**65** (0.29)	**105** (0.47)	**95** (0.42)	**195** (0.87)	–	–
			1 (25)	**85** (0.38)	**150** (0.67)	**160** (0.71)	**200** (0.89)	**105** (0.47)	**270** (1.20)	–	–
			1-1/4 (32)	**130** (0.58)	**210** (0.93)	**270** (1.20)	**290** (1.29)	**165** (0.73)	**325** (1.45)	–	–
			1-1/2 (38)	**175** (0.78)	**260** (1.16)	**270** (1.20)	**360** (1.60)	–	–	–	–
Heavy Duty Fastener	DS	**0.177** (4.5)	**3/4** (19)	**50** (0.22)	**120** (0.53)	**125** (0.56)	**135** (0.60)	–	–	–	–
			1 (25)	**130** (0.58)	**195** (0.87)	**155** (0.69)	**240** (1.07)	–	–	–	–
			1-1/4 (32)	**220** (0.98)	**385** (1.71)	**270** (1.20)	**425** (1.89)	–	–	–	–
			1-1/2 (38)	**300** (1.33)	**405** (1.80)	**355** (1.58)	**450** (2.00)	–	–	–	–
Stainless Steel Fastener	X-CR	**0.145** (3.7)	**3/4** (19)	**30** (0.13)	**40** (0.18)	**65** (0.29)	**40** (0.18)	–	–	–	–
			1 (25)	**55** (0.24)	**185** (0.82)	**120** (0.53)	**190** (0.85)	**100** (0.44)	**170** (0.76)	–	–
			1-1/4 (32)	**110** (0.49)	**290** (1.29)	**125** (0.56)	**300** (1.33)	**120** (0.53)	**440** (1.96)	–	–
			1-1/2 (38)	**265** (1.18)	**405** (1.80)	**350** (1.56)	**450** (2.00)	–	–	–	–
Gas & Battery Fasteners	X-C G3 X-C B3 X-C B4 (except 36- and 39-mm lengths)	**0.118** (3.0)	**3/4** (19)	**60** (0.25)	**90** (0.4)	**60** (0.25)	**90** (0.4)	–	–	–	–
	X-C G2 (except X-C 39 G2) X-C 36 B3 X-C 39 B4	**0.108** (2.75)	**3/4** (19)	**60** (0.25)	**90** (0.4)	**60** (0.25)	**90** (0.4)	–	–	–	–
	X-C 39 G2 X-C 39 G3	**0.101** (2.6)	**5/8** (16)	**50** (0.2)	**80** (0.35)	**50** (0.2)	**80** (0.35)	–	–	–	–
Premium Gas & Battery Fasteners	X-P G2 X-P G3 X-P B3 X-P B4	**0.118** (3.0)	**5/8** (16)	**50** (0.2)	**90** (0.4)	**50** (0.2)	**120** (0.5)	**50** (0.2)	**90** (0.4)	–	–
			3/4 (19)	**80** (0.4)	**120** (0.5)	**50** (0.2)	**120** (0.5)	**50** (0.2)	**90** (0.4)	–	–
Forming Fastener	X-CT 47[3]	**0.145** (3.7)	**1** (25)	**60** (0.27)	**65** (0.29)	–	–	–	–	–	–
	X-CT 62[3]	**0.145** (3.7)	**1** (25)	**75** (0.33)	**75** (0.33)	–	–	–	–	–	–

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 Multiple fasteners are recommended for any attachment.
3 For temporary fastening of formwork only.

Allowable loads in minimum f'_c = 3000 psi structural lightweight concrete[1,5]

Fastener description	Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Fastener location							
				Installed into concrete		Installed through 3" deep metal deck into concrete[2,3]					
				Tension lb (kN)	Shear lb (kN)	Tension lb (kN)		Shear lb (kN)			
						Upper flute	Lower flute	Upper flute	Lower flute		
Premium Concrete Fastener	X-P*	**0.157** (4.0)	**3/4** (19)	**155** (0.7)	**165** (0.7)	**130** (0.6)	**105** (0.5)	**285** (1.3)	**285** (1.3)		
			1 (25)	**225** (1.0)	**300** (1.3)	**215** (1.0)	**165** (0.7)	**340** (1.5)	**340** (1.5)		
			1-1/4 (32)	**325** (1.4)	**445** (2.0)	**295** (1.3)	**230** (1.0)	**375** (1.7)	**375** (1.7)		
			1-1/2 (38)	**425** (1.9)	**480** (2.1)	**400** (1.8)	**330** (1.5)	**365** (1.6)	**365** (1.6)		
Universal Knurled Shank Fasteners	X-U*	**0.157** (4.0)	**3/4** (19)	**125** (0.56)	**115** (0.51)	**130** (0.58)	**95** (0.42)	**245** (1.1)	**245** (1.1)		
			1 (25)	**205** (0.91)	**260** (1.16)	**215** (0.96)	**155** (0.69)	**330** (1.5)	**330** (1.5)		
			1-1/4 (32)	**315** (1.40)	**435** (1.93)	**295** (1.31)	**200** (0.89)	**375** (1.7)	**375** (1.7)		
			1-1/2 (38)	**425** (1.89)	**475** (2.11)	**400** (1.78)	**260** (1.16)	**430** (1.9)	**430** (1.9)		
Standard Fastener	X-C	**0.138** (3.5)	**3/4** (19)	**120** (0.53)	**175** (0.78)	**120** (0.53)	**95** (0.42)	**265** (1.2)	**265** (1.2)		
			1 (25)	**180** (0.80)	**260** (1.16)	**215** (0.96)	**155** (0.69)	**485** (2.2)	**485** (2.2)		
			1-1/4 (32)	**225** (1.00)	**400** (1.78)	**250** (1.11)	**200** (0.89)	**500** (2.2)	**500** (2.2)		
			1-1/2 (38)	**285** (1.27)	**400** (1.78)	**285** (1.27)	**210** (0.93)	**555** (2.5)	**555** (2.5)		
Heavy Duty Fastener	DS[4]	**0.177** (4.5)	**3/4** (19)	**100** (0.44)	**200** (0.89)	**100** (0.44)	–	**200** (0.9)	**200** (0.9)		
			1 (25)	**180** (0.80)	**360** (1.60)	**180** (0.80)	**180** (0.80)	**405** (1.8)	**405** (1.8)		
			1-1/4 (32)	**300** (1.33)	**520** (2.31)	**300** (1.33)	**250** (1.11)	**515** (2.3)	**515** (2.3)		
			1-1/2 (38)	**450** (2.00)	**680** (3.02)	**450** (2.00)	**325** (1.45)	**625** (2.8)	**625** (2.8)		
Stainless Steel Fastener	X-CR	**0.145** (3.7) **0.157** (4.0)	**1** (25)	**230** (1.02)	**240** (1.07)	**230** (1.02)	–	**240** (1.1)	**240** (1.1)		
			1-1/4 (32)	**320** (1.42)	**400** (1.78)	**320** (1.42)	–	**400** (1.8)	**400** (1.8)		
			1-1/2 (38)	**405** (1.80)	**500** (2.22)	**405** (1.80)	–	**500** (2.2)	**500** (2.2)		
Gas & Battery Fasteners	X-C G3 X-C B3 X-C B4 (except 36- & 39-mm lengths)	**0.118** (3.0)	**3/4**[6] (19)	**115** (0.5)	**140** (0.6)	**75** (0.3)	**85** (0.4)	**175** (0.8)	**215** (1.0)		
			1 (25)	**170** (0.8)	**220** (1.0)	**155** (0.7)	**160** (0.7)	**255** (1.1)	**315** (1.4)		
	X-C G2 (except X-C 39 G2) X-C 36 B3 X-C 39 B4	**0.108** (2.75)	**3/4**[6] (19)	**110** (0.5)	**140** (0.6)	**75** (0.3)	**85** (0.4)	**175** (0.8)	**215** (1.0)		
			1 (25)	**170** (0.8)	**220** (1.0)	**155** (0.7)	**160** (0.7)	**255** (1.1)	**315** (1.4)		
Premium Gas & Battery Fasteners	X-P G2 X-P G3 X-P B3 X-P B4	**0.118** (3.0)	**5/8**[6] (16)	**60** (0.3)	**140** (0.6)	**60** (0.3)	**60** (0.3)	**175** (0.8)	**215** (1.0)		

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 The steel deck profile is 3" deep composite floor deck with a minimum thickness of 20 gauge (0.0358"). Figure 1 (Section 3.2.1.6) shows the nominal flute dimensions, fastener locations, and load orientations for the deck profile.
3 Structural lightweight concrete fill above top of metal deck shall be a minimum of 3-1/4" deep, unless noted otherwise.
4 DS fasteners installed at 1-1/2" embedment through steel deck into the lower flute must be installed at a minimum distance of 6" from the edge of the floor deck.
5 Multiple fasteners are recommended for any attachment.
6 Structural lightweight concrete fill above top of metal deck shall be a minimum of 2-1/2" deep.

* More details about the innovative X-P and X-U fasteners can be found in Section 3.2.6.

Allowable Loads Into Minimum f'_c = 3000 psi Structural Lightweight Concrete Over 1-1/2" Deep, B-Type Steel Deck[1,4]

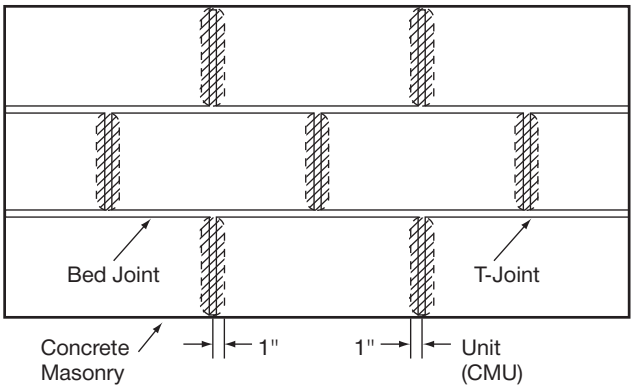
Fastener description	Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Fastener location installed through metal deck into concrete[2,3]		
				Tension lb (kN)		Shear
				Upper flute	Lower flute	lb (kN)
Premium concrete fastener	X-P	**0.157** (4.0)	**3/4** (19)	**140** (0.6)	**130** (0.6)	**335** (1.5)
			1 (25)	**215** (1.0)	**215** (1.0)	**385** (1.7)
			1-1/4 (32)	–	**270** (1.2)	**465** (2.1)
Universal knurled shank fastener	X-U	**0.157** (4.0)	**3/4** (19)	**95** (0.42)	**95** (0.42)	**370** (1.65)
			1 (25)	**125** (0.56)	**125** (0.56)	**415** (1.85)
Standard fastener	X-C	**0.138** (3.5)	**3/4** (19)	**80** (0.36)	**80** (0.36)	**315** (1.40)
			1 (25)	**205** (0.91)	**205** (0.91)	**445** (1.98)
Gas & Battery Fasteners	X-C G3 X-C B3 X-C B4 (except 36- & 39-mm lengths)	**0.118** (3.0)	**3/4** (19)	**75** (0.3)	**85** (0.38)	**175** (0.8)
			1 (25)	**155** (0.7)	**160** (0.71)	**255** (1.1)
	X-C G2 (except X-C 39 G2) X-C 36 B3 X-C 39 B4	**0.108** (2.75)	**3/4** (19)	**75** (0.3)	**85** (0.4)	**175** (0.8)
			1 (25)[5]	**155** (0.7)	**160** (0.7)	**255** (1.1)
Premium Gas & Battery Fasteners	X-P G2 X-P G3 X-P B3 X-P B4	**0.118** (3.0)	**5/8** (16)	**60** (0.27)	**60** (0.3)	**175** (0.8)

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 Steel deck profiles are 1-1/2" deep, B-type deck with a minimum thickness of 20 gauge (0.0358" thick steel). Fasteners may be installed through the metal deck into lightweight concrete having both nominal and inverted deck profile orientations with a minimum lower flute width of 1-3/4" or 3-1/2", respectively. Fasteners shall be placed at centerline of deck flutes. Refer to Figures 2 and 3 (Section 3.2.1.6) for additional flute dimensions, fastener locations, and load orientations for both deck profiles.
3 Structural lightweight concrete fill above top of metal deck shall be a minimum 2-1/2" deep, unless noted otherwise.
4 Multiple fasteners are recommended for any attachment.
5 Structural lightweight concrete fill above top of metal deck shall be a minimum of 3 1/4" deep.

Allowable Loads in Concrete Masonry Units[1,2,3,4,5,10]

Fastener Description	Fastener	Shank diameter in. (mm)	Min. embed. in. (mm)	Hollow CMU				Grout filled CMU					
				Face shell[6]		Mortar joint		Face shell[6]		Mortar joint		Top of grouted cell[8]	
				Tension lb (kN)	Shear[9] lb (kN)	Tension lb (kN)	Shear[7] lb (kN)	Tension lb (kN)	Shear[9] lb (kN)	Tension lb (kN)	Shear[7] lb (kN)	Tension lb (kN)	Shear[9] lb (kN)
Premium concrete fastener	X-P	**0.157** (4.0)	**1** (25)	**70** (0.31)	**105** (0.47)	**85** (0.38)	**70** (0.31)	**150** (0.67)	**145** (0.65)	**150** (0.67)	**155** (0.69)	**165** (0.73)	**240** (1.07)
Universal knurled shank fasteners	X-U	**0.157** (4.0)	**1** (25)	**70** (0.31)	**85** (0.38)	**25** (0.11)	**70** (0.31)	**225** (1.00)	**220** (0.98)	**150** (0.67)	**190** (0.85)	**165** (0.73)	**240** (1.07)
Standard fastener	X-C	**0.138** (3.5)	**3/4** (19)	**40** (0.18)	**85** (0.38)	**25** (0.11)	**50** (0.22)	**100** (0.44)	**105** (0.47)	**45** (0.20)	**80** (0.36)	**115** (0.51)	**175** (0.78)
Gas & Battery Fasteners	X-C G3 X-C B3 X-C B4 (except 36- & 39-mm lengths)	**0.118** (3.0)	**3/4** (19)	**145** (0.65)	**190** (0.85)	**80** (0.36)	**80** (0.36)	**155** (0.69)	**195** (0.87)	**110** (0.49)	**135** (0.60)	**105** (0.47)	**145** (0.65)
			1 (25)	**185** (0.82)	**205** (0.91)	**105** (0.47)	**105** (0.47)	**205** (0.91)	**215** (0.96)	**135** (0.60)	**190** (0.85)	**120** (0.53)	**150** (0.67)
	X-C G2 (except X-C 39 G2) X-C 36 B3 X-C 39 B4	**0.108** (2.7)	**3/4** (19)	**75** (0.33)	**140** (0.62)	**60** (0.27)	**80** (0.36)	**100** (0.44)	**170** (0.76)	**100** (0.44)	**160** (0.71)	**80** (0.36)	**130** (0.58)
			1 (25)	**110** (0.49)	**190** (0.85)	**70** (0.31)	**145** (0.65)	**135** (0.60)	**195** (0.87)	**125** (0.56)	**165** (0.73)	**110** (0.49)	**145** (0.65)
	X-C 39 G2 X-C 39 G3	**0.101** (2.6)	**5/8** (16)	**60** (0.27)	**110** (0.49)	**45** (0.20)	**65** (0.29)	**85** (0.38)	**110** (0.49)	**55** (0.24)	**105** (0.47)	-	-

1 The tabulated allowable load values are for the low-velocity fastener only, using a safety factor of 5.0 or higher calculated in accordance with ICC-ES AC70. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 The tabulated allowable load values are for low-velocity fasteners installed in normal weight or lightweight concrete masonry units conforming to ASTM C90.
3 The tabulated allowable load values are for low-velocity fasteners installed in concrete masonry units with mortar conforming to ASTM C270, Type N or S.
4 The tabulated allowable load values are for low-velocity fasteners installed in concrete masonry units with grout conforming to ASTM C476, as coarse grout.
5 The tabulated allowable load values are for one low-velocity fastener installed in an individual masonry unit cell and at least 4" from the edge of the wall.
6 Fastener can be located anywhere on the face shell or mortar joint as shown in the figure to the right.
7 Shear direction can be horizontal or vertical (Bed Joint or T-Joint) along the CMU wall plane.
8 Fastener located in center of grouted cell installed vertically.
9 Shear can be in any direction.
10 Multiple fasteners are recommended for any attachment.



Acceptable locations (NON-SHADED AREAS) for power-actuated fasteners in CMU walls

* More details about the innovative X-P and X-U fasteners can be found in Section 3.2.6.

Allowable loads in minimum ASTM A36 (F_y ≥ 36 ksi, F_u ≥ 58 ksi) steel[1,2,4,5]

Fastener description	Fastener	Shank diameter in. (mm)	Steel thickness (in.)											
			1/8		3/16		1/4		3/8		1/2		≥3/4	
			Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
Universal knurled shank*	X-U[6]	**0.157** (4.0)	–	–	**500** (2.22)	**720** (3.20)	**775** (3.45)	**720** (3.20)	**935** (4.16)	**720** (3.20)	**900** (4.00)	**720** (3.20)	**350** (1.56)	**375** (1.67)
Stepped-shank knurling-lengthwise	X-U 15[7]	**0.145** (3.7)	–	–	**155** (0.69)	**395** (1.76)	**230** (1.02)	**395** (1.76)	**420** (1.87)	**450** (2.00)	**365** (1.62)	**500** (2.22)	**365** (1.62)	**400** (1.78)
Standard knurled shank	X-S13	**0.145** (3.7)	**140** (0.62)	**300** (1.33)	**300** (1.33)	**450** (2.00)	**300** (1.33)	**450** (2.00)	**300** (1.33)	**450** (2.00)	–	–	–	–
Drywall smooth shank w/metal top hat washer	X-S16[10]	**0.145** (3.7)	–	–	**315** (1.40)	**480** (2.14)	**315** (1.40)	**480** (2.14)	**315** (1.40)	**530** (2.36)	**315** (1.40)	**480** (2.14)	–	–
Heavy duty knurled shank	EDS[3]	**0.177** (4.5)	–	–	**305** (1.36)	**615** (2.74)	**625** (2.78)	**870** (3.87)	**715** (3.18)	**870** (3.87)	**890** (3.96)	**960** (4.27)	**400** (1.78)	**655** (2.91)
Heavy duty smooth shank	DS	**0.177** (4.5)	–	–	**365** (1.62)	**725** (3.22)	**580** (2.58)	**725** (3.22)	**695** (3.09)	**725** (3.22)	**735** (3.27)	**860** (3.83)	–	–
Stainless steel smooth shank	X-R[9], X-CR	**0.145** (3.7) **0.157** (4.0)	–	–	**460** (2.05)	**460** (2.05)	**615** (2.74)	**500** (2.22)	–	–	–	–	–	–
	X-R[8,9]	**0.145** (3.7)	**300** (1.33)	**190** (0.85)	**615** (2.74)	**495** (2.20)	**760** (3.38)	**500** (2.22)	**220** (0.98)	**325** (1.45)	**225** (1.00)	**335** (1.49)	–	–
Standard gas and battery fasteners for steel	X-S 14 G3 X-S 14 B3 X-S 14 B4	**0.118** (3.0)	**140** (0.62)	**230** (1.02)	**220** (0.98)	**245** (1.09)	**225** (1.00)	**290** (1.29)	**280** (1.25)	**330** (1.47)	**280** (1.25)	**330** (1.47)	**280** (1.25)	**330** (1.47)
	X-S 14 G3[8] X-S 14 B3[8] X-S 14 B4[8]	**0.118** (3.0)	–	–	**220** (0.98)	**295** (1.31)	**260** (1.16)	**355** (1.58)	**280** (1.25)	**385** (1.71)	**280** (1.25)	**385** (1.71)	**280** (1.25)	**385** (1.71)
Premium gas and battery fasteners	X-P G3 X-P B3 X-P B4	**0.118** (3.0)	**125** (0.56)	**230** (1.02)	**170** (0.76)	**245** (1.09)	**200** (0.89)	**230** (1.02)	**250** (1.11)	**255** (1.13)	–	–	–	–

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 Low-velocity fasteners shall be driven to where the point of the fastener penetrates through the steel base material in accordance with Section 3.2.2.3, except as noted in this table.
3 EDS fasteners installed into greater than 1/2" thick steel require 1/2" minimum penetration.
4 Multiple fasteners are recommended for any attachment.
5 Refer to guidelines for fastening to steel, Section 3.2.2, for application limits.
6 Tabulated allowable load values provided for 3/4" steel are based upon minimum point penetration of 1/2" into the steel. If 1/2" point penetration into the steel is not achieved, but a point penetration of at least 3/8" is obtained, the tabulated tension value should be reduced by 20 percent and the tabulated shear load should be reduced by 8 percent.
7 X-U 15 fasteners installed into greater than 3/8" thick steel require 15/32" minimum penetration into the steel.
8 Based on testing with F_y = 50 ksi base material.
9 Fasteners installed into 3/8" or thicker base require 0.38" minimum penetration depth into the steel.
10 Published values may vary from values in ICC-ESR

Allowable tensile pullover and shear bearing load capacities for steel framing with power driven fasteners[1,2,3,4]

Fastener description	Fastener	Head dia. in. (mm)	Sheet steel thickness											
			14 ga.		16 ga.		18 ga.		20 ga.		22 ga.		24 ga.		25/26 ga.	
			Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
0.157" shank with or w/o plastic washers or MX collation	X-U, X-P	**0.322** (8.2)	**825** (3.67)	**1,085** (4.83)	**685** (3.05)	**720** (3.20)	**490** (2.18)	**525** (2.34)	**360** (1.60)	**445** (1.98)	**300** (1.33)	**330** (1.47)	**205** (0.91)	**255** (1.13)	**120** (0.53)	**145** (0.64)
0.145" shank with or w/o plastic washers or MX collation	X-C, X-R	**0.322** (8.2)	–	**985** (4.38)	**685** (3.05)	**720** (3.20)	**490** (2.18)	**515** (2.29)	**360** (1.60)	**440** (1.96)	**300** (1.33)	**310** (1.38)	**205** (0.91)	**235** (1.05)	**120** (0.53)	**145** (0.64)
0.177" shank without washer	DS, EDS	**0.322** (8.2)	**965** (4.29)	**1,085** (4.83)	**810** (3.60)	**815** (3.63)	**625** (2.78)	**535** (2.38)	**460** (2.05)	**465** (2.07)	**360** (1.60)	**350** (1.56)	**300** (1.33)	**260** (1.16)	**240** (1.07)	**180** (0.80)
0.145" shank with plastic top hat washers	X-S13 THP X-S16 TH	**0.322** (8.2)	–	**985** (4.38)	**685** (3.05)	**720** (3.20)	**490** (2.18)	**515** (2.29)	**360** (1.60)	**440** (1.96)	**300** (1.33)	**310** (1.38)	**205** (0.91)	**235** (1.05)	**120** (0.53)	**145** (0.64)

1 Allowable load values are based on a safety factor of 3.0.
2 Allowable pullover capacities of sheet steel should be compared to the allowable fastener tensile load capacities in concrete, steel, and masonry to determine controlling resistance load.
3 Allowable shear bearing capacities of sheet steel should be compared to allowable fastener shear capacities in concrete, steel and masonry to determine controlling resistance load.
4 Data is based on the following minimum sheet steel properties, F_y = 33 ksi, F_u = 45 ksi (ASTM A653 material).

* More details about the innovative X-U fastener can be found in Section 3.2.6.

3.2.6 X-P PREMIUM CONCRETE FASTENERS AND X-U UNIVERSAL KNURLED SHANK FASTENERS

3.2.6.1 PRODUCT DESCRIPTION

The Hilti X-P Premium concrete fastener is a hardened fastener with 0.157” shank, optimized for performance in concrete applications, including high strength concrete.

The Hilti X-U universal knurled shank fastener is also a 0.157” shank fastener, designed to cover a wide range of application conditions in steel and concrete. With a fully knurled shank, the X-U fastener is particularly well-suited for steel applications.

To help ensure reliable fastenings, the X-P and X-U fasteners have matched tolerance to all Hilti powder-actuated tools using 8 mm fastener guides and drive pistons through an 8 mm nail head diameter and an 8 mm plastic guidance washer set near the nail tip. The X-U program also includes fasteners with pre-mounted steel washers of 15 mm or 36 mm.

Product features: X-P Fasteners

- Conical point, optimized for penetration in standard and tough concretes
- 0.157” shank for optimal tension and shear loads and stick rate
- Comes in 4 lengths, optimized for fastening of sheet metal (up to 16 ga.) to concrete
- Available in single or collated configurations for optimal productivity

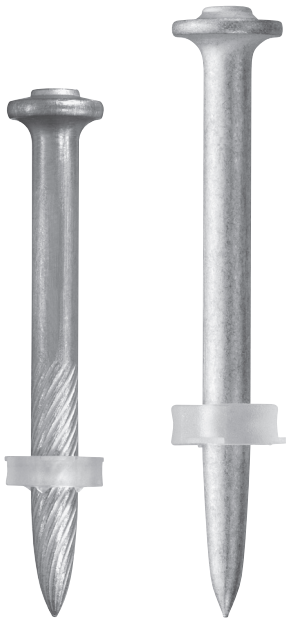
Product features: X-U Fasteners

- Unique knurling design offering higher pullout strength and anchorage in steel
- A 0.157” shank diameter for high performance in both tension and shear applications
- Full range of fasteners in single or collated configurations to maximize productivity
- Recognized for horizontal wood deck diaphragms subjected to wind or seismic forces (Reference ICC-ES ESR-2269)

3.2.6.2 MATERIAL SPECIFICATIONS

Fastener designation	Fastener material	Fastener plating	Fastener hardness
X-U	Carbon Steel	5 µm Zinc[1]	57.5 HRC
X-P	Carbon Steel	5 um Zinc[1]	59 HRC

1 ASTM B633, SC 1, Type III.



X-U X-P

Listings/Approvals

ICC-ES (International Code Council)
ESR-2269 with LABC/LARC Supplement

3.2.6.3 TECHNICAL DATA

Ultimate loads in normal weight concrete[1, 2]

Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Concrete compressive strength							
			2000 psi		4000 psi		6000 psi		8000 psi	
			Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
X-U Universal Fastener	0.157 (4.0)	3/4 (19)	570 (2.5)	840 (3.7)	705 (3.1)	765 (3.4)	790 (3.5)	1020 (4.5)	-	-
		1 (25)	855 (3.8)	1060 (4.7)	995 (4.4)	1380 (6.1)	1135 (5.1)	1630 (7.3)	-	-
		1-1/4 (32)	1225 (5.5)	1865 (8.3)	1500 (6.7)	2020 (9.0)	1300 (5.8)	2325 (10.3)	-	-
		1-1/2 (38)	1765 (7.9)	2480 (11.0)	1965 (8.7)	2250 (10.0)	-	-	-	-
X-P Premium Concrete Fastener	0.157 (4.0)	3/4 (19)	535 (2.4)	980 (4.4)	800 (3.6)	1430 (6.4)	735 (3.3)	1575 (7.0)	875 (3.9)	1475 (6.6)
		1 (25)	880 (3.9)	1395 (6.2)	1345 (6.0)	1710 (7.6)	1320 (5.9)	2040 (9.1)	1400 (6.2)	1820 (8.1)
		1-1/4 (32)	1535 (6.8)	2060 (9.2)	1865 (8.3)	2210 (9.8)	1650 (7.3)	2350 (10.5)	-	-
		1-1/2 (38)	2005 (8.9)	2280 (10.1)	-	-	-	-	-	-

Allowable loads in normal weight concrete[1, 2]

Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Concrete compressive strength							
			2000 psi		4000 psi		6000 psi		8000 psi	
			Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
X-U Universal Fastener	0.157 (4.0)	3/4 (19)	100 (0.4)	125 (0.6)	100 (0.4)	125 (0.6)	105 (0.5)	205 (0.9)	-	-
		1 (25)	165 (0.7)	190 (0.8)	170 (0.8)	225 (1.0)	110[3] (0.5)	280[3] (1.2)	-	-
		1-1/4 (32)	240 (1.1)	310 (1.4)	280 (1.2)	310 (1.4)	180 (0.8)	425 (1.9)	-	-
		1-1/2 (38)	275 (1.2)	420 (1.9)	325 (1.4)	420 (1.9)	-	-	-	-
X-P Premium Concrete Fastener	0.157 (4.0)	3/4 (19)	100 (0.4)	155 (0.7)	100 (0.4)	175 (0.8)	105 (0.5)	205 (0.9)	135 (0.6)	205 (0.9)
		1 (25)	165 (0.7)	220 (1.0)	180 (0.8)	225 (1.0)	150 (0.7)	300 (1.3)	150 (0.7)	215 (1.0)
		1-1/4 (32)	240 (1.1)	310 (1.4)	280 (1.2)	310 (1.4)	180 (0.8)	425 (1.9)	-	-
		1-1/2 (38)	310 (1.4)	420 (1.9)	-	-	-	-	-	-

1 The tabulated load values are for the low-velocity fasteners only based on testing in accordance with ICC-ES AC 70 and ASTM E1190. Allowable loads are calculated based on a safety factor of at least 5.0. Some conditions like high wind loads, shock or fatigue may require a different safety factor. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 Multiple fasteners are recommended for any attachment.
3 This allowable load value for the X-U fastener also applies to normal weight hollow core concrete slabs with f'c of 6600 psi and minimum face shell thickness of 1-3/8 in.

Ultimate and allowable loads in normal weight concrete using DX Kwik[1, 2,3]

Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Load type	Concrete compressive strength			
				4000 psi		6000 psi	
				Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
X-U 47 P8 with DX Kwik	0.157 (4.0)	1-1/2 (38)	Ultimate	1973 (8.8)	2235 (9.9)	2101 (9.3)	2859 (12.7)
			Allowable	395 (1.8)	405 (1.8)	360 (1.6)	570 (2.5)

1 The tabulated ultimate load values are for the low-velocity fasteners only based on testing in accordance with ICC-ES AC 70 and ASTM E1190. Allowable loads are calculated based on a safety factor of at least 5.0. Some conditions like high wind loads, shock or fatigue may require a different safety factor. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 Multiple fasteners are recommended for any attachment
3 X-U Fastener is installed using the DX Kwik drilled pilot hole installation procedure shown in section 3.2.1.10.

Ultimate loads in structural 3000 psi lightweight concrete[1, 4]

Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Fastener location								
			Installed into concrete		Installed through metal deck into concrete						
					3 inch deep composite floor deck[2]			1-1/2 inch deep composite floor deck[3]			
			Tension lb (kN)	Shear lb (kN)	Tension lb (kN)		Shear lb (kN)	Tension lb (kN)		Shear lb (kN)
					Upper flute	Lower flute		Upper flute	Lower flute	
X-U Universal Fastener	0.157 (4.0)	3/4 (19)	627 (2.8)	747 (3.3)	649 (2.9)	483 (2.1)	1235 (5.5)	562 (2.5)	777 (3.5)	1862 (8.3)
		1 (25)	1037 (4.6)	1387 (6.2)	1083 (4.8)	774 (3.4)	1645 (7.3)	774 (3.4)	878 (3.9)	2079 (9.3)
		1-1/4 (32)	1581 (7.0)	2173 (9.7)	1464 (6.5)	848 (3.8)	1885 (8.4)	-	-	-
		1-1/2 (38)	2116 (9.4)	2524 (11.2)	2010 (8.9)	1292 (5.7)	2155 (9.6)	-	-	-
X-P Premium Concrete Fastener	0.157 (4.0)	3/4 (19)	785 (3.5)	1005 (4.5)	738 (3.3)	525 (2.3)	1530 (6.8)	705 (3.1)	840 (3.7)	1680[5] (74.8)
		1 (25)	1245 (5.5)	1625 (7.2)	1120 (5.0)	840 (3.7)	1710 (7.6)	1310 (4.8)	1190 (5.3)	1935[5] (86.1)
		1-1/4 (32)	1720 (7.7)	2240 (10.0)	1985 (8.8)	1295 (5.8)	2025 (9.0)	-	1430 (6.4)	2675[5] (11.9)
		1-1/2 (38)	2260 (10.1)	2465 (11.0)	2335 (10.4)	2015 (9.0)	1835 (8.2)	-	-	-

Allowable loads in structural 3000 psi lightweight concrete[1, 4]

Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Fastener location								
			Installed into concrete		Installed through metal deck into concrete						
					3 inch deep composite floor deck[2]			1-1/2 inch deep composite floor deck[3]			
			Tension lb (kN)	Shear lb (kN)	Tension lb (kN)		Shear lb (kN)	Tension lb (kN)		Shear lb (kN)
					Upper flute	Lower flute		Upper flute	Lower flute	
X-U Universal Fastener	0.157 (4.0)	3/4 (19)	125 (0.6)	115 (0.5)	130 (0.6)	95 (0.4)	245 (1.1)	95 (0.4)	95 (0.4)	370 (1.6)
		1 (25)	205 (0.9)	260 (1.2)	215 (1.0)	155 (0.7)	330 (1.5)	125 (0.6)	125 (0.6)	415 (1.8)
		1-1/4 (32)	315 (1.4)	435 (1.9)	295 (1.3)	200 (0.9)	375 (1.7)	-	-	-
		1-1/2 (38)	425 (1.9)	475 (2.1)	400 (1.8)	260 (1.2)	430 (1.9)	-	-	-
X-P Premium Concrete Fastener	0.157 (4.0)	3/4 (19)	155 (0.7)	165 (0.7)	130 (0.6)	105 (0.5)	285 (1.3)	140 (0.6)	130 (0.6)	335[5] (14.9)
		1 (25)	225 (1.0)	300 (1.3)	215 (1.0)	165 (0.7)	340 (1.5)	215 (1.0)	215 (1.0)	385[5] (17.2)
		1-1/4 (32)	325 (1.4)	445 (2.0)	295 (1.3)	230 (1.0)	375 (1.7)	-	270 (1.2)	465[5] (2.1)
		1-1/2 (38)	425 (1.9)	480 (2.1)	400 (1.8)	330 (1.5)	365 (1.6)	-	-	-

1 The tabulated load values are for the low-velocity fasteners only based on testing in accordance with ICC-ES AC 70 and ASTM E1190. Allowable loads are calculated based on a safety factor of at least 5.0. Some conditions like high wind loads, shock or fatigue may require a different safety factor. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.

2 The steel deck profile for the 3" deep composite floor deck has a minimum thickness of 20 gauge (0.0358") and a minimum Fy = 33 ksi. Lower and upper flute width must be a minimum of 3-7/8". Figure 1 in Section 3.2.1.6 shows the nominal flute dimensions, fastener locations and load orientations for the deck profile. Structural lightweight concrete fill above top of steel deck must be minimum 3-1/4".

3 The steel deck profile for the 1-1/2" deep composite floor deck has a minimum thickness of 20 gauge (0.0358") and a minimum Fy = 33 ksi. Lower flute and upper flute widths must be a minimum of 1-3/4" and 3-1/2", respectively. This deck may also be inverted as shown in Figure 3 in Section 3.2.1.6. Figures 2 and 3 in Section 3.2.1.6 show the nominal flute dimensions, fastener locations and load orientations for the deck profile. Structural lightweight concrete fill above top of steel deck must be minimum 2-1/2".

4 Multiple fasteners are recommended for any attachment.

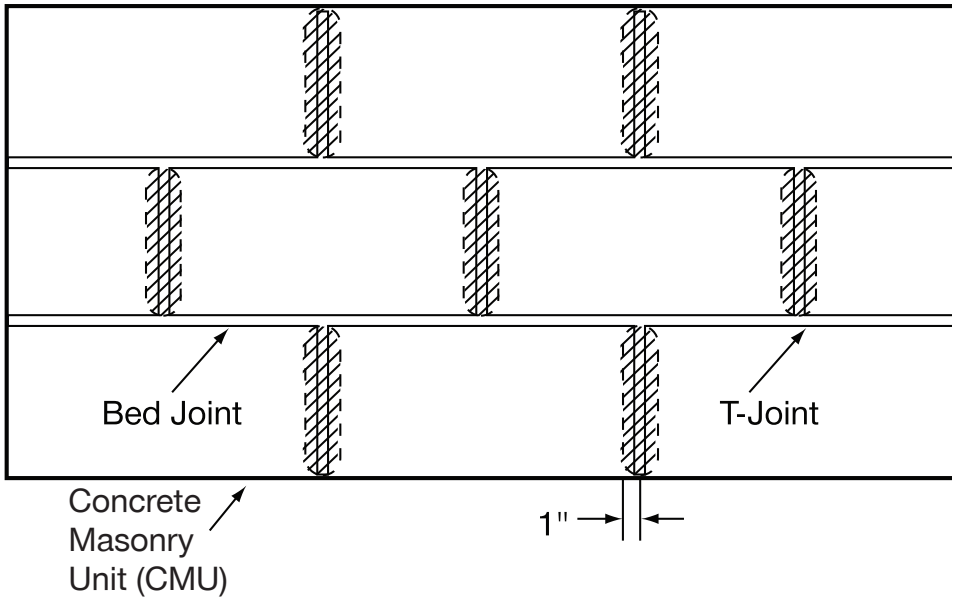
5 For installation in the lower flute only.

Ultimate and allowable loads in concrete masonry units [1, 2, 3, 4, 5, 10]

Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Load type	Hollow CMU							
				Face shell[6]				Mortar joint[6]			
				Tension lb (kN)		Shear lb (kN)		Tension lb (kN)		Shear[7] lb (kN)	
X-U	**0.157** (4.0)	**1** (25)	Ultimate	**449**	(2.0)	**524**	(2.3)	**244**	(1.1)	**483**	(2.1)
			Allowable	**70**	(0.3)	**85**	(0.4)	**25**	(0.1)	**70**	(0.3)

Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Load type	Grout-filled CMU									
				Face shell[6]				Mortar joint[6]				Top of grouted cell[8]			
				Tension lb (kN)		Shear[7] lb (kN)		Tension lb (kN)		Shear[7] lb (kN)		Tension lb (kN)		Shear[7] lb (kN)	
X-U	**0.157** (4.0)	**1** (25)	Ultimate	**1124**	(5.0)	**1093**	(4.9)	**920**	(4.1)	**993**	(4.4)	**935**	(4.2)	**1194**	(5.3)
			Allowable	**225**	(1.0)	**220**	(1.0)	**150**	(0.7)	**190**	(0.8)	**165**	(0.7)	**240**	(1.1)

1 The tabulated allowable and ultimate load values are for the low-velocity fasteners only based on testing in accordance with ICC-ES AC 70 and ASTM E1190. Allowable loads are calculated based on a safety factor of at least 5.0. Some conditions like high wind loads, shock or fatigue may require a different safety factor.
2 The tabulated allowable and ultimate load values are for low-velocity fasteners installed in normal weight or lightweight concrete masonry units conforming to ASTM C90.
3 The tabulated allowable and ultimate load values are for low-velocity fasteners installed in concrete masonry units with mortar conforming to ASTM C270, Type S.
4 The tabulated allowable and ultimate load values are for low-velocity fasteners installed in concrete masonry units with grout conforming to ASTM C476.
5 The tabulated allowable and ultimate load values are for one low-velocity fastener installed in an individual masonry unit cell and at least 4" from the edge of the wall.
6 Fastener can be located anywhere on the face shell or mortar joints as shown in the figure below.
7 Shear load direction can be horizontal or vertical (Bed Joint or T-Joint) along the CMU wall plane.
8 Fastener located in center of grouted cell installed vertically.
9 Shear load can be in any direction in top of grouted cell application.
10 Multiple fasteners are recommended for any attachment.



Acceptable Locations (NON-SHADED AREAS) for X-U Universal Knurled Shank Fasteners in CMU Walls

Ultimate and allowable loads in minimum ASTM A36 (F_y ≥ 36 ksi; F_u ≥ 58 ksi) steel [1, 2, 4, 5]

Fastener	Shank diameter in. (mm)	Load type	Steel thickness in.							
			3/16				1/4			
			Tension lb (kN)		Shear lb (kN)		Tension lb (kN)		Shear lb (kN)	
X-U	**0.157** (4.0)	Ultimate	**2872**	(12.8)	**3939**	(17.5)	**4170**	(18.6)	**3886**	(17.3)
		Allowable	**500**[6]	(2.4)	**720**	(3.2)	**775**[6]	(3.4)	**720**	(3.2)

Fastener	Shank diameter in. (mm)	Load type	Steel thickness in.									
			3/8				1/2				≥3/4[3]	
			Tension lb (kN)		Shear lb (kN)		Tension lb (kN)		Shear lb (kN)		Tension lb (kN)		Shear lb (kN)	
X-U	**0.157** (4.0)	Ultimate	**5688**	(25.3)	**4426**	(19.7)	**4690**	(20.9)	**3761**	(16.7)	**1899**	(8.5)	**2046**	(9.1)
		Allowable	**935**	(4.2)	**720**	(3.2)	**900**	(4.0)	**720**	(3.2)	**350**	(1.6)	**375**	(1.7)

1 The tabulated ultimate load values are for the low-velocity fasteners only based on testing in accordance with ICC-ES AC 70 and ASTM E1190. Allowable loads are calculated based on a safety factor of at least 5.0. Some conditions like high wind loads, shock or fatigue may require a different safety factor.
2 Low-velocity fasteners shall be driven to where the point of the fastener penetrates through the steel base material, except as noted.
3 Tabulated ultimate load values provided for ≥ 3/4" steel are based upon minimum point penetration of 1/2" into the steel. If 1/2" point penetration into the steel is not achieved, but a point penetration of at least 3/8" is obtained, the tabulated tension value should be reduced by 20% and the tabulated shear value should be reduced by 8%.
4 Multiple fasteners are recommended for any attachment
5 When used for resisting seismic forces, allowable loads are valid as per ICC-ES AC70, Annex A
6 For fastening of cold-formed sheet steel, up to 16 gauge, for static loads only, when designed in accordance with AISI S100 (Section J5.2): The tabulated allowable load may be increased by a factor of 1.25, and the design strength may be taken as the tabulated allowable load multiplied by a factor of 2.0.

Allowable tensile pullover and shear bearing load capacities for steel framing with X-P and X-U Powder-Actuated Fasteners[1,2,3,4]

Fastener description	Fastener	Head diameter in. (mm)	Sheet steel thickness							
			14 ga.		16 ga.		18 ga.		20 ga.	
			Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
0.157" shank with or without plastic washers or MX collation	X-U X-P	**0.322** (8.2)	**825** (3.67)	**1,085** (4.83)	**685** (3.05)	**720** (3.20)	**490** (2.18)	**525** (2.34)	**360** (1.60)	**445** (1.98)

Fastener description	Fastener	Head diameter in. (mm)	Sheet steel thickness					
			22 ga.		24 ga.		25/26 ga.	
			Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
0.157" shank with or without plastic washers or MX collation	X-U X-P	**0.322** (8.2)	**300** (1.33)	**330** (1.47)	**205** (0.91)	**255** (1.13)	**120** (0.53)	**145** (0.64)

1 Allowable load values are based on a safety factor of 3.0.
2 Allowable pullover capacities of sheet steel should be compared to allowable fastener tensile load capacities in concrete, steel, or masonry to determine controlling resistance load.
3 Allowable shear load bearing capacities of sheet steel should be compared to allowable fastener shear capacities in concrete, steel or masonry to determine controlling resistance load.
4 Data is based on the following minimum sheet steel properties, F_y = 33 ksi, F_u = 45 ksi (ASTM A653 material).

3.2.6.4 PERIMETER WALL APPLICATION FASTENERS

3.2.6.4.1 Application description

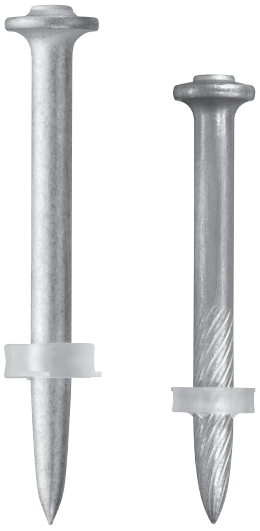
Perimeter wall applications as part of curtain walls and bypass balloon framing are common in steel and metal framed structures. Cold-formed steel framing and track encompass the outside perimeter of the building. Steel track is fastened directly or with other cold-formed steel components to steel framing members or to concrete slab edges. Insulation and/ or cladding materials are then fastened to the steel track.

Product features: X-P Fasteners

Conical point, optimized for penetration in standard and tough concretes.
0.157” shank for optimal tension and shear performance.
Comes in 4 lengths, optimized for fastening of sheet steel (up to 16 ga) to concrete.
Available in single or collated configurations for optimal productivity.

Product features: X-U Fasteners

- Unique knurling design offering higher pullout strength and anchorage in steel.
- A 0.157” shank diameter for high performance in both tension and shear applications.
- For both X-U and X-P fasteners, full range of fasteners in single or collated configurations to maximize productivity.



X-P X-U

X-U 15 DS EDS

Perimeter wall track applications

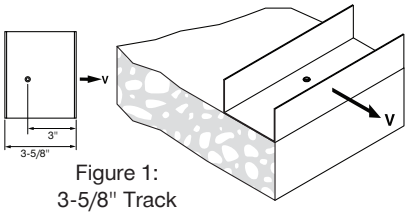


Figure 1:
3-5/8" Track
1 Fastener

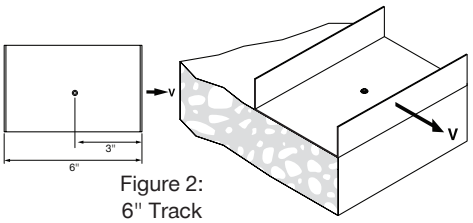


Figure 2:
6" Track
1 Fastener

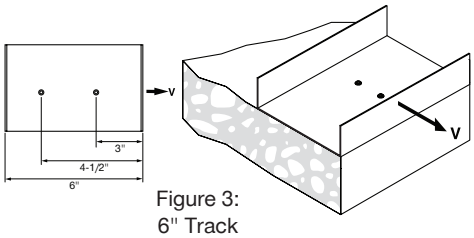


Figure 3:
6" Track
2 Fasteners

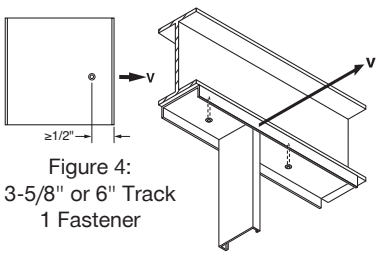


Figure 4:
3-5/8" or 6" Track
1 Fastener

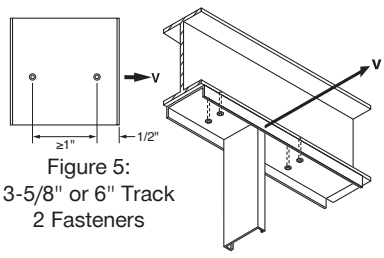


Figure 5:
3-5/8" or 6" Track
2 Fasteners

Listings/Approvals

ICC-ES (International Code Council)
ESR-2269 with LABC/LARC Supplement (X-P, X-U and X-U 15)
ESR-1663 with LABC/LARC Supplement (DS, EDS)

3.2.6.4.2 Technical data

Ultimate and allowable shear loads for attachment of perimeter track to 4000 psi normal weight concrete[1, 2, 3, 4, 5, 6]

Fastener description	Shank diameter in. (mm)	Fastener length in. (mm)		Track width in.[7]	Number of fasteners	Ultimate shear load lb (kN)		Allowable shear load lb (kN)	
X-U[8] Universal Knurled Shank Fasteners and **X-P**[8] Premium Concrete Fastener	**0.157** (4.0)	**1**	(27)	3-5/8	1	**1380**	(6.1)	**225**	(1.0)
				6	1	**1380**	(6.1)	**225**	(1.0)
					2	**3045**	(13.6)	**450**	(2.0)
		1-1/4	(32)	3-5/8	1	**2020**	(9.0)	**275**	(1.2)
				6	1	**2020**	(9.0)	**275**	(1.2)
					2	**2760**	(12.3)	**550**	(2.4)
DS[9] Heavy Duty Fasteners	**0.177** (4.5)	**1**	(27)	3-5/8	1	**1200**	(5.3)	**240**	(1.1)
				6	1	**1200**	(5.3)	**240**	(1.1)
					2	**2750**	(12.2)	**480**	(2.1)
		1-1/4	(32)	3-5/8	1	**2125**	(9.5)	**350**	(1.6)
				6	1	**2125**	(9.5)	**350**	(1.6)
					2	-	-	-	-

1 The tabulated ultimate loads were developed from testing the low-velocity fasteners with 16 gauge (Fy ≥ 33 ksi) steel track. A safety factor greater than or equal to 5.0 was used to determine allowable loads. Steel track members not meeting the specification noted must be investigated in accordance with accepted design criteria
2 Allowable values are for fasteners installed in concrete having the designated compressive strength at the time of installation.
3 Spacing and edge distance constraints are as noted in Figures 1-3 on previous page 42.
4 Allowable shear load values are for loads applied perpendicular to the edge of the concrete.
5 Multiple fasteners are recommended for any attachment.
6 Minimum edge distance of 3” cannot be decreased. Closer edge distances can result in edge breakout failure of the base material during installation. As a result, fasteners are offset from the center line of the track.
7 SSMA track designation for 3-5/8” track is 362T 150-54 and for 6” track is 600T 150-54.
8 For additional technical data and materials specifications for X-U and X-P fasteners, see Section 3.2.6.2 and 3.2.6.3 of this Technical Guide
9 For additional technical data and materials specifications for DS fasteners, see section 3.2.5.

Ultimate and allowable shear loads for attachment of perimeter track to 3000 psi light weight concrete [1, 2, 3, 4, 5, 6]

Fastener description	Shank diameter in. (mm)	Fastener length in. (mm)	Track width in.[7]	Number of fasteners	Ultimate shear load lb (kN)		Allowable shear load lb (kN)	
X-U[8] Universal Knurled Shank Fasteners and **X-P**[8] Premium Concrete Fastener	**0.157** (4.0)	**1** (27)	3-5/8	1	**1290**	(5.7)	**260**	(1.2)
			6	1	**1290**	(5.7)	**260**	(1.2)
				2	**2585**	(11.5)	**520**	(2.3)
		1-1/4 (32)	3-5/8	1	**2173**	(9.7)	**350**	(1.6)
			6	1	**2173**	(9.7)	**350**	(1.6)
				2	**2885**	(12.8)	**575**	(2.6)
		1-1/2 (37)	3-5/8	1	**2524**	(11.2)	**295**	(1.3)
			6	1	**2524**	(11.2)	**295**	(1.3)
				2	**3020**	(13.4)	**605**	(2.7)
DS[9] Heavy Duty Fasteners	**0.177** (4.5)	**1** (27)	3-5/8	1	**1020**	(4.5)	**205**	(0.9)
			6	1	**1020**	(4.5)	**205**	(0.9)
				2	**2995**	(13.3)	**600**	(2.7)
		1-1/4 (32)	3-5/8	1	**1120**	(5.0)	**225**	(1.0)
			6	1	**1120**	(5.0)	**225**	(1.0)
				2	**2965**	(13.2)	**595**	(2.6)
		1-1/2 (37)	3-5/8	1	**1075**	(4.8)	**215**	(1.0)
			6	1	**1075**	(4.8)	**215**	(1.0)
				2	**2955**	(13.1)	**590**	(2.6)

1 The tabulated ultimate loads were developed from testing the low-velocity fasteners with 16 gauge (Fy ≥ 33 ksi) steel track. A safety factor greater than or equal to 5.0 was used to determine allowable loads. Steel track members not meeting the specification noted must be investigated in accordance with accepted design criteria
2 Allowable values are for fasteners installed in concrete having the designated compressive strength at the time of installation.
3 Spacing and edge distance constraints are as noted in Figures 1-3 on page 42.
4 Allowable shear load values are for loads applied perpendicular to the edge of the concrete.
5 Multiple fasteners are recommended for any attachment.
6 Minimum edge distance of 3" cannot be decreased. Closer edge distances can result in edge breakout failure of the base material during installation. As a result, fasteners are offset from the center line of the track.
7 SSMA track designation for 3-5/8" track is 362T 150-54 and for 6" track is 600T 150-54.
8 For additional technical data and material specifications for X-U and X-P fasteners, see Section 3.2.6.2 and 3.2.6.3 of this Technical Guide.
9 For additional technical data and material specifications for DS fasteners, see section 3.2.5 of this Technical Guide.

Allowable shear loads for attachment of perimeter track to minimum ASTM A36 (F_y ≥ 36 ksi; F_u ≥ 58 ksi) steel, lb (kN)[1,2,3,4]

Fastener description	Fastener	Shank diameter in. (mm)		Number of fasteners	Steel thickness (in.)									
					3/16 lb (kN)		1/4 lb (kN)		3/8 lb (kN)		1/2 lb (kN)		≥3/4 lb (kN)	
Universal knurled shank fasteners	X-U	0.157	(4.0)	1	720	(3.2)	720	(3.2)	720	(3.2)	720	(3.2)	375[5]	(1.7)
				2	1440	(6.4)	1440	(6.4)	1440	(6.4)	1440	(6.4)	750[5]	(3.3)
	X-U 15	0.145	(3.7)	1	395	(1.8)	395	(1.8)	450	(2.0)	500[6]	(2.2)	400[6]	(1.8)
				2	800	(3.6)	790	(3.5)	900	(4.0)	1000[6]	(4.5)	800[6]	(3.6)
Heavy duty fasteners	EDS	0.177	(4.5)	1	615	(2.7)	870	(3.9)	870	(3.9)	960	(4.3)	655[7]	(2.9)
				2	1230	(5.5)	1740	(7.7)	1740	(7.7)	1920	(8.5)	1310[7]	(5.8)

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 Low-velocity fasteners shall be driven to where the point of the fastener penetrates through the steel base material, except as noted.
3 Multiple fasteners are recommended for increased reliability.
4 The minimum edge distance for fastening into steel is 1/2". Minimum spacing for fastening into steel without reduction in performance is 1".
5 Noted tabulated allowable load values are based upon minimum point penetration of 1/2" into the steel. If 1/2" point penetration into the steel is not achieved, but a point penetration of at least 3/8" is obtained, the tabulated shear load should be reduced by 8 percent.
6 Noted tabulated allowable load values are based upon minimum point penetration into the steel of 15/32".
7 Noted tabulated allowable load values are based upon a minimum point penetration into the steel of 1/2".

Deflection slip clip applications

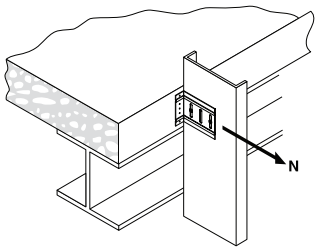


Figure 6:
Normal weight concrete

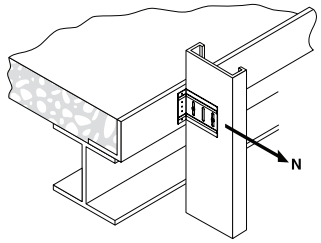
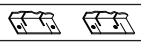


Figure 7:
Lightweight concrete with pour stop

Allowable loads for attachment of cold-formed steel deflection slip clips with X-U Universal Powder-Actuated Fasteners[3,4,5,6,7,8,9]

Clip Type[10]	Fastener	Number of fasteners	Normal weight concrete allowable load[1] lb (kN)		Lightweight concrete with pour stop allowable load[2] lb (kN)		Location of fasteners
Verticlip® SLB600 (14 GA.)	X-U 27	2	160	(0.7)	160	(0.7)	
		3	245	(1.1)	245	(1.1)	
		4	330	(1.5)	380	(1.7)	
WSC 950 (16 GA.)	X-U 27	2	125	(0.6)	155	(0.7)	
		3	145	(0.6)	275	(1.2)	
		4	220	(1.0)	275	(1.2)	
WSC 1500 (12 GA.)	X-U 27	2	90	(0.4)	130	(0.6)	
		3	185	(0.8)	235	(1.1)	
FCSC™ (14 GA.)	X-U 27	2	140	(0.6)	170	(0.8)	
		3	290	(1.3)	320	(1.4)	

1 Allowable load based on a safety factor of 5.0 in direction shown in Figure 6 for attachment of deflection slip clip to 4000 psi Normal Weight Concrete Slab.
2 Allowable load based on a safety factor of 5.0 in direction shown in Figure 7 for attachment of deflection slip clip to 3000 psi Lightweight Concrete Slab with 12 GA. sheet steel pour stop with minimum yield strength Fy = 33 ksi.
3 Testing based on deflection slip clips obtained in February 2007. Subsequent changes by the manufacturer to the deflection slip clip design may affect load values.
4 Allowable load values are for fasteners installed in concrete having the designated compressive strength at the time of installation.
5 Allowable load values are based off of the fixtures tested. Other members connected to the deflection slip clips must be investigated in accordance with accepted design criteria.
6 Spacing of fasteners depends on the design of each deflection slip clip. Fasteners should be installed through the pre-assigned locations in the deflection slip clip.
7 For base material thickness requirements, reference Section 3.2.1.4.
8 Allowable values are for loads applied perpendicular to the edge of the concrete.
9 Multiple fasteners are recommended for any attachment.
10 Verticlip is a registered trademark of The Steel Network, Inc. Fast Clip Slide Clip (FCSC) is a trademark of Ware Industries Inc.

Allowable loads for attachment of cold-formed steel deflection slip clips with X-U Universal Powder-Actuated Fasteners to minimum ASTM A36 ($F_y \geq 36$ ksi; $F_u \geq 58$ ksi) steel[1,2,3,4,5,6,7,8]

Clip type	Fastener	Number of fasteners	Allowable load lb (kN)		Location of fasteners
Verticlip SLB600 (14 GA.)	X-U 16	2	**740**	(3.3)	
	X-U 19 EDS 19	3	**1490**	(6.6)	
	EDS 22	4	**2115**	(9.4)	
WSC 950 (16 GA.)	X-U 16	2	**510**	(2.3)	
	X-U 19 EDS 19	3	**610**	(2.7)	
	EDS 22	4	**870**	(3.9)	
WSC 1500 (12 GA.)	X-U 16	2	**970**	(4.3)	
	X-U 19 EDS 19	3	**1105**	(4.9)	
	EDS 22	4	**1300**	(5.8)	
FCSC (14 GA.)	X-U 16	2	**715**	(3.2)	
	X-U 19 EDS 19	3	**940**	(4.2)	
	EDS 22	4	**1055**	(4.7)	

1 Allowable load based on a variable safety factor in accordance with Section K of AISI S100.
2 Testing based on deflection slip clips developed in February 2007. Subsequent changes by the deflection slip clip manufacturer to the clip design may affect load values.
3 Allowable load values are based off of the connections tested. Steel members connected to the deflection slip clips must be investigated in accordance with accepted design criteria.
4 Spacing of fasteners depends on the design of each deflection slip clip. Fasteners should be installed through the pre-assigned locations in the deflection slip clip.
5 For edge distance requirement reference Section 3.2.2.2.
6 Allowable load values are for loads applied perpendicular to the edge of the base steel member.
7 Multiple fasteners are recommended for any attachment.
8 Allowable load values are based on testing into 1/4" ASTM A36 structural steel. Allowable load in other base steel thicknesses can be calculated as single fastener allowable load (Tension) x number of fasteners. Reference Table "Ultimate and Allowable Loads in Minimum ASTM A36 (Fy≥36 ksi; Fu≥58 ksi) Steel" on page 41 for single fastener allowable loads in specific steel thickness. Calculated allowable load should be compared with the relevant allowable load in this table to determine controlling resistance load.

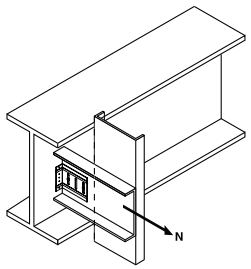


Figure 8: Steel

3.2.6.5 ORDERING INFORMATION

Fastener description	Shank length in. (mm)	Shank Ø in. (mm)	Washer Ø	Packaging Qty
X-P 22	7/8 (22)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs/ box
X-P 27	1 (27)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs/ box
X-P 34	1 1/4 (34)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs/ box
X-P 40	1 5/8 (40)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs/ box
X-U 16	5/8 (16)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs / box
X-U 19	3/4 (19)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs / box
X-U 22	7/8 (22)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs / box
X-U 27	1 (27)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs / box
X-U 32	1-1/4 (32)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs / box
X-U 37	1-1/2 (37)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs / box
X-U 42	1-5/8 (42)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs / box
X-U 47	1-7/8 (47)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs / box
X-U 52	2 (52)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs / box
X-U 57	2-1/4 (57)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs / box
X-U 62	2-1/2 (62)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs / box
X-U 72	2-7/8 (72)	0.157 (4.0)	Plastic 8 mm or collated	100 pcs / box
X-U 22 P8 S15	7/8 (22)	0.157 (4.0)	Plastic 8 mm & Steel 15 mm	100 pcs / box
X-U 27 P8 S15	1 (27)	0.157 (4.0)	Plastic 8 mm & Steel 15 mm	100 pcs / box
X-U 32 P8 S15	1-1/4 (32)	0.157 (4.0)	Plastic 8 mm & Steel 15 mm	100 pcs / box
X-U 32 P8 S36	1-1/4 (32)	0.157 (4.0)	Plastic 8 mm & Steel 36 mm	100 pcs / box
X-U 72 P8 S36	2-7/8 (72)	0.157 (4.0)	Plastic 8 mm & Steel 36 mm	100 pcs / box
X-U 16 P8 TH	5/8 (16)	0.157 (4.0)	8 mm plastic & metal "tophat"	100 pcs / box
X-U 19 P8 TH	3/4 (19)	0.157 (4.0)	8 mm plastic & metal "tophat"	100 pcs / box
X-U 27 P8 TH	1 (27)	0.157 (4.0)	8 mm plastic & metal "tophat"	100 pcs / box

For ordering information on DS and EDS fasteners, please refer to the Hilti product catalog or visit www.hilti.com or www.hilti.ca

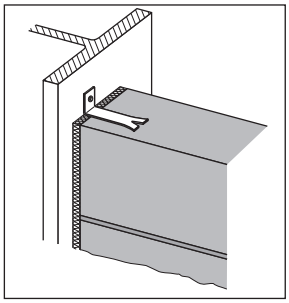
3.2.7 X-R FASTENERS FOR FASTENING TO STEEL

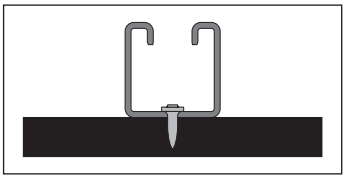
3.2.7.1 PRODUCT DESCRIPTION

The Hilti X-R powder-actuated fasteners are manufactured from a proprietary CrMnMo alloy which has corrosion resistance for outdoor environments in mildly corrosive conditions where HDG coated parts are commonly specified or used. The proprietary alloy provides a high hardness level, increasing the application limit when compared with traditional alloys. See Material Specification and Application Limit sections with more information.

Product features:

- CrMnMo Alloy with improved material hardness
- Base steel thickness from 3/16-inch to full steel*
- With proper tool and cartridge selection, can be used in base steel material with strength up to 92 ksi
- A superior performance in struts/channels application with improved application limit especially with the use of DX 450 and its narrow access base plate

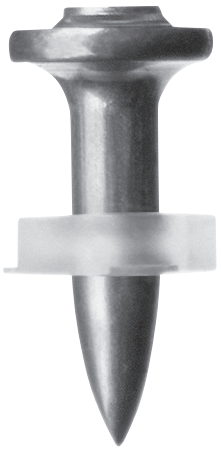




Typical applications are steel to steel fastenings, e.g. wall ties, struts, channels, etc.

3.2.7.2 MATERIAL SPECIFICATIONS

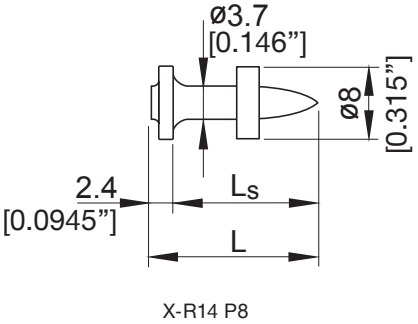
Part	Material designation	Tensile strength, Fu ksi (N/mm²)
Shank	CrMnMo Alloy P558	≥ 290 (2000)
Guidance washer	Polyethylene	N/A



X-R

Listings/Approvals

ICC-ES (International Code Council)
ESR-1663 with LABC/LARC Supplement



X-R14 P8

* Performance above 1/2“ is dependent on steel hardness, see Application limit in steel with more information

3.2.7.3 TECHNICAL DATA

Allowable loads in minimum ASTM A36 (Fy ≥ 36 ksi; Fu ≥ 58 ksi) steel[1,2]

Load type	Steel thickness in.	
	3/16	1/4
Tension lb (kN)	460 (2.05)	615 (2.74)
Shear lb (kN)	460 (2.05)	500 (2.22)

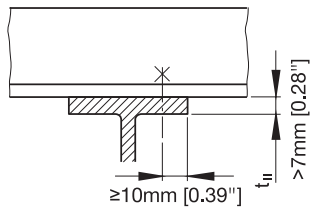
Allowable loads in minimum ASTM Grade 50 (Fy ≥ 50 ksi; Fu ≥ 65 ksi) steel[1,2]

Load type	Steel thickness in.				
	1/8	3/16	1/4	3/8[3]	1/2[3]
Tension lb (kN)	300 (1.33)	615 (2.74)	760 (3.38)	220 (0.98)	225 (1.00)
Shear lb (kN)	190 (0.85)	495 (2.20)	500 (2.22)	325 (1.45)	335 (1.49)

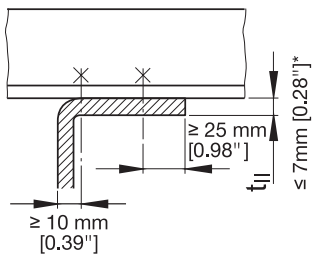
1 The tabulated allowable load values are for the X-R fasteners only, using a safety factor of 5.0 to the average ultimate values obtained based on testing in accordance with ICC-ES AC70 and ASTM E1190. Some conditions like high wind loads, shock or fatigue may require a different safety factor.
2 Fasteners shall be driven to where the point of the fastener penetrates through the steel base material, except as noted.
3 Fasteners installed into 3/8" or thicker base may not achieve point penetration through the steel, but require 0.38" minimum penetration depth into the steel.

Spacing, edge distances and base material thickness

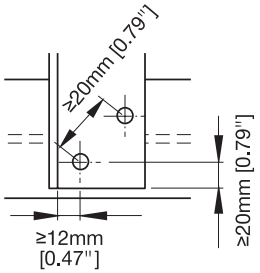
Rolled shapes

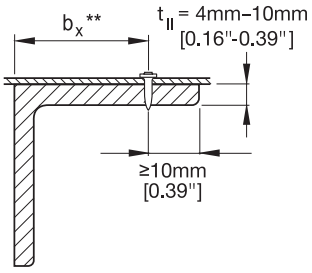


Cold-formed shapes



Fastened material





*Application limit for cold-formed shapes

**Maximum allowable bx ≤ 8 x t_{II}

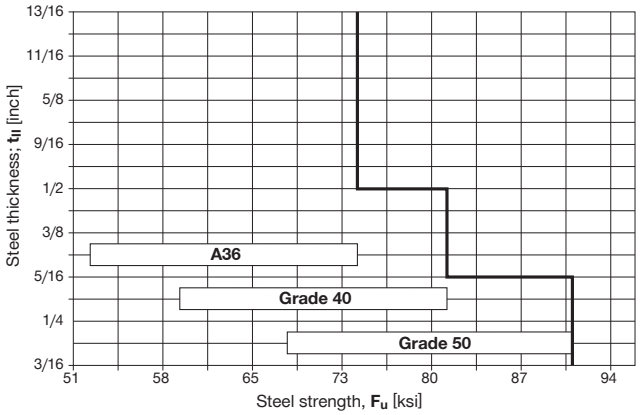
Application limit in steel

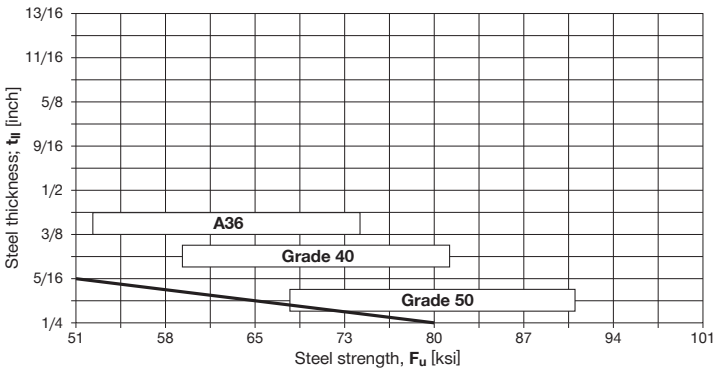
Use DX 450

Tool accessories
① Fastener guide and base plate
② Piston
③ Piston sleeve

DX 460 or DX 5

Tool accessories
① Fastener guide: X-5-460-F8
② Piston: X-5-460-P8





(Applications below and to the left of the solid line are within the recommended application range)

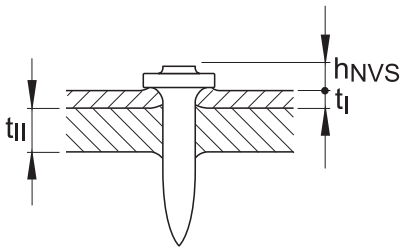
Typical cartridge selection and tool energy setting

DX 450

Base material thickness in.	3/16 – 1/4	1/4 – 5/16	> 5/16
Cartridge, 6.8/11M	Yellow	Red	
Tool energy setting	1.0 – 3.0	2.0 – 3.0	2.5 – 3.0
h_{NVS} in.	1/8 - 3/16	1/8 - 3/16	3/32 - 1/8
t_I in.	≤ 1/8		
t_{II} in.	≥ 3/16		

DX 460 or DX5

Cartridge, 6.8/11M	Red
h_{NVS} in.	1/8 – 3/16
t_I in.	≤ 1/32
t_{II} in.	≥ 1/4, ≤5/16



3.2.7.4 Ordering information

Fastener description	Shank length in. (mm)	Shank Ø in. (mm)	Guidance washer Ø	Qty
X-R14 P8	0.531 (14)	0.145 (3.7)	8 mm Plastic	200

3.2.8 X-PN 37 MX STRUCTURAL WOOD PANEL FASTENERS

3.2.8.1 PRODUCT DESCRIPTION

The Hilti X-PN 37 G2/G3/B4 MX power-driven fasteners are a knurled shank fastener designed as an efficient solution for the attachment of structural wood panel materials such as plywood and OSB (Oriented Strand Board) to cold-formed steel (CFS) framing as part of shear wall assemblies and other applications such as parapet walls, siding, and roofing. These power-driven fasteners are installed with a Hilti GX 2 or GX 3 Gas-Actuated or the BX 4 Battery-Actuated Direct Fastening Systems increasing reliability, accuracy and productivity for the installer. Hilti X-PN 37 MX fasteners have a shank diameter of 0.102 inch (2.60 mm) and a total length of 1-1/2 inches (37 mm). The X-PN 37 MX fasteners are collated in strips of 10 to increase productivity with the Hilti Gas- and Battery-Actuated DIrect Fastening systems, which holds up to 40 collated fasteners in the their magazines. The fastener shank has a unique twist knurling geometry that increases holding power and strength of wood to CFS connections.

Product features:

- 0.102 inch (2.60 mm) shank diameter for optimal penetration through structural wood panels and into CFS base materials.
- Unique knurling geometry for improved reliability and load performance.
- One fastener length covers most common wood shear wall applications.
- Increased productivity using the latest Hilti Gas- and Battery-Actuated Tools
- Wide application range including 27-68 Mils (22-14 gauge) CFS.
- IBC / IRC 2015, 2018, and 2021 seismic recognition for use with Type I shear walls in all Seismic Design Categories (SDC) A–F (ESR-3059).

Figure 1: X-PN 37 Fastener

Figure 2: X-PN 37 G3 MX Fastener

Figure 3: X-PN 37 B4 MX Fastener

Approvals/Listings

ICC-ES (International Code Council)
ESR-3059 with LABC/LARC Supplement

2012 IBC Compliant

2015 IBC Compliant

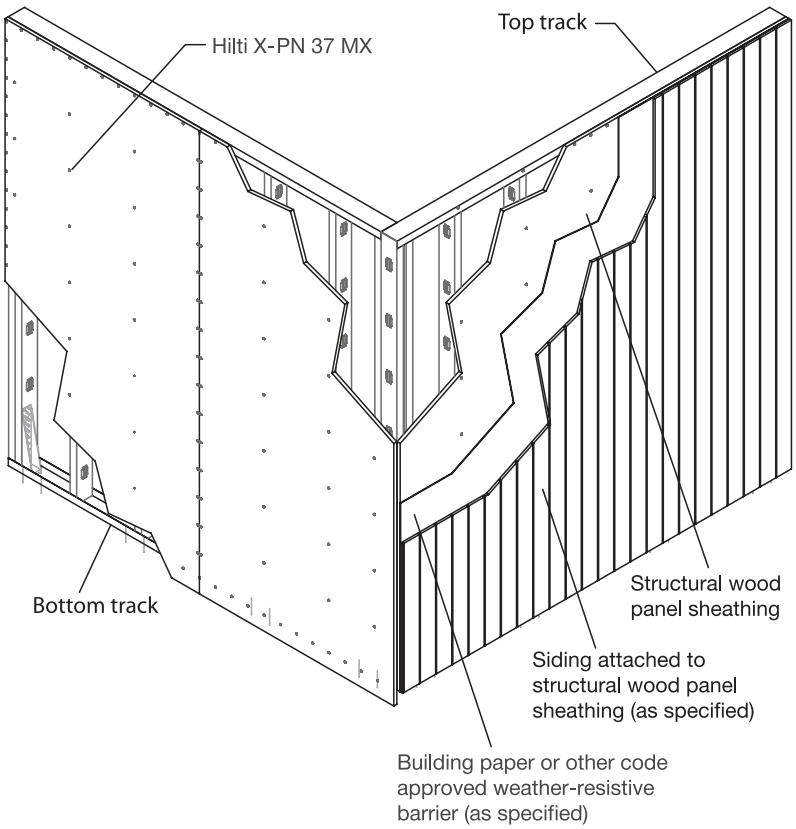


Figure 3: Typical shear wall assembly with cold-formed steel framing and structural wood panel sheathing attached with Hilti X-PN 37 MX Fasteners

3.2.8.2 Material specifications

Fastener designation	Fastener material	Fastener plating	Structural wood panels	Base material
X-PN 37 G2 MX X-PN 37 G3 MX X-PN 37 B4 MX	Carbon Steel	5 µm Zinc[1]	Exposure 1, structural 1 ply-wood complying with DOC PS-1 or oriented strand board (OSB) complying with DOC PS-2 for exposure 1	27-68 mils (0.0283-0.0713 inch) ASTM A1003 or ASTM A653 CFS Member

1 ASTM B633, SC1, Type III. Refer to Section 2.3.3.1 for more information.

3.2.8.3 SHEAR WALL DESIGN AND THEORY

3.2.8.3.1 Shear wall terminology and definitions

Shear wall terminology

AISI - American Iron and Steel Institute

AISI S240 -20 - North American Standard for Cold-Formed Steel Structural Framing

APA - American Plywood Association

CFS - Cold-Formed Steel

PN - Hilti fastener type used for attaching wood structural panel sheathing to cold-formed steel framing. The fasteners are installed using Hilti gas- and battery-actuated tools.

BX - Hilti Battery-Actuated Direct Fastening Systems

GX - Hilti Gas-Actuated Direct Fastening Systems

ICC-ES - International Code Council - Evaluation Service

Shear wall definitions

Cold-formed steel (cfs) structural member - Steel shape manufactured by press-braking blanks sheared from sheets, cut lengths of coils or plates, or by roll forming cold- or hot-rolled coils or sheets; both forming operations being performed at ambient room temperature, that is, without addition of heat, such as would be required for hot rolling.

Cold-formed steel (CFS) studs - Interior framing members. CFS framing studs are C-shaped steel members with a minimum thickness of 33 mils, minimum flange width of 1-5/8" (41.3 mm), a minimum web depth of 3-1/2" (89 mm) and a minimum edge stiffener length of 3/8" (9.5 mm).

Cold-formed steel (CFS) tracks - A U-shaped CFS track designed to accept a CFS stud member with a minimum thickness of 33-mils and a minimum flange width of 1-1/4" (31.8 mm) and a minimum web depth the same as the CFS stud members.

Exposure 1 - Panels that have full water-proof bond that will allow the panels to resist some corrosion effects on the jobsite until fully protected.

Fastener pattern - The spacing of fasteners along the perimeter and interior segments of the shear wall.

Hold-down connector - A device used to resist overturning of shear wall assemblies.

Lateral load - Fastener performance in shear.

Mils - A measure of thickness for CFS members. Reference Table 1 on page 54 for common CFS thickness designations.

OSB (Oriented Strand Board) - A mat-formed wood structural panel comprised of thin rectangular wood strands arranged in cross-aligned layers with surface layers normally arranged in the long panel direction and bonded with water proof adhesive.

Plywood - A wood structural panel comprised of plies of wood veneer arranged in cross-aligned layers. The plies are bonded with waterproof adhesive that cures on application of heat and pressure.

Self-drilling screws - Screws that are used to connect CFS members together and to attach hold-downs to CFS framing. Screws must be a minimum #8 Hilti self-drilling tapping screw recognized in ICC-ES ESR-2196.

Shear wall - Wall that provides resistance to lateral loads in the plane of the wall and provides stability for the structure.

Sill fasteners - Attachments to connect steel stud track members to concrete base material.

Structural 1 rated sheathing - An APA Rated Sheathing where the racking and cross sectional properties are higher for improved performance in demanding applications such as shear walls and diaphragms.

Transverse load - Fastener performance in direct tension (fastener pullout or pull-through).

Type I shear wall - A fully sheathed shear wall with hold-down anchors at each end of the wall segment. Type I shear walls are permitted to have openings, between hold-down anchors at each end of a wall segment, where details are provided to account for force transfer around openings.

Wood structural panels - A panel manufactured from veneers, wood strands or wafers or a combination of veneer and wood strands or wafers bonded together with waterproof synthetic resins or other suitable bonding systems.

3.2.8.3.2 General discussion

According to the International Building Code (IBC), a shear wall is a lateral force resisting structural system that provides resistance to wind, seismic and other lateral forces and provides stability to the overall structure. It is a structural assembly that can be modeled as a vertical cantilevered beam. A shear wall may be constructed using several methods. One common way of building shear walls is using CFS framing members covered with wood structural panels. An example of a CFS framed shear wall assembly is shown in Figure 3. Wood structural panels are attached to the CFS framing members with fastening systems that have been properly evaluated for this application.

Design of shear walls has traditionally been done using the available tables in AISI S240, which are based on full-scale shear wall testing. ICC-ES and the IBC allow for development of an analytical method based on the principles of mechanics to be used for the design of CFS framed wood structural panel sheathed shear walls. ICC-ES recognizes full-scale test analysis as an acceptable design approach in AC230 Acceptance Criteria for Power-Driven Pins for Shear Wall Assemblies with Cold-Formed Steel Framing and Wood Structural Panels. Shear wall analytical models are based on fastener shear connection data using the following parameters:

1. CFS member type and thickness
2. Wood structural panel type and thickness
3. Fastener spacing in the field and along the perimeter

3.2.8.3.3 Fastener test programs

Many ICC-ES small element connection tests and full-scale static and cyclic / simulated seismic load test programs have been conducted using Hilti X-PN 37 MX fasteners to determine the shear wall system performance.

1. Small element connection tests

Small element connection tests are conducted to determine fastener transverse strength (pullout or pull-through) and lateral strength (shear) with structural wood panels and CFS sections representative of typical shear wall construction. The data is analyzed and used in a predictive model to calculate the performance of the larger shear wall assemblies. These tests are conducted in accordance with following standards and shown in Figures 4 and 5.

- ICC-ES AC230 Acceptance Criteria for Power-Driven Pins for Shear Wall Assemblies with Cold-Formed Steel Framing and Wood Structural Panels
- ASTM E1190 Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members
- ASTM D1761 Standard Test Methods for Mechanical Fasteners in Wood

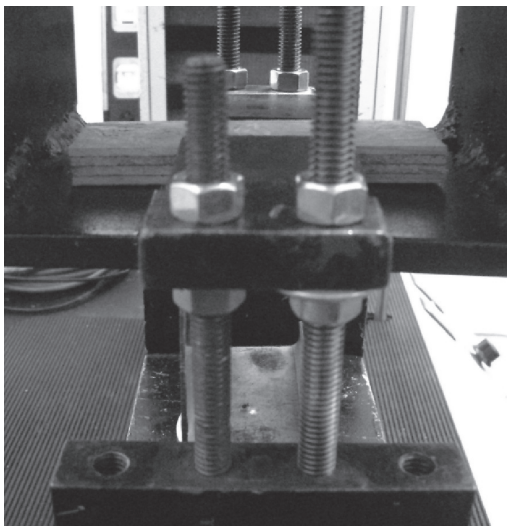


Figure 4: Small element transverse strength (pullout, pull-through) tests

Figure 5: Small element lateral strength (shear) tests

2. Full-scale shear wall assembly tests

Full-scale shear wall assembly tests are conducted to determine the strength and deflection of a larger shear wall assembly (Figure 6 and Figure 7). The data is analyzed and fit in a predictive analytical model to address varying configurations of cold-formed steel, wood thickness, specific fastener combinations and framing spans. See Figure 8 for a representative First Cycle Envelope Curve from a full-scale cyclic / simulated seismic shear wall assembly test. These tests are conducted in accordance with the following standards:

- ICC-ES AC230 Acceptance Criteria for Power-Driven Pins for Shear Wall Assemblies with Cold-Formed Steel Framing and Wood Structural Panels
- ASTM E2126 Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings, ASTM International
- CUREE Consortium of Universities for Research in Earthquake Engineering Basic Loading Protocol

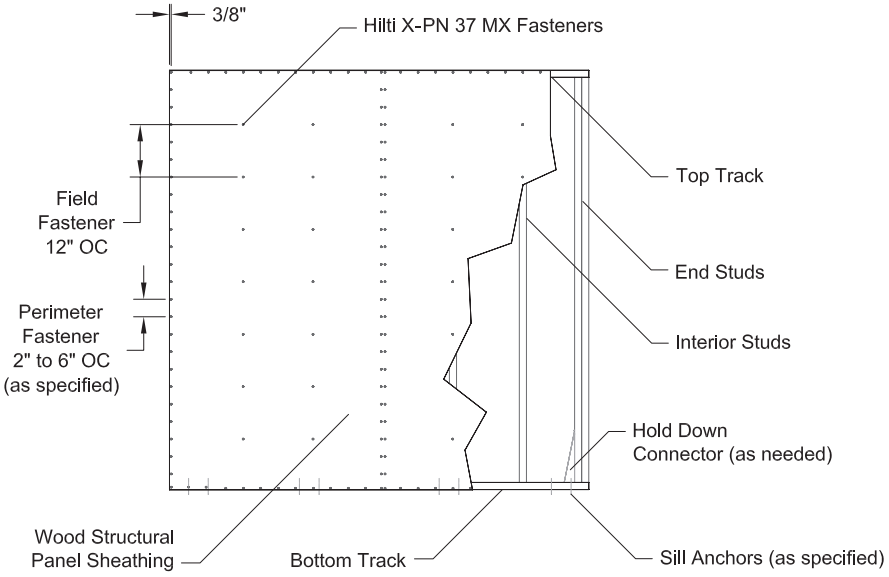


Figure 6: Shear wall assembly with CFS framing and structural wood panel sheathing

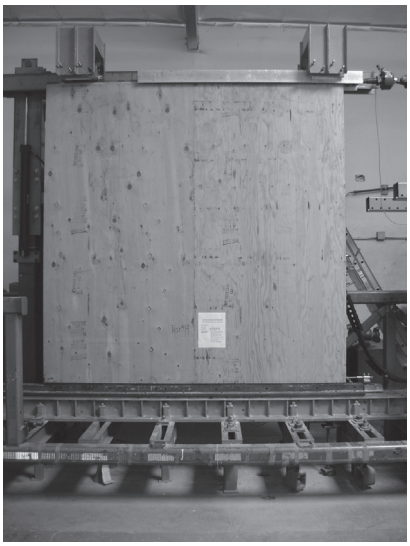


Figure 7: Full-scale shear wall cyclic / simulated seismic load test

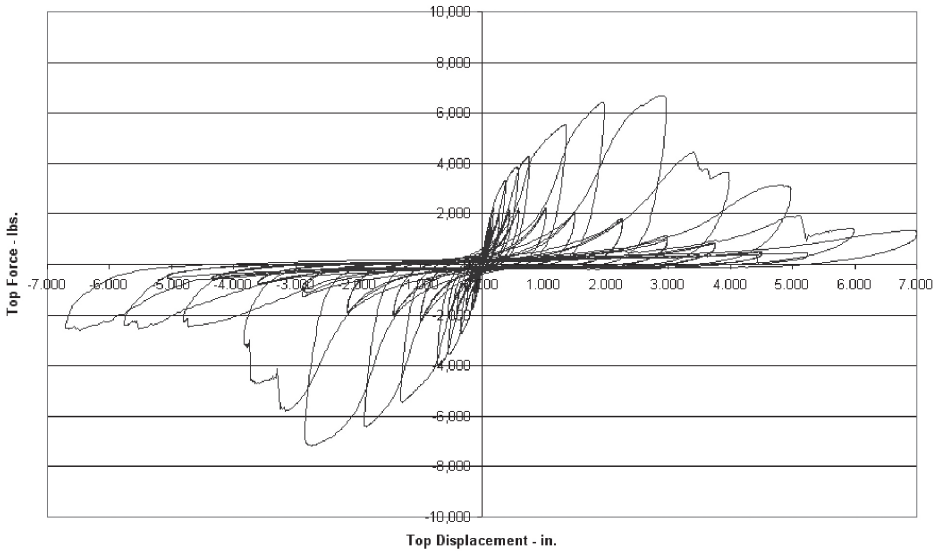


Figure 8: First cycle envelope curve from cyclic / simulated seismic load test

3.2.8.4 TECHNICAL DATA

An extensive ICC-ES AC230 independent laboratory test program was conducted to confirm the static and cyclic / simulated seismic performance of shear wall assemblies composed of CFS framing and wood structural panel sheathing attached with Hilti X-PN 37 MX power-driven fasteners. The program test scope consisted of static and cyclic / simulated seismic full-scale shear wall assembly tests, as well as comparative small element lateral strength (shear) tests and transverse strength (pullout and pull-through) tests conducted as discussed in Section 3.2.8.3.3. The resulting design data is published below and in ICC-ES ESR-3059.

The equivalent dimensions for CFS base material thicknesses are given in Table 1. Allowable transverse (pullout or pull-through) loads and allowable lateral (shear) loads are presented in Tables 2 and 3, respectively. For material thicknesses not listed, the load data corresponding to the next thinner base material may be used. The shear wall load data is presented in Table 4 for Type I shear wall assemblies.

Table 1 — Steel thickness and equivalent dimensions[2]

Minimum thickness[1], Mils	Nominal design thickness, in. (mm)	Gauge
68	**0.0713** (1.811)	14
54	**0.0566** (1.438)	16
43	**0.0451** (1.146)	18
33	**0.0346** (0.879)	20
27	**0.0283** (0.719)	22

1 Minimum Thickness represents 95% of the design thickness and is the minimum acceptable thickness delivered to the jobsite.
2 Steel thickness equivalents are taken from Steel Stud Manufacturers Association (SSMA) Product Technical Information.

Table 2 — Allowable transverse loads for connections of structural wood panels to CFS framing using Hilti X-PN 37 G2/G3/B4 MX Power-Driven Fasteners, lb (N)[3,4,5,7]

Nominal panel thickness, in. (mm)	Pull-through capacity[1,6]	Pullout capacity[2] CFS framing thickness designation, Mils (gauge)				
		27 (22)	**33** (20)	**43** (18)	**54** (16)	**68** (14)
3/8 (9.5)	**57** (253)	**17** (75)	**21** (93)	**55** (245)	**93** (414)	**93** (414)
15/32 (12)	**87** (387)	**21** (93)	**21** (93)	**55** (245)	**112** (498)	**112** (498)
19/32 (15)	**87** (387)	**21** (93)	**21** (93)	**55** (245)	**112** (498)	**112** (498)

1 The safety factor for pull-through capacity is 5.0 in accordance with ICC-ES AC230.
2 Safety factors for pullout capacity determined in accordance with AISI S100.
3 The lower of allowable pull-through capacity and pullout capacity must be used for design.
4 Panel thicknesses shown are minimums. Thicker panels, up to 3/4" (19 mm) thick, may be used.
5 Allowable transverse loads are based on a minimum panel edge distance of 3/8" (9.5 mm).
6 The tabulated values are for plywood. For connections of OSB having thicknesses equal to or greater than to those noted in the table, the allowable pull-through capacity is equal to the applicable value from the table multiplied by 0.915.
7 Multiple fasteners are recommended for any attachment.

Table 3 — Allowable lateral loads for connections of structural wood panels to CFS framing using Hilti X-PN 37 G2/G3/B4 MX Power-Driven Fasteners, lb (N)[1,2,3,4,5]

Nominal panel thickness, in. (mm)	Minimum thickness of CFS framing, Mils (gauge)				
	27 (22)	**33** (20)	**43** (18)	**54** (16)	**68** (14)
3/8 (9.5)	**68** (302)	**88** (391)	**128** (569)	**128** (569)	**155** (689)
15/32 (12)	**68** (302)	**88** (391)	**138** (614)	**155** (689)	**155** (689)
19/32 (15)	**68** (302)	**88** (391)	**150** (667)	**193** (859)	**193** (859)

1 Safety factors determined in accordance with AISI S100.
2 Panel thicknesses shown are minimums. Thicker panels, up to 3/4" (19 mm) thick, may be used.
3 Allowable shear loads are based on a minimum panel edge distance of 3/8" (9.5 mm) and a minimum plywood end distance in the direction of loading of 1" (25.4 mm).
4 The tabulated values are for plywood. For connections of OSB having thicknesses equal to or greater than those noted in the table, the allowable lateral capacity is equal to the applicable value from the table multiplied by 0.915.
5 Multiple fasteners are recommended for any attachment.

Table 4 – Nominal shear resistance to seismic and wind loads for type i shear wall assemblies constructed with Hilti X-PN 37 G2/G3/B4 MX Power-Driven Fasteners, plf (N/mm)[1,2,3,4,5,6,9,10]

Minimum CFS framing thickness designation, Mils (Gauge)	Wood structural panel thickness, in. (mm)[7,8]	Maximum stud spacing, in. (mm)	Fastener spacing at panel edges, in. (mm)			
			6 (152)	4 (102)	3 (76)	2 (51)
33 (20)	3/8 (9.5)	24 (610)	395 (58)	540 (79)	650 (95)	765 (112)
		16 (406)	475 (69)	655 (96)	805 (117)	1000 (146)
	15/32 (12)	24 (610)	395 (58)	540 (79)	650 (95)	765 (112)
		16 (406)	475 (69)	655 (96)	805 (117)	1000 (146)
	19/32 (15) & 23/32 (18)	24 (610)	395 (58)	540 (79)	650 (95)	765 (112)
		16 (406)	475 (69)	655 (96)	805 (117)	1000 (146)
43 (18)	3/8 (9.5)	24 (610)	400 (58)	545 (80)	655 (96)	775 (113)
		16 (406)	475 (69)	665 (97)	815 (119)	1010 (147)
	15/32 (12)	24 (610)	435 (63)	600 (88)	720 (105)	850 (124)
		16 (406)	525 (77)	725 (106)	890 (130)	1105 (161)
	19/32 (15) & 23/32 (18)	24 (610)	485 (71)	660 (96)	795 (116)	935 (136)
		16 (406)	580 (85)	805 (117)	985 (144)	1225 (179)
54 (16)	3/8 (9.5)	24 (610)	610 (89)	830 (121)	1000 (146)	1180 (172)
		16 (406)	730 (107)	1010 (147)	1240 (181)	1540 (225)
	15/32 (12)	24 (610)	710 (104)	975 (142)	1170 (171)	1380 (201)
		16 (406)	850 (124)	1185 (173)	1450 (212)	1800 (263)
	19/32 (15) & 23/32 (18)	24 (610)	835 (122)	1140 (166)	1370 (200)	1615 (236)
		16 (406)	995 (145)	1385 (202)	1700 (248)	2110 (308)

1 For Allowable Stress Design (ASD), the nominal shear resistance values listed in this table should be divided by a safety factor Ω of 2.0 for wind loads and 2.5 for seismic loads per AISI S213.
2 For Load and Resistance Factor Design (LRFD), the nominal shear resistance values listed in this table must be multiplied by a resistance factor Φ of 0.60 for seismic loads and 0.65 for wind loads. For Limit States Design (LSD), the nominal shear resistance values listed in this table must be multiplied by a resistance factor Φ of 0.70 for seismic and wind loads per AISI S213.
3 Tabulated values are applicable for seismic and wind loads. For other in-plane lateral loads of normal or permanent load duration as defined in AF&PA NDS, the values in the table must be multiplied by 0.63 (normal) or 0.56 (permanent).
4 The minimum distance from the fastener to the wood structural panel edge must be 3/8" (9.5 mm).
5 Fastener spacing must be a maximum of 12" (294 mm) on center in the field of the wood structural panel.
6 Hold-downs, end posts and sill fasteners must be designed to resist the required lateral loads.
7 Panel thicknesses shown are minimums. Thicker panels, up to 3/4" (19 mm) thick, may be used.
8 Tabulated values are for plywood panels. For shear wall assemblies constructed with OSB having thicknesses equal to or greater than those noted in the table, the nominal shear resistance is equal to the applicable value in the table multiplied by 0.915.
9 Tabulated design data for use in all Seismic Design Categories A-F.
10 Type I shear wall assemblies are limited to a height-width aspect ratio of 2:1.

Deflection

Deflection of Type I shear walls fastened with Hilti X-PN 37 MX power-driven fasteners, as described in this supplement, due to the applied shear loads may be calculated using the following equations, as applicable:

$$\delta = \frac{8vh^3}{E_s A_c b} + \omega_1\omega_2\frac{vh}{\rho G t_{sheathing}} + \omega_1^{9/4}\omega_2\omega_3\omega_4\left(\frac{v}{\beta}\right)^2 + \frac{h}{b}\delta_v \text{ , in.}$$

For SI:

$$\delta = \frac{2vh^3}{3E_s A_c b} + \omega_1\omega_2\frac{vh}{\rho G t_{sheathing}} + \omega_1^{9/4}\omega_2\omega_3\omega_4\left(\frac{v}{0.00290\beta}\right)^2 + \frac{h}{b}\delta_v \text{ , mm}$$

Variables and constants in the equations are as defined in Section C2.1.1 of AISI S213. Values for G*$t_{sheathing}$ are typically taken from IBC Table 2305.2(2).

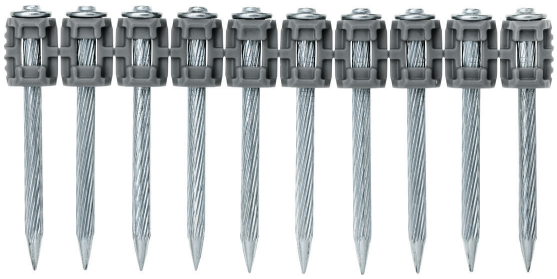
3.2.8.5 ORDERING INFORMATION

Power driven fasteners:

Fastener description	Shank length in. (mm)	Shank Ø in. (mm)	Guidance washer Ø
X-PN 37 G2 MX X- PN 37 G3 MX X-PN 37 B4 MX	**1-1/2** (37)	**0.102** (2.60)	8 mm

Hilti GX 3 Gas-Actuated Fastening Tool

Hilti GC 41 Gas Canister for GX 3



Hilti X-PN 37 G3 MX Fasteners

Hilti GX 2 Gas-Actuated Fastening System

Hilti GC 52 Gas Canister for GX 2

Hilti X-PN 37 G2 MX Fasteners

Hilti BX 4 Cordless Fastening Tool

Hilti 22V Nuron Battery

Hilti X-PN 37 B4 MX Fasteners

3.2.9 DRYWALL TRACK FASTENING SYSTEMS

3.2.9.1 PRODUCT DESCRIPTION

Hilti offers powder, gas and electro-mechanical (battery) actuated systems for attaching drywall track to concrete or steel. Powder-actuated fastening systems typically have more power than gas or battery actuated systems allowing for higher application limits with various base materials. Powder-actuated fasteners range in length from 1/2” to 2-1/2” for a wide variety of applications such as drywall track attachment. Gas and battery actuated systems are focused on high volume repetitive fastenings such as drywall track to standard strength concrete or steel (1/2” to 1-5/8” fastener length).

Product features

Powder-actuated fasteners:

- Shank diameters* of 0.138”, 0.145” or 0.157” are available providing a variety of solutions depending on application requirements.
- Knurled shank fasteners available for steel applications.
- Full range of fasteners either collated or in single fastener configurations to maximize productivity.

Gas and electro-mechanical actuated fasteners:

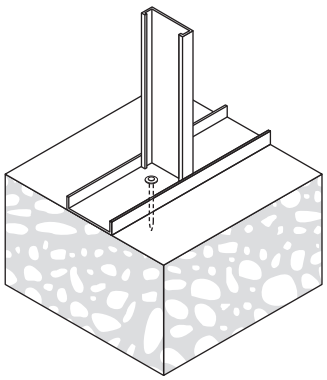
- Shank diameter of 0.101’’, 0.108’’ or 0.118’’ provides ease of penetration in concrete and steel.
- Collated fastener offering for high productivity in high volume applications.
- Ideally suited for interior (drywall track), non-load bearing, nonstructural framing applications in concrete or steel.

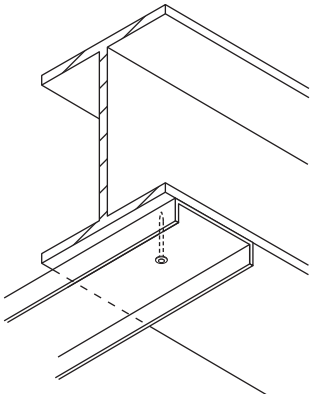
Collated track fasteners for concrete

Collated track fasteners for steel

Track Fastener with Metal “Top Hat" Washer

Track Fastener with Plastic “Top Hat" Washer





Listings/Approvals

ICC-ES (International Code Council)
ESR-2269 with LABC/LARC Supplement (X-U and X-U 15)
ESR 1752 with LABC/LARC Supplement (X-S 13, X-S16, X-C 22 P8TH, X-C 20 THP and Hilti Gas- & Battery-Actuated Fasteners)
ESR-1663 with LABC/LARC Supplement (X-C, X-C 22 P8TH and X-C 20 THP)

* X-U Universal Powder-Actuated fasteners with 0.157“ shank diameter are also available for drywall track fastening and are discussed in more detail in Sections 3.2.6.

3.2.9.2 MATERIAL SPECIFICATIONS

Fastener designation	Fastener material	Fastener plating	Base material	Powder, gas or electro-mechanical actuated
X-S13 THP	Carbon Steel	5 µm Zinc[1]	Steel	Powder-Actuated
X-S16 P8TH	Carbon Steel	5 µm Zinc[1]	Steel	Powder-Actuated
X-U 15	Carbon Steel	5 µm Zinc1	Steel	Powder-Actuated
X-C	Carbon Steel	5 µm Zinc[1]	Concrete or Masonry	Powder-Actuated
X-C 39 G2	Carbon Steel	5 µm Zinc[1]	Concrete or Masonry	Gas-Actuated
X-C 39 G3	Carbon Steel	5 µm Zinc[1]	Concrete or Masonry	Gas-Actuated
X-S 14 G2	Carbon Steel	8-to-16 µm Zinc	Steel	Gas-Actuated
X-S 14 G3	Carbon Steel	2-to-10 µm Zinc	Steel	Gas-Actuated
X-C G2	Carbon Steel	2-to-10 µm Zinc	Concrete or Masonry	Gas-Actuated
X-C G3	Carbon Steel	5 µm Zinc[1]	Concrete or Masonry	Gas-Actuated
X-P G2	Carbon Steel	2-to-10 µm Zinc	High-Strength Concrete or Steel	Gas-Actuated
X-P G3	Carbon Steel	2-to-10 µm Zinc	High-Strength Concrete or Steel	Gas-Actuated
X-C 36 B3	Carbon Steel	2-to-10 µm Zinc	Concrete or Masonry	Electro-mechanical-Actuated
X-C 39 B4	Carbon Steel	2-to-10 µm Zinc	Concrete or Masonry	Electro-mechanical-Actuated
X-S14 B3	Carbon Steel	2-to-10 µm Zinc	Steel	Electro-mechanical-Actuated
X-S 14 B4	Carbon Steel	2-to-10 µm Zinc	Steel	Electro-mechanical-Actuated
X-C B3	Carbon Steel	5 µm Zinc[1]	Concrete or Masonry	Electro-mechanical-Actuated
X-C B4	Carbon Steel	5 µm Zinc[1]	Concrete or Masonry	Electro-mechanical-Actuated
X-P B3	Carbon Steel	2-to-10 µm Zinc	High-Strength Concrete or Steel	Electro-mechanical-Actuated
X-P B4	Carbon Steel	2-to-10 µm Zinc	High-Strength Concrete or Steel	Electro-mechanical-Actuated

1 ASTM B633, SC 1, Type III. Refer to Section 2.3.3.1 for more information.

3.2.9.3 TECHNICAL DATA

Allowable loads in normalweight concrete[1,2]

Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Concrete compressive strength					
			2000 psi		4000 psi		6000 psi	
			Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
X-C 22 P8TH	0.138 (3.5)	3/4 (19.0)	55 (0.24)	130 (0.58)	90 (0.40)	170 (0.76)	100 (0.44)	200 (0.89)
X-C G2 (except X-C 39 G2) X-C 36 B3 X-C 39 B4	0.108 (2.75)	3/4 (19.0)	60 (0.27)	90 (0.40)	60 (0.27)	90 (0.40)	-	-
X-C G3 X-C B3 X-C B4 (Except 36- & 39-mm lengths)	0.118 (3.0)	3/4 (19.0)	60 (0.27)	90 (0.40)	60 (0.27)	90 (0.40)	-	-
X-C 39 G2 X-C 39 G3	0.101 (2.6)	5/8 (16.0)	50 (0.22)	80 (0.36)	50 (0.22)	80 (0.36)	-	-
X-P G2 X-P G3 X-P B3 X-P B4	0.118 (3.0)	5/8 (16.0)	50 (0.22)	90 (0.40)	50 (0.22)	120 (0.53)	50 (0.22)	90 (0.40)
		3/4 (19.0)	80 (0.36)	120 (0.53)	50 (0.22)	120 (0.53)	50 (0.22)	90 (0.40)

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 Multiple fasteners are recommended for any attachment.

Allowable loads in minimum f'_c = 3000 psi structural lightweight concrete[1,3]

Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Allowable loads lb (kN)						Minimum required concrete thickness above deck panel in.
Fastener location:			Installed into concrete		Installed through steel deck panel into concrete[2]				
					Upper flute	Lower flute	Upper flute	Lower flute	
Load direction:			Tension	Shear	Tension		Shear		
X-C20 THP	0.138 (3.5)	5/8 (16)	55 (0.24)	110 (0.49)	-	45 (0.20)	285 (1.27)	285 (1.27)	3-1/4
X-C22P8TH	0.138 (3.5)	3/4 (19)	120 (0.53)	220 (0.98)	120 (0.53)	95 (0.42)	260 (1.16)	260 (1.16)	3-1/4
X-C G2 (except X-C 39 G2) X-C 36 B3 X-C 39 B4	0.108 (2.75)	3/4 (19)	110 (0.49)	140 (0.62)	75 (0.33)	85 (0.38)	175 (0.78)	215 (0.96)	2-1/2
		1 (25)	170 (0.76)	220 (0.98)	155 (0.69)	160 (0.71)	255 (1.13)	315 (1.40)	3
X-C G3 X-C B3 X-C B4 (except 36- & 39-mm lengths)	0.118 (3.0)	3/4 (19)	115 (0.51)	140 (0.62)	75 (0.33)	85 (0.38)	175 (0.78)	215 (0.96)	2-1/2
		1 (25)	170 (0.76)	220 (0.98)	155 (0.69)	160 (0.71)	255 (1.13)	315 (1.40)	3-1/4
X-P G2 X-P G3 X-P B3 X-P B4	0.118 (3.0)	5/8 (16)	60 (0.27)	140 (0.62)	60 (0.27)	60 (0.27)	175 (0.78)	215 (0.96)	2-1/2

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 The steel deck profile is 3" deep composite floor deck with a thickness of 20 gauge (0.0358"). Figure 1 (Section 3.2.1.6) shows the nominal flute dimensions, fastener locations, and load orientations for the deck profile.
3 Multiple fasteners are recommended for any attachment.

Allowable loads in minimum f'_c = 3000 psi structural lightweight concrete over 1-1/2" deep, B-type steel deck[1,3]

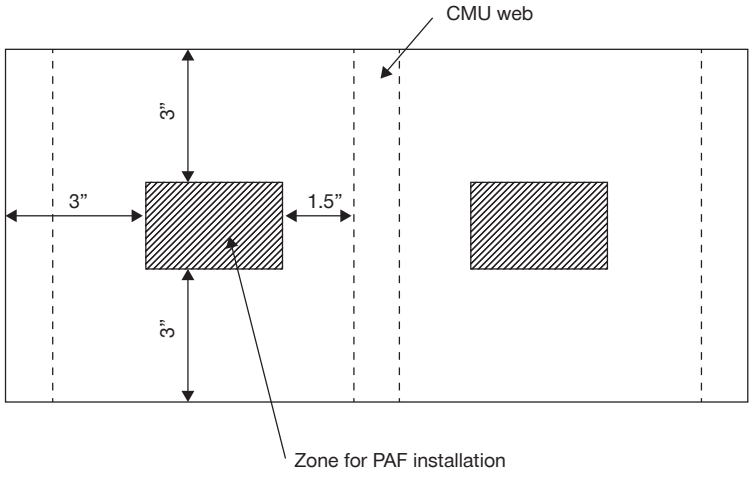
Fastener[4]	Shank diameter* in. (mm)	Minimum embedment in. (mm)	Allowable loads lb (kN)				Minimum required concrete thickness above deck panel in.
Fastener location:			Installed through steel deck panel into concrete[2]				
			Upper flute	Lower flute	Upper flute	Lower flute	
Load direction:			Tension		Shear		
X-C22P8TH	0.138 (3.5)	3/4 (19)	90 (0.40)	110 (0.49)	295 (1.31)	295 (1.31)	2-1/2
X-C G2	0.108 (2.75)	3/4 (19)	75 (0.33)	85 (0.38)	175 (0.78)	215 (0.96)	2-1/2
		1 (25)	155 (0.96)	160 (0.71)	255 (1.13)	270 (1.20)	3-1/4
X-C G3 X-C B3 X-C B4 (except 36- & 39-mm lengths)	0.118 (3.0)	3/4 (19)	75 (0.33)	85 (0.38)	175 (0.78)	215 (0.96)	2-1/2
		1 (25)	155 (0.96)	160 (0.71)	255 (1.13)	315 (1.40)	3-1/4
X-P G2 X-P G3 X-P B3 X-P B4	0.118 (3.0)	5/8 (16)	60 (0.27)	60 (0.27)	175 (0.78)	215 (0.96)	2-1/2

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 Steel deck profiles are 1-1/2" deep, B-type deck with a thickness of 20 gauge (0.0358"). Fasteners may be installed through the metal deck into lightweight concrete having both nominal and inverted deck profile orientations with a minimum lower flute width of 1-3/4" or 3-1/2", respectively. Fasteners shall be placed at centerline of deck flutes. Refer to Figures 2 and 3 (Section 3.2.1.6) for additional flute dimensions, fastener locations, and load orientations for both deck orientations.
3 Multiple fasteners are recommended for any attachment.
4 X-U Universal Powder-Actuated fasteners and X-P high performance Powder-Actuated fasteners for concrete base materials with 0.157" shank diameters are also available for drywall track fastening and are discussed in more detail in Section 3.2.6.

Allowable loads in concrete masonry units[1,2,3,4,5,7,10]

Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	CMU type, mortar type	Allowable loads lb (kN)									
Masonry type:				Hollow CMU				Grout filled CMU					
Fastener location:				Face shell[6]		Mortar joint		Face shell[6]		Mortar joint		Top of grouted cell[8]	
Load direction:				Tension	Shear[9]	Tension	Shear[7]	Tension	Shear[9]	Tension	Shear[7]	Tension	Shear[9]
X-C G2 (except for X-C 39 G2) X-C 36 B3 X-C 39 B4	0.108 (2.75)	3/4 (19.0)	Normal weight, Type N minimum	75 (0.33)	140 (0.62)	60 (0.27)	80 (0.36)	100 (0.44)	170 (0.76)	100 (0.44)	160 (0.71)	80 (0.36)	130 (0.58)
				110 (0.49)	190 (0.85)	70 (0.31)	145 (0.64)	135 (0.60)	195 (0.87)	125 (0.56)	165 (0.73)	110 (0.49)	145 (0.64)
X-C 39 G2 X-C 39 G3	0.101 (2.6)	5/8 (16.0)	Normal weight, Type N minimum	60 (0.27)	110 (0.49)	45 (0.20)	65 (0.29)	85 (0.38)	110 (0.49)	55 (0.24)	105 (0.47)	-	-
X-C G3 X-C B3 X-C B4 (except 36- & 39-mm lengths)	0.118 (3.0)	3/4 (19.0)	Normal weight, Type N minimum	145 (0.64)	190 (0.85)	80 (0.36)	80 (0.36)	155 (0.69)	195 (0.87)	110 (0.49)	135 (0.60)	105 (0.47)	145 (0.64)
		1 (25)	Normal weight, Type S minimum	185 (0.82)	205 (0.91)	105 (0.47)	105 (0.47)	205 (0.91)	215 (0.96)	135 (0.60)	190 (0.85)	120 (0.53)	150 (0.67)
X-P G2 X-P G3 X-P B3 X-P B4	0.118 (3.0)	5/8 (16.0)	Normal weight, Type S minimum	40 (0.18)	80 (0.36)	15 (0.07)	40 (0.18)	90 (0.40)	100 (0.44)	40 (0.18)	80 (0.36)	60 (0.27)	85 (0.38)

1 The tabulated allowable load values are for the low-velocity fastener only, using a safety factor of 5.0 or higher calculated in accordance with ICC-ES AC70. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 The tabulated allowable load values are for low-velocity fasteners installed in normal weight or lightweight concrete masonry units conforming to ASTM C90.
3 The tabulated allowable load values are for low-velocity fasteners installed in concrete masonry units with mortar conforming to ASTM C270, Type N.
4 The tabulated allowable load values are for low-velocity fasteners installed in concrete masonry units with grout conforming to ASTM C476, as coarse grout.
5 The tabulated allowable load values are for one low-velocity fastener installed in an individual masonry unit cell and at least 8" from the edge of the wall. Unless otherwise noted, multiple fasteners in a bed joint must be spaced a minimum of 8 inches.
6 Applicable placement zone of fastener located on the face shell is shown in the figure to the right.
7 Shear direction can be horizontal or vertical (Bed Joint or T-Joint) along the CMU wall plane.
8 Fastener located in center of grouted cell installed vertically.
9 Shear can be in any direction.
10 Multiple fasteners are recommended for any attachment.



Allowable loads for fasteners driven into steel[1,2,3,4,9,11,12]

Fastener	Shank diameter in. (mm)	Allowable loads lb (kN)											
Steel thickness (inch):		1/8		3/16		1/4		3/8		1/2		3/4	
Load direction:		Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear
X-S13 THP	0.145 (3.7)	140[10] (0.62)	300 (1.33)	300[10] (1.33)	450 (2.00)	300[10] (1.33)	450 (2.00)	300[10] (1.33)	450 (2.00)	-	-	-	-
X-S16P8TH[13]	0.145 (3.7)	-	-	315 (1.40)	480 (2.14)	315 (1.40)	480 (2.14)	315 (1.40)	530 (2.36)	315 (1.40)	480 (2.14)	-	-
X-U 15	0.145 (3.7)	-	-	155 (0.69)	395 (1.76)	230 (1.02)	395 (1.76)	420 (1.87)	450 (2.00)	365[7] (1.62)	500[7] (2.22)	365[7] (1.62)	400[7] (1.78)
X-S 14 G3 X-S 14 B3 X-S 14 B4	0.118 (3.0)	140 (0.62)	230 (1.02)	220 (0.98)	245 (1.09)	225 (1.00)	290 (1.29)	280 (1.25)	330 (1.47)	280 (1.25)	330 (1.47)	280 (1.25)	330 (1.47)
X-S 14 G3[5, 6] X-S 14 B3[5, 6] X-S 14 B4[5, 6]	0.118 (3.0)	-	-	220 (0.98)	295 (1.31)	260 (1.16)	355 (1.58)	280 (1.25)	385 (1.71)	280 (1.25)	385 (1.71)	280 (1.25)	385 (1.71)
X-P G3 X-P B3 X-P B4	0.118 (3.0)	125[10] (0.56)	230 (1.02)	170[10] (0.76)	245 (1.09)	200[10] (0.89)	230 (1.02)	250[10] (1.11)	255 (1.13)	-	-	-	-
X-P G2	0.118 (3.0)	-	-	140 (0.62)	220 (0.98)	180 (0.80)	200 (0.89)	225 (1.00)	220 (0.98)	-	-	-	-
X-S 14 G2	0.118 (3.0)	-	-	-	-	215 (0.96)	290 (1.29)	150[8] (0.67)	195[8] (0.87)	130[8] (0.58)	150[8] (0.67)	130[8] (0.58)	150[8] (0.67)

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Wood or steel members connected to the substrate must be in investigated in accordance with accepted design criteria.
2 Unless otherwise noted, allowable loads are applicable to static and seismic loads in accordance with Annex A of ICC-ES AC70.
3 Low-velocity fasteners shall be driven to where the point of the fastener penetrates through the steel base material in accordance with Section 3.2.2.3, except as noted in this table.
4 Unless otherwise noted, steel base material must have minimum yield and tensile strengths (F_y and F_u) equal to 36 ksi and 58 ksi, respectively.
5 Steel base material must have minimum yield and tensile strengths (F_y and F_u) equal to 50 ksi and 65 ksi, respectively.
6 Fasteners installed into 3/8" or thicker base steel require 0.320" minimum penetration depth.
7 Based upon minimum penetration depth into the steel of 15/32".
8 Based upon minimum penetration depth into the steel of 1/4".
9 Refer to guidelines for fastening to steel, Section 3.2.2, for application limits.
10 For steel-to-steel connections designed in accordance with Section J5 of AISI S100, the tabulated allowable load may be increased by a factor of 1.25.
11 Refer to guidelines for fastening to steel, Section 3.2.2, for application limits.
12 Multiple fasteners are recommended for any attachment.
13 Published values may vary from values in ICC-ESR

Allowable tensile pullover and shear bearing load capacities for steel framing with power-driven fasteners[1,2,3,4]

Fastener	Shank diameter in. (mm)	Head diameter in. (mm)	Sheet steel thickness lb (kN)													
			14 ga.		16 ga.		18ga.		20 ga.		22 ga.		24 ga.		25/26 ga.	
			Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear
X-C G3 X-C B3 X-C B4 X-S 14 G3 X-S 14 B3 X-S 14 B4 X-P G3 X-P B3 X-P B4	0.118 (3.0)	0.276 (7.0)	-	-	-	-	325 (1.45)	390 (1.73)	265 (1.18)	335 (1.49)	250 (1.11)	235 (1.05)	170 (0.76)	185 (0.82)	100 (0.44)	125 (0.56)
X-C 22 P8TH X-C 20 THP	0.138 (3.5)	0.322 (8.2)	-	860 (3.83)	685 (3.05)	715 (3.18)	490 (2.18)	465 (2.07)	360 (1.60)	375 (1.67)	300 (1.33)	265 (1.18)	205 (0.91)	200 (0.89)	120 (0.53)	130 (0.58)
X-S13 THP	0.145 (3.7)	0.322 (8.2)	-	985 (4.38)	685 (3.05)	720 (3.20)	490 (2.18)	515 (2.29)	360 (1.60)	440 (1.96)	300 (1.33)	310 (1.38)	205 (0.91)	235 (1.05)	120 (0.53)	145 (0.64)
X-S16P8TH X-U 15	0.145 (3.7)	0.322 (8.2)	-	-	940 (4.18)	940 (4.18)	785 (3.49)	685 (3.05)	625 (2.78)	550 (2.45)	510 (2.27)	465 (2.07)	390 (1.73)	365 (1.62)	335 (1.49)	315 (1.40)

1 Allowable load values are based on a safety factor of 3.0.
2 Allowable pullover capacities of sheet steel should be compared to the allowable fastener tensile load capacities in concrete, steel, and masonry to determine controlling resistance load.
3 Allowable shear bearing capacities of sheet steel should be compared to allowable fastener shear capacities in concrete, steel or masonry to determine controlling resistance load.
4 Data is based on the following minimum sheet steel properties, F_y = 33 ksi, F_u = 45 ksi (ASTM A653 material).

3.2.9.4 ORDERING INFORMATION

Powder-actuated (concrete)

Fastener description	Shank length in.(mm)	Shank diameter in.(mm)	Washer diameter
X-C 20 THP	3/4 (20)	0.138 (3.5)	8 mm plastic tophat
X-C 22 TH	7/8 (22)	0.138 (3.5)	8 mm metal tophat
X-C 20 MX	3/4 (20)	0.138 (3.5)	Collated

Powder-actuated (steel)

Fastener description	Shank length in.(mm)	Shank diameter in.(mm)	Washer diameter
X-S13 THP	1/2 (13)	0.145 (3.7)	8 mm plastic tophat
X-S13 MX	1/2 (13)	0.145 (3.7)	Collated
X-S16 TH	5/8 (16)	0.145 (3.7)	8 mm metal tophat
X-U 15 TH	5/8 (16)	0.145 (3.7)	8 mm metal tophat
X-U 15 MX	5/8 (16)	0.145 (3.7)	Collated

Gas-actuated (concrete)

Tool	Fastener description	Shank length in.(mm)	Shank diameter in.(mm)	Washer diameter
GX 2	**X-C 20 G2 MX**	3/4 (20)	0.108 (2.75)	Collated
	X-C 27 G2 MX	1 (27)	0.108 (2.75)	Collated
	X-C 32 G2 MX	1-1/4 (32)	0.108 (2.75)	Collated
	X-C 39 G2 MX	1-1/2 (39)	0.101 (2.6)	Collated
	X-P 17 G2 MX	11/16 (17)	0.118 (3.0)	Collated
	X-P 20 G2 MX	3/4 (20)	0.118 (3.0)	Collated
GX 3	**X-C 20 G3 MX**	3/4 (20)	0.118 (3.0)	Collated
	X-C 27 G3 MX	1 (27)	0.118 (3.0)	Collated
	X-C 32 G3 MX	1-1/4 (32)	0.118 (3.0)	Collated
	X-C 39 G3 MX	1-1/2 (39)	0.101 (2.75)	Collated
	X-P 17 G3 MX	11/16 (17)	0.118 (3.0)	Collated
	X-P 20 G3 MX	3/4 (20)	0.118 (3.0)	Collated

Gas-actuated (Steel)

Tool	Fastener description	Shank length in.(mm)	Shank diameter in.(mm)	Washer diameter
GX 2	X-S 14 G2 MX	1/2 (14)	0.118 (3.0)	Collated
	X-P 17 G2 MX	11/16 (17)	0.118 (3.0)	Collated
GX 3	X-S 14 G3 MX	1/2 (14)	0.118 (3.0)	Collated
	X-P 17 G3 MX	11/16 (17)	0.118 (3.0)	Collated
	X-P 20 G3 MX	3/4 (20)	0.118 (3.0)	Collated

Electro-Mechanical Actuated (Concrete)

Tool	Fastener description	Shank length in.(mm)	Shank diameter in.(mm)	Washer diameter
BX 3	X-C 20 B3 MX	3/4 (20)	0.118 (3.0)	Collated
	X-C 24 B3 MX	15/16 (24)	0.118 (3.0)	Collated
	X-C 36 B3 MX	1-3/8 (36)	0.108 (2.75)	Collated
	X-P 17 B3 MX	11/16 (17)	0.118 (3.0)	Collated
	X-P 20 B3 MX	3/4 (20)	0.118 (3.0)	Collated
	X-P 24 B3 MX	15/16 (24)	0.118 (3.0)	Collated
BX 4	X-C 20 B4 MX	3/4 (20)	0.118 (3.0)	Collated
	X-C 27 B4 MX	15/16 (24)	0.118 (3.0)	Collated
	X-C 32 B4 MX	1-1/4 (32)	0.118 (3.0)	Collated
	X-C 39 B4 MX	1-1/2 (37.5)	0.101 (2.6)	Collated
	X-P 17 B3 MX	11/16 (17)	0.118 (3.0)	Collated
	X-P 20 B3 MX	3/4 (20)	0.118 (3.0)	Collated
	X-P 24 B3 MX	15/16 (24)	0.118 (3.0)	Collated

Electro-Mechanical Actuated (Steel)

Tool	Fastener description	Shank length in.(mm)	Shank diameter in.(mm)	Washer diameter
BX 3	X-S 14 B3 MX	1/2 (14)	0.118 (3.0)	Collated
	X-P 17 B3 MX	11/16 (17)	0.118 (3.0)	Collated
	X-P 20 B3 MX	3/4 (20)	0.118 (3.0)	Collated
	X-P 24 B3 MX	15/16 (24)	0.118 (3.0)	Collated
BX 4	X-S 14 B4 MX	1/2 (14)	0.118 (3.0)	Collated
	X-P 17 B4 MX	11/16 (17)	0.118 (3.0)	Collated
	X-P 20 B4 MX	3/4 (20)	0.118 (3.0)	Collated
	X-P 24 B4 MX	15/16 (24)	0.118 (3.0)	Collated

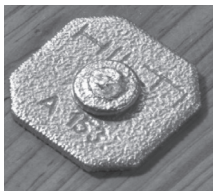
3.2.10 SILL PLATE FASTENING SYSTEMS

3.2.10.1 PRODUCT DESCRIPTION

X-CF X-CP

Listings/Approvals

ICC-ES (International Code Council)
ESR-2379 with LABC/LARC Supplement



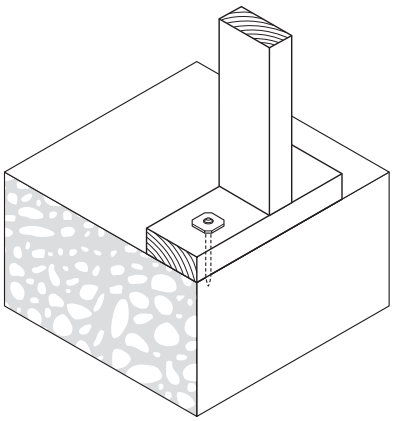
Installed X-CP fastener with “A 153" clearly marked on washer.

The 2-7/8" Hilti X-CF and X-CP fasteners are specifically designed for attaching wood sill plates to concrete substrates. Hilti offers a suitable fastener for most sill plate application conditions. The carbon steel thick coated X-CP 72 P8 S23 fastener complements the Hilti powder-actuated fastener portfolio specifically for sill plate applications where pressure treated lumber is being used.

The X-CP fasteners are suitable for use with pressure treated lumber sill plates. Reference General Guidelines on top of following page for fastener recommendation dependent on environment conditions and lumber type used. The X-CP fastener has a pre-mounted 0.905" (23 mm) 16 gauge washer for faster and more reliable installation. The X-CP fastener has an additional plastic washer that minimizes coating damage by the washer during installation. These sill plate fasteners are suitable for use with Hilti’s powder-actuated tools and cartridges.

Product features:

- Fasteners for use with chemical pressure treated lumber (X-CP).
- Pre-assembled washer for faster and more reliable installation.
- Washer clearly stamped with material/coating for easier inspection.
- X-CP: Additional plastic insert to minimize coating damage during installation.



3.2.10.2 Material specifications

Fastener designation	Fastener material	Washer material	Fastener plating	Washer plating
X-CF 72 P8 S23	Carbon Steel	Carbon Steel	5 µm Zinc[1]	5 µm Zinc[1]
X-CP 72 P8 S23	Carbon Steel	Carbon Steel	Thick Mechanical Plated[2] > 86 µm	Thick Mechanical Plated[2] > 86 µm

1 ASTM B633, SC 1, Type III. Refer to Section 2.3.3.1 for more information.
2 Equivalent in corrosion resistance to ASTM A153 HDG. Refer to Section 2.3.3.1 for more information.

General guidelines for untreated and pressure-treated lumber[1,2,3]

Environment	**Indoor - dry:** untreated lumber with no moisture exposure	**Indoor and exterior - dry:** pressure treated lumber with no moisture exposure
Wood type	Untreated lumber	SBX/DOT, Zinc borated ACQ, CA-B,CBA-A treated or untreated lumber
Fastener	Carbon Steel, electro-galvanized (min. 5 - 13 microns)	Carbon steel, thick mechanical plated (power driven fasteners > 86 microns)
Washer designation inspection	 X-CF washer	 X-CP washer denoting ASTM A153 corrosion resistance

1 If the moisture content of Pressure-Treated Lumber is high (> 18 %) or unknown, stainless steel fasteners are recommended. Select appropriate stainless steel grade for your application.
2 Guidelines based on fastener coating / material resistance to environmental corrosion (commonly called "rusting"). Evaluate site conditions which may affect these guidelines, such as: corrosive agents other than those listed; expected service life; other (non environmental) types of corrosion etc.
3 In highly corrosive environments (such as direct exposure to chlorides with average temperatures above 86 °F (30 °C)) it is generally recommended that a Highly Corrosive Resistant (HCR) Fastener be used such as Hilti HAS HCR Adhesive Anchor Rods. Contact Hilti Technical Support for more information.

3.2.10.3 TECHNICAL DATA

Allowable loads for sill plate fasteners installed in minimum f'_c = 2,000 psi normal weight concrete[1,2,3]

Fastener designation	Shank diameter **in.** (mm)	Washer diameter **in.** (mm)	Fastener length **in.** (mm)	Tension **lb** (kN)	Shear **lb** (kN)
Interior shear wall or interior non-shear wall[4]					
X-CF 72 P8 S23	**0.145** (3.7)	**0.905** (23)	**2-7/8** (72)	**130** (0.58)	**210** (0.93)
X-CP 72 P8 S23	**0.145** (3.7)	**0.905** (23)	**2-7/8** (72)	**175** (0.78)	**250** (1.11)
Exterior Shear Wall[5]					
X-CF 72 P8 S23	**0.145** (3.7)	**0.905** (23)	**2-7/8** (72)	**130** (0.58)	**165** (0.73)
X-CP 72 P8 S23	**0.145** (3.7)	**0.905** (23)	**2-7/8** (72)	**150** (0.73)	**105** (0.42)

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Wood sill plates connected to the substrate must be investigated in accordance with accepted design criteria.
2 Multiple fasteners are recommended for any attachment.
3 Allowable load values are for attachment of nominal 2x lumber with the steel washer bearing on the top surface of the wood.
4 These allowable load values based on testing performed at a minimum 3" edge distance (i.e. middle of slab).
5 These allowable load values based on testing performed at 1-3/4" edge distance.

3.2.10.4 ORDERING INFORMATION

Fastener description	Shank length **in.** (mm)	Shank Ø **in.** (mm)	Washer Ø in. (mm)	Packaging qty
Carbon steel - 5 µm zinc				
X-CF 72 P8 S23	**2-7/8** (72)	**0.145** (3.7)	**0.905** (23)	100 pcs. / box
Carbon steel - thick mechanical plated > 86 µm				
X-CP 72 P8 S23	**2-7/8** (72)	**0.145** (3.7)	**0.905** (23)	100 pcs. / box

3.2.11 STUD FASTENERS FOR ATTACHMENT TO CONCRETE

3.2.11.1 PRODUCT DESCRIPTION

The Hilti threaded stud program is for use with Hilti powder-actuated tools to provide a faster and more reliable solution for making attachments to concrete base materials. Threaded studs are available in standard carbon steel. The X-W6 and W10 threaded studs have varying shank lengths to provide more reliable fastenings to standard and high strength concrete. Thread diameters of 1/4" have thread lengths ranging from 1/2" through 1-1/2". The 3/8" thread diameter has a single thread length of 1-3/16".

X-W6 W10

Listings/Approvals

ICC-ES (International Code Council)
ESR-1663 with LABC/LARC Supplement

FM (Factory Mutual)
W10-30-27P10, W10-30-32P10 and W10-30-42P10 Fasteners for Sprinkler Pipe Hangers

UL (Underwriters Laboratories)
W10-30-32P10 and W10-30-42P10, Fasteners for Sprinkler Pipe Hangers - Up to 2-1/2" diameter pipe

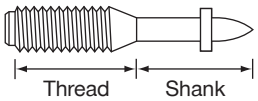
3.2.11.2 Material specifications

Fastener designation	Fastener material	Fastener plating
X-W6	Carbon Steel	5 µm Zinc[1]
W10	Carbon Steel	5 µm Zinc[1]

1 ASTM B633, SC1, Type III. Refer to Section 2.3.3.1 for more information.

3.2.11.3 Technical data

Fastener designation	Thread designation	Thread length in. (mm)	Shank length in. (mm)
X-W6-20-22	UNC 1/4-inch	**3/4** (20)	**7/8** (22)
X-W6-20-27	UNC 1/4-inch	**3/4** (20)	**1** (27)
X-W6-38-27	UNC 1/4-inch	**1-1/2** (38)	**1** (27)
W10-30-27	UNC 3/8-inch	**1-3/16** (30)	**1** (27)
W10-30-32	UNC 3/8-inch	**1-3/16** (30)	**1-1/4** (32)
W10-30-42	UNC 3/8-inch	**1-3/16** (30)	**1-5/8** (42)



Allowable loads in normal weight concrete[1,2]

Description	Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Concrete compressive strength			
				2000 psi		4000 psi	
				Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
1/4–20 Threaded stud	X-W6	**0.145** (3.7)	**3/4** (19)	**40** (0.18)	**55** (0.24)	**40** (0.18)	**55** (0.24)
			1 (25)	**85** (0.38)	**195** (0.87)	**110** (0.49)	**225** (1.00)
3/8–16 Threaded stud	W10	**0.205** (5.2)	**1** (25)	**85** (0.38)	**95** (0.42)	**100** (0.44)	**105** (0.47)
			1-1/4 (32)	**175** (0.78)	**345** (1.53)	**200** (0.89)	**380** (1.69)
			1-5/8 (41)	**285** (1.27)	**380** (1.69)	**385** (1.71)	**395** (1.76)

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.

2 Multiple fasteners are recommended for any attachment.

Allowable Loads in Minimum f'_c = 3000 psi Structural Lightweight Concrete[1,4]

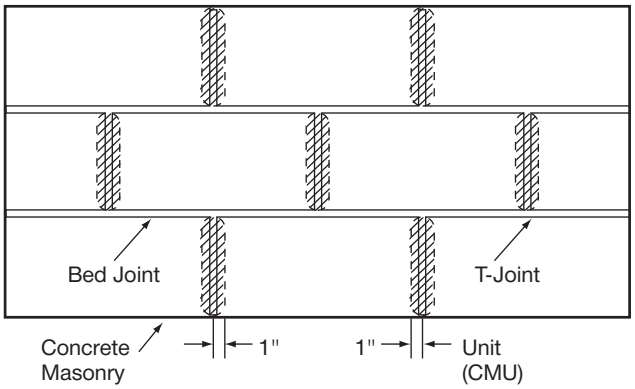
Fastener description	Fastener	Shank dia. in. (mm)	Min. embed. in. (mm)	Fastener location				
				Installed into concrete		Installed through 3" deep metal deck into concrete[2,3]		
				Tension lb (kN)	Shear lb (kN)	Tension lb (kN)		Shear lb (kN)
						Upper flute	Lower flute	
1/4–20 Threaded Stud	X-W6	**0.145** (3.7)	**3/4** (20)	**125** (0.56)	**185** (0.82)	**125** (0.56)	**115** (0.54)	**185** (0.82)
			1 (25)	**175** (0.78)	**185** (0.82)	**160** (0.71)	**180** (0.80)	**185** (0.82)
3/8–16 Threaded Stud	W10	**0.205** (5.2)	**1** (25)	**265** (1.18)	**190** (0.85)	**160** (0.71)	–	**185** (0.82)
			1-1/4 (32)	**280** (1.25)	**380** (1.69)	**160** (0.71)	**210** (0.93)	**470** (2.09)
			1-5/8 (41)	**445** (1.98)	**540** (2.40)	**435** (1.93)	**325** (1.45)	**675** (3.00)

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 The steel deck profile is 3" deep composite floor deck with a thickness of 20 gauge (0.0358"). Figure 1 (Section 3.2.1.6) shows the nominal flute dimensions, fastener locations and load orientations for the deck profile.
3 Structural lightweight concrete fill above top of metal deck shall be a minimum of 3-1/4" deep.
4 Multiple fasteners are recommended for any attachment.

Allowable Loads in Concrete Masonry Units[1,2,3,4,5,8]

Fastener description	Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Hollow CMU				Grout filled CMU			
				Face shell[6]		Mortar joint[6]		Face shell[6]		Mortar joint[6]	
				Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear[7] lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear[7] lb (kN)
1/4-20 Threaded Stud	X-W6	**0.145** (3.7)	**1** (25)	**105** (0.47)	**175** (0.78)	**80** (0.36)	**110** (0.49)	**125** (0.56)	**175** (0.78)	**135** (0.60)	**150** (0.67)

1 The tabulated allowable load values are for the low-velocity fastener only, using a safety factor of 5.0 or higher. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 The tabulated allowable load values are for low-velocity fasteners installed in normal weight or lightweight concrete masonry units conforming to ASTM C90.
3 The tabulated allowable load values are for low-velocity fasteners installed in concrete masonry units with mortar conforming to ASTM C270, Type N.
4 The tabulated allowable load values are for low-velocity fasteners installed in concrete masonry units with grout conforming to ASTM C476, as coarse grout.
5 The tabulated allowable load values are for one low-velocity fastener installed in an individual masonry unit cell and at least 4" from the edge of the wall.
6 Fastener can be located anywhere on the face shell or mortar joint as shown in the figure to the right.
7 Shear direction can be horizontal or vertical (Bed Joint or T-Joint) along the CMU wall plane.
8 Multiple fasteners are recommended for any attachment.



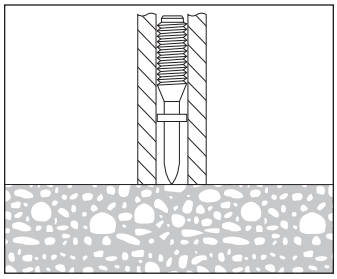
Acceptable locations (NON-SHADED AREAS) for threaded studs in CMU walls

Allowable bending moments for threaded stud fasteners installed in minimum 2,000 psi concrete[1,2]

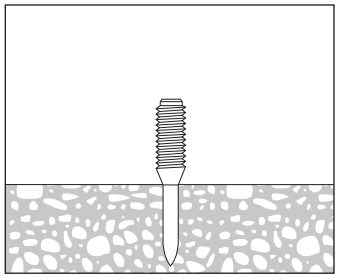
Fastener designation	M_{rec} ft-lb (Nm)
X-W6	**3.6** (4.9)
W10	**10.0** (13.6)

1 Based on a safety factor greater than or equal to 2.0.
2 For more information on bending moments, reference Section 3.2.2.7.

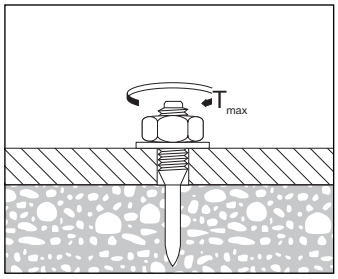
3.2.11.4 INSTALLATION INSTRUCTIONS*



1. Press tip of fastener to concrete base material. Drive fastener with Hilti powder-actuated tool.



2. Ensure proper threaded stud embedment.



3. Make attachment. Do not exceed Maximum Tightening Torque, T_{max}.

* These are abbreviated instructions which may vary by application. **ALWAYS** review/follow the instructions accompanying the product.

Maximum tightening torque, T_{max}, for threaded studs driven into concrete, ft-lb (Nm)

Stud type	
X-W6	W10
3.0 (4.0)	**4.5** (6.0)

3.2.11.5 ORDERING INFORMATION

Fastener description	Shank length in. (mm)	Shank Ø in. (mm)	Thread length in. (mm)	Thread Ø	Guidance washer Ø	Packaging quantity
X-W6-20-22 FP8	**7/8** (22)	**0.145** (3.7)	**3/4** (20)	UNC 1/4-inch	8 mm plastic	100 pcs
X-W6-20-27 FP8	**1** (27)	**0.145** (3.7)	**3/4** (20)	UNC 1/4-inch	8 mm plastic	100 pcs
X-W6-38-27 FP8	**1** (27)	**0.145** (3.7)	**1-1/2** (38)	UNC 1/4-inch	8 mm plastic	100 pcs
W10-30-27 P10	**1** (27)	**0.205** (5.2)	**1-3/16** (30)	UNC 3/8-inch	10 mm plastic	100 pcs
W10-30-32 P10	**1-1/4** (32)	**0.205** (5.2)	**1-3/16** (30)	UNC 3/8-inch	10 mm plastic	100 pcs
W10-30-42 P10	**1-5/8** (42)	**0.205** (5.2)	**1-3/16** (30)	UNC 3/8-inch	10 mm plastic	100 pcs

X-W6

W10*

* W10 threaded stud installation requires a 10mm fastener base plate.

3.2.12 STUD FASTENERS FOR ATTACHMENT TO STEEL

3.2.12.1 PRODUCT DESCRIPTION

The Hilti threaded stud program is for use with Hilti powder-actuated tools to provide a fast and reliable solution for making attachments to steel base material in lieu of through bolting, screw fastening, or stud welding. Threaded studs are available in SAE 316 stainless steel equivalent corrosion resistance or carbon steel to meet a wide range of application requirements when making fastenings to steel 3/16" and thicker. The X-EW6H and X-EW10H threaded studs are hardened fasteners with a unique knurled shank design for improved penetration and high tension and shear values in ASTM A36 and higher grades of steel. Thread diameters are 1/4", 3/8", and 8 mm with thread lengths ranging from 3/8" to 1-1/2".

X-EW6H
X-EW10H

X-ST-GR M8

X-BT-MR W6*
X-BT-MR W10*
X-BT-GR M8*

3.2.12.2 MATERIAL SPECIFICATIONS

Fastener designation	Fastener material	Fastener plating
X-EW6H	Carbon steel	5 µm Zinc[1]
X-EW10H	Carbon steel	5 µm Zinc[1]
X-ST-GR M8	SAE 316 stainless steel[2]	N/A
X-BT-MR W6*	SAE 316 stainless steel[2]	N/A
X-BT-MR W10*	SAE 316 stainless steel[2]	N/A
X-BT-GR M8*	SAE 316 stainless steel[2]	N/A

1 ASTM B633, SC 1, Type III. Refer to Section 2.3.3.1 for more information.
2 Equivalent corrosion resistance to SAE 316 stainless steel. Refer to Section 2.3.3.1 for more information.

Listings/Approvals

ICC-ES (International Code Council)
ESR-2347 with LABC/LARC Supplement

FM (Factory Mutual)
X-EW10H and X-EW6H

UL (Underwriters Laboratories)
X-EW10H and X-EW6H

ABS (American Bureau of Shipping)

Lloyds Register

GL (Germanischer Lloyd)

DNV

3.2.12.3 TECHNICAL DATA

Threaded steel stud specification table

Designation	Thread designation	Thread length in. (mm)	Shank length in. (mm)	Threaded stud stand-off, h_{NVS} in. (mm)
X-EW6H-11-9	UNC 1/4-inch	**7/16** (11)	**3/8** (9)	**3/8 – 1/2** (9.5 - 12.5)
X-EW6H-20-9	UNC 1/4-inch	**3/4** (20)	**3/8** (9)	**23/32 – 27/32** (18.5 - 21.5)
X-EW6H-28-9	UNC 1/4-inch	**1-1/8** (28)	**3/8** (9)	**1-1/16 – 1-5/32** (26.5 - 29.5)
X-EW6H-38-9	UNC 1/4-inch	**1-1/2** (38)	**3/8** (9)	**1-7/16 – 1-9/16** (36.5 - 39.5)
X-EW10H-30-14	UNC 3/8-inch	**1-3/16** (30)	**9/16** (14)	**1-3/32 – 1-7/32** (28.0 - 31.0)
X-ST-GR M8/5	Metric 8 mm	**3/8** (9)	**1/2** (12)	**15/32 - 19/32** (12.0 - 15.0)
X-ST-GR M8/10	Metric 8 mm	**5/8** (15)	**1/2** (12)	**21/32 - 25/32** (17.0 - 20.0)
X-BT-MR W6/14 SN 8*	UNC 1/4-inch	**13/16** (20)	**1/4** (6)	**1 – 1-1/16** (25.7 – 26.8)
X-BT-GR M8/7 SN 8*	Metric 8 mm	**9/16** (14)	**1/4** (6)	**5/8 – 11/16** (15.7 - 16.8)
X-BT-MR W10/15 SN 8*	UNC 3/8-inch	**15/16** (24)	**1/4** (6)	**1 – 1-1/16** (25.7 – 26.8)

Thread and Shank Length

Threaded Stud Stand-off (h_{NVS})

* Innovative blunt-tip X-BT fasteners are discussed in more detail in Section 3.2.14

Allowable loads in minimum ASTM A36 (F_y ≥ 36 ksi; F_u ≥ 58 ksi) steel[1,2]

Stud type	Shank diameter in. (mm)	Steel thickness in. (mm)									
		3/16 (4.8)		1/4 (6.4)		3/8 (9.5)		1/2 (12.7)		≥ 3/4 (19.1)	
		Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
X-EW6H	0.145 (3.7)	360 (1.60)	500 (2.22)	500 (2.22)	600 (2.67)	500 (2.22)	600 (2.67)	500 (2.22)	600 (2.67)	500 (2.22)	600 (2.67)
X-EW10H	0.205 (5.2)	–	–	970 (4.31)	1000 (4.45)	1100 (4.89)	1100 (4.89)	1100 (4.89)	1100 (4.89)	800 (3.56)	800 (3.56)
X-ST-GR M8	0.157 (4.0)	–	–	405 (1.80)	405 (1.80)	405 (1.80)	405 (1.80)	–	–	–	–
X-BT-MR W6/W10, X-BT-GR M8[3]	Tapered[4]	–	–	–	–	775 (3.45)	820 (3.65)	775 (3.45)	820 (3.65)	775 (3.45)	820 (3.65)

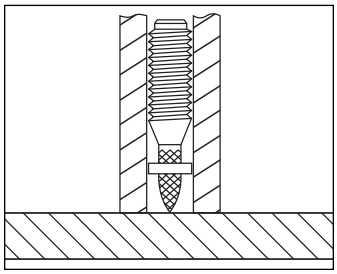
1 The tabulated allowable load values are for the low-velocity threaded studs only, using a factor of safety that is greater than or equal to 5.0, calculated in accordance with AC70. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 Tabulated allowable load values based upon embedment in steel such that threaded stud stand-off, h_{NVS}, complies with the Threaded Steel Stud Specification Table.
3 To prevent through penetration or damage to coatings on the base steel, a minimum base steel thickness of 5/16" is required for X-BT threaded studs. Load values provided for 3/8" base steel thickness are also valid for 5/16" base steel thickness. For further information, reference Section 3.2.14.
4 Shank diameter: 0.213" - 0.193" (5.4mm - 4.9mm)

Allowable bending moments for threaded stud fasteners installed in minimum ASTM A36 steel[1,2]

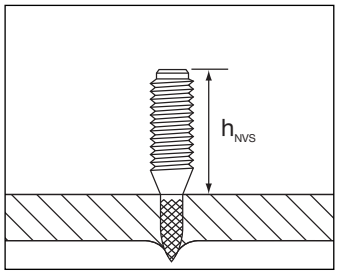
Fastener nomenclature	M_{rec} ft-lb (Nm)
X-EW6H	2.2 (3.0)
X-EW10H	6.5 (8.8)
X-ST-GR M8	4.0 (5.5)
X-BT-MR W6/W10, X-BT-GR M8*	14.8 (20.0)

1 Based on a safety factor greater than or equal to 2.0.
2 For more information on bending moments, reference Section 3.2.2.7.

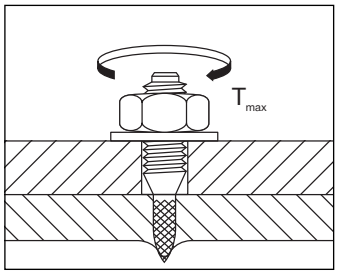
3.2.12.4 INSTALLATION INSTRUCTIONS[1,2]



1. Press tip of fastener to steel material. Drive fastener with Hilti powder-actuated tool.



2. Ensure proper threaded stud stand-off.



3. Make attachment. Do not exceed maximum tightening torque, T_{max}.

1 These are abbreviated instructions which may vary by application. **ALWAYS** review/follow the instructions accompanying the product.
2 Installation instructions for innovative blunt-tip X-BT fasteners are provided in Section 3.2.14.4

Maximum tightening torque, T_{max}, for threaded studs driven into steel, ft-lb (Nm)

Stud type									
X-EW6H		X-EW10H		X-ST-GR M8		X-BT-MR W6/W10*		X-BT-GR M8*	
3.0	(4.1)	**11.0**	(14.9)	**6.0**	(8.1)	**14.8**	(20.0)	**12.0**	(16.0)

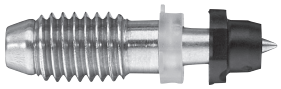
*Innovative blunt-tip X-BT fasteners are installed with a Hilti DX 351 BT powder-actuated tool and discussed in more detail in Section 3.2.14.

3.2.12.5 ORDERING INFORMATION

Fastener description	Shank length in. (mm)	Shank Ø in. (mm)	Thread length in. (mm)	Thread Ø	Guidance washer Ø	Packaging quantity
X-EW6H-38-9FP8	**3/8** (9)	**0.145** (3.7)	**1-1/2** (38)	UNC 1/4-inch	8 mm plastic	100 pcs
X-EW6H-28-9FP8	**3/8** (9)	**0.145** (3.7)	**1-1/8** (28)	UNC 1/4-inch	8 mm plastic	100 pcs
X-EW6H-20-9FP8	**3/8** (9)	**0.145** (3.7)	**3/4** (20)	UNC 1/4-inch	8 mm plastic	100 pcs
X-EW6H-11-9FP8	**3/8** (9)	**0.145** (3.7)	**7/16** (11)	UNC 1/4-inch	8 mm plastic	100 pcs
X-EW10H-30-14P10	**9/16** (14)	**0.205** (5.2)	**1-3/16** (30)	UNC 3/8-inch	10 mm plastic	100 pcs
X-BT-MR W6/14 SN 8	**1/4** (6)	**Tapered**	**13/16** (20)	UNC 1/4-inch	12 mm steel	100 pcs
X-BT-MR W10/15 SN 8	**1/4** (6)	**Tapered**	**15/16** (24)	UNC 3/8-inch	12 mm steel	100 pcs
X-BT-GR M8/7 SN 8	**1/4** (6)	**Tapered**	**9/16** (14)	Metric 8 mm	12 mm steel	100 pcs
X-ST-GR M8/10	**1/2** (12)	**0.157** (4.0)	**5/8** (15)	Metric 8 mm	8 mm plastic	100 pcs
X-ST-GR M8/5	**1/2** (12)	**0.157** (4.0)	**3/8** (9)	Metric 8 mm	8 mm plastic	100 pcs

DX 5 Tool

X-EW6H and X-EW10H



X-ST-GR M8

X-BT 4000-A Drill and TX-BT Step Drill Bit

DX 351 BT Tool and Brown Cartridge Strip

X-BT*

* Innovative blunt-tip X-BT fasteners are discussed in more detail in Section 3.2.14

3.2.13 X-ST-GR STUD FASTENERS FOR FASTENING TO STEEL

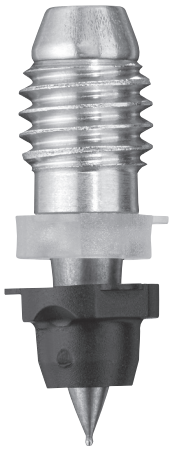
3.2.13.1 PRODUCT DESCRIPTION

The Hilti X-ST-GR threaded studs consist of a threaded sleeve and a drive pin. The drive pin is manufactured from a proprietary CrMnMo alloy which has corrosion resistance equivalent to SAE 316 stainless steel. The proprietary alloy provides a high hardness level, increasing the application limit when compared with traditional alloys. See Material Specification and Application Limit sections with more information.

Product features:

- CrMnMo Alloy with improved material hardness
- Base steel thickness from 1/4 inch to full steel*
- With proper tool and cartridge selection, can be used in high strength base steel material up to 92 ksi.

* Performance above 1/2" is dependent on steel hardness, see Application Limit in Steel with more information



X-ST-GR

Listings/Approvals

ICC-ES (International Code Council)
ESR-2347 with LABC/LARC Supplement

3.2.13.2 MATERIAL SPECIFICATIONS

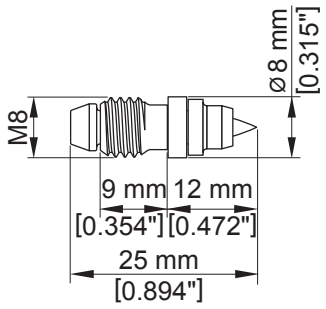
Part	Material designation	Tensile strength, Fu ksi (N/mm²)
Shank	CrMnMo Alloy P558	≥ 290 (2000)
Threaded Sleeve	Stainless Steel	≥ 110 (750)
Guidance Washer	Polyethylene	N/A

3.2.13.3 TECHNICAL DATA

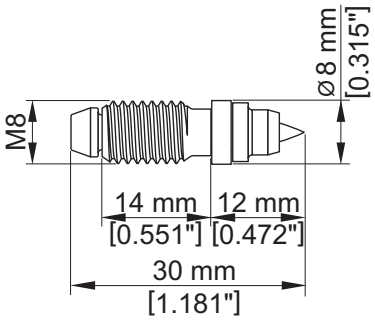
Allowable Loads in Minimum ASTM A36 (Fy ≥ 36 ksi; Fu ≥ 58 ksi) Steel[1]

Load type	Steel thickness in.
	1/4, 3/8 or 1/2-inch Steel
Tension lb (kN)	405 (1.8)
Shear lb (kN)	405 (1.8)
Torque ft-lb (Nm)	6.0 (8.1)
Moment ft-lb (Nm)	4.0 (5.5)

1 The tabulated allowable load values are for the X-ST-GR fasteners only, using a safety factor of 5.0 to the average ultimate values obtained based on testing in accordance with ICC-ES AC70 and ASTM E1190. Some conditions like high wind loads, shock or fatigue may require a different safety factor.

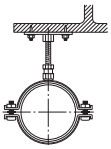


X-ST-GR M8/5 P8

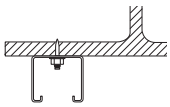


X-ST-GR M8/10 P8

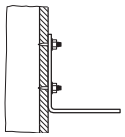
Applications



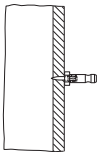
Base plates for pipe hangers



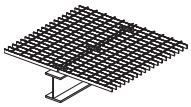
Strut profile fastening



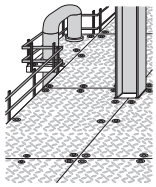
Facade brackets



Multi-purpose connections



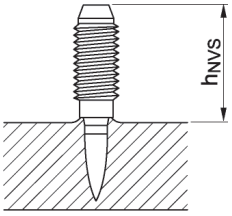
Grating



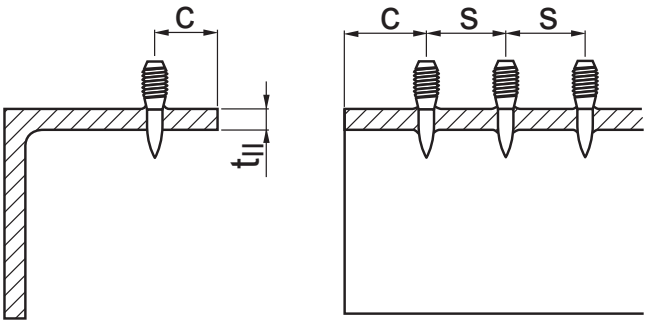
Checker plate

Fastener selection

Designation	Thread dimension	h_{NVS} in. (mm)
X-ST-GR M8/5 P8	M8	1/2 - 19/32 (12.0 - 15.0)
X-ST-GR M8/10 P8	M8	11/16 – 13/16 (17.0 - 20.0)



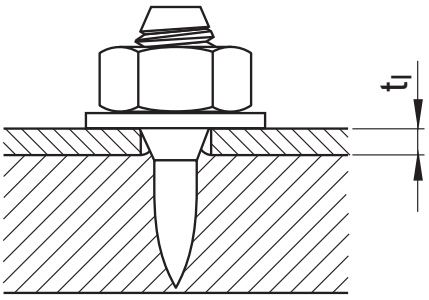
Spacing, edge distances and base material thickness



C, S ≥ 0.59 inch

t_{II} ≥ 0.24 inch

Thickness of fastened material



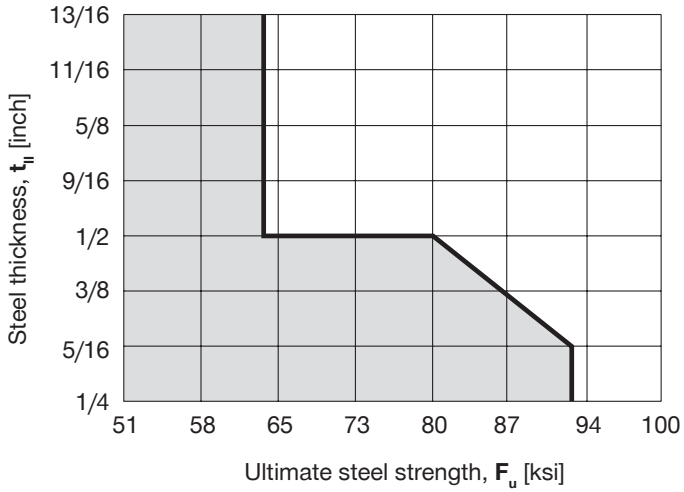
t_I ≤ 0.4 inch for X-ST-GR M8/10 P8

t_I ≤ 0.2 inch for X-ST-GR M8/5 P8

Tool selection

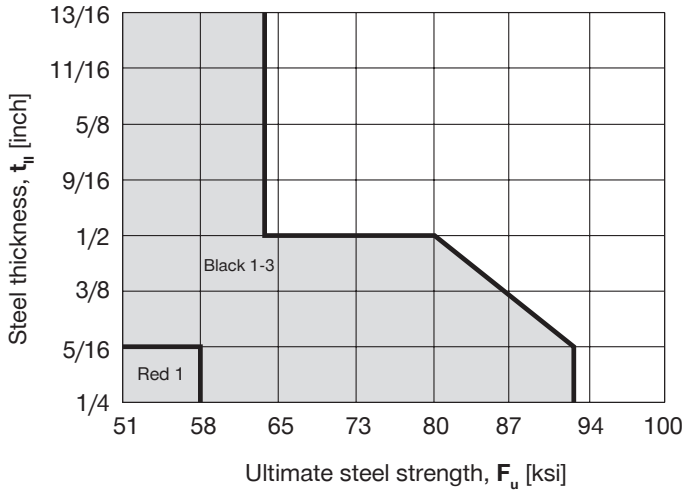
DX 5 with fastener guide X-5-460-F8N15.

Application limit in steel



(Applications below and to the left of the solid line are within the recommended application range)

Cartridge and tool power level selection*



(Applications below and to the left of the solid line are within the recommended application range)

Using DX 5
6.8/11M black or red cartridge

* Typical cartridge selection. Site testing is required to confirm proper cartridge level.

3.2.13.4 ORDERING INFORMATION

Fastener description	Shank length in. (mm)	Shank Ø in. (mm)	Thread length in. (mm)	Thread Ø	Guidance washer Ø	Qty
X-ST-GR M8/5 P8	1/2 (12)	0.157 (4)	3/8 (9)	Metric 8 mm	8 mm Plastic	100
X-ST-GR M8/10 P8	1/2 (12)	0.157 (4)	5/8 (15)	Metric 8 mm	8 mm Plastic	100

3.2.14 X-BT FASTENING SYSTEMS

3.2.14.1 PRODUCT DESCRIPTION

The Hilti X-BT Fastening System is an innovative method of fastening to pre-painted steel with little to no damage to the surface coating. The system consists of a Hilti powder-actuated or battery-actuated tool equipped with specially adapted fastener guides for use with X-BT threaded studs. The X-BT fasteners are stainless steel threaded studs available with thread diameters 8 mm, 1/4" (W6) and 3/8" (W10). The stud, with or without sealing washer, is set in a small pre-drilled hole in the base steel. The X-BT system is designed to work on carbon steels as thin as 5/16" (8 mm) without through-penetration and little to no damage to the back surface coatings, helping to elminate time consuming surface preparation and rework (such as with welding).

The X-BT-GR M8 threaded stud, in conjunction with the X-FCM grating disks, can be used to fasten grating to a variety of different steel shapes (Refer to Section 3.4.2.). X-BT-MR W6 and W10 threaded fasteners can be used to support cable/conduit connectors and trays, piping, channels, instrumentation, lighting fixtures, signage, junction boxes, and other fastenings to steel.

Product features and benefits

- More efficient: No through penetration of base material — helping elminate rework of the base steel coating.
- Fast: Up to 100 studs per hour can be set by one user.
- Durable: Highly corrosion resistant stainless steel. Fusion to base steel resulting in high load capacities compared to similar methods of fastening.
- Flexible: Works on most steel shapes and thicknesses down to 5/16" (8mm), ideal for both mild and high strength carbon steel base materials.
- Simple: Easy to use portable system requiring no electrical cords or heavy equipment.

X-BT-MR W6, X-BT-MR W10, X-BT-GR M8

Listings/Approvals

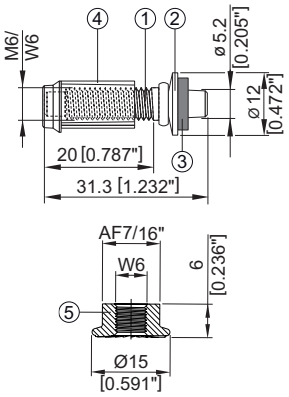
ICC-ES (International Code Council)
ESR-2347 with LABC/LARC Supplement

ABS (American Bureau of Shipping)

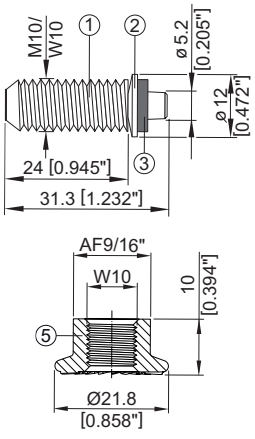
Lloyds Register

DNVGL

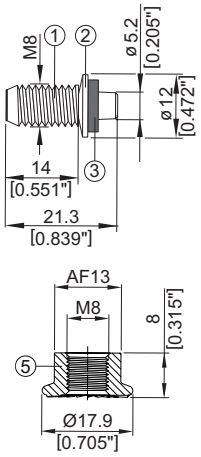
BV (Bureau Veritas)



X-BT-MR W6/10 SN 8
X-BT-MR W6/14 SN 8



X-BT-MR W10/15 SN 8



X-BT-GR M8/7 SN 8

3.2.14.2 MATERIAL SPECIFICATIONS

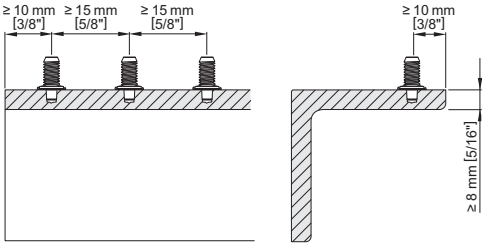
Part	Material designation
(1) Shank and Thread	S31803 (1.4462) equivalent to A4 / AISI Grade 316
(2) SN washer	S31635 (X2CrNiMo 17-12-2, 1.4404)
(3) Sealing washer	Elastomer, black resistant to: UV, salt water, water, ozone, oils, etc.
(4) Removable guide sleeve	Plastic
(5) Flange Nuts	A4 / AISI Grade 316

3.2.14.3 TECHNICAL DATA

3.2.14.3.1 North American load tables

Allowable loads in steel base materials 5/16” or greater[1,2,3,4]

Load type		Minimum ASTM A36 steel	Minimum grade 50 steels
Static	Tension, lb (kN)	775 (3.4)	840 (3.7)
	Shear, lb (kN)[6]	820 (3.6)	885 (3.9)
	Moment, ft-lb (Nm)	14.8 (20.0)	14.8 (20.0)
Seismic[5]	Tension, lb (kN)	775 (3.4)	840 (3.7)
	Shear, lb (kN)[6]	545 (2.4)	590 (2.6)



1 The tabulated allowable load values are for the X-BT-MR and X-BT-GR fasteners only, using a safety factor of 5.0. Wood or steel members connected to the base material must be investigated in accordance with accepted design criteria.
2 Minimum edge distance and minimum spacing are 3/8" and 5/8", respectively.
3 Maximum installation torque for the X-BT-MR is 14.8 ft-lb. Maximum installation torque for the X-BT-GR is 14.8 ft-lb when in connection with the X-FCM-R HL and 5.9 ft-lb when in connection with the standard X-FCM-R.
4 Multiple fasteners are recommended for any attachment.
5 Allowable Loads commonly used in North America. Static and seismic allowable loads based on testing and evaluation in accordance with ICC-ES AC70-16, including Annex A.
6 Allowable shear load requires that the shear is transferred directly to the fastener steel washer at surface. Shear loads shown are not valid for friction as a shear transfer mechanism.

3.2.14.3.2 European load tables

Recommended static loads in steel base materials 5/16” or greater[1,2]

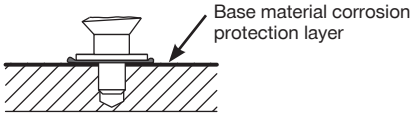
Load type	Minimum ASTM A36 steel	Minimum grade 50 steels
Tension, lb (kN)	810 (3.6)	1035 (4.6)
Shear, lb (kN)	970 (4.3)	1190 (5.3)
Moment, ft-lb (Nm)	14.8 (20.0)	14.8 (20.0)
Torque, ft-lb (Nm)	14.8 (20.0)	14.8 (20.0)

1 Recommended loads are based on a global safety factor of 2.8 applied to the characteristic resistance for static tension or shear, which are derived from the 5% fractile of the ultimate load. Recommended moment values are based on a global safety factor of 1.75. This safety concept is commonly used in regions outside of North America, where design is carried out in accordance with the Eurocode.
2 Multiple fasteners are recommended for any attachment.

Design resistance in steel base materials 5/16” or greater[1,2]

Load type	Minimum ASTM A36 steel	Minimum grade 50 steels
Tension, lb (kN)	1120 (5.0)	1460 (6.5)
Shear, lb (kN)	1350 (6.0)	1680 (7.5)
Moment, ft-lb (Nm)	20.5 (28.0)	20.5 (28.0)

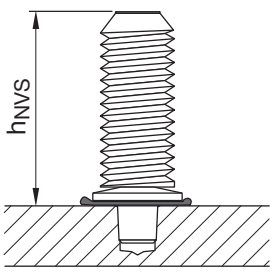
1 Design resistance is based on a safety factor of γM = 2.0 applied to the characteristic resistance for static tension or shear, which is derived from the 5% fractile of the ultimate load. Moment design resistance values are based on a safety factor of γM = 1.25. Design resistance should be greater than calculated demand that has been reduced by a partial safety factor. This safety concept is commonly used in regions outside of North America, where design is carried out in accordance with the Eurocode.
2 Multiple fasteners are recommended for any attachment.



Thickness of base material corrosion protection layer ≤ 0.02 inch (0.5 mm).
For thicker coatings, please contact Hilti.

3.2.14.3.3 X-BT Fastener selection[1]

Designation	Diameter	h_{NVS}[2] **in.** (mm)
For use in coated steel or HDG		
X-BT-MR W6/10 SN 8	1/4	**1.055** (26.8)
X-BT-MR W6/14 SN 8[3]	1/4	**1.055** (26.8)
X-BT-MR W10/15 SN 8	3/8	**1.055** (26.8)
X-BT-GR M8/7 SN 8	M8	**0.661** (16.8)



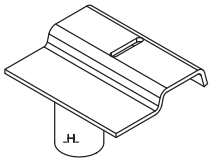
1 Unless indicated otherwise, dimension in inches
2 Maximum value allowable. May vary by - 0.043" (- 1.1 mm.)
3 For use with DX 351 BT only

3.2.14.4 INSTALLATION INSTRUCTIONS

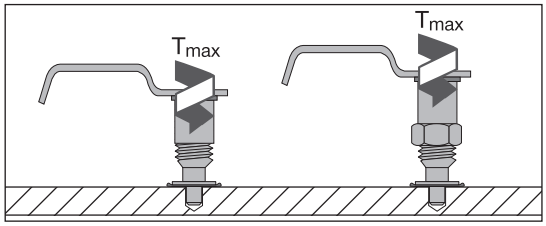
Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com. Because of the possibility of changes, always verify that downloaded IFU are current when used.

Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

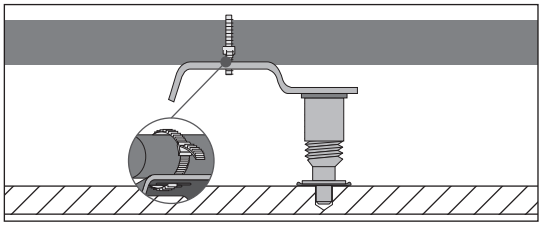
Stainless steel T-bar for fastening cables to steel structures[1,2,3]



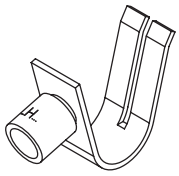
Slotted T-bar



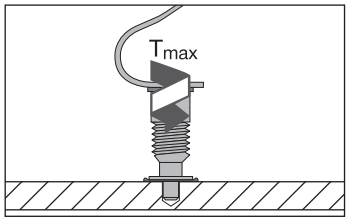
1. Attach Slotted T-bar on installed X-BT fastener. Do not exceed Maximum Tightening Torque, T_{max} = 6 ft-lb (8 Nm).



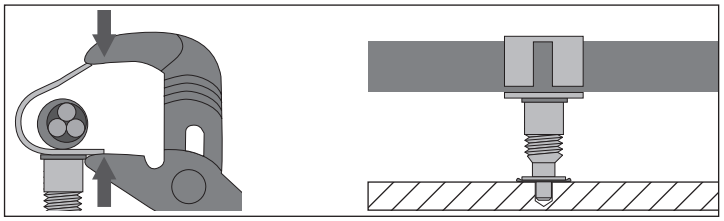
2. Place and attach cable to Slotted T-bar.



Crimp T-bar



1. Attach Crimp T-bar on installed X-BT fastener. Do not exceed Maximum Tightening Torque, T_{max} = 6 ft-lb (8 Nm).



2. Insert cable into Crimp T-bar and wrap Crimp T-bar around cable.

1 These are abbreviated instructions which may vary by application. **ALWAYS** review/follow the instructions accompanying the product.

2 Reference Section 3.2.14.5 for information on number and size of cables.

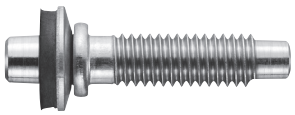
3 Space T-bars at approximately 24" to 32" (60-80 cm). Adjust as necessary to control cable sagging.

3.2.14.5 ORDERING INFORMATION

X-BT Stainless Steel Threaded Studs[1]

Tapered shank, sealing washer diameter 1/2" (12 mm)

Thread diameter	Thread length in. (mm)	Package contents	Ordering designation
M8	9/16 (14)	100	X-BT-GR M8/7 SN 8
W6	13/16 (20)	100	X-BT-MR W6/10 SN 8
W6	13/16 (20)	100	X-BT-MR W6/14 SN 8
W10	15/16 (24)	100	X-BT-MR W10/15 SN 8



Box includes: 100 studs, 1 power regulation guide, 1 coating protector, 1 TX-BT step drill bit

1 X-BT stainless steel threaded studs also available without sealing washer on request by special order

TX-BT Step Drill Bits[1]

4.7 mm drill bit diameter, 7 mm drilling depth

Overall length in. (mm)	Package contents	Ordering designation
3-1/8 (80)	10	TX-BT 4.7/7-80 drill bit
4-5/16 (110)	10	TX-BT 4.7/7-110 drill bit

1 150 mm length bits available upon request by special order

Cartridges

(in magazine strips of 10)

Color code	Package contents	Ordering designation
Brown	100	6.8/11M brown cartridge

Tool sets

For use with	Package contents	Ordering designation
X-BT-MR W6/14 SN 8 and X-BT-MR W10/15 SN 8	1	X-BT Set
X-BT-GR M8/7 SN 8	1	X-BTG Set

DX 351 Set includes: 1 DX 351 BT or BTG powder-actuated tool, 1 BT cleaning kit, 1 SF BT 22-A cordless drill, 1 charger, 2 batteries, 1 information sheet, 1 spray lube, 3 operating instructions, packed complete in a Hilti toolbox.

Individual tools

For use with	Package contents	Ordering designation
X-BT-MR W6/10 SN 8	1	BX 3-BT Battery-actuated Tool X-FG B3-BT W Fastener Guide
Supplied in an impact-resistant plastic toolbox with cleaning kit and operating instructions, info sheet.		
X-BT-GR M8/7 SN 8	1	BX 3-BTG Battery-actuated Tool X-FG B3-BTG Fastener Guide
Supplied in an impact-resistant plastic toolbox with cleaning kit and operating instructions, info sheet.		
X-BT-MR W6/14 SN 8	1	DX 351 BT powder-actuated tool
Supplied in an impact-resistant plastic toolbox with cleaning kit, spray lubricant and operating instructions, info sheet.		
X-BT-GR M8/7 SN 8	1	DX 351 BTG powder-actuated tool
Supplied in an impact-resistant plastic toolbox with cleaning kit, spray lubricant and operating instructions, info sheet.		
X-BT	1	SF BT 22-A
Supplied in a cardboard box with operating instructions. Battery and charger sold separately.		

Supplied in a cardboard box with operating instructions. Battery and charger sold separately.

T-bar Cable Hangers

Hanger descrilption	Recommended max. no. of cables	Cable ø
Slotted T-bars		
T-bar X-P15002-ESL-2	2	Up to 1.25"
T-bar X-P15002-ESL-3	3	Up to 1.25"
T-bar X-P15002-ESL-4	4	Up to 1.25"
T-bar X-P15002-ESL-6	6	Up to 1.25"
T-bar X-P15002-ESL-8	8	Up to 1.25"
Crimp T-bars		
T-bar X-1026-1	1	0.437" to 0.750"
T-bar X-1027-1	1	0.680" to 0.900"
T-bar X-1030-1	1	0.750" to 1.000"
T-bar X-1040-1	1	0.375" to 0.531"
T-bar X-2002-2	2	0.437" to 0.750"
T-bar X-2003-2	2	0.680" to 0.900"

3.2.14.7 X-BT-ER ELECTRICAL CONNECTION SYSTEMS

3.2.14.7.1 Product description

X-BT-ER stainless steel threaded studs are designed for electrical connections under permanent current, short circuit current and lightning current conditions. Packaged with two stainless nuts and one stainless steel lock washer, the X-BT-ER can be used for electrical grounding such as bonding and lightning protection in potentially corrosive environments. The X-BT-ER is available in W6/3 SN8, W6/7 SN 8 and W10/7 SN 8 sizes.

Product features and benefits

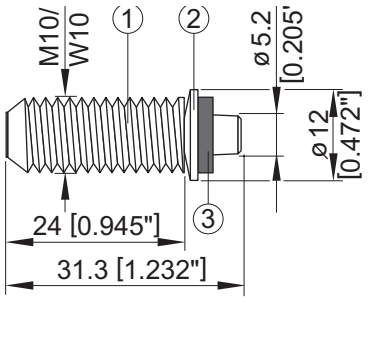
- Faster: A connection can be made in less than 1 minute. Removing and reapplication of coatings are not required.
- More reliable: Stainless steel stud is generally suitable for corrosive industrial environments. The vibration resistant stud helps prevent the connection from accidentally coming loose.
- Simpler: Drill, fasten and connect. External power source is not needed and not dependent on weather.

3.2.14.7.2 Material specifications

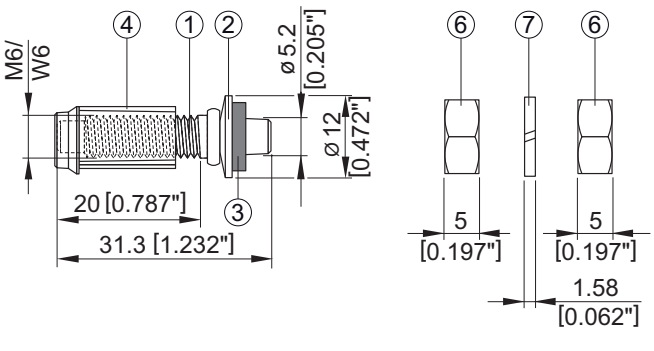
Part	Fastener material
① **Shank and thread**	S31803 (1.4462) equivalent to A4 / AISI grade 316
② **SN washer**	S31635 (X2CrNiMo 17-12-2, 1.4404)
③ **Sealing washer**	Elastomer, black; resistant to UV, salt water, water, ozone, oils, etc.
⑥ **Nuts**	Equivalent to A4 / AISI grade 316 material
⑦ **Lock washers**	Equivalent to A4 / AISI grade 316 material
④ **Removable guide sleeve**	Plastic

Listings/Approvals

UL (Underwriters Laboratories)
E257069
ABS (American Bureau of Shipping)
Lloyds Register
DNVGL
BV (Bureau Veritas)



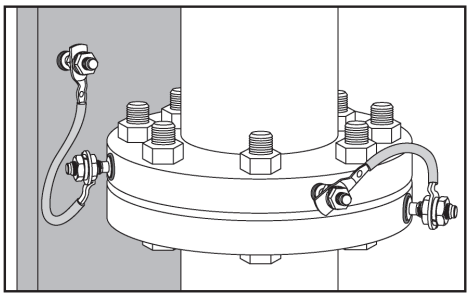
X-BT-ER W10/7 SN 8



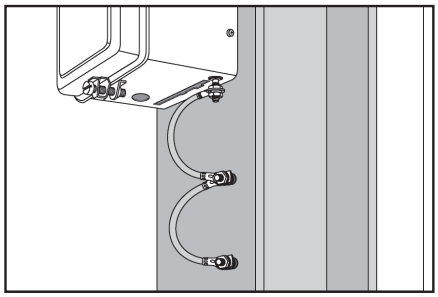
X-BT-ER W6/3 SN 8
X-BT-ER W6/7 SN 8

3.2.14.7.3 Technical data

Application examples



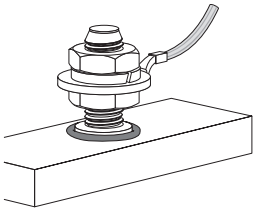
Functional and protective bonding in pipe (outer diameter of installed surface ≥ 5.9”



Protective bonding circuit – double point connection

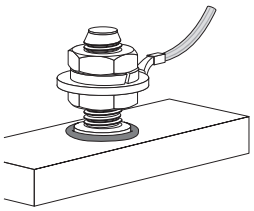
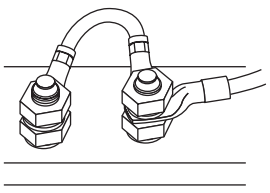
Functional bonding and terminal connection in a circuit

For low permanent current due to static charge built up in pipes or for low permanent current when closing an electrical circuit

Single point connection	Recommended electrical connectors	Maximum allowable permanent current	Notes
	X-BT-ER W10/7 SN 8 X-BT-ER WR6/7 SN 8 X-BT-ER W6/3 SN 8	= 40A	Recommended connected cable size (tested to 40A) according to IEC/EN 60204-1shall not exceed 10mm² copper (8AWG). Fastening of thicker cable is acceptable provided the maximum permanent current of 40A is not exceeded and the provisions on cable lug thickness are observed.

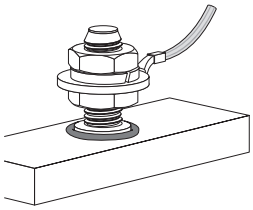
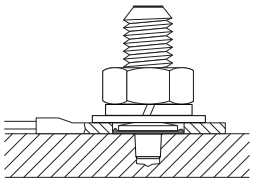
Protective bonding circuit

For discharging short circuit current while assisting in protecting electrical equipment or earth/ground or bonding cable trays and ladders

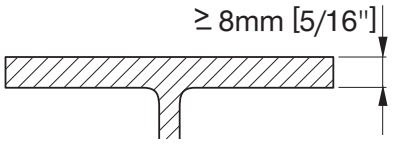
Single point connection	Recommended electrical connectors	Maximum short circuit current for period of 1s	Notes
	X-BT-ER W10/7 SN 8 X-BT-ER W6/7 SN 8 X-BT-ER W6/3 SN 8	= 1250A	Recommended connected cable size (tested to 1250A for 1s) following IEC/EN 60947-7-2 shall not exceed 10mm² copper (8AWG). Fastening of thicker cable is acceptable provided the maximum current of 1250A for a period of 1 second is not exceeded and the provisions on cable lug thickness are observed. Recommended connected cable size (tested to 750A for 4s) according to UL 467: ≤ 10AWG
Double point connection	**Recommended electrical connectors**	**Maximum short circuit current for period of 1s**	**Notes**
	X-BT-ER W10/7 SN 8 X-BT-ER W6/7 SN 8	= 1800A	Recommended connected cable size (tested to 1800A for 1s) following IEC/EN 60947-7-2 shall not exceed 16mm² copper (6AWG). Fastening of thicker cable is acceptable provided the maximum current of 1800A for a period of 1 second is not exceeded and the provisions on cable lug thickness are observed.

Lightning protection

For high temporary current due to lightning.

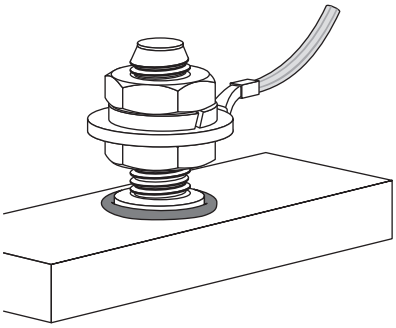
Single point connection	Recommended electrical connectors	Maximum current (According to EN 62561-1:2012-01)	
	X-BT-ER W10/7 SN 8 X-BT-ER W6/7 SN 8 X-BT-ER W6/3 SN 8	≤ 50kA for 2ms	
One nut with cable lug	**Recommended electrical connectors**	**Maximum tested current**	**When one nut is utilized and cable lug is in contact with base material**
	X-BT-ER W10/7 SN 8 X-BT-ER W6/7 SN 8 X-BT-ER W6/3 SN 8	≤ 100kA for 2ms	Cable lug must be in direct contact with non-coated base material. Extra W10 stainless steel washer to be used and installed between lock washer and cable lug. Base material must not contact the X-BT-ER SN washer, lock washer and nut. Cable lug thickness = 0.079" to 0.47" (2mm to 12mm). Cable lug hole diameter ≥ 0.55" (14mm). Max. tightening torque = 14.8 ft-lb (20 Nm)

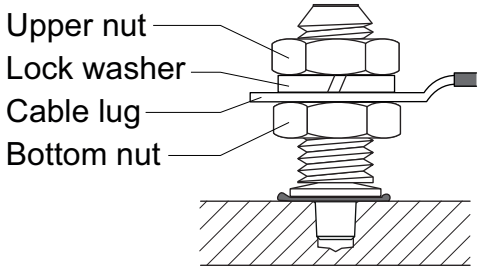
3.2.14.7.4 Installation parameters



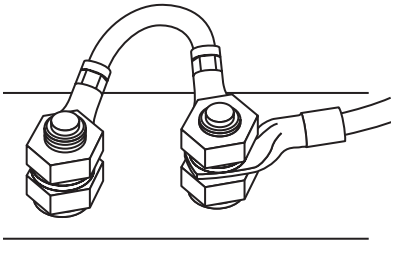
Thickness of base material must be ≥ 5/16'' (8 mm), spacing of the fasteners must be ≥ 5/8'' (15 mm), edge distance of the fasteners must be ≥ 1/4'' (6 mm).

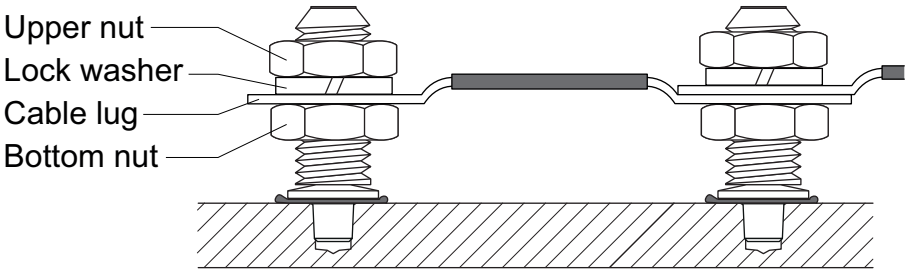
Thickness of base material corrosion protection layer ≤ 0.02'' (0.5 mm). For thicker coatings, please contact Hilti.





Single point connection for all X-BT-ER





Double point connection for X-BT-ER W10/7 SN 8

3.2.14.7.5 Installation Instructions

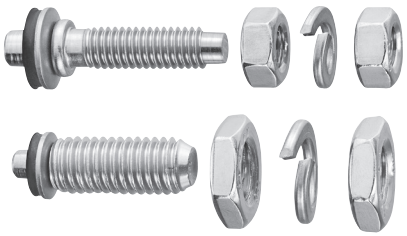
Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com. Because of the possibility of changes, always verify that downloaded IFU are current when used.

Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

3.2.14.7.6 Ordering information*

X-BT-ER Stainless Steel Threaded Studs

Description	Notes	Packaging quantity
X-BT-ER W6/3 SN 8	Including two nuts and one lock washer	100
X-BT-ER W6/7 SN 8	Including two nuts and one lock washer For use with DX 351 only	100
X-BT-ER W10/7 SN 8	Including two nuts and one lock washer	100



* Ordering information about tools and cartridge can be found on pages 77-78.

3.2.15 S-BT HL FASTENING SYSTEMS

3.2.15.1 Product Description

The Hilti S-BT HL Fastening System is an innovative method of fastening to steel or a aluminum base materials. The system consists of threaded stud fasteners and matched installation tools which help ensure proper setting of the fasteners.

The S-BT HL fasteners are manufactured from carbon steel or stainless steel with thread diameters 8 mm (M8) and 3/8" (W10). Carbon steel studs are supplied with an aluminum sealing washer Ø10 mm, stainless steel studs are supplied with a stainless steel sealing washer Ø12 mm, both with an EPDM sealing ring, and are cleanly set in a pre-drilled hole in the base steel. The S-BT system is designed to work on carbon steel from 1/8" to 3/16" thick with a pre-drilled through hole and both carbon steel and Aluminum base materials ≥ 1/4" with a pre-drilled pilot hole.

Product Features

- No propellants required for installation.
- No through penetration of steel and aluminum base materials 1/4" and thicker.
- Little to no rework of coated steel required for non-through hole applications with base material thickness larger than 1/4".
- Fastening options for both stainless and carbon steel materials.
- Increased load capacity compared to the original S-BT threaded studs.

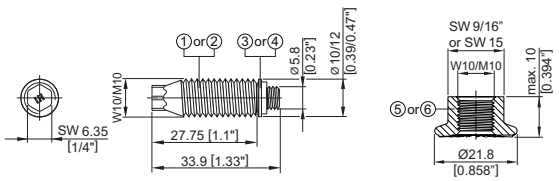
Listings/Approvals

ICC-ES (International Code Council)
ESR-4185 with LABC/LARC Supplement
ABS (American Bureau of Shipping)
LR (Lloyd's Register)
DNV-GL
BV (Bureau Veritas)

3.2.15.2 Material Specifications

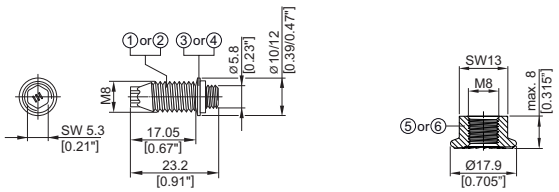
Product	Part	Material designation	Tensile strength, F_u ksi (N/mm²)
Stainless steel (S-BT-_R)	① **Shank**	Corrosion resistant stainless steel S 31803 (1.4462)	≥ 190 (320)
	③ **SN washer**	Corrosion resistant stainless steel S 31603 (1.4404)	N/A
	⑤ **Serrated flange Nut**	Corrosion resistant stainless steel grade A4 – 70/80	≥ 100 (700)
Carbon steel (S-BT-_F)	② **Shank**	Carbon steel 1038 duplex coated	≥ 130 (900)
	④ **AN washer**	Aluminium	N/A
	⑥ **Serrated flange nut**	Carbon steel HDG	≥ 125 (870)
Both stainless steel (S-BT-_R) and carbon steel (S-BT-_F)	**Sealing washer**	Elastomer, black resistant to: UV, water, ozone, oils, etc.	N/A

S-BT-MR W10/15 SN6 HL
S-BT-MF W10/15 AN6 HL
S-BT-MR M10/15 SN6 HL
S-BT-MF M10/15 AN6 HL



S-BT-GR M8/7 SN 6 HL*
S-BT-GF M8/7 AN 6 HL*

* package does not include serrated flange nuts



3.2.15.3 Technical Data

3.2.15.3.1 Load tables

Allowable loads in minimum ASTM A36 (F_y ≥ 36 ksi; F_u ≥ 58 ksi) steel[1,2,3]

Fastener	Steel Thickness in.				Moment lb-ft (Nm)
	1/8, 3/16"		≥ 1/4		
	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	
S-BT-GR M8/7 SN 6 HL S-BT-MR M8/15 SN 6 HL S-BT-MR W10 or M10/15 SN 6 HL	345 (1.53)	675 (3.00)	640 (2.85)	725 (3.23)	8.0 (11.1)
S-BT-GF M8/7 AN 6 HL S-BT-MF W10 or M10/15 AN 6 HL	345 (1.53)	475 (2.11)	640 (2.85)	525 (2.34)	5.0 (6.7)

1 The tabulated allowable values are for the S-BT HL fasteners only, using a safety factor determined as per ICC-ES Acceptance Criteria 499.
2 Multiple fasteners are recommended for any attachment.
3 Allowable loads are applicable to static and seismic loads.

Allowable loads in minimum ASTM G50 (F_y ≥ 50 ksi; F_u ≥ 65 ksi) steel[1,2,3]

Fastener	Steel Thickness in.				Moment lb-ft (Nm)
	1/8, 3/16”		≥ 1/4		
	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	
S-BT-GR M8/7 SN 6 HL S-BT-MR M8/15 SN 6 HL S-BT-MR W10/15 SN 6 HL	380 (1.7)	760 (3.4)	720 (3.2)[4]	810 (3.6)	8.0 (11.1)
S-BT-GF M8/7 AN 6 HL S-BT-MF W10 or M10/15 AN 6 HL	380 (1.7)	510 (2.3)	720 (3.2)	535 (2.4)	5.0 (6.7)

1 The tabulated allowable values are for the S-BT HL fasteners only, using a safety factor calculated as per ICC ES Acceptance Criteria 499.
2 Multiple fasteners are recommended for any attachment.
3 Allowable loads are applicable to static and seismic loads, unless noted otherwise.
4 Allowable tension load for X-BT GR and S-BT MR fasteners is application to static loads only; for seismic loads, multiply this number by 0.94.

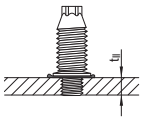
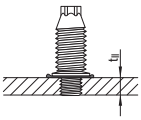
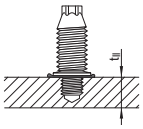
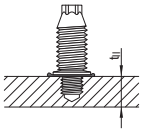
Allowable loads in minimum F_u ≥ 39 ksi aluminum[1,2]

Fastener	Aluminum thickness t_{II} in.		Moment lb-ft (Nm)
	t_{II} ≥ 1/4		
	Tension lb (kN)	Shear lb (kN)	
S-BT-GR M8/7 SN 6 HL S-BT-MR M8/15 SN 6 HL S-BT-MR W10/15 SN 6 HL	470 (2.1)	675 (3.0)	8.0 (11.1)

1 The tabulated allowable values are for the S-BT HL fasteners only.
2 Multiple fasteners are recommended for any attachment.

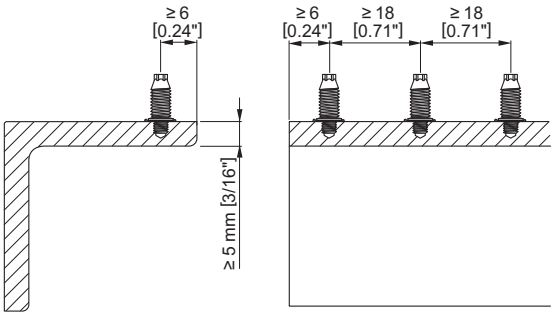
3.2.15.3.2 Additional technical information

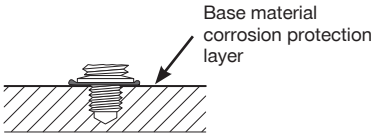
Maximum tightening torque on serrated flange nut, ft-lb (Nm) and type of bore hole

Fastener	Steel thickness t_{II} in.			Aluminum thickness t_{II} in.
	1/8 ≤ t_{II} < 3/16 Torque 5.9 (8)	**3/16 ≤ t_{II} < 1/4** Torque 11.8 (16)	**t_{II} ≥1/4** Torque 11.8 (16)	**t_{II} ≥1/4** Torque 5.9 (8)
S-BT-GR M8/7 SN 6 HL **S-BT-MR W10 or M10/15 SN6 HL** **S-BT-GF M8/7 AN 6 HL** **S-BT-MF W10 or M10/15 AN 6 HL**				
Drill through hole*	Drill through hole*	Pilot hole*	Pilot hole*	

* In case of a drill through hole, or a pilot hole in steel with thickness of 1/4 inch, rework of the coating on the back side of the plate / profile may be needed.

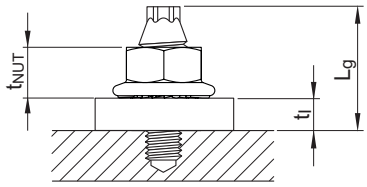
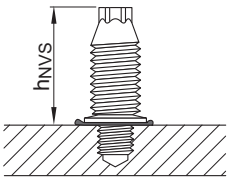
Spacing and edge distances



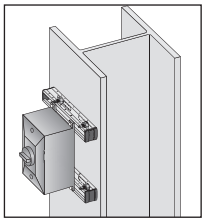
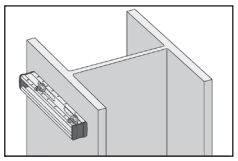
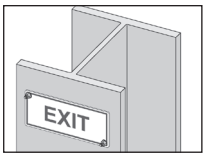
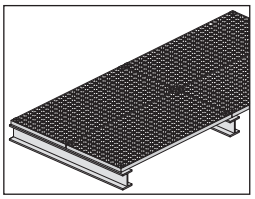


Remark: thickness of base material corrosion protection layer ≤ 0.8 mm [0.032"].
For thicker coatings, please contact Hilti.

Application requirements

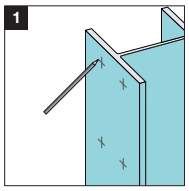
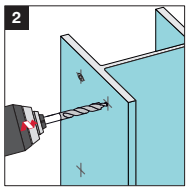
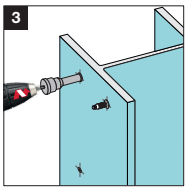
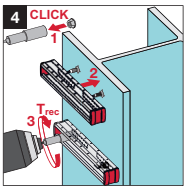
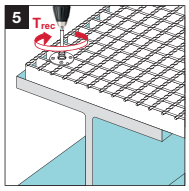
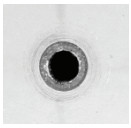
Thickness of fastened materials	Checking stand-off from the base material
	
S-BT-MF W10 or M10/15 AN6 HL: 1.6 mm [0.063"] ≤ t_I ≤15.0 mm [0.59"]	S-BT-MF W10 or M10/15 AN6 HL: h_{NVS} = 29.3 mm to 29.8 mm [1.15" to 1.17"]

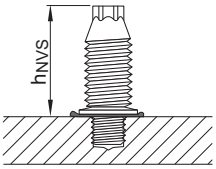
Applications

Multipurpose fastening			Grating with X-FCM*
S-BT-MR W10 or M10/15 SN6 HL			S-BT-GR M8/7 SN6 HL
S-BT-MF W10 or M10/15 AN6 HL			S-BT-GF M8/7 AN6 HL
			
Junction box, etc.	Channel installation	Signage	Grating fastening

* Load data, application requirements, corrosion information, fastener selection, system recommendation, material specification and coating refer to section X-FCM Grating Fastening

3.2.15.4.1 Installation with Calibrated Depth Gauge S-DG BT

<table>
<tr><td>① Mark location for each fastening</td><td>② Pre-drill with TS-BT stepped drill bit</td><td>③ Screw-in S-BT studs into drilled hole</td><td>④ Fasten component or grating on base material</td></tr>
<tr><td>  </td><td>  </td><td>  </td><td>   </td></tr>
<tr><td></td><td>Usage of drill driver SBT 4-A22 or SF 6-(A)22. Pre-drill until the shoulder grinds a shiny ring to assure proper drilling depth.
 
Before fastener installation:
The drilled hole and the area around the drilled hole must be clear of liquids and debris.</td><td>Usage of drill driver SBT 4-A22 or SF 6-(A)22 in combination with the calibrated depth gauge S-DG BT.

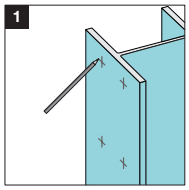
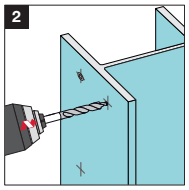
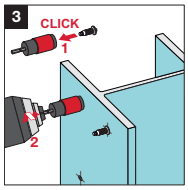
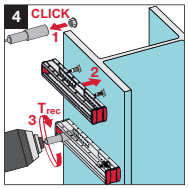
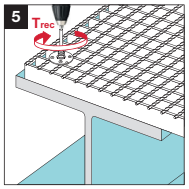
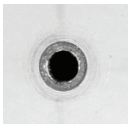
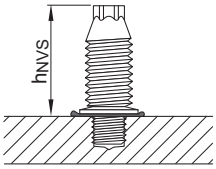
Verify stud stand-off h_{NVS} with check S-CG-BT or S-CC BT 6.
 
Sealing washer must be properly compressed.</td><td>Position component or grating on S-BT studs and hold in place. Tighten the nuts or grating fastener with the suited tightening torque T.

Tighten using:
• Torque wrench and wrench socket, or
• Torque tool S-BT 1/4" - 8 Nm or S-BT 1/4" - 16 Nm, or
• Drill driver SBT 4-A22 or SF 6-(A)22 and suitable wrench socket S-NS

<table>
<tr><td rowspan="2">Hilti screwdriver:</td><td colspan="2">T*)</td></tr>
<tr><td>8 Nm</td><td>16 Nm</td></tr>
<tr><td colspan="3">Torque setting:</td></tr>
<tr><td>SBT 4-A22</td><td>7</td><td>n.a.</td></tr>
<tr><td>SF 6-(A)22</td><td>3</td><td>4</td></tr>
</table>
*) T for grating application:
refer to Product Data Sheet for X-FCM grating faster.</td></tr>
</table>

Important: These are abbreviated instructions which may vary by application. ALWAYS review/follow the instructions for use (IFU) accompanying the product. In case of a drill through hole, rework of the coating on the back side of the plate/profile may be needed.

3.2.15.4.2 Installation with Hilti SBT 6-22 Cordless Drill Driver

① Mark location for each fastening	② Pre-drill with TS-BT 5.3-65 S stepped drill bit	③ Screw-in S-BT studs into drilled hole	④ Fasten component or grating on base material
			 
	Usage of drill driver SBT 6-22. Using “Drill assist” mode. Set the gear selector switch to 2 and BT clutch setting. Speed of the tool reduces automatically when the hole is drilled to the correct depth. A shiny ring should be visible around the borehole after the drilling process.  **Before fastener installation:** The drilled hole and the area around the drilled hole must be clear of liquids and debris.	Usage of drill driver SBT 6-22 in combination with the stud holder S-SH BT. Using “Fasten S-BT stud” mode. Set the gear selector switch to 1 and BT clutch setting. Insert the S-BT stud into the stud holder. The torque limiter trips when the stud reaches the correct depth. Verify stud stand-off h_{NVS} with check S-IC BT.  Sealing washer must be properly compressed.	Position component or grating on S-BT studs and hold in place. Tighten the nuts or grating fastener with the suited tightening torque T. Tighten using: • Torque wrench and wrench socket, or • Torque tool S-BT 1/4" - 8 Nm or S-BT 1/4" - 16 Nm, or • Drill driver SBT 6-22 and suitable wrench socket S-NS

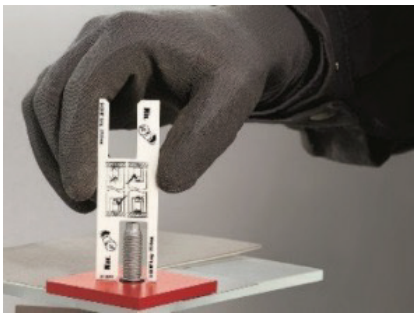
Hilti screwdriver:	T*)	
	8 Nm	16 Nm
	Clutch setting:	
SBT 6-22	3	4

*) T for grating application: refer to Product Data Sheet for X-FCM grating faster.

Important: These are abbreviated instructions which may vary by application. ALWAYS review/follow the instructions for use (IFU) accompanying the product. In case of a drill through hole, rework of the coating on the back side of the plate/profile may be needed..

Fastening inspection for installation with calibrated depth gauge S-DG BT

The installer is responsible for the correct setting of the S-BT studs. For the periodic verification of the correct stud stand-off the S-CG BT check gauge or S-CC BT 6 calibration card can be used.

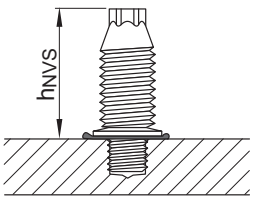


Design and functionality of the check gauge S-CG BT

Verify stud stand-off h_{Nvs} with S-CG BT or S-CC BT 6.

S-BT-____/7____6 h_{Nvs} = 18.6 mm to 19.1 mm (0.732" to 0.752")

S-BT-____/15____6 h_{Nvs} = 29.3 mm to 29.8 mm (1.153" to 1.173")



Fastener quality assurance for installation with calibrated depth gauge S-DG BT

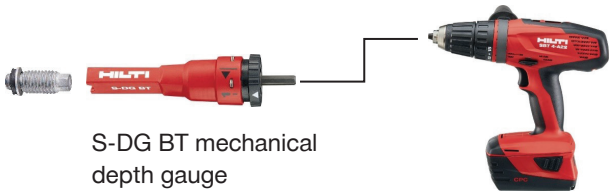
In order to ensure the exact screw-in depth and a properly compressed sealing washer, the S-BT HL studs have to be installed with the appropriate depth gauge. With this tool the screw-in depth can be adjusted in a range of ~0-1.5 mm (3 steps, ~0.5 mm per step).

The S-CC BT calibration card is needed to check the initial stand-off of the S-BT HL stud and to adjust/calibrate the S-DG BT depth gauge. After finding the right adjustment level for the S-DG BT depth gauge, the gauge can be adjusted and the studs can be installed without additional check of the S-DG BT depth gauge.

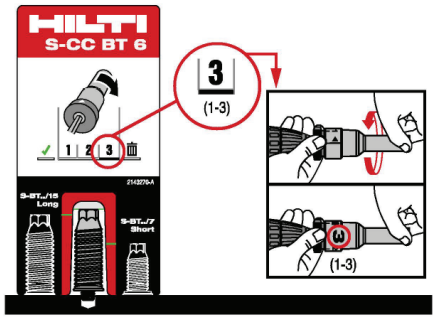
The correct stud stand-off has to be checked and, if necessary, the depth gauge has to be re-adjusted (calibrated) at following times:

- Start of the installation process
- Change of the working position (upwards, downwards, horizontal) and base material (thickness, strength, type)
- Installer change
- After each package change after the installation of 100 S-BT studs

The lifetime of the S-DG BT depth gauge is ≧ 1000 settings.



S-DG BT mechanical depth gauge



Design and functionality of the mechanical calibration card S-CC BT

Fastener quality assurance for installation with SBT 6-22 and S-SH BT

In order to ensure the exact screw-in depth and a proper compressed sealing washer, the S-BT HL studs may be installed with the SBT 6-22 tool. With this tool the screw-in depth of the S-BT HL studs is controlled.

The S-IC BT inspection card can be used to check the stand-off in cases where the washer compression of the S-BT HL is assessed as incorrect (over or under compressed). Based on the coating thickness specified, the user can see if the inspection card shows green in this region. Green indicates the stud is set within the correct embedment depth range. Orange indicates that the stud is under set. To achieve the correct embedment depth, the user can place the tool over the stud and re-trigger in BT mode. This will incrementally add 1/4 rotations. After each trigger the user shall check with the inspection card and stop when the inspection card shows green. If the card shows red, this indicates that the stud is overset and should not be used.

3.2.15.5 Ordering Information

Ordering designation	Item no.	For use with
S-BT-GF M8/7 AN 6 HL threaded stud (use with X-FCM grating disc)	**2345766**	Grating
S-BT-MF M8/7 AN 6 HL threaded stud (includes serrated flange nut)	**2345768**	Multipurpose
S-BT-MF W10/15 AN 6 HL threaded stud (includes serrated flange nut)	**2346061**	Multipurpose
S-BT-GR M8/7 SN 6 HL threaded stud (use with X-FCM grating disc)	**2345767**	Grating
S-BT-MR M8/7 SN 6 HL threaded stud (includes serrated flange nut)	**2346062**	Multipurpose
S-BT-MR M8/15 SN 6 HL threaded stud (includes serrated flange nut)	**2346063**	Multipurpose
S-BT-MR W10/15 SN 6 HL threaded stud (includes serrated flange nut)	**2346065**	Multipurpose
S-BT-MR M8/7 SN 6 HL AL threaded stud (includes serrated flange nut)	**2346066**	Multipurpose
S-BT-MR W10/15 SN 6 HL AL threaded stud (includes serrated flange nut)	**2346069**	Multipurpose
TS-BT 5.3-65 S stepped drill bit	**2346083**	Base material steel
TS-BT 5.3-95 S stepped drill bit	**2346084**	Base material steel
TS-BT 5.5-74 AL stepped drill bit	**2143138**	Base material aluminum
S-SH BTM8 stud holder	**2361441**	S-BT studs M8
S-SH BT M10/W10 stud holder	**2361442**	S-BT studs M10 and W10
S-NS 13 C 95/3 1/4" nut setter	**2149244**	Serrated flange nut M8
S-NS 15 C 95/3 1/4" nut setter	**2149245**	Serrated flange nut M10
S-NS 9/16” C 95/3 1/4" nut setter	**2149246**	Serrated flange nut W10
S-DG BT M8/7 Short 6 depth gauge	**2279735**	Exact setting of the S-BT HL
S-DG BT M8/15 Long 6 depth gauge	**2148575**	Exact setting of the S-BT HL
S-DG BT M10-W10/15 Long 6 depth gauge	**2143261**	Exact setting of the S-BT HL
S-CG BT /7 Short 6 check gauge	**2143262**	Verification of the stud standoff
S-CG BT /15 long check gauge	**2143263**	Verification of the stud standoff
S-IC BT inspection card	**2383883**	Verification of the stud standoff
S-CC BT6 calibration card	**2143270**	Calibration of the depth gauge; Verification of the stud standoff
X-BT 1/4" - 8 Nm manual torque tool	**2119272**	Applying Torque - 8 Nm
S-BT 1/4" - 16 Nm/11 .8 lbf - ft manual torque tool	**2346085**	Applying Torque - 16 Nm
SBT 4-A22 drill driver	**Refer to Hilti Online**	Drilling the pilot hole, setting in the stud and fastening an element
SBT 6-22 drill driver with drill assist and installation assist	**Refer to Hilti Online**	Drilling the pilot hole, setting in the stud and fastening an element
SF 6-A22 drill driver	**Refer to Hilti Online**	Drilling the pilot hole, setting in the stud and fastening an element
SF 6-22 drill driver	**Refer to Hilti Online**	Drilling the pilot hole, setting in the stud and fastening an element

3.2.15.6 S-BT-ER AND S-BT-EF ELECTRICAL CONNECTION SYSTEMS

3.2.15.6.1 Product description

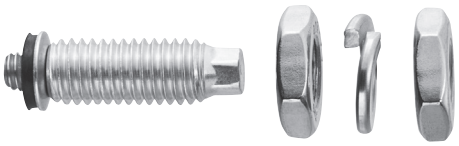
S-BT-ER stainless steel screw-in threaded studs and S-BT-EF carbon steel screw-in threaded studs are designed for electrical connections under permanent current, short circuit current, and lightning current conditions. Packaged with two stainless steel nuts and one stainless steel lock washer, the S-BT-ER can be used for electrical grounding such as bonding and lightning protection under corrosive environments. The S-BT-EF is packaged with two carbon steel nuts and one carbon steel lock washer to be used in non-corrosive environments. High current versions of the S-BT-ER and S-BT-EF are also available (S-BT-ER HC and S-BT-EF HC), which are packaged with one nut, one lock washer, and one copper alloy conductivity disc.

Product Features and benefits

- No propellants required.
- No through penetration of steel base materials 1/4" and thicker.
- Little to no rework of coated steel required for non-through hole applications with base material thickness larger than 1/4''.
- Offer fastening options for both stainless and carbon steel materials.
- Easier removal — S-BT fastener is removable.

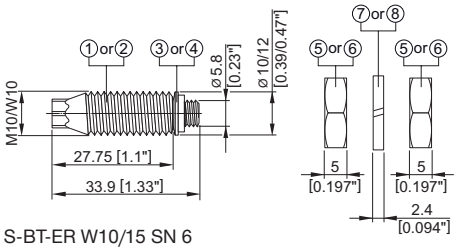
3.2.15.6.2 Material specifications

Product	Part	Material designation
Stainless steel (S-BT-ER)	① **Threaded Shank**	Corrosion resistant stainless steel S 31803 (1.4462), zinc coated
	③ **SN12-R washer**	Corrosion resistant stainless steel S 31603 (1.4404), Ø 0.47” (12mm)
	⑤ **Nut**	Corrosion resistant stainless steel grade A4 / AISI 316
	⑦ **Lock washer**	Corrosion resistant stainless steel grade A4 / AISI 316
Carbon steel (S-BT-EF)	② **Threaded Shank**	Carbon steel 1038 duplex coated
	④ **AN10-F washer**	Aluminum, Ø 0.39” (10mm)
	⑥ **Nut**	Carbon steel HDG
	⑧ **Lock washer**	Carbon steel HDG
Both stainless steel (S-BT-ER) and carbon steel (S-BT-EF)	**Sealing ring of sealing washer**	Chloroprene runner CR 3.1107, black, resistant to UV, salt water, water, ozone, oils, etc.
High Current (S-BT-E_ HC)	⑨ **Conductivity disc**	HC AWG 2 copper alloy CuSn8 (tin coated) with sealing ring
	⑩ **Conductivity disc**	HC AWG 4/0 copper alloy CuSn8 (tin coated) with sealing ring
	Sealing ring of conductivity disc	Resistant to UV, salt water, water, ozone, atmospheric conditions, oils, etc.

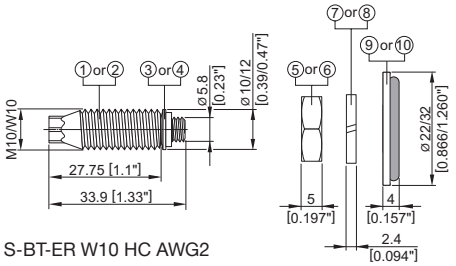


Listings/Approvals

UL (Underwriters Laboratories)
E257069
ABS (American Bureau of Shipping)
Lloyds Register
DNVGL
BV (Bureau Veritas)



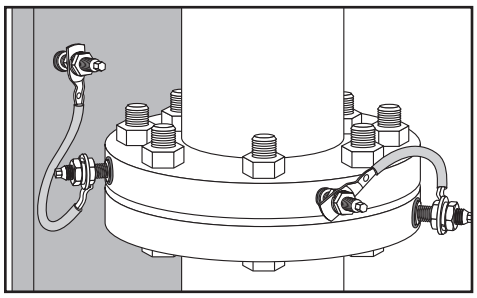
S-BT-ER W10/15 SN 6
S-BT-EF W10/15 AN 6



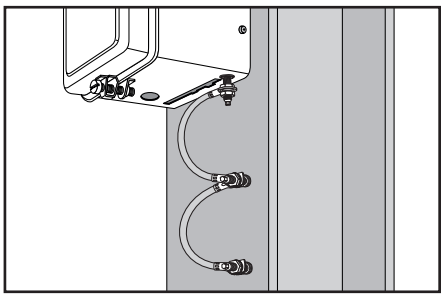
S-BT-ER W10 HC AWG2
S-BT-ER W10 HC AWG4/0
S-BT-EF W10 HC AWG2
S-BT-EF W10 HC AWG4/0

3.2.15.6.3 Technical data

Application examples



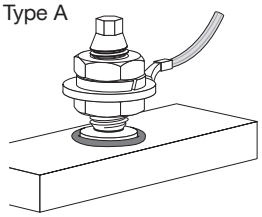
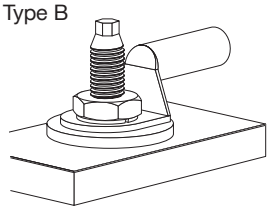
Functional and protective bonding of pipes (outer diameter of installed surface ≥ 5.9”). Only for Type A cable connections



Protective bonding circuit – double point connection

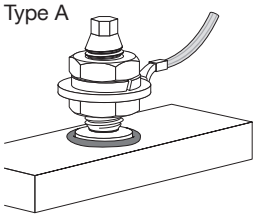
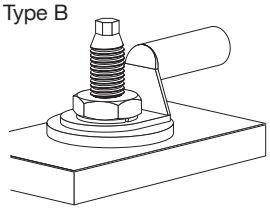
Functional bonding and terminal connection in a circuit

For permanent current (leakage current) due to static charge built up in pipes or when closing an electrical circuit.

Single point connection	Recommended electrical connectors	Maximum allowable permanent current	Notes
Type A 	S-BT-ER W10/15 SN 6 S-BT-EF W10/15 AN 6	= 57 A	Recommended maximum cross section of connected cables according to IEC 60947-7-2 and IEC 60947-7-1: Type A: 8 AWG copper (tested permanent current = 57 A) Type B: 2 AWG copper (tested permanent current = 125 A) 4/0 AWG copper (tested permanent current = 269 A) Fastening of thicker cable is acceptable, if the maximum allowable permanent current is not exceeded and the provisions on cable lug thickness are observed.
Type B 	S-BT-ER W10 HC AWG2 S-BT-EF W10 HC AWG2	= 125 A	
	S-BT-ER W10 HC AWG4/0 S-BT-EF W10 HC AWG4/0	= 269 A	

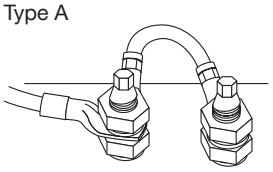
Protective bonding circuit (continued on next page)

For discharging short circuit current while protecting electrical equipment or earth/ground or bonding cable trays and ladders

Single point connection	Recommended electrical connectors	Maximum short circut current according to IEC and UL	Notes
Type A 	S-BT-ER W10/15 SN 6 S-BT-EF W10/15 AN 6	= 1.20 kA (IEC) = 0.75 kA (UL)	Recommended maximum cross section of connected cables according to IEC 60947-7-2 and IEC 60947-7-1: Type A: 8 AWG copper (tested short circuit current = 1.20 kA for 1 s) Type B: 2 AWG copper (tested short circuit current = 4.20 kA for 1 s) 4/0 AWG copper (tested short circuit current = 14.40 kA for 1 s) Recommended maximum cross section of connected cables according to UL 467: Type A: 10 AWG copper (tested short circuit current = 0.75 kA for 4 s) Type B: 2 AWG copper (tested short circuit current = 3.90 kA for 6 s) 4/0 AWG copper (tested short circuit current = 10.10 kA for 9 s) Fastening of thicker cable is acceptable, if the maximum short circuit current and the exposure time is not exceeded and the provisions on cable lug thickness are observed.
Type B 	S-BT-ER W10 HC AWG2 S-BT-EF W10 HC AWG2	= 4.20 kA (IEC) = 3.90 kA (UL)	
	S-BT-ER W10 HC AWG4/0 S-BT-EF W10 HC AWG4/0	= 14.40 kA (IEC) = 10.10 kA (UL)	

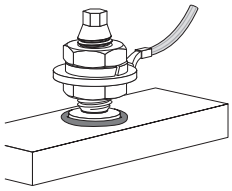
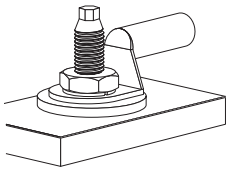
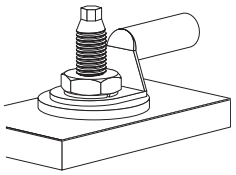
Protective bonding circuit (continued from previous page)

For discharging short circuit current while protecting electrical equipment or earth / ground or bonding cable trays and ladders

Double point connection	Recommended electrical connectors	Maximum short circuit current according to IEC	Notes
Type A 	S-BT-ER W10/15 SN 6 S-BT-EF W10/15 AN 6	= 1.92 kA (IEC)	Recommended maximum cross section of connected cables according to IEC 60947-7-2 and IEC 60947-7-1: 6 AWG copper (tested short circuit current = 1.92 kA for 1 s) Fastening of thicker cable is acceptable, if the maximum short circuit current and the exposure time is not exceeded and the provisions on cable lug thickness are observed.

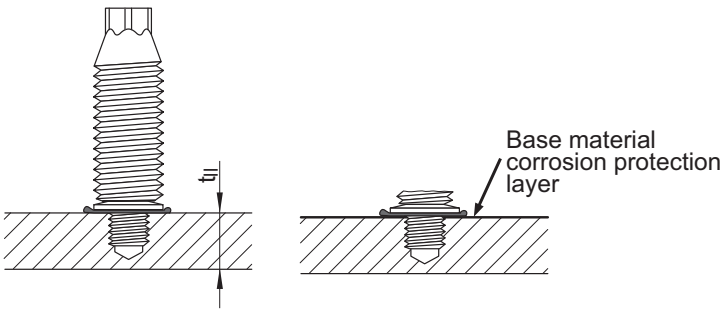
Lightning protection

For high temporary current due to lightning

Single point connection	Recommended electrical connectors	Maximum lightning current	Notes
Classification N (acc. IEC 62561-1): Type A 	S-BT-ER W10/15 SN 6 S-BT-EF W10/15 AN 6	= 50 kA for ≤ 5 ms (IEC 62561-1)	When S-BT-ER/EF is used in class H applications only type B cable connections are allowed. Tightening torque of 5.90 ft-lb (8 Nm) must be observed accurately for type B cable connections.
Classification N (acc. IEC 62561-1): Type B 	S-BT-ER W10 HC AWG2 S-BT-EF W10 HC AWG2 S-BT-ER W10 HC AWG4/0 S-BT-EF W10 HC AWG4/0		
Classification H (acc. IEC 62561-1): Type B 	S-BT-ER W10 HC AWG2 S-BT-EF W10 HC AWG2 S-BT-ER W10 HC AWG4/0 S-BT-EF W10 HC AWG4/0	= 100 kA for ≤ 5 ms (IEC 62561-1)	

Application requirements

Base material thickness t_{II} ≥ 6 mm

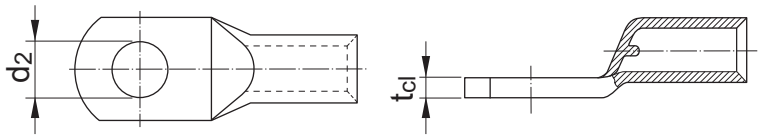


Thickness of base material corrosion protection layer ≤ 0.0315" (0.8 mm). For thicker coatings, please contact Hilti.

For single point connection type B, the conductivity disc must be in direct contact with non-coated base material.

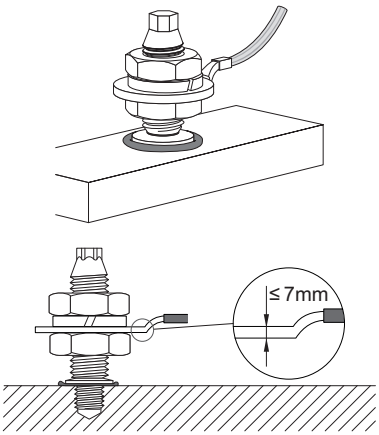
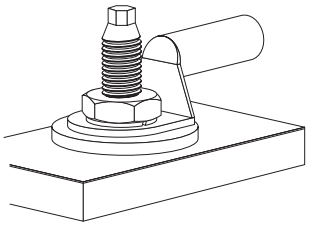
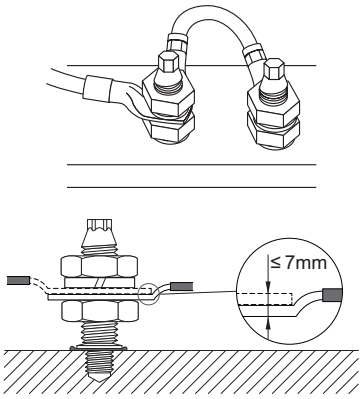
Cable lug characteristics and connector types

Cable lug thickness t_{cl} and inner hole diameter d_2



Fastener	Single point connector				Double point connector	
	Type A		Type B		Type A	
	t_{cl}[1] In. (mm)	d_2 In. (mm)	t_{cl}[1] In. (mm)	d_2 In. (mm)	t_{cl}[1] In. (mm)	d_2 In. (mm)
S-BT-ER W10/15 SN 6	≤ 0.28 (7)	0.375 (9.5) ≤ d_2 ≤ 0.53 (13.5)	-	-	≤ 0.28 (7)	0.375 (9.5) ≤ d_2 ≤ 0.53 (13.5)
S-BT-EF W10/15 AN 6	≤ 0.28 (7)	0.375 (9.5) ≤ d_2 ≤ 0.53 (13.5)	-	-	≤ 0.28 (7)	0.375 (9.5) ≤ d_2 ≤ 0.53 (13.5)
S-BT-ER W10 HC AWG2	-	-	≤ 0.47 (12)	0.375 (9.5) ≤ d_2 ≤ 0.53 (13.5)	-	-
S-BT-EF W10 HC AWG2	-	-	≤ 0.47 (12)	0.375 (9.5) ≤ d_2 ≤ 0.53 (13.5)	-	-
S-BT-ER W10 HC AWG4/0	-	-	≤ 0.47 (12)	0.375 (9.5) ≤ d_2 ≤ 0.53 (13.5)	-	-
S-BT-EF W10 HC AWG4/0	-	-	≤ 0.47 (12)	0.375 (9.5) ≤ d_2 ≤ 0.53 (13.5)	-	-

1 Design current must be considered when determining cable lug thickness.

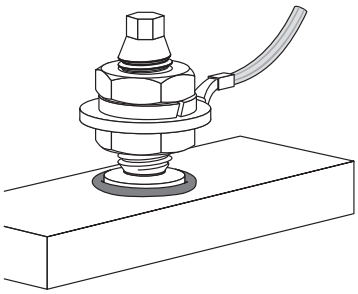
Single point connector		Double point connector
Type A	Type B	Type A
		

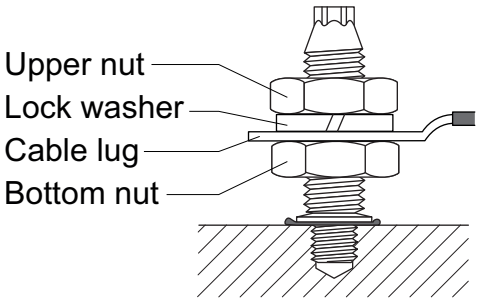
3.2.6.15.4 Installation Instructions

Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com. Because of the possibility of changes, always verify that downloaded IFU are current when used.

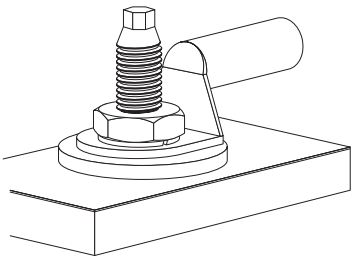
Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

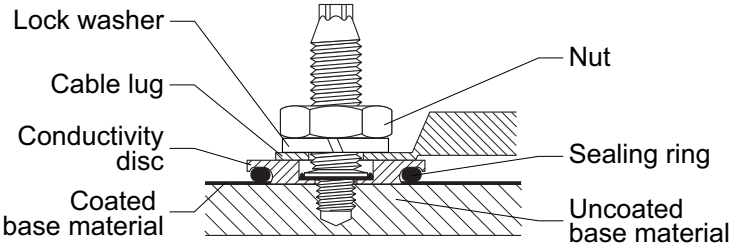
Single point connection type A:



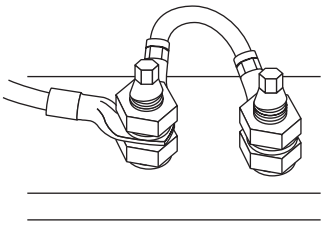


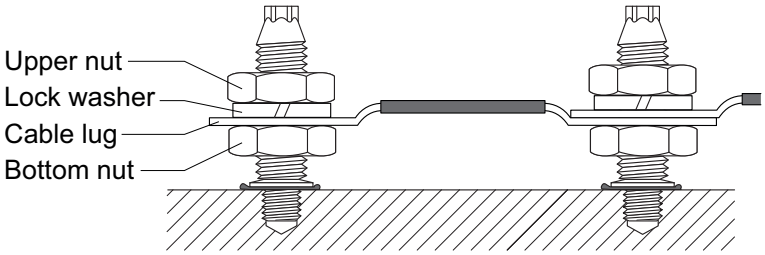
Single point connection type B:





Double point connection type A:



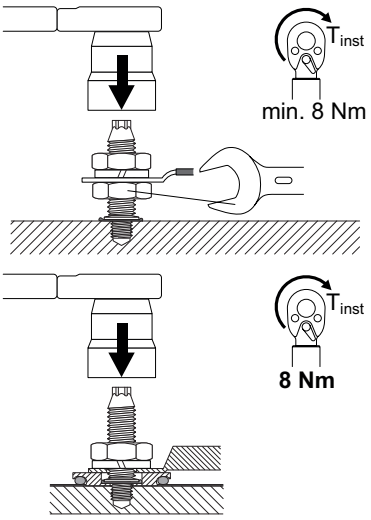


For type B cable connection the following requirements have to be observed::

- The conductivity disc must be in direct contact with the non-coated base material. Coating has to be removed with the coating removal drill bit.
- Tightening torque of 5.90 ft-lb (8 Nm) must be observed accurately.

Torque recommendation

Single point connection type A and double point connection type A:



Hold the bottom nut with a spanner while tightening the upper nut.

Tightening torque:	Min. 5.90 ft-lb (8 Nm) Max. 14.75 ft-lb (20 Nm)

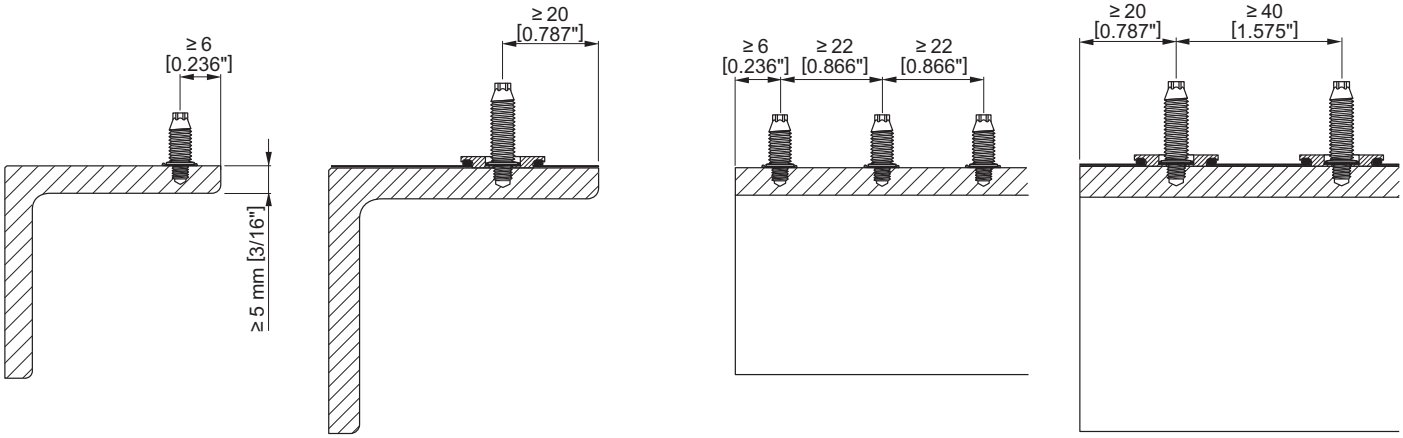
The tightening torque is 5.90 ft-lb (8 Nm). Exceeding or falling below this tightening torque value is not allowed. Tighten the nut using the torque tool X-BT 1/4" (8 Nm), torque wrench, or Hilti screw driver SBT 4-A22, SFC 18-A (torque setting 5) with socket S-NS.

These are abbreviated instructions which may vary by application. **ALWAYS** review and follow the instructions accompanying the product.

Spacing and edge distances:

Edge distance:
Type A connector: ≥ 0.236” (6 mm)
Type B connector: ≥ 0.787” (20 mm)

Spacing:
Type A connector: ≥ 0.866” (22 mm)
Type B connector: ≥ 1.575” (40 mm)



3.2.15.6.5 Ordering information[1,2]

Ordering designation	Notes	Package quantity
S-BT-ER W10/15 SN 6	Includes two nuts and one lock washer	100
S-BT-EF W10/15 AN 6	Includes two nuts and one lock washer	100
S-BT-ER W10 HC AWG2[3]	Includes one nut, one lock washer, and one conductivity disc	100
S-BT-EF W10 HC AWG2[3]	Includes one nut, one lock washer, and one conductivity disc	100
S-BT-ER W10 HC AWG4/0	Includes one nut, one lock washer, and one conductivity disc	100
S-BT-EF W10 HC AWG4/0	Includes one nut, one lock washer, and one conductivity disc	100

1 Ordering information about tools and accessories can be found on page 91-92.
2 Box includes: one W10 check gauge and one TS-BT step drill bit for steel base materials.
3 Available only through special order.

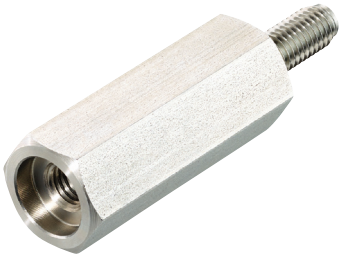
3.2.16 STANDOFF ADAPTERS FOR THREADED STUDS

3.2.16.1 PRODUCT DESCRIPTION

The MR and MF standoff adaptors are used in conjunction with Hilti X-BT and S-BT threaded stud fastening systems, to provide an extension to those fasteners. The threaded studs are installed into steel, according to their installation instructions, to provide a threaded protrusion for a variety of applications, including fastening of electrical cables and conduit, support of slotted framing channel (strut) and hanging of pipes from steel. Both the X-BT and S-BT systems provide a high level of corrosion protection for the steel that is being fastened to. Please see Sections 3.2.14 and 3.2.15 for detailed information regarding these products.

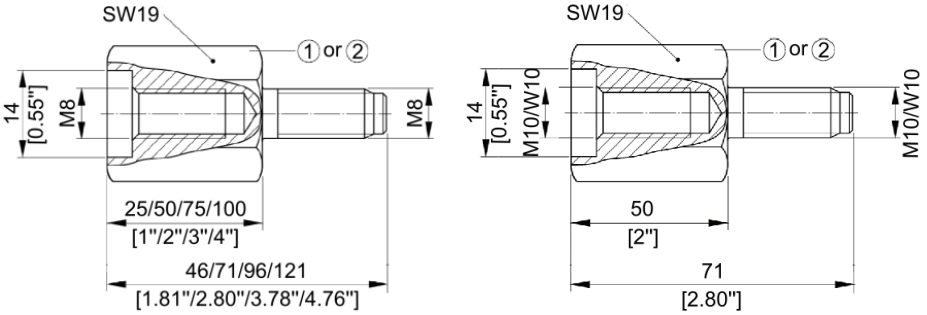
The Standoff Adapters are supplied in four lengths, in order to accommodate situations where a cantilever is needed to complete the application. Specifically, the adapters are used when fastening directly to steel with thick coatings, such as intumescent fire protection coatings. A small cylindrical section of the coating is removed using a special tool, allowing for installation of the X-BT or S-BT stud, followed by screwing the adaptor on the installed threaded stud. The adapter allows for various elements to be attached without damage to the coating as may occur with traditional methods like welding or clamping.

X-BT MR Threaded Stud



MR-M8 Standoff Adaptor

3.2.16.2 MATERIAL SPECIFICATIONS



Designation	Internal Thread Diameter	Standoff height in. (mm)	Overall height in. (mm)	Material designation [1,2]
Adapter M8-MR 25	8 mm	0.98 (25)	1.81 (46)	Stainless steel
Adapter M8-MR 50	8 mm	1.97 (50)	2.80 (71)	Stainless steel
Adapter M8-MR 75	8 mm	2.96 (75)	3.78 (96)	Stainless steel
Adapter M8-MR 100	8 mm	3.94 (100)	4.76 (121)	Stainless steel
Adapter M8-MF 25	8 mm	0.98 (25)	1.81 (46)	Carbon steel HDG
Adapter M8-MF 50	8 mm	1.97 (50)	2.80 (71)	Carbon steel HDG
Adapter M8-MF 75	8 mm	2.96 (75)	3.78 (96)	Carbon steel HDG
Adapter M8-MF 100	8 mm	3.94 (100)	4.76 (121)	Carbon steel HDG
Adapter W10-MR 50	3/8”	1.97 (50)	2.80 (71)	Stainless steel
Adapter W10-MF 50	3/8”	1.97 (50)	2.80 (71)	Carbon steel HDG

1 Stainless steel - AISI 316 (X5CrNiMo)
2 Carbon steel - duplex coated

3.2.16.3 APPLICATION

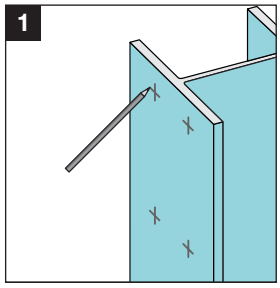
3.2.16.3.1 STANDOFF ADAPTOR WITH S-BT THREADED STUDS

S-BT threaded studs with Hilti standoff adapter for attaching instrumentation. junction boxes, lighting, installation channel systems etc. to steel with a Passive Fire Protection (PFP) coating or insulated steel members e.g. instulated bulkheads.

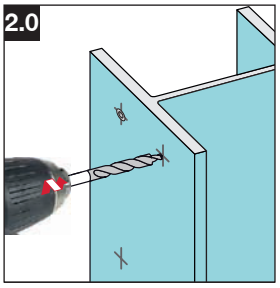
Installation Instructions

Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com. Because of the possibility of changes, always verify that downloaded IFU are current when used.

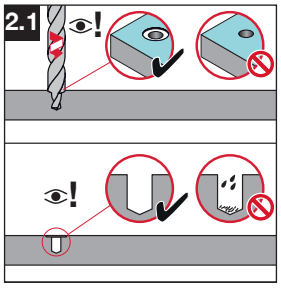
Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.



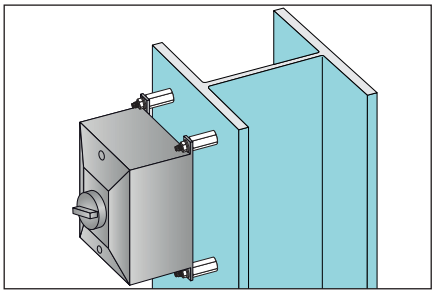
Mark location of each fastening.

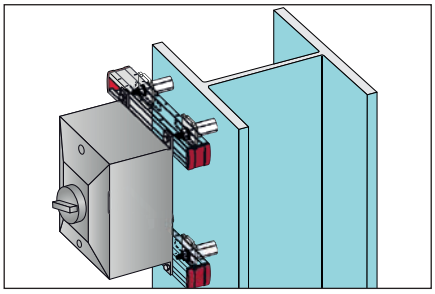


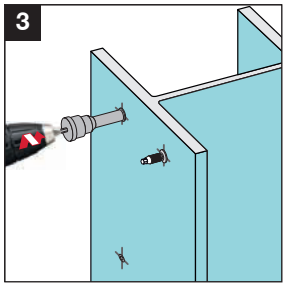
Pre-drill with TS-BT stepped drill bit.



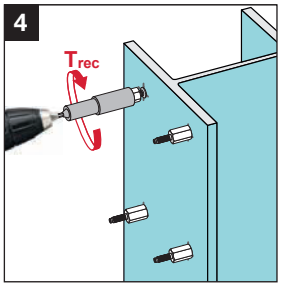
Pre-drill until shoulder grinds a shiny ring. The drilled hole and the area around drilled hole must be clean and free from liquids and debris.



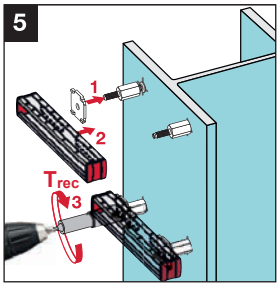




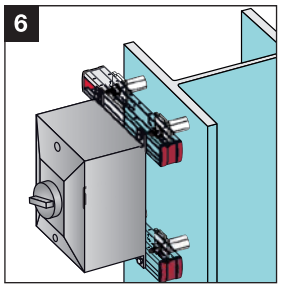
Screw-in S-BT studs into drilled hole.



Screw-on the Hilti standoff adapter on the S-BT stud and tighten it with the suited installation torque.



Position channel on standoff adapter and hold in place. Tighten the nuts with a tightening torque T_{rec} of 20 Nm.



Fasten the accessory on the channel with the suited installation torque.

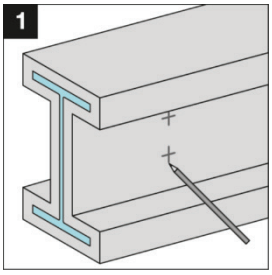
Tightening torque (standoff adapter on S-BT)
T_{rec} = 8 Nm
T_{rec} = 5 Nm [1)]

[1)] for steel base material thickness
3 mm ≤ tII < 5 mm

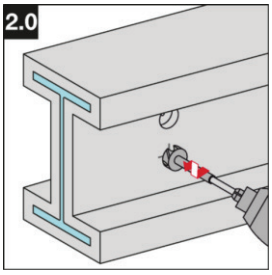
Tightening torque (nut on standoff adapter)
T_{rec} = 20 Nm

Notes:
1. See section 3.2.16.5 and 3.2.15 for more detailed instructions on the setting procedure for S-BT threaded studs.
2. The Standoff Adaptor can be used with X-BT threaded studs for applications similar to those shown above. It can also be used with both the X-BT and S-BT where Passive Fire Protection (PFP) coating is present. The installation process is similar but includes removal of a plug of the PFP. See application instructions 3.2.16.3.2 below for more information.

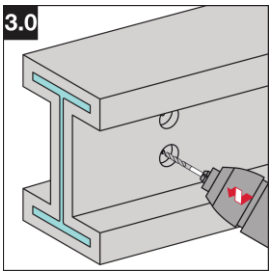
3.2.16.3.2 STANDOFF ADAPTOR WITH X-BT THREADED STUDS AND PFP COATED STEEL



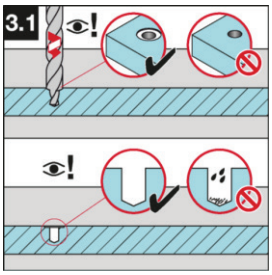
Mark location of each fastening.



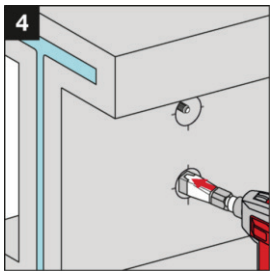
Pre-drill with TS-BT 31-74 PFP stepped drill bit...



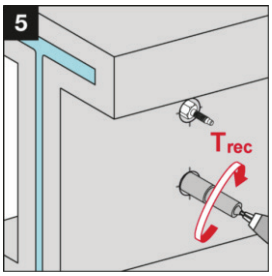
Pre-drill with TX-BT stepped drill bit...



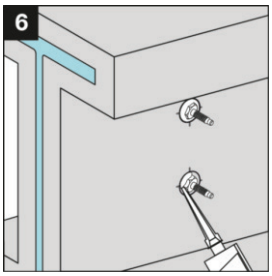
... until shoulder grinds a shiny ring. The area must be clean and free from liquids and debris.



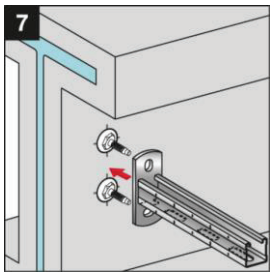
Set X-BT studs into drilled hole.



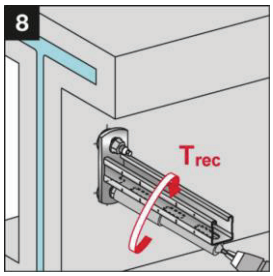
Tighten the standoff adapter with the recommended installation torque of 8 Nm.



Close the opening less than 4 hours after the opening is made in accordance to the patching instructions by the PFP-manufacturer.



Position accessory on standoff adapter and hold in place.

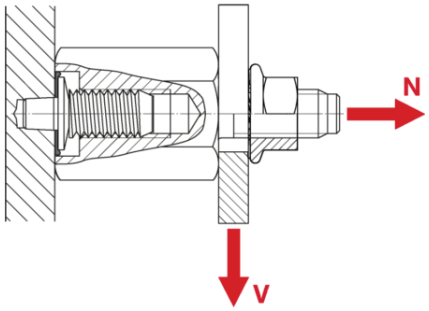


Fasten the accessory on the standoff adapter with the recommended installation torque of 20 Nm.

Notes:
1. See section 3.2.16.5 and 3.2.15 for more detailed instructions on the setting procedure for S-BT threaded studs.
2. The Standoff Adaptor can be used with S-BT threaded studs for applications similar to those shown above. Both the X-BT and S-BT can also be used in applications where Passive Fire Protection (PFP) coating is not present. The installation process is similar but does not include removal of the PFP. See application instructions 3.2.16.3.1 above for more information.

3.2.16.4 TECHNICAL DATA

3.2.16.4.1 LOAD APPLICATION



3.2.16.4.2 NORTH AMERICAN LOAD TABLES

Allowable static loads — Standoff Adaptor with X-BT MR threaded studs [1,2,3,4,5]

Load type/fastener		Minimum ASTM A36 steel	Miniumum grade 50 steel
Tension, lb (kN) 25, 50, 75, 100 mm		775 (3.45)	840 (3.74)
Shear, lb (kN) 25 mm Adaptor		175 (0.78)	205 (0.91)
Shear, lb (kN) 50 mm Adaptor		95 (0.42)	115 (0.51)
Shear, lb (kN) 75 mm Adaptor		75 (0.33)	85 (0.38)
Shear, lb (kN) 100 mm Adaptor		50 (0.22)	60 (0.27)
Tightening Torque, ft-lb (Nm)[6]	Standoff Adaptor on X-BT	5.9 (8.0)	5.9 (8.0)
	Nut on Standoff Adaptor	14.8 (20.0)	14.8 (20.0)

Notes:
1. Allowable loads are for MR and MF Standoff Adaptors in conjunction with X-BT MR M8 threaded studs. Moments on the stud beyond those induced by the shear load must be evaluated.
2. All installation parameters for X-BT MR M8 fasteners must be followed.
3. Allowable loads based on a minimum safety factor of 5.0 applied to the average ultimate load.
4. Multiple fasteners are recommended for any attachment.
5. Fastened material must be considered separately.
6. When installing nut on standoff adaptor, care should taken to ensure standoff adaptor connection to S-BT does not experience excess torque.

Allowable static loads — Standoff Adaptor with S-BT threaded studs [1,2,3,4,5]

Load type/fastener		Minimum ASTM A36 steel		Miniumum grade 50 steel	
		1/8" - 3/16" Thick	≥ 7/32" Thick	1/8" - 3/16" Thick	≥ 7/32" Thick
Tension, lb (kN) 25, 50, 75, 100 mm		225 (1.00)	405 (1.80)	295 (1.31)	520 (2.31)
Shear, lb (kN) 25 mm Adaptor		85 (0.38)	120 (0.53)	100 (0.44)	145 (0.64)
Shear, lb (kN) 50 mm Adaptor		45 (0.20)	65 (0.29)	55 (0.24)	80 (0.36)
Shear, lb (kN) 75 mm Adaptor		35 (0.16)	50 (0.22)	40 (0.18)	60 (0.27)
Shear, lb (kN) 100 mm Adaptor		25 (0.11)	35 (0.16	30 (0.13)	40 (0.18)
Tightening Torque, ft-lb (Nm)[6]	Standoff Adaptor on S-BT	3.6 (5.0)	5.9 (8.0)	3.6 (5.0)	5.9 (8.0)
	Nut on Standoff Adaptor	14.8 (20.0)	14.8 (20.0)	14.8 (20.0)	14.8 (20.0)

Notes:
1. Allowable loads are for MR and MF Standoff Adaptors in conjunction with S-BT threaded studs. Moments on the stud beyond those induced by the shear load must be evaluated.
2. All installation parameters for S-BT fasteners must be followed.
3. Allowable loads based on a minimum safety factor of 5.0 applied to the average ultimate load.
4. Multiple fasteners are recommended for any attachment.
5. Fastened material must be considered separately.
6. When installing nut on standoff adaptor, care should taken to ensure standoff adaptor connection to S-BT does not experience excess torque.

3.2.16.4.3 EUROPEAN LOAD TABLES

Recommended static loads — Standoff Adaptor with X-BT MR threaded studs [1,2,3,4,5]

Load type/fastener		Minimum ASTM A36 Steel	Minimum grade 50 steel
Tension, lb (kN) 25, 50, 75, 100 mm		810 (3.60)	1035 (4.60)
Shear, lb (kN) 25 mm Adaptor		255 (1.14)	320 (1.43)
Shear, lb (kN) 50 mm Adaptor		140 (0.62)	175 (0.78)
Shear, lb (kN) 75 mm Adaptor		115 (0.52)	145 (0.65)
Shear, lb (kN) 100 mm Adaptor		80 (0.35)	100 (0.44)
Tightening Torque, ft-lb (Nm)[6]	Standoff Adaptor on X-BT	5.9 (8.0)	5.9 (8.0)
	Nut on Standoff Adaptor	14.8 (20.0)	14.8 (20.0)

Notes:
1. Recommended laods are for MR and MF Standoff Adaptors in conjunction with X-BT MR M8 threaded studs. Moments on the stud beyond those induced by the shear load must be evaluated.
2. All installation parameters for X-BT MR M8 fasteners must be followed.
3 Recommended loads are based on a global safety factor of 2.8 applied to the characteristic resistance for static tension or shear, which are derived from the 5% fractile of the ultimate load. Recommended moment values are based on a global safety factor of 1.75. This safety concept is commonly used in regions outside of North America, where design is carried out in accordance with the Eurocode.
4. Multiple fasteners are recommended for any attachment.
5. Fastened material must be considered separately.
6. When installing nut on standoff adaptor, care should taken to ensure standoff adaptor connection to S-BT is does not experience excess torque.

Design resistance — Standoff Adaptor with X-BT MR threaded studs [1,2,3,4,5]

Load type/fastener	Minimum ASTM A36 Steel	Minimum grade 50 steel
Tension, lb (kN) 25, 50, 75, 100 mm	1120 (5.00)	1460 (6.50)
Shear, lb (kN) 25 mm Adaptor	360 (1.60)	450 (2.00)
Shear, lb (kN) 50 mm Adaptor	195 (0.87)	245 (1.09)
Shear, lb (kN) 75 mm Adaptor	165 (0.73)	205 (0.91)
Shear, lb (kN) 100 mm Adaptor	110 (0.49)	135 (0.61)

Notes:
1. Design resistances are for MR and MF Standoff Adaptors in conjunction with X-BT MR M8 threaded studs. Moments on the stud beyond those induced by the shear load must be evaluated.
2. All installation parameters for X-BT MR M8 fasteners must be followed.
3. Design resistance is based on a safety factor of γM = 2.0 applied to the characteristic resistance for static tension or shear, which is derived from the 5% fractile of the ultimate load. Design resistance should be greater than calculated demand that has been reduced by a partial safety factor. This safety concept is commonly used in regions outside of North America, where design is carried out in accordance with the Eurocode.
4. Multiple fasteners are recommended for any attachment.
5. Fastened material must be considered separately.

Recommended static loads — Standoff Adaptor with S-BT threaded studs [1,2,3,4,5]

Load type/fastener		Minimum ASTM A36 steel		Miniumum grade 50 steel	
		1/8" - 3/16" Thick	≥ 7/32" Thick	1/8" - 3/16" Thick	≥ 7/32" Thick
Tension, lb (kN) 25, 50, 75, 100 mm		405 (1.8)	425 (1.9)	470 (2.1)	515 (2.3)
Shear, lb (kN) 25 mm Adaptor		125 (0.55)	190 (0.84)	125 (0.55)	225 (1.00)
Shear, lb (kN) 50 mm Adaptor		70 (0.31)	100 (0.45)	70 (0.31)	120 (0.54)
Shear, lb (kN) 75 mm Adaptor"		55 (0.24)	75 (0.33)	55 (0.24)	90 (0.40)
Shear, lb (kN) 100 mm Adaptor		40 (0.18)	50 (0.23)	40 (0.18)	60 (0.28)
Tightening Torque, ft-lb (Nm)[6]	Standoff Adaptor on S-BT	3.6 (5.0)	5.9 (8.0)	3.6 (5.0)	5.9 (8.0)
	Nut on Standoff Adaptor	14.8 (20.0)	14.8 (20.0)	14.8 (20.0)	14.8 (20.0)

Notes:
1. Recommended loads are for MR and MF Standoff Adaptors in conjunction with S-BT threaded studs. Moments on the stud beyond those inudced by the shear load must be evaluated.
2. All installation parameters for S-BT fasteners must be followed.
3. Recommended loads are based on a global safety factor of 2.8 applied to the characteristic resistance for static tension or shear, which are derived from the 5% fractile of the ultimate load. Recommended moment values are based on a global safety factor of 1.75. This safety concept is commonly used in regions outside of North America, where design is carried out in accordance with the Eurocode.
4. Multiple fasteners are recommended for any attachment.
5. Fastened material must be considered separately.
6. When installing nut on standoff adaptor, care should taken to ensure standoff adaptor connection to S-BT is does not experience excess torque.

Design resistance — Standoff Adaptor with S-BT threaded studs [1,2,3,4,5]

Load type/fastener	Minimum ASTM A36 steel		Minimum grade 50 steel	
	1/8" - 3/16" Thick	≥ 7/32" Thick	1/8" - 3/16" Thick	≥ 7/32" Thick
Tension, lb (kN) 25, 50, 75, 100 mm	560 (2.5)	605 (2.7)	670 (3.0)	715 (3.2)
Shear, lb (kN) 25 mm Adaptor	170 (0.77)	260 (1.17)	170 (0.77)	315 (1.41)
Shear, lb (kN) 50 mm Adaptor	95 (0.43)	140 (0.64)	95 (0.43)	170 (0.76)
Shear, lb (kN) 75 mm Adaptor	75 (0.34)	105 (0.47)	75 (0.34)	125 (0.55)
Shear, lb (kN) 100 mm Adaptor	55 (0.25)	70 (0.32)	55 (0.25)	90 (0.39)

Notes:
1. Design resistances are for MR and MF Standoff Adaptors in conjunction with S-BT threaded studs. Moments on the stud beyond those induced by the shear load must be evaluated.
2. All installation parameters for S-BT fasteners must be followed.
3. Design resistance is based on a safety factor of γM = 2.0 applied to the characteristic resistance for static tension or shear, which is derived from the 5% fractile of the ultimate load. Design resistance should be greater than calculated demand that has been reduced by a partial safety factor. This safety concept is commonly used in regions outside of North America, where design is carried out in accordance with the Eurocode.
4. Multiple fasteners are recommended for any attachment.
5. Fastened material must be considered separately.

3.2.16.5 INSTALLATION INSTRUCTIONS

Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com. Because of the possibility of changes, always verify that downloaded IFU are current when used.

Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

3.2.16.6 ORDERING INFORMATION

Description	Ordering designation (package quantity)	Item number
Standoff Adaptors (includes one M8 flange nut per adaptor)	Adapter M8-MR 25 (50)	2268522
	Adapter M8-MR 50 (50)	2268523
	Adapter M8-MR 75(50)	2268524
	Adapter M8-MR 100(50)	2268525
	Adapter M8-MF 25 (50)	2268526
	Adapter M8-MF 50 (25)	2268527
	Adapter M8-MF 75 (25)	2268528
	Adapter M8-MF 100 (25)	2268529
	Adapter W10-MR 50 (25)	2281191
	Adapter W10-MF 50 (25)	2281192
Drill bit (S-BT installation only)	Drill Bit TS-BT 5.5-74 S	2143137
Drill bit (X-BT installation only)	Drill Bit TX-BT 4.7/7 - 150	2197629
Drill bit for PFP coating removal (X-BT and S-BT)	Drill Bit TS-BT 31-74 PFP	2270470

Note: For additional installation accessories for X-BT threaded studs and S-BT threaded studs, see sections 3.2.14 and 3.2.15 respectively.

3.2.17 MECHANICAL/ELECTRICAL CLIPS AND HANGERS

3.2.17.1 PRODUCT DESCRIPTION

X-DR and X-DR MX Drop Rods

For suspending telecommunications, electrical cables or conduits from concrete ceiling or steel members. Available as single clip or with a preassembled 1/4” threaded or smooth rod. Drop rods are available with premium pre-mounted fasteners (X-DR) for use with powder actuated tools or without pre-mounted fasteners (X-DR MX) for use with battery actuated tools and X-S B3/B4 or X-P B3/B4 fasteners. The product is UL/cUL listed per NEC requirements. Product meets ANSI/TIA/EIA-568-A/-569-A, UL 2239 standards for cable and conduit support devices, which limits center-to-center spacing for hangers to 5’ or less.

X-BW Batwing Clip

For suspending single thin wall and small rigid conduits or single metal clad electrical cables to a 1/4” threaded or smooth rod, 8 to 12 ga. wire, or steel flange. Contact Hilti for UL/cUL listing information.

X-MS and X-MS BW MC stackers

For suspending multiple metal clad electrical cables to a 1/4” threaded or smooth rod and 8 to 12 ga. wire. This product is UL/cUL listed.

X-HS and X-EHS MX Hangers

Threaded rod hangers available with pre-mounted fastene (X-HS W6 and X-HS W10) or without pre-mounted fastene (X-EHS W6 MX) for use with magazine tools. For attachment of 1/4” (W6) or 3/8” (W10) threaded roads to concrete or steel.

Threaded Studs with Couplers

For attachment of 1/4” (X-W6) or 3/8” (W10) threaded rods to concrete or steel. More information on Threaded Studs can be found in Section 3.2.11 and 3.2.12.

X-DH and X-DH BW Data Hooks

For suspending telecommunication cables in side mounting or ceiling applications (X-DH). Also available with a batwing connection (X-DH BW) for suspending telecommunication cables attachments to a 1/4” threaded or smooth rod or 8 to 12 ga wires. The product is UL/cUL listed, plenum rated (for air handling spaces) per requirements of UL 62275 and CAN/CSA C22.2 No. 62275.

X-ECH Cable Holder

For supporting telecommunication or electrical cable from concrete or steel. UL/cUL listed, plenum rated (for air handling spaces) per the requirements of UL62275 and CAN/CSA C22.2 No. 62275.

Listings/Approvals

ICC-ES (International Code Council)
ICC-ES (International Code Council) ESR-2795 (X-HS, X-DR and X-DR MX) with LABC/LARC Supplement

FM (Factory Mutual)
W10-30-27P10, W10-30-32P10 and W10-30-42P10 fasteners for sprinkler pipe hangers in concrete

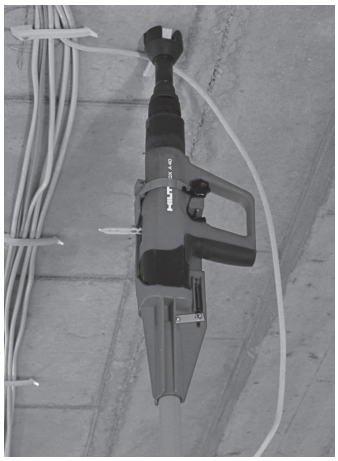
EW10-30-15P10, X-EW10H, X-EW6H and X-HS U19 fasteners for sprinkler pipe hanger in steel

UL (Underwriters Laboratories)
X-ECH, X-EKB and X-ECT hangers for positioning devices

W10-30-32P10, W10-30-42P10, EW10-30-15P10, X-EW10H and X-EW6H fasteners for sprinkler pipe hangers

Cable and Conduit Hardware Hangers X-HS W6, X-HS W10 and EMTSC, X-DR, X-DR MX, X-DH, X-DH BW, X-BW, X-MS, X-MX BW, X-BR, X-BR MX, X-BR S and X-BR S MX

Threaded and smooth rod hangers



Cable and conduit attachment

X-BR S and X-BR S MX Bridle ring with saddle

For telecommunication cable applications. Bridle ring with saddle increases the cable holding surface and provides optimal bending radius for cables. Product is available with premium pre-mounted fasteners (X-BR S) for use with powder actuated tools or without pre-mounted fasteners (X-BR S MX) for use with battery actuated tools. UL/cUL listed, plenum rated (for air handling spaces) per the requirements of UL62275 and CAN/CSA C22.2 No. 62275.

X-BR and X-BR MX Bridle Ring

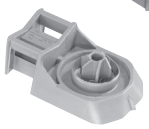
For telecommunication, network wiring, or metal clad electrical cable fastenings to concrete ceilings. Product is available with premium pre-mounted fasteners (X-BR)) for use with powder actuated tools or without pre-mounted fasteners (X-BR MX) for use with Battery-actuated Tools. UL/cUL listed.

X-EKB MX Cable Clamps

For telecommunications and network wiring applications. Cable clamp attached directly to base material; designed to support multiple cables approximately 1/4" in diameter. UL/ cUL listed.

X-ECT Cable Tie Fastener

For telecommunications and premise wiring applications. Cable or conduit support using an adjustable cable tie to secure cable or pipe.UL/cUL listed.



X-EMTC and X-BX/EMTC MX Thin Wall Conduit Clips

Thin wall conduit clips available with standard pre-mounted fastener (X-EMTC C27) or premium pre-mounted fastener (X-EMTC U22.) Also available without pre-mounted fastener for use with magazine tools (X-BX/EMTC MX) for use with magazine tools. For fastening thin wall conduit.

X-EMTSC MX Stand-Off Conduit Clips

Similar to EMTC clips to hold conduits away from base material and align conduit to knockouts on junction boxes. UL/ cUL listed.

X-ECC MX

Metal ceiling clip for light-duty electrical/mechanical fastenings on ceiling and use with collated fasteners. For use with cable trays and electrical applications.

3.2.17.2 MATERIAL SPECIFICATIONS

Clip/hanger designation	Fastener material	Fastener plating[1]	Clip/hanger material	Clip/hanger plating
X-HS W10/W6	Carbon Steel	5 um Zinc	Carbon Steel	5 um Zinc
X-HS W6 MX	Carbon Steel	5 um Zinc[2]	Carbon Steel	5 um Zinc
X-ECH	Carbon Steel	5 um Zinc	Nylon Plastic	N/A
X-EKB MX	Carbon Steel	5 um Zinc[2]	Plastic	N/A
X-ECT MX	Carbon Steel	5 um Zinc[2]	Plastic	N/A
X-EMTC	Carbon Steel	5 um Zinc	Carbon Steel	5 um Zinc
X-BX/EMTC MX	Carbon Steel	5 um Zinc[2]	Carbon Steel	5 um Zinc
X-EMTSC MX	Carbon Steel	5 um Zinc[2]	Carbon Steel	5 um Zinc
X-DR	Carbon Steel	5 um Zinc	Carbon Steel	5 um Zinc
X-DR MX	Carbon Steel	5 um Zinc[2]	Carbon Steel	5 um Zinc
X-ECC MX	Carbon Steel	5 um Zinc[2]	Carbon Steel, Plastic	5 um Zinc
X-BR / X-BR S	Carbon Steel	5 um Zinc	Carbon Steel, Polyamid (Saddle)	5 um Zinc
X-BR MX / X-BR S MX	Carbon Steel	5 um Zinc[2]	Carbon Steel, Polyamid (Saddle)	5 um Zinc
X-DH / X-DH BW	N/A	N/A	Carbon Steel, Nylon Plastic (Saddle) Spring Steel (Batwing)	5 um Zinc
X-BW	N/A	N/A	Spring Steel	5um zinc
X-MS / X-MS BW	N/A	N/A	Carbon Steel, Plastic, Spring Steel	5 um Zinc

1 The 5 µm coating is in accordance with ASTM B633, SC1, Type III. Reference Section 2.3.3.1 for more information.
2 Noted clips/hangers do not come with a pre-mounted power-actuated fastener. Collated battery actuated fasteners are recommended to be used with those clips. Material and plating information provided for the poder-actuated fasteners commonly used with these clips.

Allowable loads in normal weight concrete[1,2]

Description	Fastener	Shank diameter	Concrete compressive strength						
			2000 psi			4000 psi			6000 psi
			Tension	Shear	45-Degree[3]	Tension	Shear	45-Degree	Tension
		in. (mm)	lb (kN)	lb (kN)	lb (kN)	lb (kN)	lb (kN)	lb (kN)	lb (kN)
Threaded Rod Hanger with pre-mounted fastener	X-HS U32	0.157 (4.0)	75 (0.33)	100 (0.44)	60 (0.27)	85 (0.38)	150 (0.67)	120 (0.53)[3]	–
	X-HS U22	0.157 (4.0)	50 (0.22)	–	–	50 (0.22)	–	–	–
X-DR Drop rod with pre-mounted fastener	X-ALH 22	0.177 (4.5)	–	–	–	40 (0.18)	–	–	–
	X-ALH 27	0.177 (4.5)	–	–	–	50 (0.22)	–	–	100 (0.44)
X-DR MX Drop rod	X-P 20 B3/B4	0.118 (3.0)	–	–	–	30 (0.13)	–	–	–
X-ECC MX	X-P 20 B3/B4	0.118 (3.0)	–	–	–	30 (0.13)[4]	–	–	–

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70.
2 Multiple fasteners are recommended for any attachment. Threaded or smooth rod must be investigated in accordance with accepted design criteria.
3 Allowable loads for 45-degree applications are based on testing. For allowable loads at other angles of installation, refer to Section 3.2.1.8.
4 Nail stand-off must be less than or equal to 0.2-inch, testing was done using concrete with 3,500 psi compressive strength

Allowable loads in minimum f'_c = 3000 psi structural lightweight concrete[1]

Fastener	Shank diameter	Fastener location														
		Installed into concrete			Installed through 3" deep metal deck into concrete[2]						Installed through 1-1/2" deep metal deck into concrete[3]					
					Upper flute			Lower flute			Upper flute			Lower flute		
		Tension	Shear	45-Degree	Tension lb (kN)	Shear lb (kN)	45-Degree[6] lb (kN)	Tension lb (kN)	Shear\ lb (kN)	45-Degree lb (kN)	Tension lb (kN)	Shear lb (kN)	45-Degree lb (kN)	Tension lb (kN)	Shear lb (kN)	45-Degree lb (kN)
X-HS U32[4,5,7]	0.157 (4.0)	95 (0.42)	115 (0.51)	105[6] (0.47)	125 (0.56)	220 (0.98)	175[6] (0.78)	95 (0.42)	220 (0.98)	135[6] (0.60)	95 (0.42)	220 (0.98)	135[6] (0.60)	95 (0.42)	220 (0.98)	135[6] (0.60)
X-DR ALH 22	–	–	–	–	100 (0.44)	–	–	60 (0.27)	–	–	–	–	–	–	–	–
X-DR ALH 27	–	–	–	–	100 (0.44)	–	–	80 (0.36)	–	–	–	–	–	–	–	–
X-DR MX, X-P20 B3/B4	–	–	–	–	80 (0.36)	–	–	60 (0.27)	–	–	–	–	–	–	–	–
X-ECC MX, X-P20 B3/B4	–	–	–	–	80 (0.36)	–	–	40 (0.18)	–	–	–	–	–	–	–	–

1 The tabulated allowable load values are calculated using a safety factor that is greater than or equal to 5.0, in accordance with ICC-ES AC70. Multiple fasteners are recommended for any attachment. Threaded rod must be investigated in accordance with accepted design criteria.
2 The steel deck profile for the 3" deep composite floor deck has a minimum thickness of 20 gauge (0.0358") and a minimum F_y = 33 ksi. Lower and upper flute width must be a minimum of 3-7/8". Figure 1 in Section 3.2.1.6 shows the nominal flute dimensions, fastener locations and load orientations for the deck profile. Structural lightweight concrete fill above top of steel deck must be minimum 3-1/4".
3 The steel deck profile for the 1-1/2" deep composite floor deck has a minimum thickness of 20 gauge (0.0358") and a minimum F_y = 33 ksi. Lower flute and upper flute widths must be a minimum of 1-3/4" and 3-1/2", respectively. This deck may also be inverted as shown in Figure 3 in Section 3.2.1.6. Figures 2 and 3 in Section 3.2.1.6 show the nominal flute dimensions, fastener locations and load orientations for the deck profile. Structural lightweight concrete fill above top of steel deck must be minimum 2-1/2".
4 Nailhead Standoff, h_{NVS}, must be less than or equal to 3/8" for the X-HS U32 hanger assembly. Reference Section 3.2.16.4.
5 Allowable loads apply to X-HS threaded rod hanger assemblies with either the 1/4" or 3/8" diameter internally threaded hole.
6 Allowable loads for 45-degree applications are based on testing. For allowable loads at other angles of installation, refer to Section 3.2.1.8.
7 Values shown for the X-HS threaded rod hanger assembly are for use with the X-U powder-actuated fastener.

Allowable loads in minimum ASTM A36 ($F_y \geq 36$ ksi; $F_u \geq 58$ ksi) steel[1,2,3,4]

Fastener description	Fastener	Shank diameter in. (mm)	Steel thickness in. (mm)											
			3/16 (4.8)			1/4 (6.4)			3/8 (9.5)			1/2 (12.7)		
			Tension lb (kN)	Shear lb (kN)	45-Degree[4] lb (kN)	Tension lb (kN)	Shear lb (kN)	45-Degree[4] lb (kN)	Tension lb (kN)	Shear lb (kN)	45-Degree[4] lb (kN)	Tension lb (kN)	Shear lb (kN)	45-Degree[4] lb (kN)
Threaded rod hanger with pre-mounted fastener	X-HS U19	157 (4.0)	270 (1.20)	220 (0.98)	275 (1.22)	270 (1.20)	220 (0.98)	275 (1.22)	270 (1.20)	220 (0.98)	275 (1.22)	270 (1.20)	220 (0.98)	275 (1.22)
X-DR Drop rod with pre-mounted fastener	X-ALH 22	0.177 (4.5)	100 (0.44)	–	–	100 (0.44)	–	–	–	–	–	100 (0.44)	–	–
X-DR MX Drop rod for BX technology	X-S 14 B3/B4	0.118 (3.0)	90 (0.40)	–	–	85 (0.38)	–	–	–	–	–	80 (0.36)	–	–

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Threaded rod must be investigated in accordance with accepted design criteria.

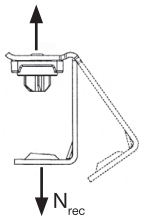
2 Low-velocity fasteners shall be driven to where the point of the fastener penetrates through the steel base material in accordance with Section 3.2.2.3.

3 Multiple fasteners are recommended for any attachment. Reference Section 3.2.16.4 for installation instructions for X-HS.

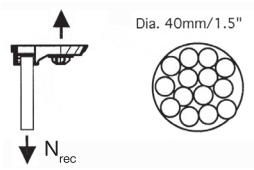
4 Allowable loads for 45-degree applications are based on testing. For allowable loads at other angles of installation, refer to Section 3.2.2.8.

Allowable loads values for Hangers and Clips

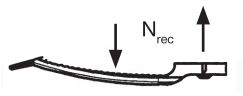
X-EHS W6 MX[1,3]
Allowable load N_{rec}
Tensile
lb (kN)
15 (0.07)



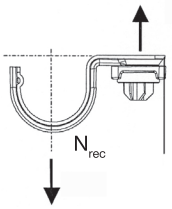
X-ECT MX[1,3]
Allowable load N_{rec}
Tensile
lb (kN)
10 (0.04)



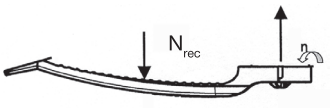
X-EKB 4 MX[1,3]
Allowable load N_{rec}
Tensile
lb (kN)
5 (0.02)



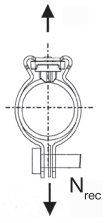
X-BX 3/8" MX[1,2,3] X-EMTC MX[1,2,3]
Allowable load N_{rec}
Tensile
lb (kN)
10 (0.04)



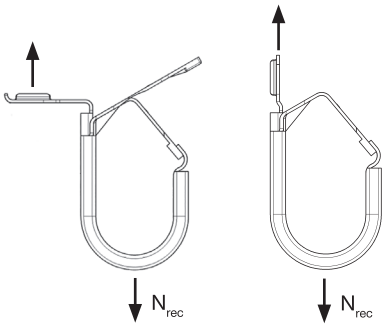
X-EKB 8 MX[1,3]
Allowable load N_{rec}
Tensile
lb (kN)
10 (0.04)



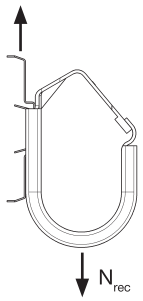
X-EMTSC 1/2" MX[1,3] X-EMTSC 1" MX[1,3]
Allowable load N_{rec}
Tensile
lb (kN)
15 (0.07)



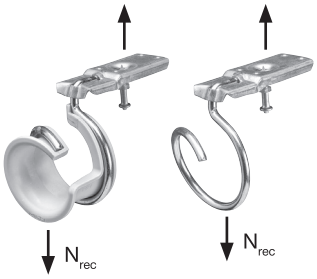
X-DH
Allowable load N_{rec}
Tensile
lb (kN)
70 (0.31)



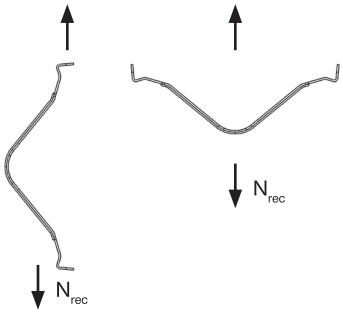
X-DH BW
Allowable load N_{rec}
Tensile
lb (kN)
30 (0.13)



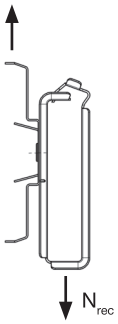
X-BR ALH 27, X-BR S ALH 27, X-BR MX[7]
Allowable load N_{rec}
Tensile
lb (kN)
15 (0.07)



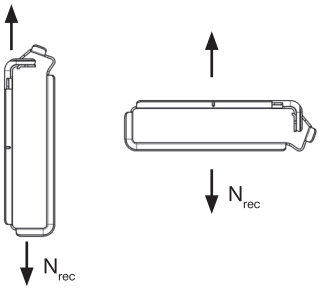
X-BW
Allowable load N_{rec}
Tensile
lb (kN)
15 (0.07)



X-MS BW
Allowable load N_{rec}
Tensile
lb (kN)
15 (0.07)



X-MS
Allowable load N_{rec}
Tensile
lb (kN)
15 (0.07)



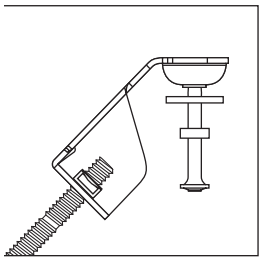
1 The allowable load capacities are based on tests with the predecessors to the X-P 20 B3/B4/G3, X-C 27 G3, and X-S 14 fasteners, using a safety factor that is greater than or equal to 5.0.
2 Load capacites are based on armored cable and EMT.
3 X-P 20 B3/B4/G3 must be installed at a minimum penetration depth of 9/16" into concrete. X-C 27 must be installed at a minimum penetration depth of 3/4" into CMU or mortar joint. X-S 14 must be installed at a minimum penetration depth of 0.320" through or into steel. Hanger assemblies must be firmly clamped to the base material.
4 Concrete base materials include 2000 to 6000 psi normal weight or lightweight types and also includes attachment through steel deck into concrete.
5 Steel base materials include 1/8" or thicker carbon steel base material with minimum yield strength F_y = 36 ksi.
6 CMU base materials include hollow or grout-filled concrete masonry units conforming to ASTM C90.
7 X-P24 B3/B4 fasteners are not recommended for X-BR MX applications.

3.2.17.4 INSTALLATION INSTRUCTIONS

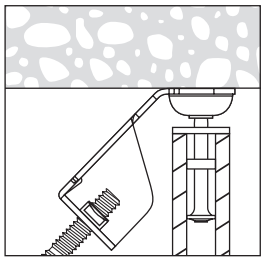
X-HS Installation instructions

Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com. Because of the possibility of changes, always verify that downloaded IFU are current when used.

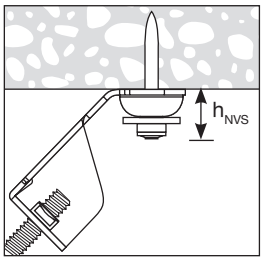
Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.



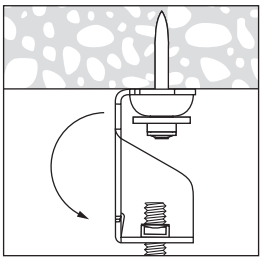
1. Insert appropriate sized threaded rod into hanger.

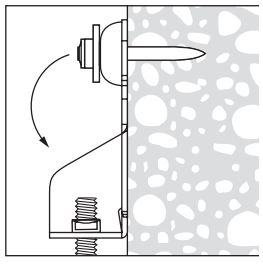


2. Press tip of fastener to concrete/steel base material. Drive with Hilti powder-actuated tool.



3. Ensure proper fastener embedment. $h_{NVS} \leq 3/8"$ (9.5 mm)





4. Bend clip until threaded rod is in desired location, vertical or horizontal for ceiling or wall hanger applications, respectively.

3.2.17.5 ORDERING INFORMATION

X-HS and X-HS MX Threaded Rod Hangers

Fastener description	Fastener length in. (mm)	Fastener shank Ø in. (mm)	Thread rod Ø
Concrete			
X-HS W6 U32 P8S15	**1-1/4** (32)	**0.157** (4.0)	**UNC 1/4-inch**
X-HS W10 U32 P8S15	**1-1/4** (32)	**0.157** (4.0)	**UNC 3/8-inch**
X-HS W6 U22 P8S15	**7/8** (22)	**0.157** (4.0)	**UNC 1/4-inch**
X-HS W10 U22 P8S15	**7/8** (22)	**0.157** (4.0)	**UNC 3/8-inch**
Steel			
X-HS W10 U19 P8S15	**5/8** (16)	**0.157** (4.0)	**UNC 3/8-inch**
X-HS W6 U19 P8S15	**5/8** (16)	**0.157** (4.0)	**UNC 1/4-inch**
MX Version (without pre-mounted fastener)			
X-HS W6 MX	N/A	N/A	**UNC 1/4-inch**

Threaded studs

Fastener description	Shank length in. (mm)	Fastener shank Ø in. (mm)	Thread length in. (mm)	Thread Ø
Steel				
X-EW6H-11-9 FP8	**3/8** (9)	**0.145** (3.7)	**1/2** (11)	**UNC 1/4-inch**
X-EW6H-20-9 FP8	**3/8** (9)	**0.145** (3.7)	**3/4** (20)	**UNC 1/4-inch**
X-EW6H-28-9 FP8	**3/8** (9)	**0.145** (3.7)	**1-1/8** (28)	**UNC 1/4-inch**
X-EW6H-38-9 FP8	**3/8** (9)	**0.145** (3.7)	**1-1/2** (38)	**UNC 1/4-inch**
X-EW10H-30-14 P10	**9/16** (14)	**0.205** (5.2)	**1-3/16** (30)	**UNC 3/8-inch**

Couplers

Fastener description	Overall length in. (mm)	Thread Ø stud	Thread Ø rod
Coupler 1/4-20	**1** (25)	**UNC 1/4-inch**	**UNC 1/4-inch**
Coupler 3/8-16	**1-1/8** (28)	**UNC 3/8-inch**	**UNC 3/8-inch**
Adapter B-1/4x3/8	**7/8** (22)	**UNC 1/4-inch**	**UNC 3/8-inch**

X-ECH Cable Holder

Fastener description	Fastener length in. (mm)	Fastener shank Ø in. (mm)	Number of 1/4" Ø cables
Without pre-mounted fastener			
X-ECH-F/R-S	N/A	N/A	**15-22**
X-ECH-F/R-M	N/A	N/A	**30-37**
X-ECH-F/R-L	N/A	N/A	**45-52**
With pre-mounted fastener			
X-ECH-F/R-S U37	**1-1/2** (37)	**0.157** (4.0)	**15-22**
X-ECH-F/R-M U37	**1-1/2** (37)	**0.157** (4.0)	**30-37**
X-ECH-F/R-L U37	**1-1/2** (37)	**0.157** (4.0)	**45-52**
Tool accessories			
ECH adapter	For use with DX 351 and DX 5-F8		

X-ECH

X-EKB MX Cable Clamps

Fastener description	Max diameter of cable in. (mm)	Maximum no. of cables
X-EKB 4 MX	**1/4** (6)	**4**
X-EKB 8 MX	**1/4** (6)	**8**

X-EKB MX

3.2.17.6 ORDERING INFORMATION

X-ECT MX Cable Tie Fastener*

Fastener description	Cable tie* size in. (mm)
X-ECT MX	**1/2** (12)

*Cable tie is not available through Hilti.

X-ECT
without Cable Tie

X-EMTC and X-BX/EMTC MX Conduit Clips

Fastener description	Fastener length in. (mm)	Fastener shank Ø in. (mm)	Conduit Ø in. (mm)
Premium grade (with pre-mounted fastener)			
X-EMTC-3/8" U22	**7/8** (22)	**0.157** (4.0)	**3/8** (10)
X-EMTC-1/2" U22	**7/8** (22)	**0.157** (4.0)	**1/2** (13)
X-EMTC-3/4" U22	**7/8** (22)	**0.157** (4.0)	**3/4** (19)
X-EMTC-1" U22	**7/8** (22)	**0.157** (4.0)	**1** (25)
Standard grade (with pre-mounted fastener)			
X-EMTC-3/8" C27	**1** (27)	**0.138** (3.5)	**3/8** (10)
X-EMTC-1/2" C27	**1** (27)	**0.138** (3.5)	**1/2** (13)
X-EMTC-3/4" C27	**1** (27)	**0.138** (3.5)	**3/4** (19)
X-EMTC-1" C27	**1** (27)	**0.138** (3.5)	**1** (25)
MX version (without pre-mounted fastener)			
X-BX 3/8" MX	N/A	N/A	**3/8** (10)*
X-EMTC 1/2" MX	N/A	N/A	**1/2** (13)
X-EMTC 3/4" MX	N/A	N/A	**3/4** (19)
X-EMTC 1" MX	N/A	N/A	**1** (25)
X-EMTC 1-1/4" MX	N/A	N/A	1-1/4 (32)

*Also valid for 3/8” metal jacketed cable.

X-EMTC

X-BX/EMTC MX

X-EMTSC Stand-Off Conduit Clips

Fastener description	Conduit Ø
MX version (without pre-mounted fastener)	
X-EMTSC 1/2" MX	**1/2** (13)
X-EMTSC 3/4" MX	**3/4** (19)
X-EMTSC 1" MX	**1** (25)

X-EMTSC MX

X-DR Drop Rod

Fastener description	Fastener length in. (mm)	Fastener shank Ø in. (mm)	Threaded Rod Ø in. (mm)	Rod Length	Rod Type
Steel and post-tension concrete					
X-DR 1’ T ALH22	7/8 (22)	0.177 (4.5)	1/4-inch	1 feet	Threaded
X-DR 2’ T ALH22	7/8 (22)	0.177 (4.5)	1/4-inch	2 feet	Threaded
X-DR 3’ T ALH22	7/8 (22)	0.177 (4.5)	1/4-inch	3 feet	Threaded
X-DR 4’ T ALH22	7/8 (22)	0.177 (4.5)	1/4-inch	4 feet	Threaded
X-DR 6’ T ALH22	7/8 (22)	0.177 (4.5)	1/4-inch	6 feet	Threaded
X-DR ALH22	7/8 (22)	0.177 (4.5)	UNC 1/4-inch	N/A	N/A

3.2.17.6 ORDERING INFORMATION

X-DR Drop Rod

Fastener description	Fastener length in. (mm)	Fastener shank Ø in. (mm)	Threaded Rod Ø in. (mm)	Rod Length	Rod Type
Concrete					
X-DR 1’ T ALH27	1 (27)	0.177 (4.5)	1/4-inch	1 feet	Threaded
X-DR 2’ T ALH27	1 (27)	0.177 (4.5)	1/4-inch	2 feet	Threaded
X-DR 3’ T ALH27	1 (27)	0.177 (4.5)	1/4-inch	3 feet	Threaded
X-DR 4’ T ALH27	1 (27)	0.177 (4.5)	1/4-inch	4 feet	Threaded
X-DR 6’ T ALH27	1 (27)	0.177 (4.5)	1/4-inch	6 feet	Threaded
X-DR 1’ S ALH27	1 (27)	0.177 (4.5)	1/4-inch	1 feet	Smooth
X-DR 2’ S ALH27	1 (27)	0.177 (4.5)	1/4-inch	2 feet	Smooth
X-DR 3’ S ALH27	1 (27)	0.177 (4.5)	1/4-inch	3 feet	Smooth
X-DR 4’ S ALH27	1 (27)	0.177 (4.5)	1/4-inch	4 feet	Smooth
X-DR 6’ S ALH27	1 (27)	0.177 (4.5)	1/4-inch	6 feet	Smooth
X-DR ALH27	1 (27)	0.177 (4.5)	UNC 1/4-inch	N/A	N/A

X-DR MX Drop Rod

Fastener description	Fastener length in. (mm)	Fastener shank Ø in. (mm)	Threaded Rod Ø in. (mm)	Rod Length	Rod Type
Without premounted fastener					
X-DR 1’ T MX	N/A	N/A	1/4-inch	1 feet	Threaded
X-DR 2’ T MX	N/A	N/A	1/4-inch	2 feet	Threaded
X-DR 3’ T MX	N/A	N/A	1/4-inch	3 feet	Threaded
X-DR 4’ T MX	N/A	N/A	1/4-inch	4 feet	Threaded
X-DR 6’ T MX	N/A	N/A	1/4-inch	6 feet	Threaded
X-DR 1’ S MX	N/A	N/A	1/4-inch	1 feet	Smooth
X-DR 2’ S MX	N/A	N/A	1/4-inch	2 feet	Smooth
X-DR 3’ S MX	N/A	N/A	1/4-inch	3 feet	Smooth
X-DR 4’ S MX	N/A	N/A	1/4-inch	4 feet	Smooth
X-DR 6’ S MX	N/A	N/A	1/4-inch	6 feet	Smooth
X-DR MX	N/A	N/A	UNC 1/4-inch	N/A	N/A

3.2.17.5 ORDERING INFORMATION

X-DH and X-DH BW Data Hook*

Fastener description	Batwing attachable to	Number of CAT 5e cables (70% fill rate)	Number of CAT 6 cables (70% fill rate)	Number of CAT 6A cables (70% fill rate)	Number of CAT 7A cables (70% fill rate)
With preassembled batwing, max. recommended overbending distance 1 in. (25 mm)					
X-DH 1" BW	1/4-inch rod, 8-12 ga wire	30	20	12	10
X-DH 2" BW	1/4-inch rod, 8-12 ga wire	95	70	40	35
X-DH 4" BW	1/4-inch rod, 8-12 ga wire	360	260	155	125
Without preassembled batwing					
X-DH 2" C	N/A	95	70	40	35
X-DH 2"	N/A	95	70	40	35
X-DH 4"	N/A	360	260	155	125

X-MS MC Stacker*

Fastener description	Batwing attachable to	Max. pieces of 14-2 MC cables	Max. pieces of 8-3 MC cables
With preassembled batwing, max. recommended overbending distance 1 in. (25 mm)			
X-MS 3" BW	1/4-inch rod, 8-12 ga wire	7	4
Without preassembled batwing			
X-MS 3"	N/A	7	4

X-BR Bridle Ring*

Fastener description	Fastener length in. (mm)	Fastener shank Ø in. (mm))	Number of fire alarm 18/2 cables (70% fill rate)	Number of MC Cables
With premounted fastener				
X-BR 1-1/4" ALH 27	1 (27)	0.177 (4.5)	39	1
X-BR 2" ALH27	1 (27)	0.177 (4.5)	60	3
Without premounted fastener				
X-BR 1-1/4" MX	N/A	N/A	39	1
X-BR 2" MX	N/A	N/A	60	3

* For spacing requirements, please refer to TIA 569.

3.2.17.6 ORDERING INFORMATION

X-BR S Bridle Ring with Saddle

Fastener description	Fastener length in. (mm)	Fastener shank Ø in. (mm)	Number of CAT 5e cables (70% fill rate)	Number of CAT 6 cables (70% fill rate)	Number of CAT 7A cables (70% fill rate)
With premounted fastener					
X-BR S 2" ALH 27	1 (27)	0.177 (4.5)	37	30	15
Without premounted fastener					
X-BR S 2" MX	N/A	N/A	37	30	15

X-BW Batwing

Fastener description	Number of EMT / MC Cables	Maximum Recommended Overbending Distance in. (mm)
X-BW 1/2"	1	1.2 (30)
X-BW 3/4"	1	1.2 (30)
X-BW 1''	1	1.2 (30)
X-BW W	1	0.6 (16)

X-BW 1/2"

X-BW 3/4"

X-BW 1"

X-BW W

Application	Size	Attachable to					
		Wire #12, #10	Wire #9, #8	Rod 1/4"	Flange 1/8 to 1/4"	Flange 5/16 to 3/8"	Flange 7/16 to 1/2"
EMT	1/2"	X-BW 1/2"	X-BW 1/2"	X-BW 1/2"	X-BW 1/2"	X-BW 3/4"	X-BW 3/4"
	3/4"	X-BW 3/4"	X-BW 3/4"	X-BW 3/4"	X-BW 3/4"	X-BW 1"	X-BW 1"
	1"	-	X-BW 1"	X-BW 1"	X-BW 1"	X-EMTC 1"	X-EMTC 1"
MC cable	14-2 to 14-4	X-BW W	X-BW W	X-BW 1/2"	X-EMTC 3/8"	X-EMTC 3/8"	X-EMTC 3/8"
	12-2 to 10-3	X-BW W	X-BW W	X-BW 1/2"	X-BW 1/2"	X-EMTC 3/8"	X-EMTC 3/8"
	10-4	X-BW W	X-BW 1/2"	X-BW 1/2"	X-BW 1/2"	X-EMTC 3/8"	X-EMTC 3/8"
Rigid	1/2"	X-BW 1/2"	X-BW 3/4"	X-BW 3/4"	X-BW 3/4"	X-BW 3/4"	X-BW 1"
	3/4"	X-BW 3/4"	X-BW 3/4"	X-BW 1"	X-BW 1"	-	-

3.2.18 X-MW MECHANICAL / ELECTRICAL CLIPS AND HANGERS

3.2.18.1 PRODUCT DESCRIPTION

X-MW MX Wire hanging system
For fastening heating, ventilation, and air condition (HVAC), and lighting to ceiling. System can be used with battery-actuated tools and X-P 20 B3/B4 MX, and X-S 14 B3/B4 MX fasteners. Wire length is from 6 ft up to 20 ft. System utilizes loop lock and wire holder.

X-MW ALH Wire hanging system
For fastening heating, ventilation, and air condition (HVAC), cable tray, conduit rack and lighting to ceiling. System is pre-mounted with X-ALH 22, X-ALH 27 or X-ALH 32 powder-actuated fasteners. Wire length is from 6 ft up to 20 ft. System utilizes loop lock or channel lock.

Listings / Approvals

ICC-ES (International Code Council)

ESR-2795 with LABC/LARC Supplement

UL (Underwriters Laboratories)
File 505298 under UL2239 for X-MW ALH27 CL and X-MW ALH32 CL

File 517614 under UL1598 for X-MW MX, X-MW ALH27 L and X-MW ALH32 L

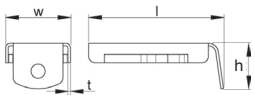
3.2.18.2 MATERIAL SPECIFICATIONS

Description	Material	Coating	Minimum Coating Thickness
X-MW MX	Carbon steel	Zinc	3 µm
X-MW ALH	Carbon steel	Zinc	3 µm
Loop lock	Aluminum + brass	Nickel	-
Channel lock	Steel + brass	Zinc + Nickel	-
Wire	Carbon steel	Zinc	3 µm

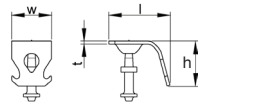
Dimensions

Clip Designation	Width of Wire Holder Plate	Length of Wire Holder Plate	Height of Cable Holder	Thickness Cable Holder Plate
	w	l	h	t
X-MW MX	1.18"	2.56"	0.82"	0.03"
X-MW ALH	0.79"	1.18"	0.89"	0.03"

X-MW MX

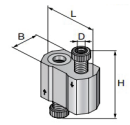


X-MW ALH



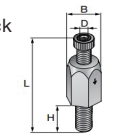
Description	Width of Cable Lock W in. (mm)	Length of Cable Lock L in. (mm)	Height of Cable Lock H in. (mm)
MW-L Loop Lock 2.0	1/2" (12.4)	15/16" (23.1)	1-11/16" (42.5)

Loop lock



Description	Width of Cable Lock B in. (mm)	Length of Cable Lock L in. (mm)	Thread Diameter H in. (mm)	Thread Length H in. (mm)
MW-CL Channel Lock	1-1/4" (32.5)	2-1/4" (58)	3/8" (10)	1" (25)

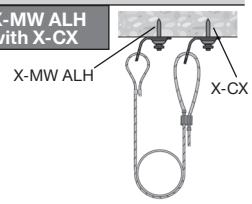
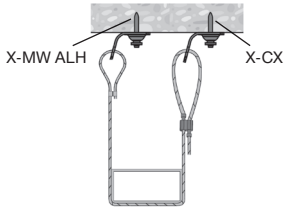
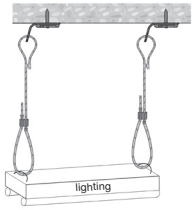
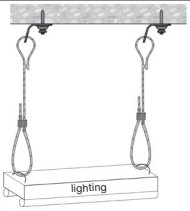
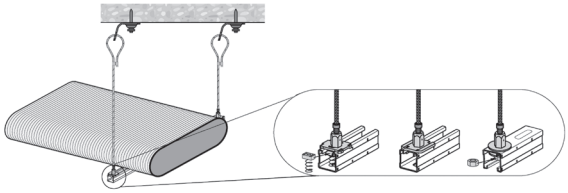
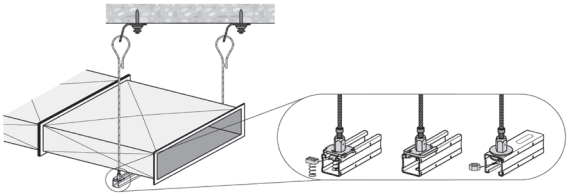
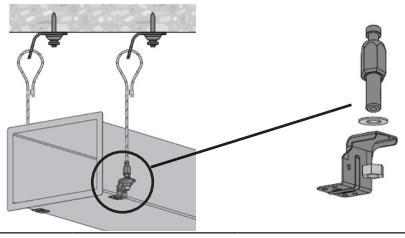
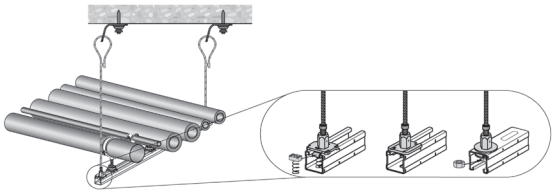
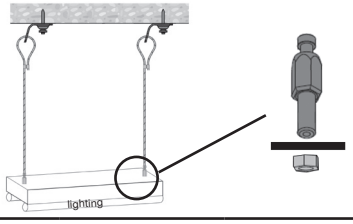
Channel lock



Cable Size	Diameter	Available Lengths
No. 2.0	5/64"	6ft, 10ft, 20ft

No. 2 cable wire

Applications

Lock Type	Typical Application	
	**Spiral HVAC**	**X-MW MX**  **X-MW ALH**  **X-MW ALH with X-CX** 
	Rectangular HVAC	**X-MW ALH with X-CX** 
	Lighting or misc.	**X-MW MX**  **X-MW ALH** 
	**Spiral HVAC**	**X-MW ALH with MQA** 
	Rectangular HVAC	**X-MW ALH with MQA**  **X-MW ALH with MVA** 
	Conduit or Cable Tray	**X-MW ALH with MQA** 
	Lighting	**X-MW AL** 

3.2.18.3 TECHNICAL DATA

Performance Data

Allowable loads in normal weight concrete[1, 2]

Description	Fastener	Shank Diameter in. (mm)	Concrete compressive strength			
			4000 psi		6000 psi	
			Tension lb (kN)	45-Degree lb (kN)	Tension lb (kN)	45-Degree lb (kN)
X-MW wire hanger with pre-mounted fastener	X-ALH 22	0.177 (4.5)	60 (0.27)	100 (0.44)	60 (0.27)	60 (0.27)
	X-ALH 27	0.177 (4.5)	100 (0.44)	100 (0.44)	100 (0.44)	100 (0.44)
	X-ALH 32	0.177 (4.5)	100 (0.44)	100 (0.44)	100 (0.44)	100 (0.44)
X-MW MX wire hanger	X-P 20 B3/B4 MX, X-P 24 B3/B4 MX	0.118 (3.0)	30 (0.13)	-	-	-

1. The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70.
2. Multiple fasteners are recommended for any attachment.

Allowable loads in minimum f'_c = 3000 psi structural lightweight concrete[1, 2]

Description	Fastener	Shank Diameter in. (mm)	Fastener Location			
			Installed through 3" deep metal deck into concrete			
			Upper Flute		Lower Flute	
			Tension lb (kN)	45-Degree lb (kN)	Tension lb (kN)	45-Degree lb (kN)
X-MW wire hanger with pre-mounted fastener	X-ALH 22	0.177 (4.5)	100 (0.44)	100 (0.44)	90 (0.40)	100 (0.44)
	X-ALH 27	0.177 (4.5)	100 (0.44)	100 (0.44)	100 (0.44)	100 (0.44)
	X-ALH 32	0.177 (4.5)	100 (0.44)	100 (0.44)	100 (0.44)	100 (0.44)
X-MW MX wire hanger	X-P 20 B3/B4 MX, X-P 24 B3/B4 MX	0.118 (3.0)	80 (0.36)	-	60 (0.27)	-

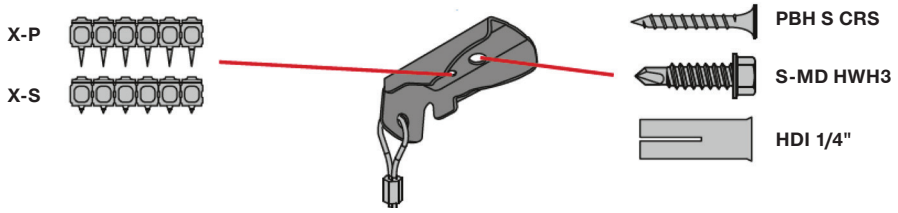
1. The tabulated allowable load values are for the low-velocity fasteners only using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Multiple fasteners are recommended for any attachment.
2. 2 The steel deck profile for the 3" deep composite floor deck has a minimum thickness of 20 gauge (0.0358") and a minimum F_y = 33 ksi. Lower and upper flute width must be a minimum of 3-7/8". Figure 1 in Section 3.2.1.6 shows the nominal flute dimensions, fastener locations and load orientations for the deck profile. Structural light weight concrete fill above top of steel deck must be minimum 3-1/4".

Allowable loads in minimum ASTM A36 (F_y≥36 ksi; F_u≥58 ksi) steel[1, 2, 3]

Description	Fastener	Shank Diameter in. (mm)	Steel Thickness in. (mm)		
			3/16" (4.8)	1/4" (6.4)	1/2" (12.7)
			Tension lb (kN)	Tension lb (kN)	Tension lb (kN)
X-MW MX wire hanger	X-S 14 B3/B4	0.118 (3.0)	90 (0.40)	85 (0.38)	80 (0.36)

1. The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70.
2. Multiple fasteners are recommended for any attachment.
3. For allowable loads of X-CX ALH 22, reference Section 3.3.2 X-CX Ceiling Clip.

Allowable load when installing X-MW MX with PHB S CRS wood screw, S-MD HWH3 or HDI 1/4"

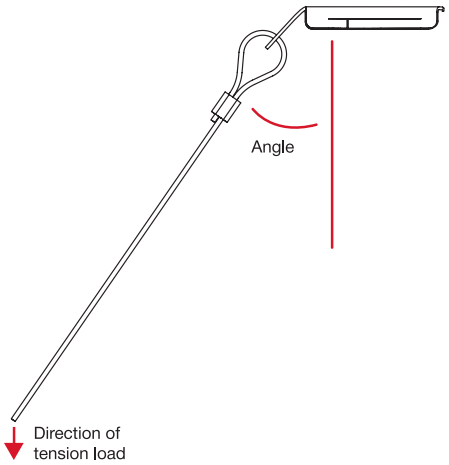


X-MW MX clip can be either installed with a X-P or X-S Battery-actuated Fastener through the smaller hole or an HDI 1/4" anchor or screws through the larger hole. When installed using anchor or screws, 30 lbs (0.13 kN) allowable load using a safety factor of 5.0 can be used. Reference X-MW MX installation instruction for more information.

Load reduction with wire hanger angle [1,2,3]

Angle from vertical	0°	15°	30°	45°	60°
Load adjustment factor	1.00	0.96	0.86	0.70	0.50

1. The tabulated load adjustment values are for loads in the vertical down orientation as depicted in the accompanying figure.
2. Fastener and clip installation shall be such that the angle of the wire extends away from the nail.
3. Load adjustment factor shall be multiplied by the applicable X-MW allowable load.



Spiral HVAC single wall with 10' hanging space[1]

Diameter	Circumference	Weight (lbs)		
		26 Gauge	24 Gauge	22 Gauge
8"	2' 2"	23	29	36
12"	3' 2"	35	44	54
16"	4' 2"	47	59	72
20"	5' 3"	58	73	90
24"	6' 3"	70	88	108
28"	7' 4"	81	103	126
32"	8' 5"	93	117	144
36"	9' 5"	105	132	162

Spiral HVAC double wall with 10' hanging space[1]

Inside Diameter	Outside Gauge	Inside Gauge	Weight per ft. (lb/ft)
8"	26	26	6
12"	26	26	8

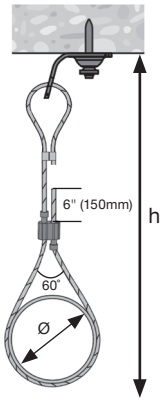
Weight of rectangular duct, based on 8' and 10' hanging space[1]

Rectangle Duct Size (height + width)	Weight per ft.		Weight / 8 ft.	Weight / 10 ft.
	20 Gauge	22 Gauge		
8 x 6"	-	3.57	28.56	35.70
10 x 6"	-	4.08	32.64	40.80
12 x 6"	-	4.59	36.72	45.90
14 x 10"	-	6.12	48.96	61.20
16 x 16"	-	8.16	65.28	81.60
24 x 12"	-	9.18	73.44	91.80
36 x 18"	-	13.77	110.16	137.70
40 x 22"	18.34	-	146.73	183.42
50 x 20"	20.71	-	165.67	207.08

1. Weight per foot is calculated based on SMACNA HVAC Systems Duct Design.

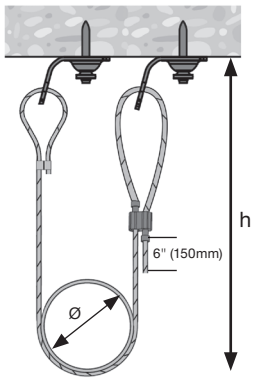
Hanger length charts for spiral HVAC with one fastening point using BX/DX loop lock

Required Elevation h (ft.)	1	3	5	8	10	12	15
Diameter Ø (in.)	Cable Length l (ft.)						
8"	3	5	7	10	12	14	17
12"	4	6	8	11	13	15	18
16"	6	8	8	11	13	15	18
20"	7	9	9	12	14	16	19
24"	9	11	10	13	15	17	20
28"	10	12	11	14	16	18	-
32"	12	14	11	14	16	18	-
36"	13	15	12	15	17	19	-



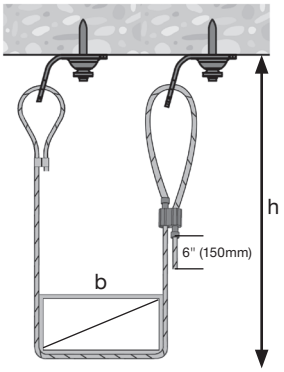
Hanger length charts for spiral HVAC with two fastening points using DX loop lock

Required Elevation h (ft.)	1	2	3	4	5	7	9
Diameter Ø (in.)	Cable Length l (ft.)						
8"	3	5	7	9	11	15	19
12"	3	5	7	9	11	15	19
16"	3	5	7	9	11	15	19
20"	3	5	7	9	11	15	19
24"	4	6	8	10	12	16	20
28"	4	6	8	10	12	16	20
32"	4	6	8	10	12	16	20
36"	4	6	8	10	12	16	20



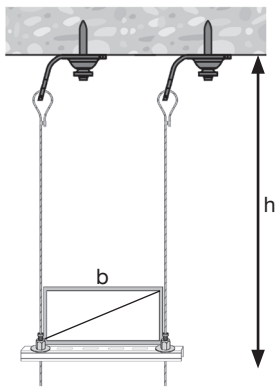
Hanger length charts for rectangular HVAC with two fastening points using DX loop lock

Required Elevation h (ft.)	1	2	3	4	5	7	9
Width b (in.)	Cable Length l (ft.)						
8"	3	5	7	9	11	15	19
12"	3	5	7	9	11	15	19
16"	3	5	7	9	11	15	19
20"	3	5	7	9	11	15	19
24"	4	6	8	10	12	16	20
28"	4	6	8	10	12	16	20
32"	4	6	8	10	12	16	20
36"	4	6	8	10	12	16	20



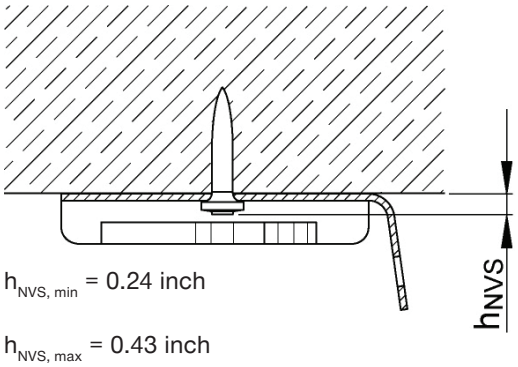
Hanger length charts for rectangular HVAC with two fastening points using DX channel lock

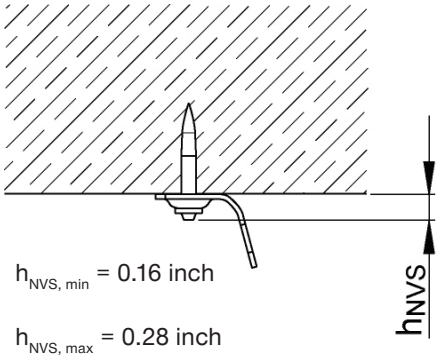
Required Elevation h (ft.)	1	2	3	4	5	7	9
Width b (in.)	Cable Length l (ft.)						
8"	1.5	2.5	3.5	4.5	5.5	7.5	9.5
12"	1.5	2.5	3.5	4.5	5.5	7.5	9.5
16"	1.5	2.5	3.5	4.5	5.5	7.5	9.5
20"	1.5	2.5	3.5	4.5	5.5	7.5	9.5
24"	1.5	2.5	3.5	4.5	5.5	7.5	9.5
28"	1.5	2.5	3.5	4.5	5.5	7.5	9.5
32"	1.5	2.5	3.5	4.5	5.5	7.5	9.5
36"	1.5	2.5	3.5	4.5	5.5	7.5	9.5



6" (150mm)

Fastening Quality Assurance
Fastening standoff





3.2.18.4 ORDERING INFORMATION

Fastener Description	Fastener Length in. (mm)	Fastener Shank Ø in. (mm)	Lock Type	Wire Ø in. (mm)	Wire Length ft. (m)
Without pre-mounted fastener					
X-MW MX L	-	-	Loop	0.08" (2.0)	6.6 (2)
X-MW MX L	-	-	Loop	0.08" (2.0)	10 (3)
X-MW MX L	-	-	Loop	0.08" (2.0)	20 (6.1)
With pre-mounted fastener					
X-MW ALH 22 L 10ft/3m	0.87" (22)	0.177" (4.5)	Loop	0.08" (2.0)	10 (3)
X-MW ALH 27 L 6ft/2m	1" (27)	0.177" (4.5)	Loop	0.08" (2.0)	6.6 (2)
X-MW ALH 27 L 10ft/3m	1" (27)	0.177" (4.5)	Loop	0.08" (2.0)	10 (3)
X-MW ALH 27 L 20ft/6m	1" (27)	0.177" (4.5)	Loop	0.08" (2.0)	20 (6.1)
X-MW ALH 32 L 10ft/3m	1.26" (32)	0.177" (4.5)	Loop	0.08" (2.0)	10 (3)
X-MW ALH 27 CL 6ft/2m	1" (27)	0.177" (4.5)	Channel	0.08" (2.0)	6.6 (2)
X-MW ALH 27 CL 10ft/3m	1" (27)	0.177" (4.5)	Channel	0.08" (2.0)	10 (3)
X-MW ALH 27 CL 20ft/6m	1" (27)	0.177" (4.5)	Channel	0.08" (2.0)	20 (6.1)
X-MW ALH 32 CL 10ft/3m	1.26" (32)	0.177" (4.5)	Channel	0.08" (2.0)	10 (3)

3.2.19 X-IE INSULATION/SOFT MATERIAL ATTACHMENT FASTENERS

3.2.19.1 PRODUCT DESCRIPTION

The X-IE 6 insulation fastener is a unique fastener designed for the attachment of a wide range of insulation materials to concrete, masonry, or steel base materials. The product is recommended for use with materials such as mineral wool, EPS, XPS, PIR, PUR, and multilayer boards. The fastener is pushed through the insulation until it touches the base material and then it is fastened in place with a Hilti powder-actuated tool. The X-IE 6 fastener can fasten insulation panels ranging in thickness from 3/4" through 7-7/8".

The X-SW soft washer with pre-mounted powder-actuated fastener is designed for attaching thin membranes or panels to concrete base materials. The washers are 30mm and 60mm in diameter with nail lengths of 1-1/2", 1-7/8" and 2-1/2". These fasteners are installed using a Hilti powder-actuated tool.

X-IE 6

X-SW

3.2.19.2 MATERIAL SPECIFICATIONS

Fastener designation	Powder-actuated fastener material	Powder-actuated fastener plating[1]	Washer material[2]
X-IE 6	Carbon Steel	5 µm Zinc	Plastic
X-SW	Carbon Steel	5 µm Zinc	Plastic

1 ASTM B633, SC1, Type III. Reference Section 2.3.3.1 for more information.
2 Due to potential embrittlement degradation of fastener plastic, exposure to UV light should be limited to less than 90 days.

3.2.19.3 TECHNICAL DATA

Recommended loads for X-IE 6 Fasteners [1,2]

Base Material	Tension lb (kN)		Shear lb (kN)	
Concrete [3]	**90**	(0.4)	**90**	(0.4)
CMU Masonry Walls [4]	**45**	(0.2)	**45**	(0.2)
Solid Brick	**45**	(0.2)	**45**	(0.2)
Steel [5]	**135**	(0.6)	**135**	(0.6)

1 The tabulated allowable load values are for the X-IE 6 fasteners only. For pull-over of the insulation material under tension, please consult insulation material supplier.
2 Multiple fasteners are recommended for any attachment.
3 Based on attachment to concrete (f'_c = 2000 psi - 6500 psi).
4 Wall must be fully grouted.
5 Based on attachment to 1/8" or 1/4" thick steel (Fy = 36 to 50 ksi).

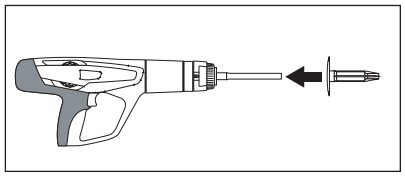
Allowable loads for X-SW Fasteners[1,2,3]

Description	Tension lb (kN)		Shear lb (kN)	
X-SW	**65**	(0.30)	**65**	(0.30)

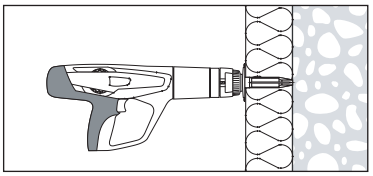
1 Multiple fasteners are recommended for any attachment.
2 Loads valid for fastener strength. Fastened material must be considered separately.
3 Based on attachment to concrete ($f'_c \geq 4000$ psi).

3.2.19.4 INSTALLATION INSTRUCTIONS*

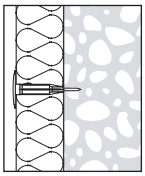
Installation instructions for X-IE 6 Insulation Fasteners



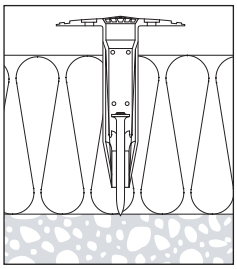
1. Load X-IE 6 on powder-actuated tool.



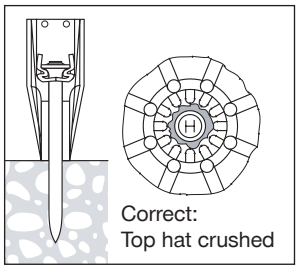
2. Push the X-IE 6 all the way into the insulation. Fastener tip must touch base material.

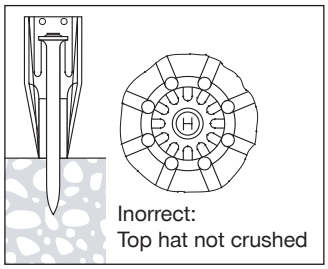


3. Make the fastening.



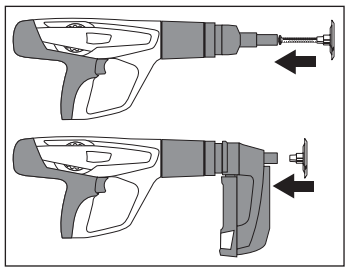
4. Verify successful fastening. Remove if not clamped tight to insulation.



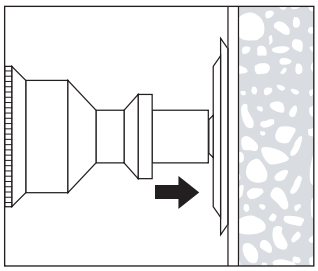


5. Visual check immediately after fastening.

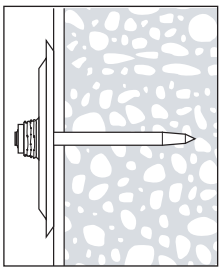
Installation instructions for X-SW Fasteners



1. Load X-SW on powder-actuated tool.



2. Press the X-SW against the surface.



3. Make the fastening.

* Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com. Because of the possibility of changes, always verify that downloaded IFU are current when used. Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

3.2.19.5 ORDERING INFORMATION

X-IE

Description	Shank length in. (mm)	Shank Ø in. (mm)	Insulation material thickness in. (mm)	Washer color
X-IE 6-20	**1-7/16** (36)	**0.177** (4.5)	**3/4** (20)	White
X-IE 6-25	**1-7/8** (47)	**0.177** (4.5)	**1** (25)	White
X-IE 6-35	**1-7/8** (47)	**0.177** (4.5)	**1-3/8** (35)	White
X-IE 6-40	**2-1/2** (62)	**0.177** (4.5)	**1-1/2** (4)	White
X-IE 6-50	**2-1/2** (62)	**0.177** (4.5)	**2** (50)	White
X-IE 6-60	**2-1/2** (62)	**0.177** (4.5)	**2-3/8** (60)	White
X-IE 6-70	**2-1/2** (62)	**0.177** (4.5)	**2-3/4** (70)	White
X-IE 6-75	**2-1/2** (62)	**0.177** (4.5)	**3** (75)	White
X-IE 6-80	**2-1/2** (62)	**0.177** (4.5)	**3-1/8** (80)	White
X-IE 6-100	**2-1/2** (62)	**0.177** (4.5)	**4** (100)	White
X-IE 6-120	**2-1/2** (62)	**0.177** (4.5)	**4-3/4** (120)	White
X-IE 6-140	**2-1/2** (62)	**0.177** (4.5)	**5-1/2** (140)	White
X-IE 6-150	**2-1/2** (62)	**0.177** (4.5)	**5-7/8** (150)	White
X-IE 6-160	**2-1/2** (62)	**0.177** (4.5)	**6-1/4** (160)	White
X-IE 6-180	**2-1/2** (62)	**0.177** (4.5)	**7-1/8** (180)	White
X-IE 6-200	**2-1/2** (62)	**0.177** (4.5)	**7-7/8** (200)	White

X-SW

Description	Shank length in. (mm)	Shank Ø in. (mm)	Washer Ø in. (mm)	Washer color
X-SW 30 C-37	**1-1/2** (37)	**0.138** (3.5)	**1-3/16** (30)	Gray
X-SW 30 C-37	**1-1/2** (37)	**0.138** (3.5)	**1-3/16** (30)	Gray
X-SW 30 W C-37	**1-1/2** (37)	**0.138** (3.5)	**1-3/16** (30)	White
X-SW 30 C-62	**2-1/2** (62)	**0.138** (3.5)	**1-3/16** (30)	Gray
X-SW 60 C-37	**1-1/2** (37)	**0.138** (3.5)	**2-3/8** (60)	Gray
X-SW 60 C-47	**1-7/8** (47)	**0.138** (3.5)	**2-3/8** (60)	Gray
X-SW 60 C-62	**2-1/2** (62)	**0.138** (3.5)	**2-3/8** (60)	Gray

3.2.20 X-IE-G INSULATION FASTENER

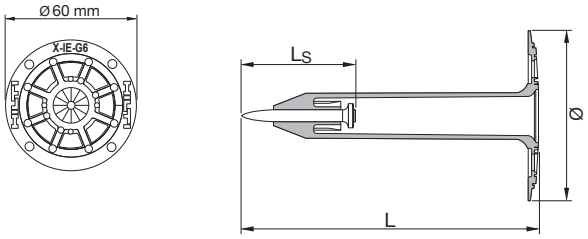
3.2.20.1 PRODUCT DESCRIPTION

The X-IE-G Insulation Fastening system consists of a Gas-Actuated Fastener pre-mounted in a non-metallic insulation fastener assembly, and installed using the Hilti GX-IE Gas-Actuated tool. The resulting fastener assembly allows for various insulation materials to be attached more rapidly and securely to concrete base materials, providing more efficient and safer installation. Due to the design of the fastener and the non-metallic material, the thermal conductivity of the fastening point is minimal, regardless of the insulation thickness. Thermal bridging is minimized.

X-IE-G 6

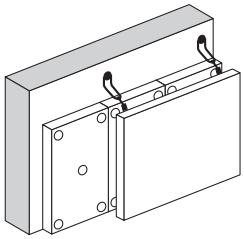
3.2.20.2 SPECIFICATIONS

Dimensions

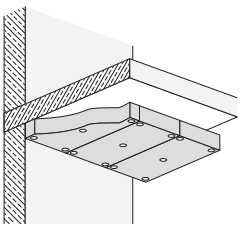


X-IE-G6

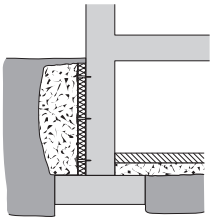
Material specification	
Plate	X-IE-G 6 — HDPE, colorless
Nail	Carbon steel shank: HRC 57.5 Zinc coating: 2 – 13 µm Designation: X-P 36



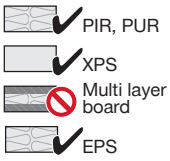
Insulation behind curtain walls



Insulation in ceilings



Temporary fixing of insulation of moisture barriers/drainage plates



3.2.20.3 ADDITIONAL SYSTEM REQUIREMENTS

Tool	GX-IE, GX-IE XL*
Gas can	GC52

*Required for all X-IE G6 with length > 150 mm

3.2.20.4 TECHNICAL DATA

Thickness of base material

Concrete: h_{min} = 3 1/8”

Thickness of fastened material

Insulation thickness [in.]:

X-IE-G 6 (for the use with mineral wool, EPS, XPS, PIR, PUR)	1 – 8

Note: Max. tolerance of insulation thickness = +/- 1/8”

Edge distances and minimum number of X-IE-G

For spacing of insulation fasteners, and minimum distances to the insulation edges, please consult with the insulation material supplier. If spacing recommendations are not available from supplier, please use a minimum of (2) X-IE G fasteners per ft².

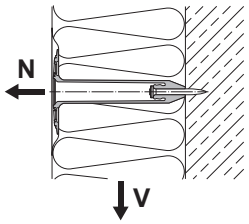
Application limits

Concrete: f’ = 2200–6500 psi (aggregate size ≤ 1 ¼”)

Performance data

Recommended Loads [lb] for concrete base material:	
Tension (lb)	22
Shear (lb)	22

When base material properties are questionable, jobsite testing is recommended



Thermal efficiency

Example for insulation material (EPS or mineral wool) with a thermal conductivity λ = 0.03 W/mK

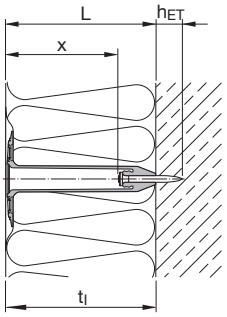
Insulation thickness (inch)	1	2	3	4	5	6	7	8
Hilti insulation fastener	**X-IE-G 25**	**X-IE-G 50**	**X-IE-G 75**	**X-IE-G 100**	**X-IE-G 120**	**X-IE-G 150**	**X-IE-G 180**	**X-IE-G 200**
Thermal conductivity λ [W/mK]	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Thermal resistance R [m^2K/W]	0.85	1.69	2.54	3.39	4.23	5.08	5.93	6.77
Thermal transmittance U [W/m^3K]	1.181	0.591	0.394	0.295	0.236	0.197	0.169	0.148
Point thermal transmittance x [W/K]	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001
Uc = U + n*x [W/m^2K] for n = 1	1.183	0.593	0.396	0.296	0.237	0.198	0.170	0.149
Thermal efficiency = U/Uc	99.8%	99.7%	99.5%	99.7%	99.6%	99.5%	99.4%	99.3%

λ Thermal conductivity [W/mK]
R Thermal resistance [m^2K/W], R = d/λ with d = thickness of inslation or component
U Thermal transmittance [W/m^3K]
Up = x Point thermal transmittance x [W/K] per single fastener
Uc Corrected thermal transmittance [W/m^2K]

1

Fastening quality assurance

Fastening inspection



Insulation thickness t_i [mm][1]

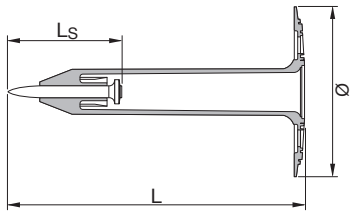
	25/30	40	50	60	70	75	80	90
h_{ET} = 12-19 mm								
x_{min} [mm]	3	14	24	34	44	49	54	64
x_{max} [mm]	10	21	31	41	51	56	61	71

Insulation thickness t_i [mm][1]

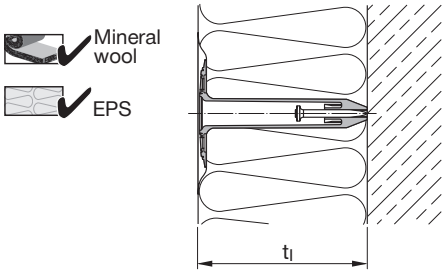
	100	120	130	140	150	160	180	200
h_{ET} = 12-19 mm								
x_{min} [mm]	74	94	104	114	124	134	154	174
x_{max} [mm]	81	100	111	121	131	141	161	181

1 Dimensions are provided in millimeters for accurate field measurement.

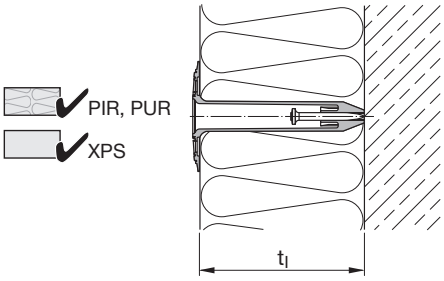
3.2.20.5 ORDERING INFORMATION



Select fastener with designation equivalent to the insulation thickness t_I.



Soft insulation boards (Mineral wool, EPS):
Fasteners are allowed to be countersunk as shown in the drawing.
Note:
For mineral wool of intermediate thicknesses use next shorter X-IE-G.



Hard insulation boards (XPS, PIR, PUR):
The fastener is not countersunk, fastener disc needs to be flush with the board prior to installation as shown in the drawing. For convenience, pre-core the board before installation.

Note:
For intermediate thicknesses, use the next longer X-IE-G.

Designation	Item number	t_I (mm)	Insulation thickness [in][1]
X-IE-G 6-25	2192914	25	1
X-IE-G 6-30	2163810	30	1 1/8
X-IE-G 6-40	2163811	40	1 5/8
X-IE-G 6-50	2163812	50	2
X-IE-G 6-60	2163813	60	2 1/2
X-IE-G 6-70	2163814	70	2 3/4
X-IE-G 6-75	2192915	75	3
X-IE-G 6-80	2163815	80	3 1/4
X-IE-G 6-90	2192916	90	3 1/2
X-IE-G 6-100	2163816	100	4
X-IE-G 6-120	2192917	120	4 3/4
X-IE-G 6-130	2192918	130	5 1/8
X-IE-G 6-140	2163817	140	5 1/2
X-IE-G 6-150	2163818	150	6
X-IE-G 6-160	2163819	160	6 1/4
X-IE-G 6-180	2163820	180	7 1/8
X-IE-G 6-200	2163821	200	8

1 Equivalent insulation thickness converted from mm (Soft Conversion.)

3.2.21 X-IE-GS AND X-IE-GSP INSULATION FASTENER

3.2.21.1 PRODUCT DESCRIPTION

The X-IE-GS and X-IE-GSP Insulation Fastening system consists of Gas-Actuated Fastener pre-mounted in a non-metallic insulation fastener assembly, and installed using the Hilti GX-IE Gas-Actuated tool. The resulting fastener assembly allows various insulation boards to be attached rapidly and securely to steel studs, providing more efficient and safer installation.

Product Features and benefits

- X-IE-GS is designed for insulation fastening to cold formed steel studs with sheathing backing and X-IE-GSP is designed for applications without sheathing backing
- Suitable for wide range of steel stud thicknesses from 18 gauge to 12 gauge
- Suitable for wide range of insulation materials
- Insulation thickness range from 1" to 4" (through 8" for mineral wool with sheathing backing)
- Designed to work with water proofing membranes and vapor permeable air barriers
- Solid fastener shank helps prevent water and moisture penetration in the insulation material

X-IE-GS

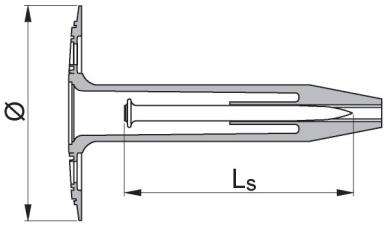
X-IE-GSP

3.2.21.2 SPECIFICATIONS

Material specification		
Body / Plate	**X-IE-GS**	**X-IE-GSP**
	Material: HDPE Color: Grey Other properties: UV stabilized material	Material: HDPE Color: Beige Other properties: UV stabilized material
Nail	**X-GS 57**	**X-GS 44**
	Carbon steel shank: HRC 57.5 Zinc-Nickel coating: 5-25µm	Carbon steel shank: HRC 57.5 Zinc-Nickel coating: 5-25 um

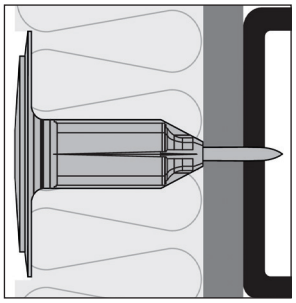
Dimensions

Description	Diameter Ø	Nail Length L_s
X-IE-GS	2.36"	2.31"
X-IE-GSP	2.36''	1.73''

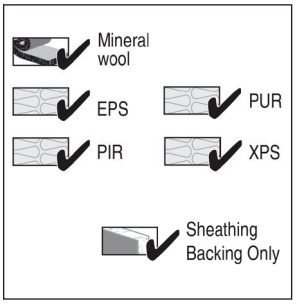


Applications

X-IE-GS

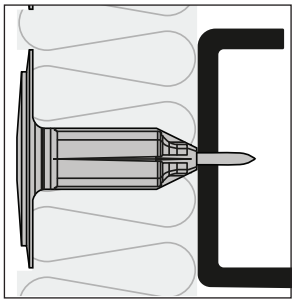


Exterior wall insulation on cold formed steel studs with sheathing backing

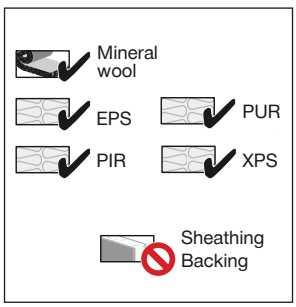


Insulation materials
Note: For insulation thicknesses of 6-8", X-IE-GS fastener is suitable for Mineral Wool only. Not suitable for hard insulation boards.

X-IE-GSP



Exterior wall insulation on cold formed steel studs without sheathing backing

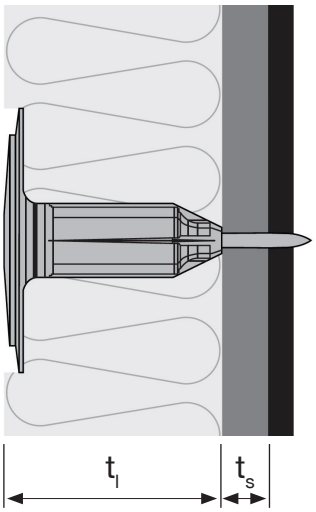


Insulation materials

Environmental Conditions

- During construction, exposure to moisture and water of the fixing element shall not exceed 40 days.
- During construction, exposure to UV due to solar radiation of the fixing element not protected by rendering shall not exceed 40 days.
- The temperature during installation of the fixing element shall not be less than 14°F (-10°C)

These conditions apply only to fixing element. Follow board manufacturers recommendations in regard to environmental exposure of other wall components.



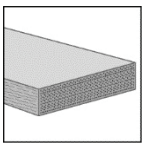
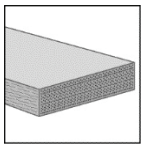
3.2.21.4 TECHNICAL DATA

Dimensions for X-IE-GS and X-IE-GSP

Fastened Material	Compressive Strength	Fastened Material Thickness t_I
Rigid mineral wool	< 70 psi	1" – 8"[1]
EPS, XPS, PIR, PUR	< 70 psi	1" – 4"
PIR, PUR with foil facing	< 70 psi	1" – 4"

1 Thickness limited to 4" with X-IE GSP fastener.

Sheathing backing properties for use with X-IE-GS

Sheathing Material [1, 2, 3]		Sheathing Material Thickness, t_s
	Gypsum	1/2" – 5/8"
	Plywood (OSB)	1/2" – 5/8"

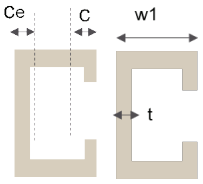
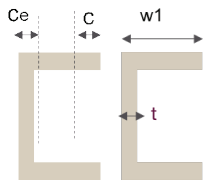
1. Stacking multiple sheathing layers is not recommended
2. For suitability of other sheathing materials than described above, please contact Hilti
3. For application without sheathing backing, use X-IE-GSP

Waterproofing Membrane Properties

WPM Material [1,2,3]	Max. WPM thickness Inch (mm)
Liquid Applied and Sheet Based (bitumen or paper wrap)	0.08 (2)
Sprays	

1. WPM sprays should be installed according to manufacturers' instructions
2. No more than 2 layers of wrap WPM's
3. WPM between stud and insulation is only allowed for the X-IE-GS fastener.

Base Material Properties[1]

Base Material		Material Strength	Base Metal Thickness t_i	Web Width w_i	Minimum Corner Distance c_e	Minimum Edge Distance c
	Cold formed steel studs	f_{cc}= 30-60 ksi	18ga (43 mils) – 12ga (97 mils)	1-3/8" – 3"	0.2"	0.2"
	Track sections	f_{cc}= 30-60 ksi	18ga (43 mils) – 12ga (97 mils)	1-3/8" – 3"	0.2"	0.2"

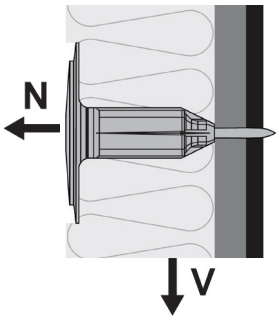
1. Fastening should be done on cold-formed steel or track sections, not at intersection between studs and tracks at corners.

Fastening Pattern, Edge Distance and Spacing on Insulation Materials

Fastened Material	Minimum Number of Fasteners Per Square-Foot[1]	Pattern, Edge Distance and Spacing
Rigid mineral wool **EPS, XPS, PIR, PUR, PIR/PUR with foil facing**	0.6	Follow insulation board manufacturer's recommendations

1. Required even if ancillary support is provided, or if the board manufacturer's minimum spacing is greater.

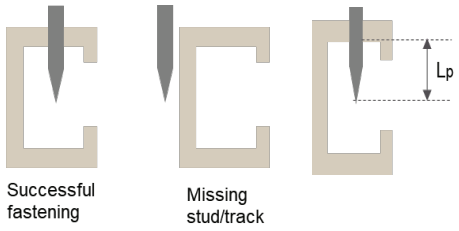
Performance Data

Recommended resistance under tension and shear load		
	Tension lb (kn) N_{rec}	Shear lb (kn) V_{rec}
	45 (0.2)	45 (0.2)

- Minimum cold-formed steel base material strength 33ksi.
- Minimum base material thickness 18ga (43 mils).
- The above data is valid when fasteners are installed according to edge and corner distance specifications and all successful fastening points have nail at least 0.36" nail protrusion.
- The above data values are for cold formed steel studs and track sections based on laboratory and field testing.
- The above data refers to the fastener pull-out failure mode.
- For pull-over capacity please consult insulation material supplier.

Fastening Quality Assurance

Nail protrusion



Fastening System	Minimum acceptable nail protrusion L_p for successful fastenings on cold form steel studs and track sections
X-IE-GS X-IE-GSP	0.36"

- Visible setting failures **must be replaced with a new fastener**, not in the same hole.

3.2.21.4 ADDITIONAL SYSTEM REQUIREMENTS

Tool and Energy Recommendation



Fastener	GX-IE*	GX-IE XL*	GC 52
X-IE-GS	✓	✓	✓
X-IE-GSP	✓	✓	✓

Note: For insulation thicknesses > 6", GX-IE XL tool is required.

* **Note:** GX-IE and GX-IE XL tools need to have an X-IE-GS and X-IE-GSP enabled fastener guide which is indicated by a red ring as the picture below. If the fastener guide doesn't have the red ring, please contact Hilti for support.

3.2.21.5 ORDERING INFORMATION

Fastened Material	Insulation Thickness[1] t_i	X-IE-GS			X-IE-GSP		
		Designation	Nail	Item No.	Designation	Nail	Item No.
Rigid mineral wool; EPS, XPS, PIR, PUR, PIR/PUR with foil facing	1"	X-IE-GS 1"	X-GS 57	2299884	X-IE-GSP 1"	X-GS 44	2375249
	1.5"	X-IE-GS 1-1/2"	X-GS 57	2293071	X-IE-GSP 1-1/2"	X-GS 44	2325570
	2"	X-IE-GS 2"	X-GS 57	2293072	X-IE-GSP 2"	X-GS 44	2323571
	2.5"	X-IE-GS 2-1/2"	X-GS 57	2293073	X-IE-GSP 2-1/2"	X-GS 44	2325572
	3"	X-IE-GS 3"	X-GS 57	2293074	X-IE-GSP 3"	X-GS 44	2325573
	3.5"	X-IE-GS 3-1/2"	X-GS 57	2299885	X-IE-GSP 3-1/2"	X-GS 44	2325574
	4"	X-IE-GS 4"	X-GS 57	2293075	X-IE-GSP 4"	X-GS 44	2325575
Rigid mineral wool only	6"	X-IE-GS 6"	X-GS 57	2386280	-	-	-
	7"	X-IE-GS 7"	X-GS 57	2386281	-	-	-
	8"	X-IE GS 8"	X-GS 57	2362644	-	-	-

1. Insulation board thickness tolerance +/- 1/8"

3.3 CEILING FASTENING SYSTEMS

3.3.1 CEILING FASTENING SYSTEMS SELECTION AND DESIGN

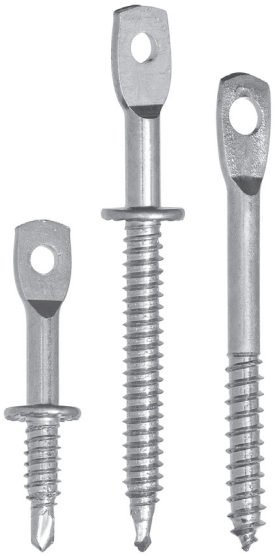
3.3.1.1 CEILING FASTENING SYSTEMS SELECTION

The following sections describe suspended ceiling system attachment solutions for lay-in panel or acoustical suspended ceilings. These solutions consist of powder-actuated and mechanical fasteners that provide the installer with highly productive, high quality solutions designed to fit the needs of the particular application.

The primary criterion when determining which solution to choose will depend on the base material. The innovative Hilti X-CX ALH and X-CX C powder-actuated fastening systems are intended for use in concrete and concrete over metal deck base materials. The X-CX ALH is especially well-suited for very hard or tough concrete. The X-CX ALH ceiling clip assembly may also be used in steel base materials. The eye-lag ceiling fastening system is a solution for wood and thin gauge cold-formed steel base materials.

X-CX ALH Ceiling Clip Assembly

X-CX Assembly with Pre-Tied Wire



Eye-Lag Fastening System

Hilti Ceiling attachment system product selection guide

Ceiling fastening system	Applicable base material	Fastener types	Recommended installation tools	Wire type	Section
X-CX C	Concrete, lightweight concrete over metal deck	X-C27	DX 351-CT with Pole Tool	Pre-tied to ceiling clip or provided by others	3.3.2
X-CX ALH	Concrete, lightweight concrete over metal deck, steel	X-ALH 22, X-ALH 27, X-ALH 32	DX 351-CT with Pole Tool	Pre-tied to ceiling clip or provided by others	3.3.2
Eye-lag screw	Wood, sheet steel	EL WS, EL S, EL SD	Telescopic Screw Ceiling Tool	Provided by others	3.3.3

3.3.1.2 CEILING FASTENING SYSTEMS DESIGN

Figures 1 and 2 illustrate the installation of a suspended ceiling system as described in ASTM C635. The ceiling systems shown are composed of ceiling panels which are supported by a suspension system of main runners, cross runners and wall moulding for direct hung ceiling systems. Carrying channels are part of indirect hung ceiling systems where the main runners are attached to carrying channels which are attached to concrete using Hilti ceiling fastening systems.

The entirety of the suspended ceiling system depends on the Hilti ceiling fastening hangers which support the suspension system main load carrying members. The spacing between ceiling fasteners must be determined by the design architect or engineer of record based on the loads and building code requirements or as recommended by ceiling manufacturer. Hanger wires must be wrapped by the installer to the specific requirements at the point of installation to the main runner or channel members as shown in the figures below.

The wires must be wrapped in a similar fashion at the wire hole for the X-CX ceiling clip assemblies.

Hilti ceiling fastening systems should not be used for anchorage of seismic bracing channels or compression struts. Hilti recommends the use of ICC-ES AC193 qualified mechanical anchors, such as Hilti KB-TZ, for attachment of seismic bracing for suspended ceiling systems. Reference Section 2.4 for more discussion on seismic considerations.

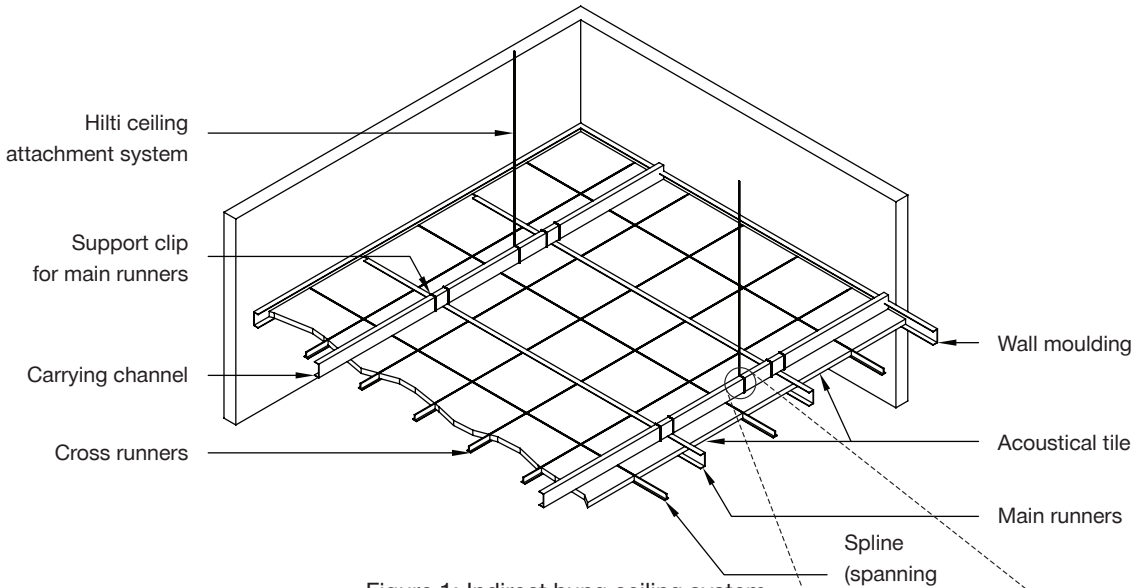


Figure 1: Indirect hung ceiling system (reference ASTM C635)

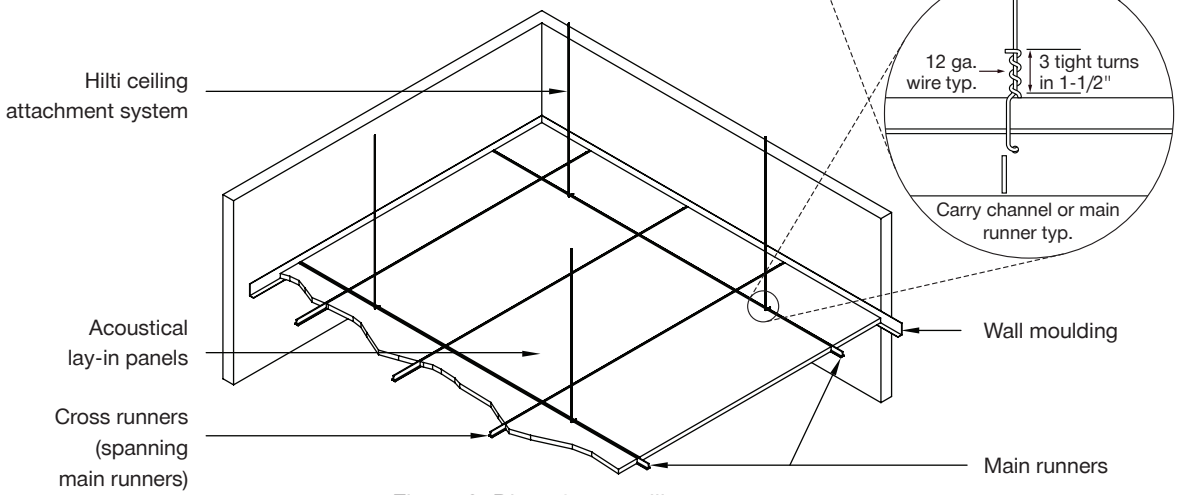
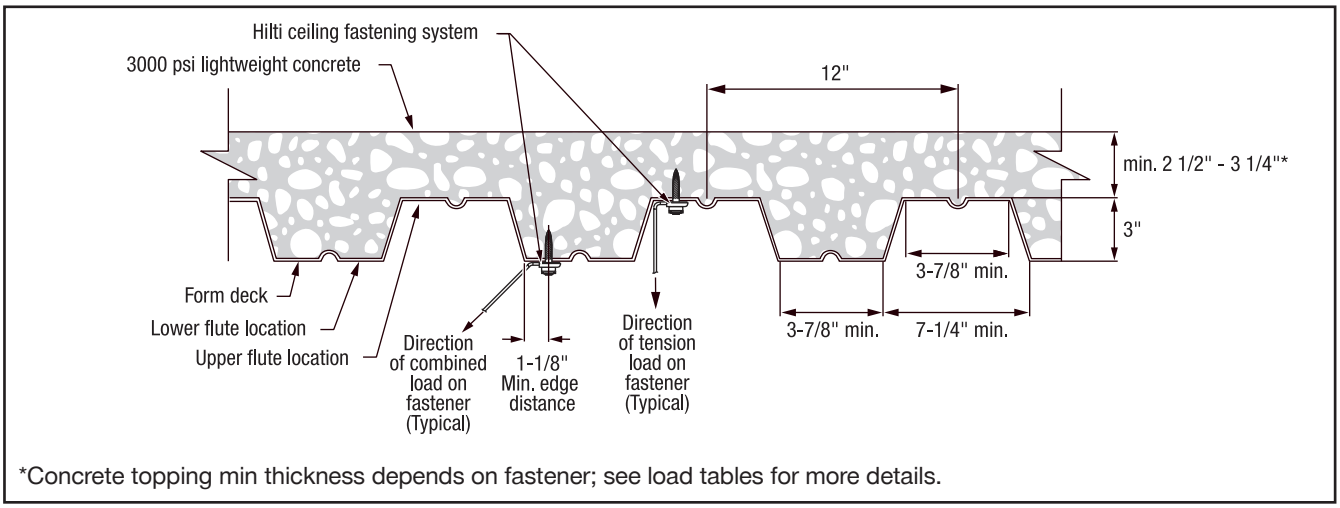


Figure 2: Direct hung ceiling system (reference ASTM C635)

3.3.1.3 CEILING FASTENER LOCATIONS WHEN INSTALLING INTO LIGHTWEIGHT CONCRETE OVER METAL DECK



*Concrete topping min thickness depends on fastener; see load tables for more details.

Figure 3: Hilti ceiling fastening system location in 3-in.-deep composite floor deck, normal deck profile orientation

Listings/Approvals

ICC-ES (International Code Council)
ESR-2184 with LABC/LARC Supplement

3.3.2 X-CX CEILING CLIP AND HANGER ASSEMBLIES

3.3.2.1 PRODUCT DESCRIPTION

Ceiling clip assemblies are an economical and recognized method of suspending acoustical ceiling grids and panels from concrete and steel. These pre-assembled ceiling clips consist of a sheet metal clip with a pre-mounted powder-actuated fastener and are pre-tied with wires of various lengths and gauges depending on ceiling height and other requirements. When the fastening is made, the clip, fastener and wire are installed in one step. Further productivity can be achieved through the use of a Hilti powder-actuated pole tool.

Product features:

The X-CX ceiling clip is premounted with either an X-AL-H fastener or an X-C fastener.

The X-AL-H fastener has a long conical tip design, which better ensures optimal tension loads and stick rate while X-C fastener is a standard solution for fastening into normal weight concrete or concrete over metal deck.

3.3.2.2 MATERIAL SPECIFICATIONS

Part	Material designation	Steel diameter/ thickness	Plating
X-AL-H Fastener	Carbon Steel	0.177"	5 µm Zinc[1]
X-C27 Fastener	Carbon Steel	0.138"	5 µm Zinc[1]
X-CX Clip	Carbon Steel	16 GA	5 µm Zinc[1]
Wire	Carbon Steel	12 GA, 9 GA or 8 GA	Class 1[2]

1 ASTM B633, SC 1, Type III.
2 Pre-mounted ASTM A641/A641M Class 1 wires come attached with a minimum of three tight turns in 1-1/2" length.

3.3.2.3 TECHNICAL DATA

Allowable loads in normal weight concrete[1,2,3]

Fastener designation	Concrete compressive strength			
	4,000 psi		6,000 psi	
Load direction	Tension lb (kN)	45-degree lb (kN)	Tension lb (kN)	45-degree lb (kN)
X-CX ALH22	90 (0.40)	125 (0.56)	90 (0.40)	125 (0.56)
X-CX ALH27	125 (0.56)	165 (0.73)	110 (0.49)	150 (0.67)
X-CX ALH32	160 (0.71)	210 (0.93)	145 (0.64)	200 (0.89)
X-CX C27	90 (0.40)	125 (0.56)	-	-

1 The tabulated allowable load values are for the powder-actuated ceiling clip assemblies only, using a safety factor that is greater or equal to 5.0, calculated based on testing in accordance with ICC-ES AC70 and ASTM E1190. Connected components, including wires, must be investigated separately.
2 Multiple fasteners are recommended for any attachment.
3 The concrete thickness at the point of penetration must be a minimum of three times the fastener embedment depth.

Allowable Loads in structural 3000 psi lightweight concrete over metal deck[1,2,3,4]

Fastener designation	Fastener location			
	Lower flute		Upper flute	
Load direction	Tension lb (kN)	45-degree lb (kN)	Tension lb (kN)	45-degree lb (kN)
X-CX ALH22	90 (0.40)	110 (0.49)	110 (0.49)	110 (0.49)
X-CX ALH27	120 (0.53)	125 (0.56)	150 (0.67)	130 (0.67)
X-CX ALH32	150 (0.67)	145 (0.64)	190 (0.85)	160 (0.71)
X-CX C27	80 (0.36)	110 (0.49)	110 (0.49)	110 (0.49)

1. The tabulated allowable load values are for the powder-actuated ceiling clip assemblies only, using a safety factor that is greater or equal to 5.0, calculated based on testing in accordance with ICC-ES AC70 and ASTM E1190. Connected components, including wires, must be investigated separately.
2. Multiple fasteners are recommended for any attachment.
3. The concrete thickness at the point of penetration must be a minimum of three times the fastener embedment depth.
4. Deck panel must be a 3-inch deep composite floor deck and have a minimum 0.0358 inch base-metal thickness, a minimum yield strength of 40 ksi and a minimum tensile strength of 55 ksi.

Allowable loads in minimum ASTM A36 (Fy ≥ 36 ksi; Fu ≥ 58 ksi) steel[1,2,3]

Fastener designation	Steel thickness in.					
	1/4		3/8		1/2[4]	
Load direction	Tension lb (kN)	45-degree lb (kN)	Tension lb (kN)	45-degree lb (kN)	Tension lb (kN)	45-degree lb (kN)
X-CX ALH22	260	260	260	260	260	260

1 The tabulated allowable load values are for the powder-actuated ceiling clip assemblies only, using a safety factor that is greater or equal to 5.0, calculated based on testing in accordance with ICC-ES AC70 and ASTM E1190. Connected components, including wires, must be investigated separately.
2 Low-velocity fasteners shall be driven to where the point of the fastener penetrates through the steel base material, except otherwise noted.
3 Multiple fasteners are recommended for any attachment.
4 For fastening into 1/2-inch or thicker steel, DX460/DX5 with black cartridge may be needed. For more information, contact Hilti technical service.

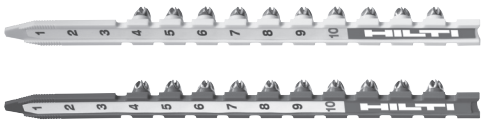
3.3.2.4 ORDERING INFORMATION

Fastener designation	Shank length in. (mm)	Shank Ø in. (mm)	Guidance washer Ø	Packaging quantity
X-CX ALH22[1]	7/8 (22)	0.177 (4.5)	8 mm Plastic	100 pcs
X-CX ALH27[1]	1 (27)	0.177 (4.5)	8 mm Plastic	100 pcs
X-CX ALH32[1]	1-1/4 (32)	0.177 (4.5)	8 mm Plastic	100 pcs
X-CX C27[2]	1 (27)	0.138 (3.5)	8 mm Plastic	100 pcs

1 Fasteners are also available with pre-tied wire, 12 GA, 9 GA or 8 GA, with lengths ranging from 4' to 12'.
2 Fasteners are also available with pre-tied wire, 12 Ga, with lengths ranging from 4' to 8'.

DX 351-CT Powder-Actuated Tool

Pole tool accessories for DX 351 CT



Booster cartridges

X-CX ALH Fastener
without ceiling wire

X-CX ALH Fastener
with pre-tied ceiling wire

X-CX C27 Fastener
without ceiling wire

X-CX C27 Fastener
with pre-tied ceiling wire

3.3.3 EYE LAG CEILING FASTENING HANGER

3.3.3.1 PRODUCT DESCRIPTION

The Hilti eye lag ceiling fastening hanger system is a cost effective and efficient means of supporting direct and indirect hung suspended lay-in panel ceilings. The eye lag ceiling hanger is manufactured from a hardened zinc electroplated mild carbon steel and is designed for attachment of suspended ceiling hanger wires into wood and sheet steel base materials. Each hanger is provided with a 0.177" pre-punched hole for attachment of ceiling wires. The EL S and EL SD versions are manufactured with steel washers to provide stability during installation into steel base materials.

1/4" EL WS

1/4" EL S

1/4" EL SD

3.3.3.2 MATERIAL SPECIFICATIONS

Fastener designation	Fastener material	Base material	Fastener pating[1]
1/4" EL WS	Carbon steel	Wood	8 µm zinc
1/4" EL S	Carbon steel	Steel deck 20 - 25 gauge and wood	8 µm zinc
1/4" EL SD	Carbon steel	Steel deck 16 - 22 gauge	8 µm zinc

1 Zinc plated per EN/ISO 4042 A3F. Reference Section 2.3.3.1 for more information.

3.3.3.3 TECHNICAL DATA

Allowable loads for Hilti Eye Lag Ceiling Fastening Hanger installed in wood[1,3,4,5]

Fastener description	Wood[4]	
	Tension lb (kN)	45-degree[2] lb (kN)
1/4" x 3" EL WS	260 (1.15)	185 (0.82)
1/4" x 2-3/4" EL S		135 (0.60)

1 The tabulated allowable load values are for the Eye Lag screws only, using a safety factor of 3.0 per ICC-ES AC233 and AC118. Ceiling wires or other attachments must be investigated in accordance with accepted design criteria.
2 Oblique load applied 45-Degrees from the longitudinal axis of the fastener.
3 Based on minimum 1-1/2" Eye Lag screw penetration into the wood member. For fasteners with integrated washer, fastener should be driven so that washer is in contact with base material.
4 Based on testing in wood with minimum specific gravity of 0.50. For wood members with different specific gravity measurements, refer to Section 11 of the National Design Specification for Wood Construction.
5 For edge, end distance and spacing requirements, refer to Table 11.5.1E of the National Design Specification for Wood Construction.

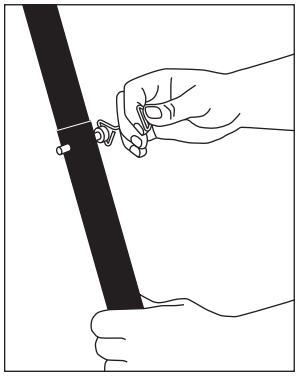
Allowable loads for Hilti Eye Lag Ceiling Fastening Hanger installed in sheet steel[1,2,3]

Fastener description	Steel thickness, ga. (in.)									
	25 (0.021)		22 (0.030)		20 (0.036)		18 (0.048)		16 (0.060)	
	Tension (lb) (kN)	45-degree[4] (lb) (kN)	Tension (lb) (kN)	45-degree[4] (lb) (kN)	Tension (lb) (kN)	45-degree[4] (lb) (kN)	Tension (lb) (kN)	45-degree[4] (lb) (kN)	Tension (lb) (kN)	45-degree[4] (lb) (kN)
1/4" x 2-3/4" EL S	**60** (0.26)	**70** (0.31)	**110** (0.49)	**150** (0.67)	**150** (0.67)	**230** (1.02)	—	—	—	—
1/4" x 2" EL SD	—	—	**75** (0.33)	**100** (0.44)	**115** (0.51)	**140** (0.62)	**165** (0.73)	**225** (1.00)	**215** (0.96)	**235** (1.04)
1/4" x 3" EL SD	—	—								

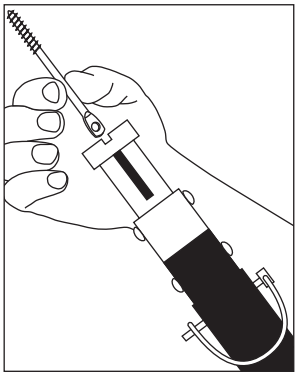
1 The tabulated allowable load values are for the Eye Lag screws only, using a safety factor of 3.0 per ICC-ES AC233 and AC118. Ceiling wires or other attachments must be investigated in accordance with accepted design criteria.
2 Values are based on ASTM A653 grade steel having a minimum yield strength of F_y = 33 ksi.
3 Based on minimum three full threads penetration through the sheet steel member.
4 Oblique angle load applied 45-Degrees from the longitudinal axis of the fastener.

Warning: Because of the potential for delayed hydrogen assisted stress corrosion cracking, many hardened steel fasteners are not recommended for use with dissimilar metals or chemically treated wood when moisture may be present or in corrosive environments. For further information, contact Hilti Technical Support at 1-877-749-6337.

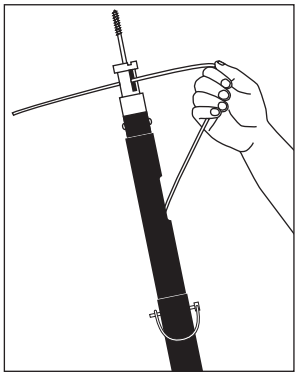
3.3.3.4 INSTALLATION INSTRUCTIONS*



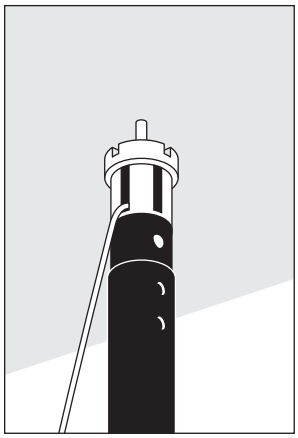
1. Adjust the telescoping tubes to the proper lengths.



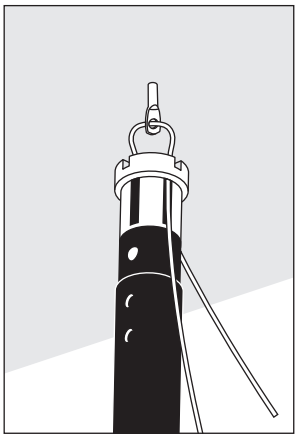
2. Insert the Eye Lag screw into top slot.



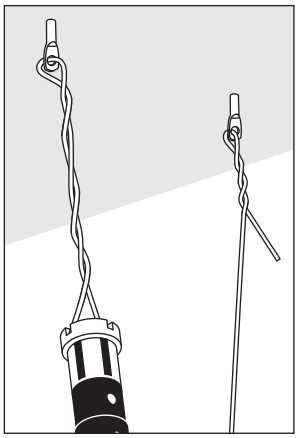
3. Insert wire into side of slot through the eyelet in the Eye Lag screw. Then bend the wire end down. Provide adequate length of wire to properly develop the required number of loops after twisting.



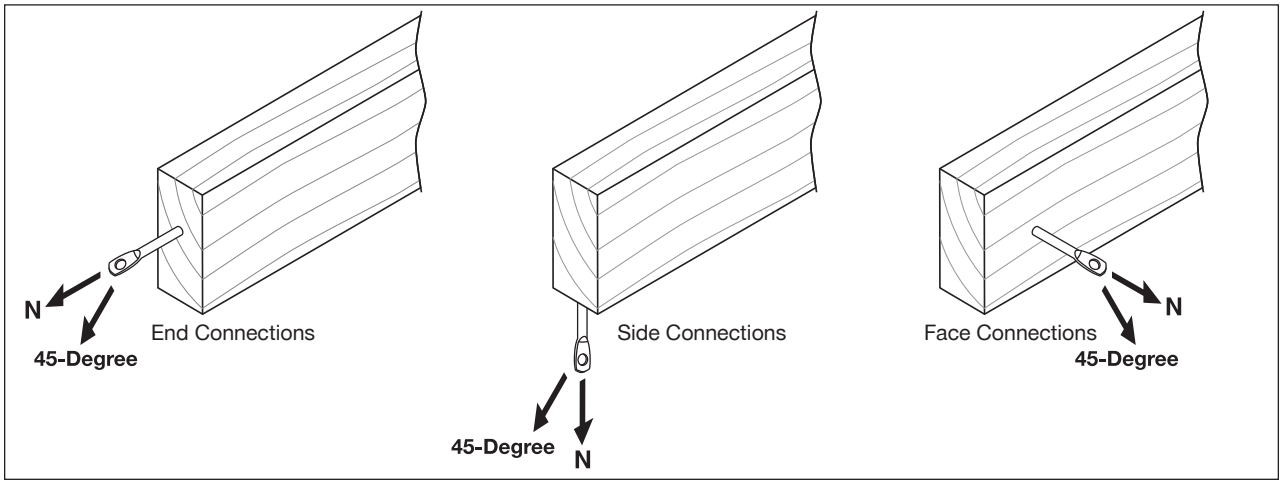
4. Raise tool against the ceiling, rotate the pole tool until the Eye Lag screw is at least 1-1/2" into the wood base material (embedment varies for steel base material - refer to Section 3.3.3.3 for additional details). CAUTION: In steel base material, stop turning before washer contacts base material to avoid stripping of the base steel.



5. Lower the tool about 2" from base material surface as shown.



6. Rotate the tool again to twist the wire. The pole tool may be turned by hand or by using a 1/2" variable speed drill. CAUTION: If using drill, do not grip pole tightly with hand, but allow it to turn loosely. Reference Figures 2 and 3 for typical wire tying requirements.



Connection Locations for Wood Applications

* These are abbreviated instructions which may vary by application. **ALWAYS** review/follow the instructions accompanying the product.

3.3.3.5 ORDERING INFORMATION

Eye lag ceiling fastening hanger

Fastener Description	Shank Ø in. (mm)	Fastener length in. (mm)	Base material	Quantity
Eye Lag screw - 1/4 x 3" wood screw zinc (EL WS)	1/4 (6.3)	3 (76)	Wood	100 pcs
Eye Lag Screw - 1/4" x 4" wood screw zinc (EL WS)	1/4 (6.3)	4 (102)	Wood	100 pcs
Eye Lag screw - 1/4 x 2-3/4" sharp zinc (EL S)	1/4 (6.3)	2-3/4 (70)	Sheet Steel 20-25 ga. and Wood	100 pcs
Eye Lag screw - 1/4 x 2" self drilling zinc (EL SD)	1/4 (6.3)	2 (51)	Sheet Steel 16-22 ga.	100 pcs
Eye Lag screw - 1/4 x 3" self drilling zinc (EL SD)	1/4 (6.3)	3 (76)	Sheet Steel 16-22 ga.	100 pcs

Pole tool description	Notes	Quantity
Telescopic screw ceiling tool - SF PT 4' - 12'	The pole tool can be used either by hand or with a 1/2" variable speed drill.	1 pcs
Telescopic screw ceiling tool - SF PT 8' - 24'	The pole tool can be used either by hand or with a 1/2" variable speed drill.	1 pcs

Telescopic Screw Ceiling Tool

1/4" EL WS

1/4" EL S

1/4" EL SD

Warning: Because of the potential for delayed hydrogen assisted stress corrosion cracking, many hardened steel fasteners are not recommended for use with dissimilar metals or chemically treated wood when moisture may be present or in corrosive environments. For further information, contact Hilti Technical Support at 1-877-749-6337.

3.4 GRATING AND CHECKERPLATE

3.4.1 GRATING AND CHECKERPLATE FASTENER SELECTION

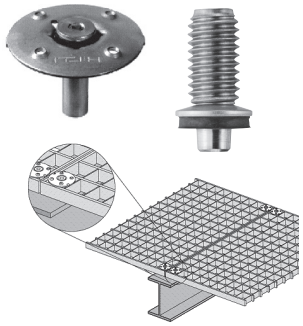
The following sections describe grating and checkerplate fastening solutions for marine and industrial environments. These solutions consist of powder-actuated, screw-in and mechanical fasteners which provide the installer with highly productive, high quality solutions which are designed to fit the needs of the particular application.

The primary concern when determining which solution to choose is the level of corrosion resistance required. For marine environments, Hilti offers a stainless steel grating or checkerplate disk and powder-actuated or screw-in stud. Stainless steel studs are attached directly to the base steel, while the disk is then attached using a screw fastening tool. If through penetration of the base material is not desired, or if the base material onto which the grating panels are installed is very thick, an option for stud attachment is the Hilti X-BT-GR system. The Hilti X-BT-GR system consists of a specialized tool set which enables the installer to pre-drill a small pilot hole into the base steel. A blunt tip stud, the diameter of which is slightly larger than that of the pre-drilled hole is then fastened with a Hilti powder-actuated tool directly into the pilot hole. Finally, the disk is installed on the stud with a screw fastening tool.

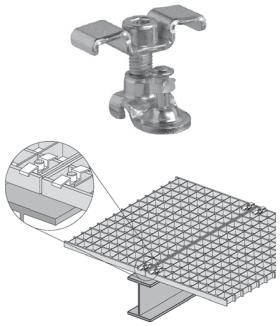
The Hilti S-BT system offers solutions to not only thick base material but also thin base material in which through penetration is acceptable. The Hilti S-BT system also consists of a specialized tool for pre-drilling the base steel, a threaded tip which cuts into the pre-drilled hole using a Hilti screw fastening tool equipped with proper depth gauge. And similarly the disk can be installed on the S-BT stud. More information about the innovative S-BT fastening system can be found in Section 3.2.15.

For less corrosive environments, Hilti offers the X-GR powder-actuated fasteners which feature stainless steel fasteners and duplex coated (similar to hot dip galvanized) pre-mounted saddle clip fasteners. These fasteners offer high productivity and corrosion resistance at a level which is typically needed in non-marine, semi-corrosive exposed environments. For those cases where powder-actuated solutions are not desired, Hilti also offers a mechanical clamp, the X-MGR. This fastener features a hot dip galvanized coating and will fit most standard open bar grating panels.

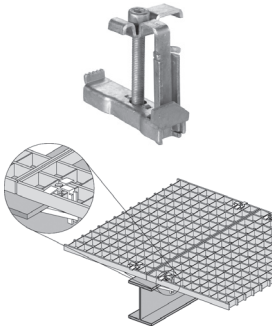
X-FCM Grating Disk System



X-GR Grating Fastening System



X-MGR Grating Fastening System



Hilti grating and checkerplate product selection guide[1,5]

Hilti system	Corrosion resistance[2]		Grating/ checkerplate height in. (mm)	Base steel thickness in. (mm)	Connection type
	Hot-dipped galvanized	Stainless steel			
X-FCM Grating Disk System	X-FCM-F Duplex Coated[2]	X-FCM-R	Steel or FRP grating **1 to 2** (25 to 50)	≥ **1/4**[3] (≥ 6)	Powder-actuated or screw-in
X-FCP Checkerplate Disk System	X-FCP-F Duplex Coated[2]	X-FCP-R	Checkerplate **1/4 to 1/2** (6 to 12)		Powder-actuated
X-GR Grating Fastening System	Duplex Coated[2]	–	Steel grating **1 to 1-1/2** (25 to 38)	**3/16 to 1/2**[4,5] (4 to 12)	Powder-actuated
X-MGR Grating Fastening System	HDG minimum 45 µm	–	Steel grating **1 to 1-1/2** (25 to 38)	**1/8 to 1** (3 to 25)	Mechanical

1 Reference entire section for specific details on allowable load values, selection and installation. More information on X-FCM Grating and X-FCP Checkerplate Disk Systems can be found in Section 3.4.2. More information on X-GR and X-MGR Grating Systems can be found in Section 3.4.3.
2 Reference Section 2.3.3.1 for more information on coatings and corrosion resistance.
3 X-BT-GR M8 threaded studs require a minimum steel thickness of 5/16" (8 mm) to ensure no through point penetration. Refer to Section 3.2.15 for steel thickness requirement for S-BT screw-in studs. X-ST-GR M8 threaded studs have a maximum application limit of 1/2" (12 mm).
4 Disk or saddle may be removed easily. Threaded stud or base will remain in base steel unless removed by overloading fastener.
5 Fastening in base material thickness beyond 1/2'' (12 mm) is possible for A36 and Grade 40 steels. Site testing required.

3.4.2 X-FCM AND X-FCP GRATING AND CHECKERPLATE

3.4.2.1 PRODUCT DESCRIPTION

The Hilti grating fastening system consists of the X-FCM grating disk, an 8 mm powder-actuated threaded stud, and a powder-actuated tool equipped with a special grating adapter that fits through the bar grating and contacts the base steel, or an 8 mm screw-in threaded stud with S-BT system. The X-FCM grating disk is available in three lengths to accommodate grating thickness of 1" to 2". Carbon steel disks are available with duplex coating (X-FCM-F). The stainless steel disks (X-FCM-R) offer the highest corrosion resistance. The 8 mm threaded studs are available in stainless steel.

The X-FCP fastening system is used to fasten flat steel floorplates with thicknesses of 1/4" to 1/2" to supporting steel structures. The Hilti X-FCP fastening system includes the X-FCP disk, an 8 mm powder-actuated threaded stud and a powder-actuated tool with specialized adapter. The adapter is designed to fit through a 3/4" diameter pre-drilled hole in the checkerplate or other similar solid flooring material, and contact the base steel. The X-FCP disk is available in duplex coated carbon steel (X-FCP-F) or stainless steel (X-FCP-R). The 8 mm threaded studs are available in stainless steel.

Product features:

- Grating or checkerplate are fastened in place
- Topside only access needed
- Removable* and reusable*
- Corrosion resistance of stainless disks and X-ST-GR threaded studs
- Non-trip profile
- Non-slip surfaces
- No electrical or pneumatic power required

* Only disk part of fastener can be removed and reused. Threaded stud remains in place unless removed by over-loading the fastener and not reusable.

Guide specification

05500 Metal fabrications
05530 Grating

Disk: X-FCM disk shall be duplex coated carbon steel or stainless steel, which consists of an assembly of a disk and an 8 mm internally threaded screw manufactured by Hilti.

Stud: Powder-actuated threaded stud shall be X-ST-GR M8/10 P8, X-BT-GR M8/7 SN 8 stainless steel studs , screw-in threaded stud shall be S-BT-GR M8/7 SN6 stainless steel studs or S-BT-GF M8/7 AN6 carbon steel studs for attaching the X-FCM disk.

Installation: Contact a manufacturer's representative from Hilti to provide training to the operators at the project site.

05540 Floor plates

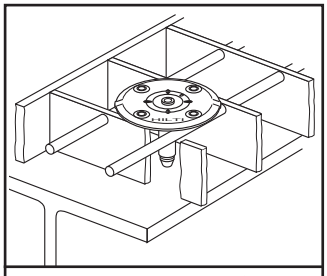
Disk: X-FCP disk shall be duplex coated carbon steel or stainless steel, which consists of an assembly of a disk and an 8 mm internally threaded screw manufactured by Hilti.

Stud: Powder-actuated threaded stud for attaching the X-FCP disk shall be X-ST-GR M8/5 P8 or X-ST-GR M8/10 P8 stainless steel studs manufactured by Hilti.

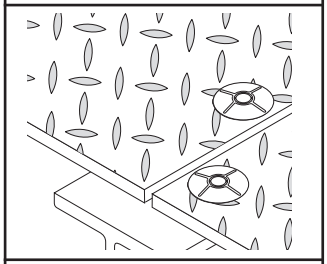
Installation: Contact a manufacturer's representative from Hilti to provide training to the operators at the project site.

X-FCM

X-FCP



Bar grating (with X-FCM)



Checker plate (with X-FCP disk)

Listings/Approvals

ABS (American Bureau of Shipping)
for X-FCM-R and X-FCP-R
Lloyds Register
for all X-FCM types and X-FCP-R
DNV Certification
for X-FCM-F and X-FCM-R
GL (Germanischer Lloyd)
for X-FCM-F and X-FCM-R

3.4.2.2 MATERIAL SPECIFICATIONS

Component	X-FCM-F and X-FCP-F		X-FCM-R and X-FCP-R	
	Material	Coating	Material	Coating
Disk	Carbon steel	Duplex[1]	SAE 316	None
Threaded extension	Carbon steel	Duplex[1]	SAE 316	None
Threaded stud	SAE 316 Equivalent or carbon steel	None	SAE 316 Equivalent	None

1 Duplex coating is comparable to 45 µm HDG coating. Reference Section 2.3.3.1 for more information.

3.4.2.3 TECHNICAL DATA

Allowable static tension loads for X-FCM-F or X-FCM-R with grating, lb (kN)[1,2,4]

Fastener description	Rectangular grid barspacing in. (mm)				Square grid barspacing in. (mm)			
	3/4	(19)	**1-3/16**	(30)	**3/4**	(19)	**1-3/16**	(30)
X-FCM-F	**180**	(0.8)	**180**	(0.8)	**405**	(1.8)[3]	**180**	(0.8)
X-FCM-R	**315**	(1.4)	**225**	(1.0)	**405**	(1.8)[3]	**225**	(1.0)

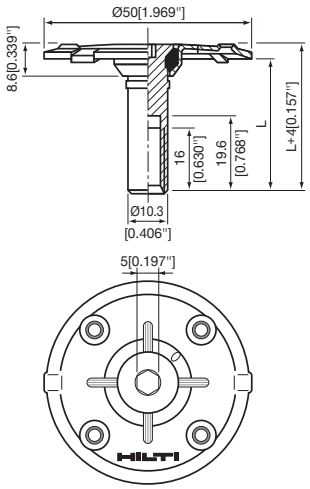
1 Allowable loads represent the capacity of the Hilti Grating System only. The capacity of the grating must be investigated in accordance with accepted design criteria.
2 Unless otherwise noted, load values are limited by plastic deformation of the X-FCM disk.
3 Allowable load value is limited by Allowable load for threaded stud. Reference Sections 3.2.13, 3.2.14, 3.2.15.
4 X-FCM-F and X-FCM-R Fastening Systems resist shear by friction and are not suitable for explicit shear load designs (e.g. diaphragms). Depending on surface characteristics, shear loads of up to 65 lb (0.3 kN) will not result in permanent deformation. Therefore, small unexpected shear loads can generally be accommodated without damage.

Allowable Static Tension Load for X-FCP-F and X-FCP-R with Checkerplate[1,3]

Fastener description	Allowable tension loads[2]	
	lb	(kN)
X-FCP-F X-FCP-R	**405**	(1.8)

1 Allowable loads represent capacity of X-FCP disk or threaded stud. The capacity of checkerplate must be investigated in accordance with accepted design criteria.
2 Allowable load value is limited by the Allowable load for the threaded stud used with the grating disk.
3 X-FCP-F and X-FCP-R are not intended for shear loading.

3.4.2.4 INSTALLATION INSTRUCTIONS

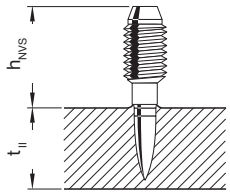
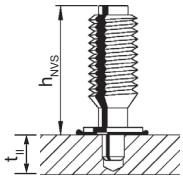
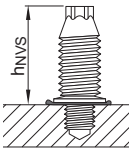
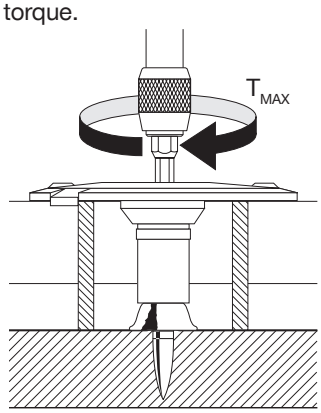
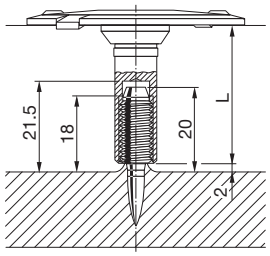
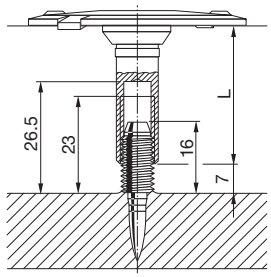


Product Selection Guide for Grating

	Duplex coated[1]	Stainless steel	L		Grating height	
			in.	(mm)	**in.**	(mm)
Grating disk	X-FCM-F 25/30	X-FCM-R 25/30	**0.906**	(23)	**1 to 1-3/16**	(25-30)
	X-FCM-F 1 -1/4	X-FCM-R 1-1/4	**1.063**	(27)	**1-1/4**	(32)
	X-FCM-F 35/40	X-FCM-R 35/40	**1.299**	(33)	**1-3/8 to 1-9/16**	(35-40)
	X-FCM-F 45/50	X-FCM-R 45/50	**1.693**	(43)	**1-3/4 to 2**	(45-50)
Threaded stud	X-ST-GR M8/10 P8					
	X-BT-GR M8/7 SN 8					
	S-BT-GR M8/7 SN6					
	S-BT-GF M8/7 AN6					

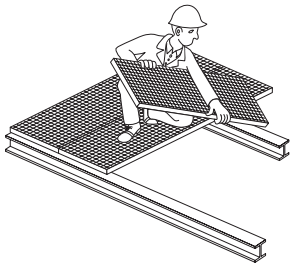
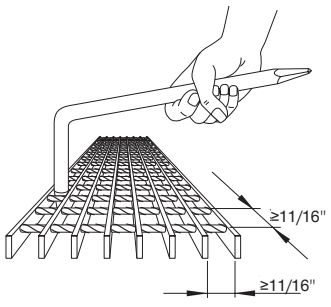
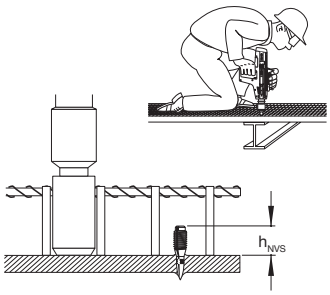
1 480 hour salt spray test per DIN 50021 and 10 cycles Kesternich test per DIN 50018/2.0 (Comparable to 45 microns HDG coating).

Installation details for X-FCM grating disks[1]

Threaded stud placing	Tightening torque	Fitting tolerances/height of grating (dimensions in mm)	
X-ST-GR M8/10 P8 h_{NVS} = 5/8" to 25/32" (16.0 to 20.0 mm) t_{II} = 1/4" to 1/2" (6 to 12 mm)  X-BT-GR M8/7 SN 8[1] h_{NVS} = 5/8" to 11/16" (15.7 to 16.8 mm) t_{II} ≥ 5/16" (8 mm)   S-BT-GR M8/7 SN6 S-BT-GF M8/7 AN6 h_{NVS} = 0.732"-0.752" (18.6 19.1mm) Refer Section 3.2.14 for base steel thickness	T_{max} = 6.0 ft-lb (8.0 N-m) for X-ST-GR. T_{max} = 12.0 ft-lb (16.0 N-m) for X-BT-GR M8 studs.[1] T_{max} = 3.6 ft-lb (5.0 N-m) for S-BT M8 studs. Tightening tool: Hilti screwdriver SF 18-A, SFH 18-A, SF 144-A or SFH 144 with 5 mm Torx Bit Set clutch to appropriate setting to obtain desired torque.  	Min. grating height = L + 2  Governing requirement: • Minimum 2 mm clearance between X-FCM and surface of base steel to allow for deflections Example: X-FCM 25/30 Min. grating ht. = 23 + 2 = 25 mm Max. grating ht. = 23 + 7 = 30 mm Grating height of 32 can be accommodated if h_{NVS} ≥ 18 mm	Max. grating height = L + 7  Governing requirement: • Minimum 5 mm thread engagement at the minimum allowable stand-off, h_{NVS}. Note: • The maximum grating height for an X-FCM type can be extended if h_{NVS} is tightly controlled (e.g. at 18 mm instead of 16 mm).[2]

1 Reference Section 3.2.14 for more details on proper installation of X-BT fasteners. Reference Section 3.2.15 for more details on proper installation of S-BT fasteners. Always consult "Instructions for Use" for more detailed installation instructions.
2 Maximum grating height can be extended with the use of the X-SEA-R30 M8. Reference Section 3.4.2.4 for photo.

Installation procedure for bar grating[1]

1. Place the grating sections following recognized safety precautions.	2. Widen opening at fastening	3. Place the threaded stud	4. Tighten the disk, without exceeding maximum tightening torque
	 	 	

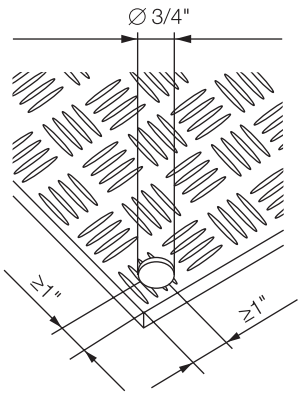
1 Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com. Because of the possibility of changes, always verify that downloaded IFU are current when used. Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

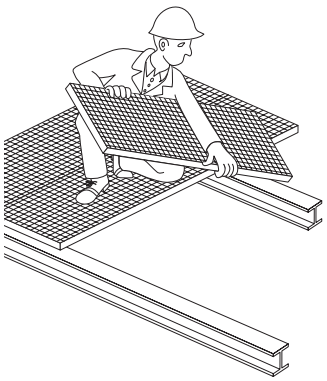
Product selection guide for checkerplate

Fastening height in. (mm)	**X-FCP Disk**[1]	**DX 460-GR Stud**
1/4 to 21/64 (6.4 to 8.3)	X-FCP-F5/10 X-FCP-R5/10	X-ST-GR M8/5 P8 Stud Stand-off 31/64" – 37/64"
11/32 to 1/2 (8.7 to 12.7)	X-FCP-F5/10 X-FCP-R5/10	X-ST-GR M8/10 P8 Stud Stand-off 41/64" – 25/32"
1/4 to 1/2 (6.4 to 12.7)	X-FCP sealing ring	Optional

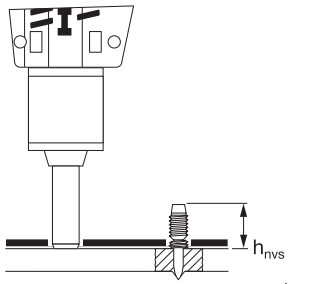
1 X-FCP-F = Duplex Coated Carbon Steel, X-FCP-R = Stainless

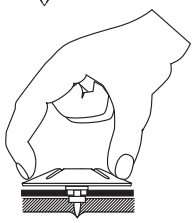
Installation procedure for checkerplate[1]





1. Place and align the plate section following recognized safety precautions.





2. Install the 8 mm stainless threaded stud through the pre-drilled hole.

3. Start the X-FCP on the stud by hand.

4. Tighten the disk, without exceeding maximum tightening torque.

h_{NVS} = Stud Stand-off Length

1 Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com. Because of the possibility of changes, always verify that downloaded IFU are current when used. Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

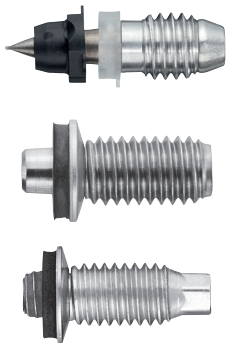
3.4.2.5 ORDERING INFORMATION

Grating disks

Description	Coating/material	Box qty
X-FCM-F 25/30	Duplex Coated	100
X-FCM-F 35/40	Duplex Coated	100
X-FCM-F 1-1/4	Duplex Coated	100
X-FCM-F 45/50	Duplex Coated	100
X-FCM-R 25/30	Stainless Steel	100
X-FCM-R 35/40	Stainless Steel	100
X-FCM-R 1-1/4	Stainless Steel	100
X-FCM-R 45/50	Stainless Steel	100

Threaded studs

Description	Coating/material	Box qty
X-ST-GR M8/10 P8	Stainless Steel	100
X-ST-GR M8/10 P8	Stainless Steel	100
X-BT-GR M8/7 SN 8	Stainless Steel	100
X-ST-GR M8/5 P8	Stainless Steel	100
X-ST-GF M8/7 AN6	Duplex Coated	100
S-BT-GR M8/7 SN6	Stainless Steel	100
S-BT-GF M8/7 AN6	Duplex Coated	100



Checkerplate disks

Description	Coating/material	Box qty
X-FCP-F5/10	Duplex Coated	200
X-FCP-R5/10	Stainless Steel	200
X-FCP Sealing Ring	Polyurethane	200

Grating extensions

Description	Coating/material	Box qty
X-SEA 30	Stainless Steel	100

3.4.3 X-GR AND X-MGR GRATING FASTENING SYSTEMS

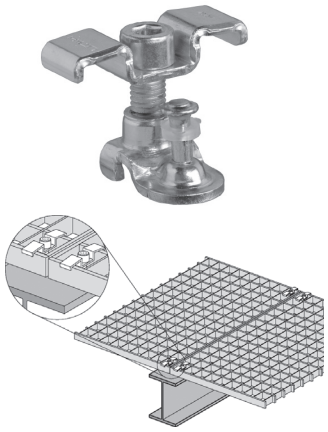
3.4.3.1 PRODUCT DESCRIPTION

Hilti provides a wide range of solutions for the attachment of grating. These solutions allow attachment of different grating heights, have HDG* equivalent corrosion resistance and provide the ability to remove the grating.

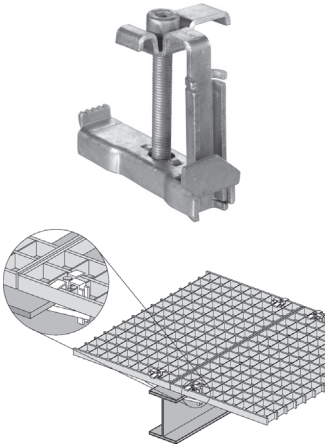
Product features:

- Grating fastened in place
- Topside only access needed
- Removable and reusable**
- Corrosion resistance of HDG*
- Non-trip profile
- No electrical or pneumatic power required

* Refer to material specifications below for more details on coatings.
** Only saddle clip and screw parts of X-GR and X-MGR grating fastening systems fasteners can be removed and reused.



X-GR Grating Fastening System



X-MGR Grating Fastening System

3.4.3.2 MATERIAL SPECIFICATIONS

System component	X-GR		X-MGR	
	Material	Coating[1]	Material	Coating[1]
Saddle clip	Carbon steel	Duplex[2]	Carbon steel	65 µm zinc
Powder-actuated fastener	CrMnMo alloy[4]	8 µm zinc[3]	–	–
Screw	Carbon steel	Duplex[2]	Carbon steel	60 µm zinc
Nut	–	–	Carbon steel	45 µm zinc
Nut holder	–	–	Stainless steel	–

1 Reference Section 2.3.3.1 for more information on coatings.
2 Duplex coating is comparable to 45 µm HDG coating. Reference Section 2.3.3.1 for more information.
3 Zinc coating on X-GR stainless steel powder-actuated fasteners are for improved driving performance during installation.
4 Equivalent to grade 316 stainless steel

3.4.3.3 TECHNICAL DATA

Allowable static tension loads for Hilti grating fastening systems[1,2,3]

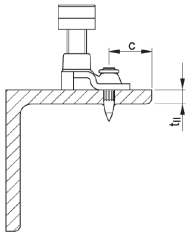
Fastener description	Bearing bar spacing[4] in. (mm)	Base steel thickness in. (mm)	Allowable tension load lb. (kN)
X-GR	**1 to 1-1/4** (25 to 32)	**3/16 to 1/2[5]** (4 to 12)	**180** (0.8)
X-MGR	**≥ 1-3/16** (≥ 30)	**1/8 to 1** (3 to 25)	**135** (0.6)

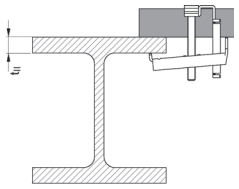
1 Allowable loads represent the static capacity of the Hilti Grating System only. The capacity of the grating must be investigated in accordance with accepted design criteria.
2 Allowable load values are limited by plastic deformation of the X-GR or X-MGR saddle clip.
3 X-GR and X-MGR Grating Fastening Systems resist shear by friction and are not suitable for explicit shear load designs, (e.g. diaphragms). Depending on surface characteristics, shear loads of up to 65 lb (0.3 kN) will not result in permanent deformation. Therefore, small unexpected shear loads can generally be accommodated without damage.
4 Reference installation instructions for more details regarding bearing and cross bar dimensions.
5 Fastening in base material thicknesses beyond 1/2" (12 mm) is possible for A36 and Grade 40 steels. Site testing required.

*For application limits and cartridge selection of X-GR grating fastening system, please refer to Section 3.2.4

3.4.3.4 INSTALLATION INSTRUCTIONS (INCLUDING SELECTION GUIDES)

General spacing edge distance and base steel thickness guidelines





X-GR

Edge distance: c ≥ 1/2" (12 mm)

Spacing: s ≥ 5/8" (15mm)

Base steel thickness: t_{II} = 3/16" to 1/2" (4 mm to 12 mm)*

* Fastening X-GR fasteners into base steel thicknesses greater than 1/2" (12 mm) is possible for A36 and Grade 40 steels. Site testing required. Reference X-GR installation instructions for more information.

X-MGR

Edge distance: No general restriction for end of beam condition (reference X-MGR Installation Procedures for more detail).

Spacing: No general restriction.

Base steel (flange) thickness: 1/8" to 1" (3 mm to 25 mm)

X-GR selection guide for grating

Fastener description	Powder-actuated fastener[1]	Nominal grating height in. (mm)	Min. cross bar spacing[2] in. (mm)	Bearing bar spacing[2] in. (mm)	Base steel thickness[3] in. (mm)	DX tool
X-GR 1"	X-R 20-4.0 Zn P8	**1** (25)	**1-3/16** (30)	**1 to 1-1/2** (23 to 38)	**3/16 to 1/2** (4 to 12)	**DX 5-GR** or **DX 6-GR** with **6.8/11M** cartridges
X-GR 1-1/4"		**1-1/4** (32)				
X-GR 1-1/2"		**1-1/2** (38)				

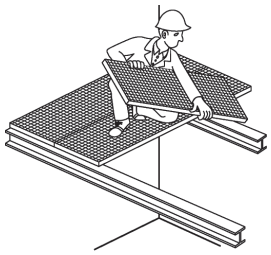
1 Comes pre-assembled as part of X-GR fastener.

2 Reference step 2 of the X-GR Installation Procedures below for more details on bar spacing requirements.

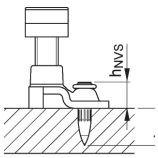
3 Fastening X-GR fasteners into base material thicknesses greater than 1/2" (12 mm) is possible for A36 and Grade 40 steels. Site testing required. Reference X-GR installation instructions for more information.

X-GR standard installation procedures for grating[1]

1. Place the grating sections following recognized safety precautions.



4. Check installed fastener

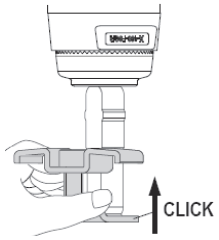


h_{NVS} = 0.28" – 0.41"
(7.0 mm – 10.5 mm)

4a. Check nail stand-off (h_{NVS}).

4b. Check that screw has not been over tightened as shown in step 3.

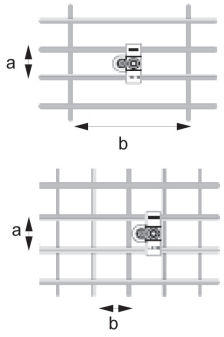
2. Install X-GR Fastener per the "Instructions for Use."



Note: position the flat side of the fastener guide to the saddle!

Bearing bar spacing (a): a = 1" to 1-1/2"
(23 to 38 mm)

Cross bar spacing (b): b ≥ 1-3/16"
(30 mm)

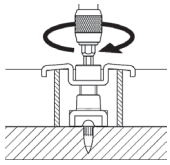


3. Tighten the screw[2]

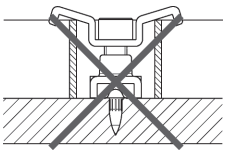
T_{rec} = 2.2 – 3.7 ft-lb (3 - 5 Nm)

Tightening tool:

- Screw driver with torque release coupling (TRC)
- 6 mm Allen-type bit



Do not over tighten: The saddle of the fastener should not be bent.



1 These are abbreviated instructions which may vary by application. **ALWAYS** review/follow the instructions accompanying the product.

2 Tool torque settings are for guideline purposes. Tool wear and temperature as well as battery charge will influence torque characteristics.

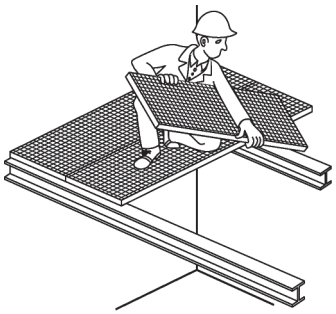
X-MGR selection guide for grating

Fastener description	Powder-actuated fastener	Grating height in. (mm)	Minimum cross bar spacing[1] in. (mm)	Bearing bar spacing[1] in. (mm)	Maximum bearing bar thickness[1] in. (mm)	Base Steel Thickness in. (mm)
X-MGR-W60	None	**1 to 1-1/2** (25 to 38)	**1-3/16** (30)	**1** (25)	**3/16** (4.8)	**1/8 to 1** (3 to 25)

1 Reference step 2 of the X-MGR Installation Procedures below for more details on bar spacing and thickness requirements.

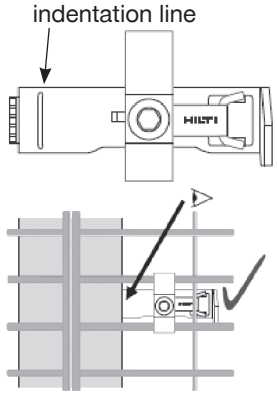
X-MGR installation procedures for grating[2]

1. Place the grating sections following recognized safety precautions.



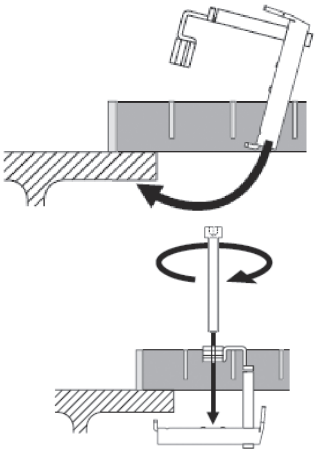
4. Check

4a. Check that the indentation line on the clip is positioned under the steel flange as shown below.

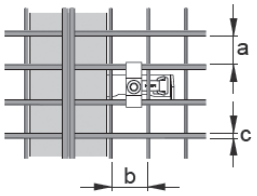


4b. Check that screw has not been over tightened as shown in step 3.

2. Install the X-MGR Fastener per the "Instructions for Use."



	a	b	c
X-MGR W60	1" (25 mm)	≥ 1-3/16" (30 mm)	≤ 3/16" (4.8 mm)

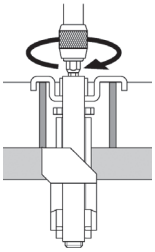


3. Tighten the screw[1]

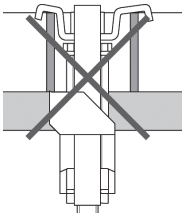
T_{rec} = 3.7 - 6.0 lb-ft (5 - 8 Nm)

Tightening tool:

- Screw driver with torque release coupling (TRC)
- 1/4" Allen-type bit



Do not over tighten: The saddle of the fastener should not be bent.



1 Tool torque settings are for guideline purposes. Tool wear and temperature as well as battery charge will influence torque characteristics.

2 Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com. Because of the possibility of changes, always verify that downloaded IFU are current when used. Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

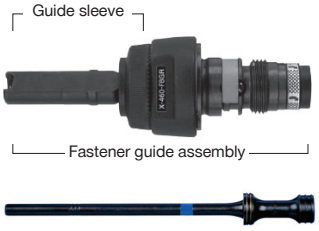
3.4.3.5 ORDERING INFORMATION

Fastening Tools

Description
DX 5-GR Deluxe Grating Tool
DX 6-GR Deluxe Grating Tool
DX 460-GR

Replacement parts

Description
X-5-460-F8GR Fastener guide assembly
X-6-FGR Fastener guide assembly
X-6-5-PGR Piston



X-GR Fastener

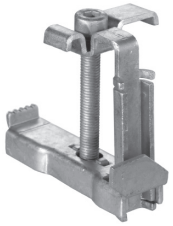
Fastener only packs

Non-combo description
X-GR 1" 25/30 CR 20 P8
X-GR 1-1/4" CR 20 P8
X-GR 1-1/2" CR 20 P8

X-MGR Fastener

Fastener only packs

Description
X-MGR W 60



.27 Caliber cartridge — short (strips of 10 each)

Description
6.8/11 M10 Red (for DX 5 & 460)
6.8/11 M10 Black (for DX 5 & 460)
6.8/11 M10Titanium (for DX 6)
6.8/11 M10 Black (for DX 6)

3.5 STEEL DECK FASTENING SYSTEMS

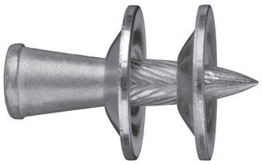
3.5.1 STEEL DECK FASTENER DESIGN AND SELECTION

The following sections describe Hilti steel deck fastening solutions for the steel and metal trades. These solutions consist of powder-actuated and screw fastening systems which provide the installer with highly productive, high quality solutions which are designed to fit the needs of the particular application.

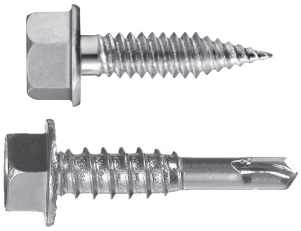
Hilti steel deck fastening systems are model code compliant alternatives to welds and offer many advantages to the building owner, designer and installer. Frame fastening systems consist of powder-actuated fasteners for attachment of a wide variety of steel deck profiles to structural steel and open web steel joists / bar joists or screw fasteners for attachment to bar joists or gauge purlins. Sidelap fastening systems consist of screw fasteners for attachment of steel deck panels to adjacent panels.

X-HSN 24 Powder-Actuated and Racing Tip Screw Fastening Systems for bar joist or gauge purlin

X-ENP-19 Frame Fastener for structural steel



SLC-01 and SLC-02 Sidelap Fasteners



Hilti steel deck fastening systems have been extensively evaluated and hold all relevant model building code approvals and evaluations including International Code Council - Evaluation Service (ICC-ES), Steel Deck Institute (SDI), Los Angeles Department of Building and Safety (LADBS), Factory Mutual (FM), Underwriter's Laboratory (UL) and American Bureau of Shipping (ABS).

Please see the sections 3.5.2, 3.5.3, 3.5.4, 3.5.5 and 3.5.6 for more information on specific product approvals, evaluations and application limits.

In order to make selection and design with Hilti steel deck fasteners quicker and easier, Hilti developed the revolutionary Profis DF Diaphragm Software package. This design and submittal generator program incorporates a powerful design optimization feature to produce the most cost-effective and reliable steel deck design solutions. Producing project submittals including Hilti steel deck fasteners is also streamlined through an automatic design and submittal generator function. Visit the Hilti Decking Design Center to download your copy or ask your Hilti Field Engineer or Steel and Metal Account Manager for details today.

3.5.1.1 TERMINOLOGY AND DEFINITIONS

3.5.1.1.1 Fastener terminology

DX = Hilti terminology for direct fastening powder-actuated technology

ENP = Hilti fastener type used for attaching steel deck to structural support steel with DX 76 and DX 9-ENP powder-actuated tools (X-ENP19 L15)

F = diaphragm flexibility factor, micro-inch/lb (mm x 10^{-6}/N)

G' = diaphragm shear stiffness lb/in. (N/mm x 10^{-6})

HSN = Hilti High Shear Nail fastener type for attaching steel deck to bar joist support steel used with DX 9-HSN and DX 5-SM powder-actuated tools (X-HSN 24)

S_n = allowable diaphragm shear, plf (N/mm)

P_{nf} = structural connector strength, lb (kN)

P_{ns} = fastener strength, panel to panel, lb (kN)

S_f = fastener flexibility factor, panel to frame, in./kip (mm/kN)

S_s = fastener flexibility factor, panel to panel, in./kip (mm/kN)

$t_f (t_{\|})$ = flange thickness of beam or bar joist for steel deck applications, in. (mm)

AISI = American Iron and Steel Institute

ICC-ES = International Code Council - Evaluation Service

SDI = Steel Deck Institute

CSSBI = Canadian Sheet Steel Building Institute

3.5.1.1.2 X-HVB Shear Connector terminology

h_r = nominal rib height, in. (mm)

H_s = connector height, in. (mm)

N_r = number of connectors in one rib

q = allowable shear strength, lb (kN)

Q_n = nominal shear strength, lb (kN)

R_g = coefficient to account for group effect

w_r = average width of rib, in. (mm)

Y_{con} = distance from top of steel beam to top of concrete slab, in. (mm)

3.5.1.1.3 Steel deck definitions

Base Material - The existing part of the work that is a base for the fastening. The structural steel or bar joist framing members in steel deck applications.

Beam - One of the principal horizontal supporting members of a building.

Burn through - Unintended welding-related holes created in steel deck.

Button punch - A mechanical means of connecting two pieces of sheet metal together by crimping with a special tool. This method is used on BI or interlocking deck panels.

Direct fastening - A fastening method in which the fastenings are made without any preparation steps such as drilling a hole. Examples are powder-actuated fastening and self-drilling screws.

Diaphragm deck - A decking system which is designed to carry lateral loads due to wind or seismic action in addition to gravity loads and wind uplift.

Endlap - The overlap of adjacent steel deck panels at the ends of the panels (end edges perpendicular to the steel deck panel fluting). Typically specified as 2 or 4 inches. Butted deck with no endlap is used for some steel deck (e.g., cellular).

Fastener pattern - The number and spacing of fasteners at each support for a steel deck panel.

Fastened material - The component that must be attached to the base or supporting material.

Fastening - The combination of fastener, fastened material and base material all in final position.

Fastening system - The fastener, fastening tool and driving power source all taken together as a system with specific performance characteristics.

Gauge - A measure of thickness for sheet metal. Reference Section 3.5.1.6 for common steel deck gauges.

Interlocking sidelap (BI connection) - Steel deck panels having male and female side edges. The adjacent deck panel male and female edges interlock into each other when the deck is installed. The interlocks are fastened together using button punches, proprietary punch systems, welds, or screws.

Joist - A structural member in a building which is used to support a floor or roof.

Nestable sidelap - Steel deck type in which the side edge of a steel deck panel contains a partial valley profile and overlaps, or “nests" on top of the side edge of the adjacent steel deck panel, which contains a full valley profile. Often fastened together using self-drilling stitch screws.

Non-diaphragm deck - A steel deck system which is designed to carry only gravity loads.

Powder-actuated cartridge - A powder filled metal casing used as the source of driving energy in a powder-actuated tool. The ANSI A10.3 terminology for Hilti powder loads is a “cased powder load.”

Powder-actuated fastener (PAF) - A nail or threaded stud fastener capable of being driven into steel, concrete or masonry. Fasteners may be equipped with washers suitable for clamping the fastened material to the base or supporting material. Also referred to as Hilti DX, powder-actuated fasteners, power-driven fasteners (PDF), drive pins or shot pins.

Low velocity powder-actuated tool - A powder-actuated tool in which the expanding gas of the powder load acts on a captive piston, which in turn drives the fastener into the base material. If the average test velocity of the lightest fastener when using the strongest powder load does not exceed 328 fps (100 m/s), the tool meets the ANSI A10.3 requirements and is classified as a low-velocity tool. All Hilti powder-actuated tools used in the construction industry are classified as low-velocity.

Profis DF Diaphragm Software - Hilti developed, revolutionary design and submittal generator program. It incorporates a powerful design optimization feature to produce cost-effective and reliable steel deck solutions.

Pullout - As related to fasteners, a failure mode that occurs when the fastener pulls out of the base steel support.

Pullover - As related to fasteners, a failure mode that occurs when the steel deck panel pulls over the fastener head or washer(s).

Punch systems - A mechanical means of connecting two pieces of sheet metal together by punching through the steel to create a flap of metal which is then crimped. This is done with a proprietary pneumatic tool on interlocking deck panels.

Purlin - A secondary horizontal structural member attached to the primary frame and supporting the roof covering.

Sidelap - The side edge overlap of adjacent steel deck panels (side edges parallel to the steel deck panel fluting).

Stitch screws - Screws used to fasten the overlapping edges of two deck panels between joists or beams.

Tack weld - A weld of no structural significance. Used for temporary attachment of steel to the supporting frame. A weld made to hold the parts in proper alignment until the final welds are made.

Uplift - Vertical load on the steel deck panels due to wind forces.

Wind tacking - Limited fastening of the steel deck panel at the edges to hold the panels in place until all specified fastenings have been made.

3.5.1.2 STEEL DECK DIAPHRAGM DESIGN AND THEORY

3.5.1.2.1 General discussion

A steel deck diaphragm is a horizontal assembly that resists wind, seismic and other lateral forces. A diaphragm can be modeled as a horizontal beam with interconnected floor and roof deck units that act as the beam web. Intermediate joists or beams act as web stiffeners and perimeter beams or reinforcement on the diaphragm perimeter act as the beam flanges. Figure 1, based on graphics from the Steel Deck Institute (SDI) Diaphragm Design Manual (DDM), depicts a roof deck diaphragm model.

Design of steel deck diaphragms can be done using the Steel Deck Institute (SDI) Diaphragm Design Manual (DDM) or American Iron and Steel Institute (AISI) S310. These methods provide the basic equations for determining the strength and stiffness of the diaphragm considering the following parameters:

1. Steel Deck Profile Type and Thickness
2. Supporting Steel Frame Spacing or Deck Span
3. Frame Fastener Type and Spacing (connector for steel deck to steel frame)
4. Sidelap Fastener Type and Spacing (connector for steel deck panel edge to edge)
5. Safety Factors (ASD) or Resistance Factors (LRFD/LSD) based on load type (wind, seismic, other) and fastening type (mechanical, weld)

ICC Evaluation Services (ICC-ES) recognizes the AISI S310 design methods as acceptable in AC43, “Acceptance Criteria for Steel Deck Roof and Floor Systems”. An ICC Evaluation Service Report (ESR) based on ICC-ES AC43 provides recognition for use with the IBC. Hilti deck fasteners are currently listed in the SDI Deck Design Manual Version 04 (DDM04) and were evaluated in ICC-ES ESR-3693, ESR-2776 and ESR-2197. Hilti deck fastener performance with decking systems is also documented in ICC-ES ESR-1169, ESR-2635, ESR-2657 and IAPMO ER-0217, ER-2018, and ER-0329. Additional industry research has shown that metal deck systems, bare and filled, provide a high level of ductility and overstrength, when tested as part of a horizontal diaphragm. Metal deck fastened to the structure using specially designed Power-actuated fasteners perform especially well in absorbing excess energy in the inelastic range. The Steel Diaphragm Innovation Initiative, www.steeli.org, has compiled a comprehensive report containing a database of small element and full scale static and cyclic tests.

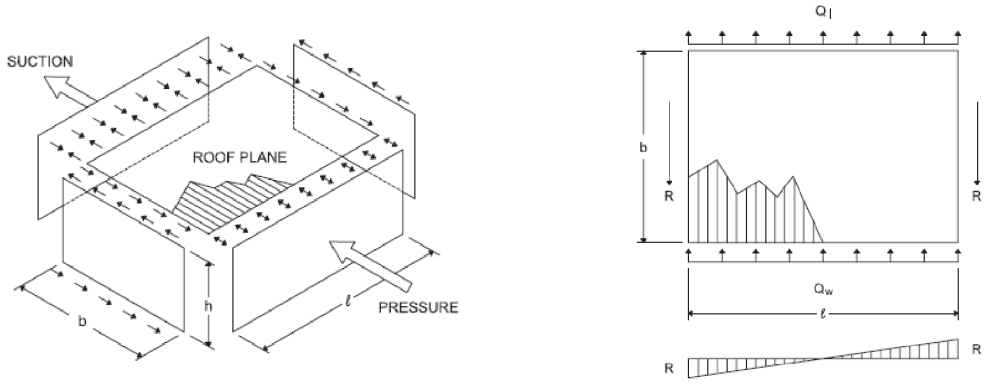


Figure 1: diaphragm model

3.5.1.2.2 Fastener test programs

Many small element and full scale test programs have been conducted using Hilti deck fasteners to evaluate their performance.

1. Small element connection tests

Small element connection tests are used to determine fastener pullout, pullover and lap-joint shear strength and stiffness with sheet steel and base steel representative of typical construction. The data is analyzed and used in a predictive model to calculate the performance of the larger steel deck diaphragm assembly or system. These tests are conducted in accordance with the following standards, and shown in Figure 2.

- AISI S905 Test Methods for Mechanically Fastened Cold-Formed Steel Connections
- ASTM E1190 Standard Test Methods for Strength of Power-Actuated Fasteners Installed In Structural Members
- ICC-ES AC70 Acceptance Criteria for Fasteners Power Driven Into Concrete, Steel and Masonry Elements
- ICC-ES AC118 Acceptance Criteria for Tapping Screw Fasteners

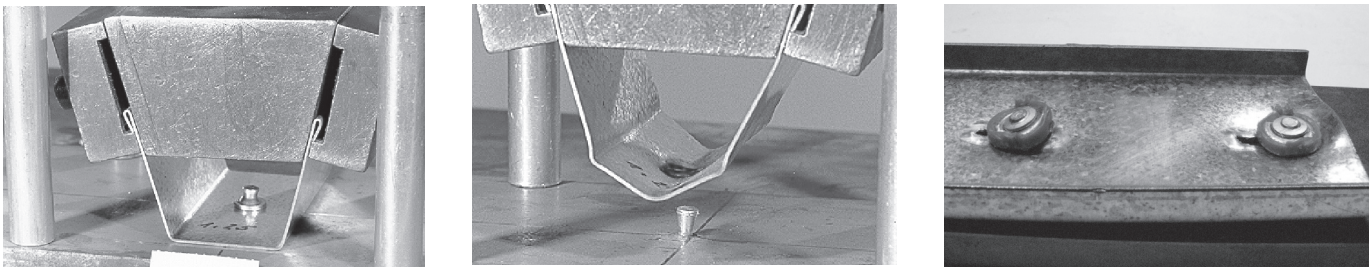


Figure 2: Small element connection tests

2. Full scale diaphragm system tests (cantilever tests)

Full scale diaphragm system tests are used to determine the strength and stiffness of a larger steel deck diaphragm assembly directly. The data is analyzed and fit in a predictive model to address varying configurations of base steel, steel deck, specific fastener combinations and spans. These tests are conducted in accordance with the following standards and shown in Figures 3, 4 and 5.

- ICC-ES AC43 Acceptance Criteria for Steel Deck Roof and Floor Systems
- AISI S907 Cantilever Test Method for Cold-Formed Steel Diaphragms
- ASTM E455 Standard Test Method for Static Load Testing of Framed Floor or Roof Diaphragm Constructions for Buildings

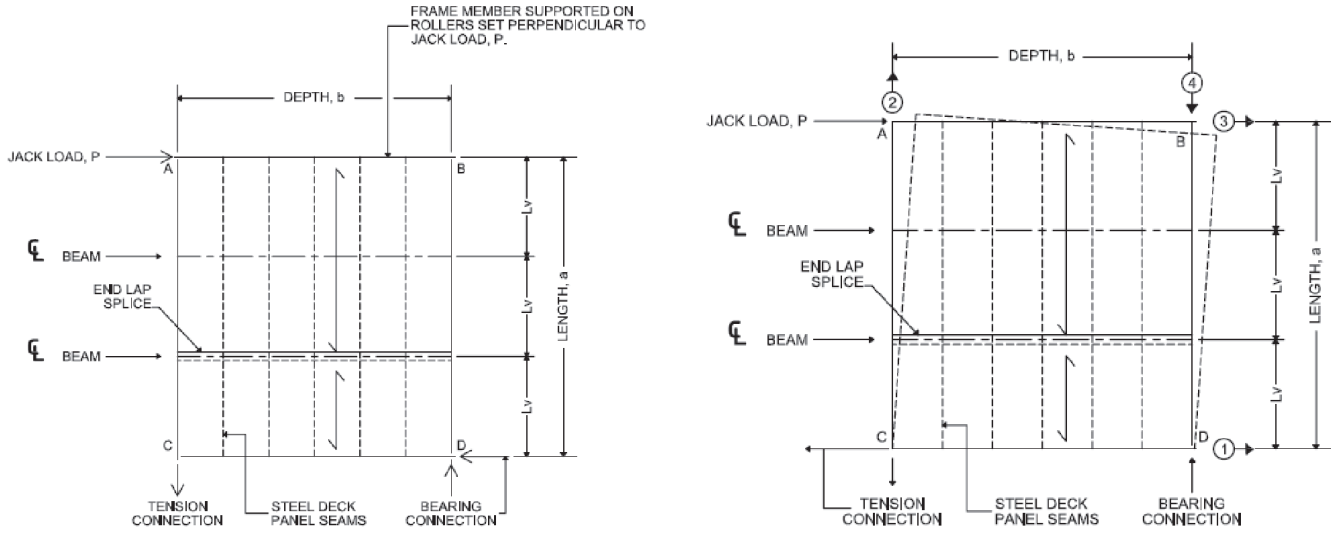


Figure 3: ICC-ES AC43 diaphragm test frame schematics

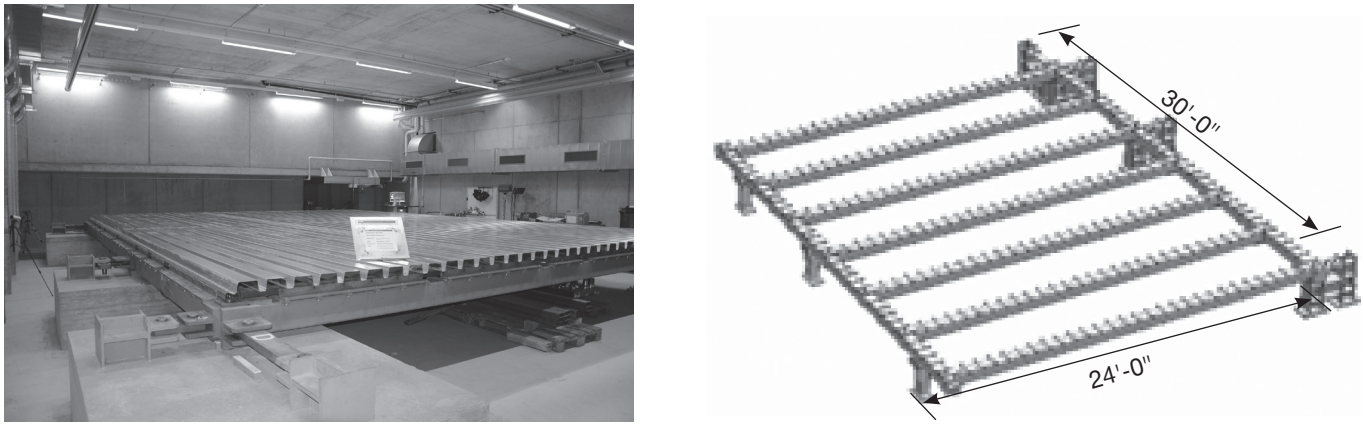


Figure 4: AC43 diaphragm test frame
Fastening Systems Research Laboratory (FSRL), Schaan, Liechtenstein

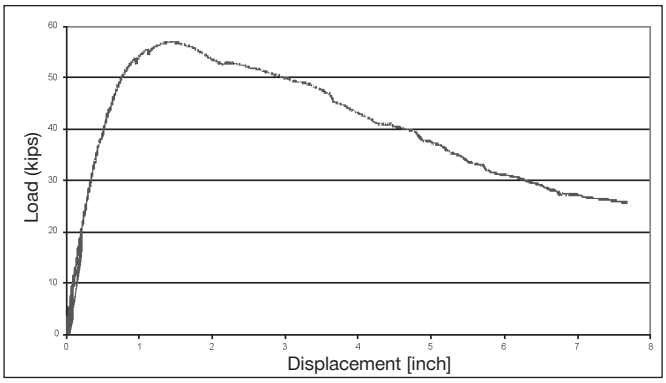


Figure 5: AC43 deck diaphragm load displacement curve

Hilti power-actuated deck fasteners are recognized alternatives to arc spot puddle welds and self-drilling screws. The fasteners can be used on roof deck diaphragms as well as composite concrete filled floor diaphragms. Hilti provides training for powder-actuated tool operators in accordance with ANSI A10.3 Safety Requirements for Powder-Actuated Fastening Systems.

Hilti mechanical fastening systems provide superior solutions for attaching steel deck to steel support members

- Consistent fastening quality
- High production rate
- No burn throughs or joist damage from welding
- Superior cyclic load performance and system ductility

3.5.1.2.3 Proper fastener selection and steel deck layout (pre-fastener installation)

Selection of the proper Hilti deck fastener depends on the supporting base steel thickness as shown in Section 3.5.1.3.1. The Hilti Deck Fastener Selection Gauge shown in Figure 6 should be used by the decking installer to confirm fastener selection. The cut-out slot on the gauge is fit against the bar joist top chord or steel beam flange. As the internal card slides in the gauge, the proper Hilti deck fastener is highlighted with a green box. A red box indicates that the corresponding Hilti deck fastener is outside the base material application limits and should not be used for steel deck fastening to the base material being gauged. Note that because of wide variations in base material hardness, on-site test installation is always required.

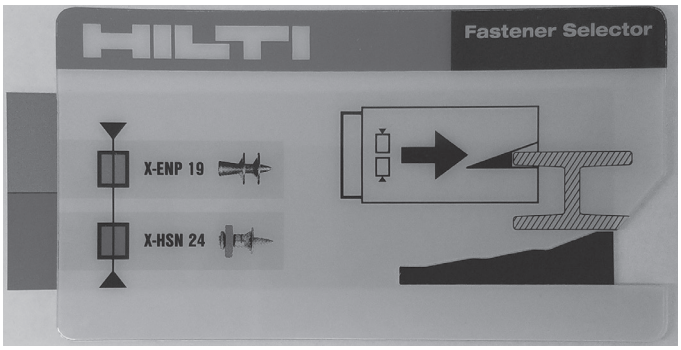
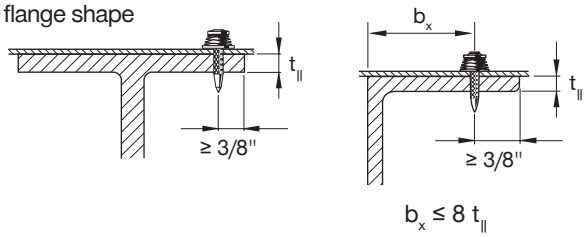


Figure 6: Hilti Deck Fastener Selection Gauge

Steel deck installers must layout deck properly and mark frame fastening lines in order to ensure that steel deck panels are connected to the supporting steel frame. Marking frame fastening lines is essential, especially when attaching steel deck to thin base steels (t_{II} < 1/4"), including open web steel joists. For all applications, the fasteners should be installed at least 3/8" (10 mm) from the edge or toe of the joist top chord or light steel beam flange. Additionally, when installing into a bar joist top chord (angle), the fasteners need to be installed at a distance from the angle, $b_x \leq 8 \times t_{II}$. Reference Figure 7 for edge distance and b_x dimensions.

Rolled beam or wide flange shape

Angles or joist top chords



$b_x \leq 8\ t_{II}$

Figure 7: Edge distance recommendations

Extra care must be taken at the endlap and corner lap conditions where multiple layers of steel deck nest or interlock on adjacent panels. It is particularly important that endlap and corner lap conditions of two and four deck layers must be snug and tight against one another and the supporting steel frame in order for a proper fastening to be made as shown in Figure 8. Tight endlap and corner lap requirements are independent of the fastening type and contribute directly to the performance of arc spot welds, screws, power-actuated fasteners, punches and crimps/clinches. If the steel deck endlaps and corner laps are not tight, a proper fastening cannot be made.

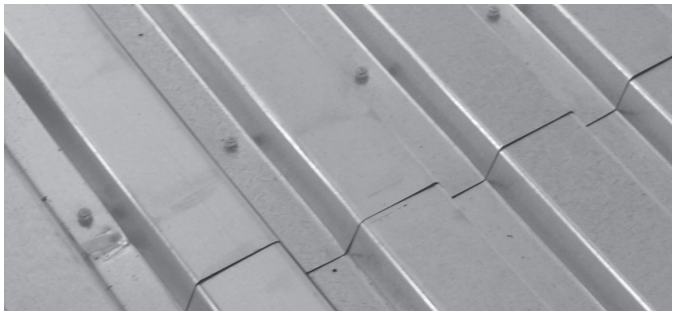


Figure 8: Tight nesting of steel deck sheets

3.5.1.2.4 Fastener inspection (post-fastener installation)

Steel deck construction projects may present a challenge with respect to the quality control of connections between sheet steel and the supporting steel structure. Quality control for traditional fastening methods may present a challenge as they typically consist of visual checks and dimensional or size verifications, which may or may not confirm a proper fastening. Field verification of the adequacy of power-actuated mechanical steel deck fastenings can be conducted as described in this section.

The use of mechanical fasteners does not imply a need to inspect every fastening point unless specified by the Structural Engineer. No guideline standards are published by SDI, AWS, AISC or OSHA for percentages of steel deck connections that must be checked or that can be unsatisfactory. This determination must be made by the Structural Engineer and Authority Having Jurisdiction.

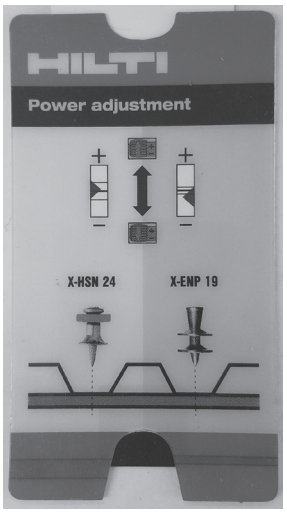


Figure 9:
Hilti Power
Adjustment Guide

Hilti has multiple systems in place that help ensure steel deck fastenings are done correctly the first time. Together with a commitment to field quality control by the steel deck installer, these systems may alleviate the need for post-fastener installation inspection. Hilti has over 1,000 Account Managers and Field Engineers available for training steel deck installers. This hands-on training includes the use of the Hilti Powder-Actuated Tools in accordance with ANSI A10.3 safety requirements, use of the Deck Fastener Selector Gauge, proper steel deck layout and end/corner lap nesting as discussed in Section 3.5.1.2.3. Proper power-actuated fastener, tool and cartridge selection as discussed in Section 3.5.1.3, as well as the use of the Hilti Power Adjustment Guide, shown in Figure 9 and discussed in more detail in Section 3.5.1.3.3, are also key elements of the installer training. Furthermore, the Hilti DX9 -HSN tools come equipped with piston brakes, which virtually eliminate the possibility of overdriven fasteners. and punch-through if the base steel is missed.

There are three main characteristics of proper fastenings that must be considered:

1. Fasteners installed in proper locations. The fasteners must be installed in the proper steel deck valleys or flutes in accordance with the structural roof and floor deck plans and design, and in the proper location in the base steel (Reference Section 3.5.1.2.3). The fastener point must penetrate into, but not necessarily through, the supporting steel (top chord or flange), depending on the fastener/deck/base steel configuration.

2. Clamping of fastened part to base material. The fasteners must clamp the steel deck down to the base steel (top chord or flange). There should not be any visible gaps between the steel deck and the base steel or between steel deck laps.

3. Washer placement and condition. In general, the fastener washer edges must be clamping the steel deck sheet to the base steel. The washers should not curl upwards away from the deck surface and must not be digging or cutting into the steel deck surface. For the X-HSN 24 fastener, the top hat washer must be compressed. For the X-ENP-19 fastener, the piston mark (indentation) should be clearly visible on the fastener washer as shown in Figure 10.

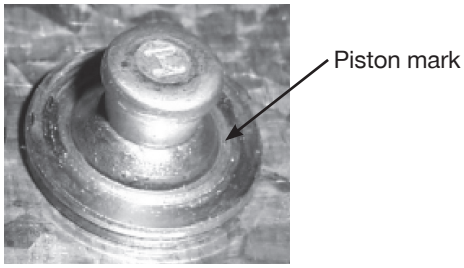


Figure 10: X-ENP-19 L15 piston mark (indentation)

When the compression of the top hat washer or the piston mark is unclear, the Hilti Power Adjustment Guide may be used to measure for optimal power-actuated fastener nailhead stand-off, h_{NVS}. Note that measuring nail head stand-off does not verify proper fastener embedment unless the steel deck and base material are tightly clamped, with the base steel not deformed or bent. Conversely, measuring nail head stand-off does not necessarily indicate an improper fastening. If slightly outside the range, further investigation into the three characteristics of proper fastenings given above should be completed.

The following Figures 11 and 12 provide visual examples of proper and improper steel deck fastenings for Hilti powder-actuated bar joist (X-HSN 24) and structural steel (X-ENP-19 L15) fasteners, respectively.

Inspection of the installed steel deck and installation of roof coverings, insulation and membrane should be done soon after steel deck installation to assist in alleviating corrosion or other issues that could arise due to long-term exposure.

Decking screws must be completely protected from the weather within 90 days after installation. Decking nails can be exposed to weather conditions for maximum 180 days. Theses standard values are only valid for typical atmospheric environments. Exposure time can be significantly affected by localized conditions like close distance to the sea, elevated temperatures and humidity, high levels of airborne pollutants, etc.

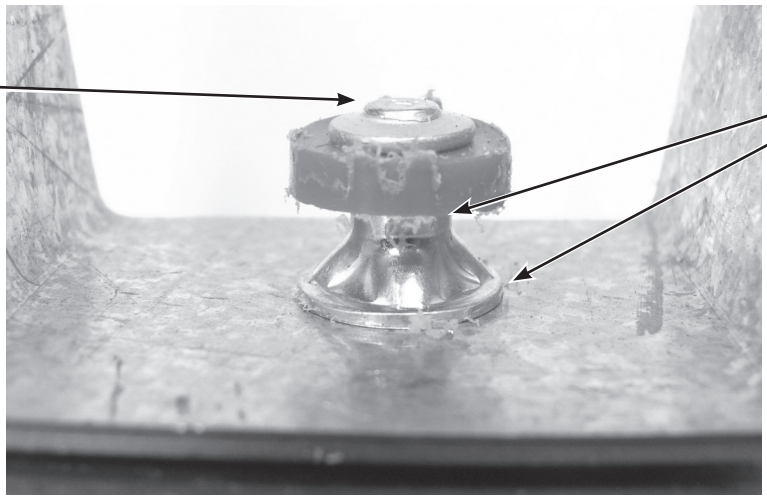


Figure 11a: Under driven X-HSN 24 fastener with single sheet to base steel

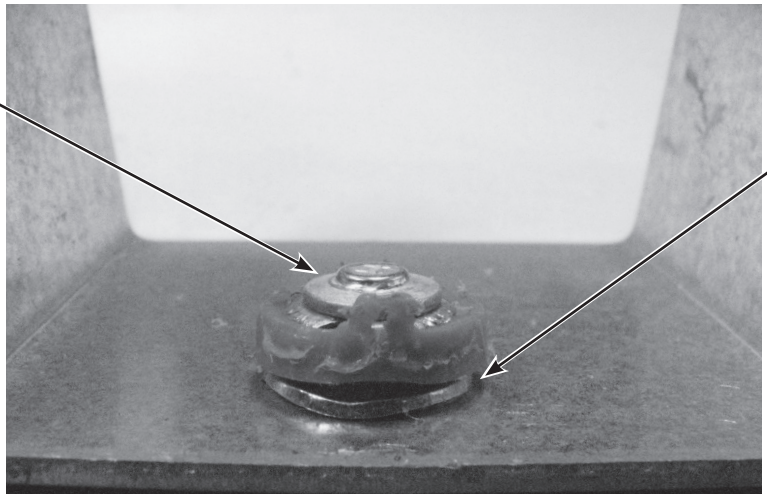


Figure 11b: Properly driven X-HSN 24 fastener with single sheet to base steel

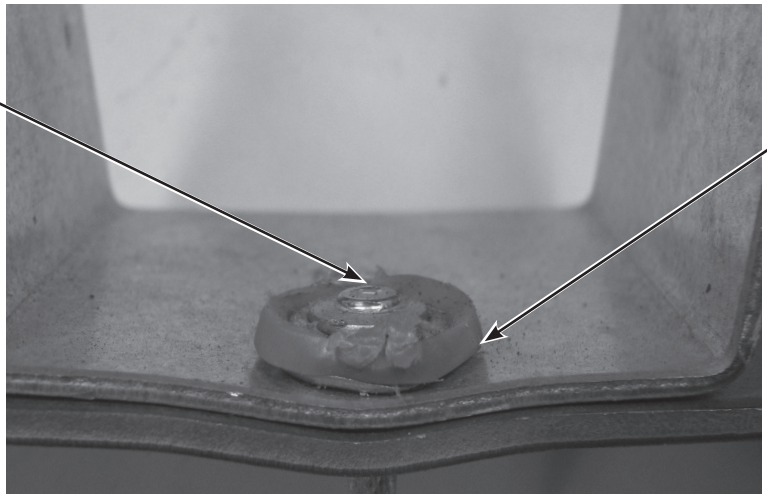
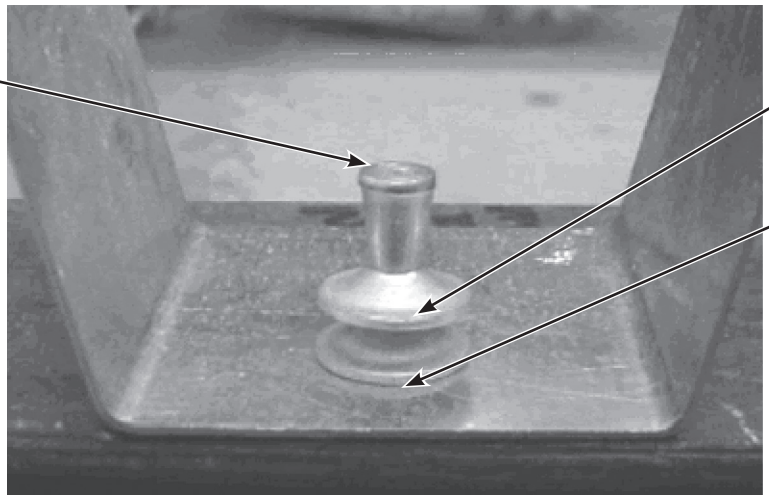


Figure 11c: Over driven X-HSN 24 fastener with single sheet to base steel

* Optimal stand-off (h_{NVS}) range for the X-HSN 24 fastener is 5 mm ≤ h_{NVS} ≤ 9 mm.

h_{NVS} well above optimal range*

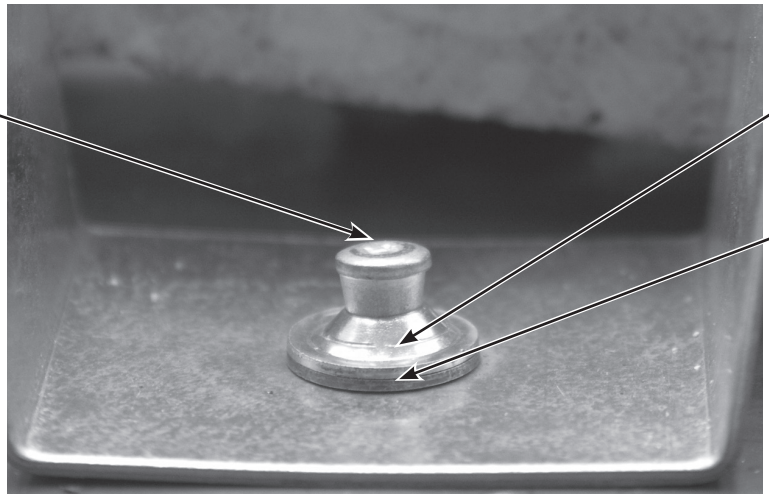


Piston mark (indentation) not visible on fastener
Gap visible between washers

Washers not clamping deck sheet to base steel

Figure 12a: Under driven X-ENP-19 fastener with single sheet to base steel.

h_{NVS} within optimal range*

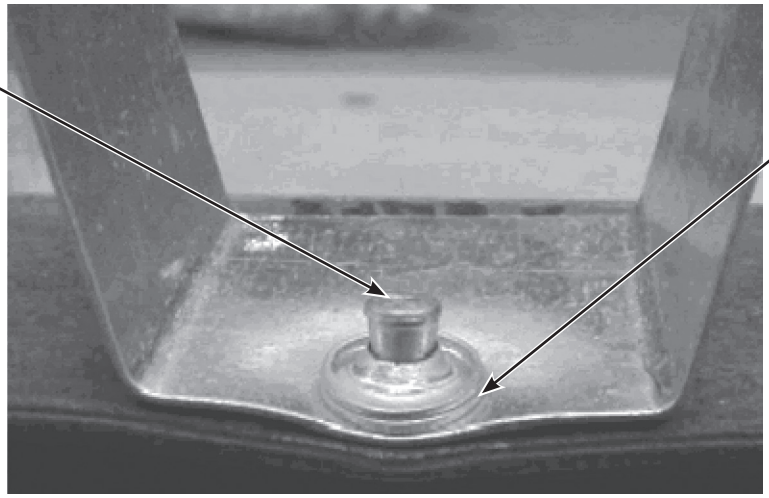


Piston mark (indentation) clearly visible on fastener

Washers snug against one another and clamping deck sheet to base steel

Figure 12b: Properly driven X-ENP-19 fastener with single sheet to base steel

h_{NVS} well below optimal range*



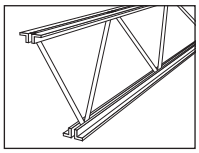
Washers cutting into deck sheet, deforming base steel and deck sheet

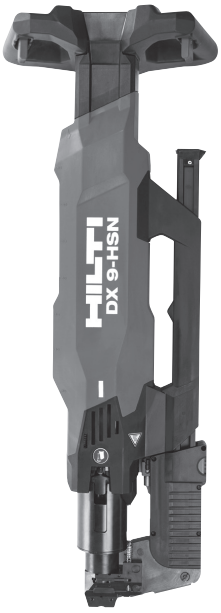
Figure 12c: Over driven X-ENP-19 fastener with single sheet to base steel

* Optimal stand-off (h_{NVS}) range for the X-ENP-19 fastener is 8.2 mm ≤ h_{NVS} ≤ 9.8 mm.

3.5.1.3 FASTENER, TOOL AND CARTRIDGE SELECTION

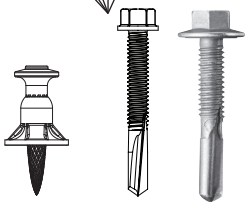
Solutions for bar joist (open web joists) applications (Reference Section 3.5.2, 3.5.4 and 3.5.5)



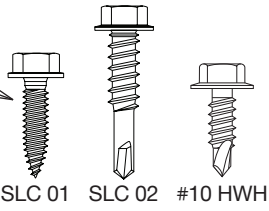


DX 9-HSN

DX 5-SM



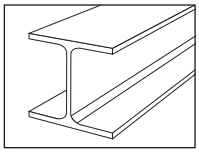
X-HSN 24 S-RT5+ M9 or
S-RT5 (S-MD 12-24 x 1-5/8 M HWH5)

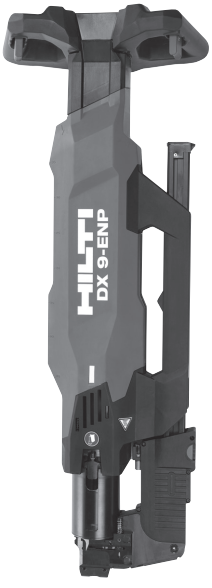


SLC 01 SLC 02 #10 HWH

SDT 9

Solutions for structural steel applications (Reference Section 3.5.3)

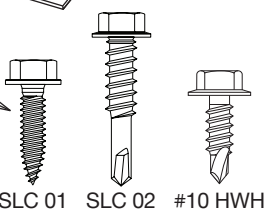




DX 9-ENP

DX 76

X-ENP-19 L15



SLC 01 SLC 02 #10 HWH

SDT 9

3.5.1.3.1 Fastener selection

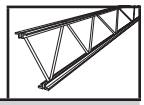
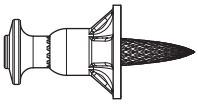
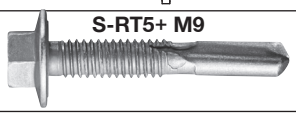


Table 1 — Bar joist and light structural steel frame fasteners (Reference Section 3.5.2, 3.5.4 and 3.5.5)

Base material[1]	Fastener type[2]	Recommended installation tool
Bar joist and structural steel 1/8" (3 mm) ≤ t_f ≤ 3/8" (10 mm)	**X-HSN 24** 	DX 9-HSN
	S-RT5+ M9 	SDT 9
Gauge purlin and light bar joist 0.0598" (1.5 mm) ≤ t_f ≤ 1/4" (6 mm)	**S-MD 12-24x1-5/8 M HWH5** 	SDT 9

1 Steel base material strength (F_u) shall be in the range of 58 to 91 ksi for base steel thicknesses (t_f) less than or equal to 5/16". For base steel thicknesses greater than 5/16", the tensile strength shall be in the range of 58 to 75 ksi.
2 The X-HSN 24 and Racing Tip Fastening Systems DO NOT fit in deck profiles Type A.

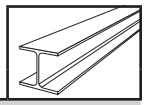
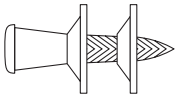
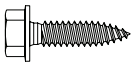
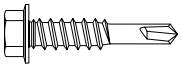
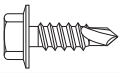


Table 2 — Structural steel frame fasteners (Reference Section 3.5.3)

Base material[1]	Fastener type[2]	Recommended installation tool
Structural steel, hardened structural steel and heavy bar joist t_f ≥ 1/4" (6 mm)	**X-ENP-19 L15** 	DX 9-ENP

1 Steel base material tensile strength (F_u) shall be in a range of 58 to 91 ksi.
2 X-ENP-19 L15 fasteners DO NOT fit is deck profiles Type A and Type F.

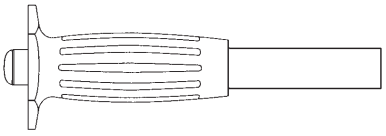
Table 3 — Deck-to-deck sidelap fasteners (Reference Section 3.5.6)[2]

Deck gauges	Fastener Type[1]	Recommended installation tool
18[3] to 26	**S-SLC 01 M HWH** 	SDT 9
18 to 22	**S-SLC O2 MHWH** 	SDT 9
16[4] to 26	**Hilti #10 HWH Screw** 	SDT 9

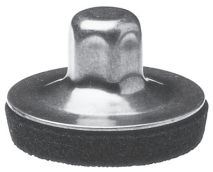
1 For use with all types of nestable deck or screwable interlocking deck.
2 Other sidelap connector types are possible with Hilti's power actuated frame fasteners. Please reference the Steel Deck Institute (SDI) Diaphragm Design Manual 3rd Edition (DDM03).
3 Use of S-SLC 01 M HWH with 18 gauge steel deck is recommended only for standard tensile strength (45 ≤ F_u ≤ 65 ksi) steel deck. For high tensile strength (F_u > 65 ksi) 18 gauge steel deck, use S-SLC 02 M HWH.
4 Use of screws with full drill points recommended for 16 gauge steel deck.

Sealing caps

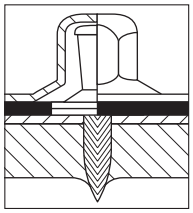
The SDK2 is an SAE 316 stainless steel sealing cap with a neoprene seal. This is installed over the head of the X-ENP-19 fastener using the SDK2 hand setting tool. The SDK2 sealing cap provides added corrosion protection for exposed exterior steel deck applications in accordance with IBC requirements.



SDK2 Setting Tool



SDK2 Sealing Cap



X-ENP-19 L15
h_{nvs} = 8.2 mm- 9.8 mm

Note: The sealing cap and fastener must be installed correctly to achieve a water-resistant seal. Contact Hilti for details.

3.5.1.3.2 Tool selection

Bar joist and light structural steel powder-actuated frame tools (Reference Section 3.5.2)

DX 9-HSN

The DX 9-HSN stand up decking tool is a digitally enabled fully automatic powder-actuated tool designed for attaching steel deck to bar-joist steel base materials. With a high fastening rate and 40-fastener magazine, the DX 9-HSN can significantly help reduce the time it takes to attach deck. Fastenings can be made on very thin support structures without the need for weld washers. Suitable for base steels with a thickness of 1/8" to 3/8". Fastens X-HSN 24 collated fasteners.

DX 5-SM

The DX 5-SM decking tool is a digitally enabled medium duty powder-actuated tool with adjustable power regulation used for attaching steel deck to bar-joist steel base materials. This system is best suited for deck with a flute width of 1/2" or greater and for base steels with a thickness of 3/16" to 3/8". Fastens X-HSN 24 collated fasteners.

Structural steel powder-actuated frame tools (Reference Section 3.5.3)

DX 9-ENP

The DX 9-ENP is a digitally enabled fully automatic powder-actuated tool designed for attaching steel deck to structural steel beams. The tool has capacity of 1 strip of 40 cartridges and 4 flexible strips of 10 each X-ENP-19 fasteners in an MXR collated configuration.

The DX 9-ENP is ergonomically designed to work in an upright position, and can be loaded without the operator bending over. The system is suitable for deck with a flute width of 3/4" or greater and base steels with a thickness of 1/4" or greater.

DX 76

The DX 76 decking system is a heavy duty fastening system consisting of semi-automatic, low-velocity powder-actuated tool, fasteners and cartridges for attaching steel deck to structural steel base materials. Special features include cartridge power regulation which allows for high productivity. This system is suitable for deck with a flute width of 3/4” or greater and base steels with a thickness of 1/4” or greater. Use with X-ENP-19 fasteners in single, MX or MXR collated configurations.

Gauge purlin and light bar joist screw frame tool and deck-to-deck sidelap fastening tool (Reference Section 3.5.4, 3.5.5 or 3.5.6)

SDT 9

The SDT 9 stand up decking tool is a steel deck sidelap and frame fastening tool. Combined with the DX 9-HSN or DX 9-ENP, these tools deliver a high speed, high productivity system for mechanical attachment of steel deck. The SDT 9 can consistently drive up to 50 S-MD 12-24x1-5/8 M HWH5 frame fasteners or SLC sidelap connectors before reloading. Its comfortable, durable design features an 18 position torque clutch to provide more consistent fastening quality. In a competitive market, the SDT 9 represents a major gain in productivity essential to staying on time and on budget.

3.5.1.3.3 Powder-actuated cartridge and power regulation selection

When installing powder-actuated deck fasteners, it is important for the installed fasteners to have a nailhead stand-off, h_{NVS}, within the specified range. The Hilti Power Adjustment Guide, shown in Figure 13, is a valuable quality assurance aid to the decking foreman. It is primarily intended for power adjustment of the powder-actuated tool. This is done by installing test fastenings into representative base steel and then checking the nailhead stand-off, h_{NVS}, at the beginning of the work to achieve the optimal cartridge and tool power level. This is a critical step in the work because of variations in the structural steel strengths (F_y, F_u) and member thicknesses. By investing time up front and properly correlating the fastening system to actual site materials, most fastening issues can be avoided. During installation, it is also advisable to check the work periodically to spot deficiencies before large portions of the deck might be fastened incorrectly. Failure to properly set the tool, fastener and cartridge prior to starting work can decrease fastening quality consistency.

Prior to starting work, the installer shall install a test fastening and check the h_{NVS} using the Hilti Power Adjustment Guide. If necessary, the installer shall adjust the power or force that drives the fastener into the base steel. There are two ways to accomplish this power adjustment. One is by use of different cartridge colors and the other is by adjusting the power regulator on the tool itself.

Cartridge colors available for Hilti decking tools are (in order of increasing power): yellow, blue, red and black. All Hilti decking tools come equipped with a power adjustment capability. The settings on the power regulation dials range from 1 to 4.

Figures 14 and 15 provide the installer with a recommended cartridge color and power setting for Hilti bar joist and structural steel deck fasteners, respectively. These charts are guidelines that the installer can use to start the process of test fastenings discussed above. This also helps ensure the installer will have the proper color cartridges on the project site.

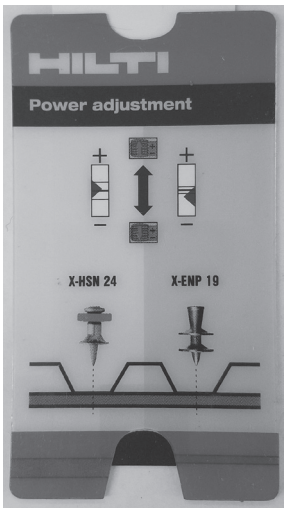


Figure 13: Hilti Power Adjustment Guide

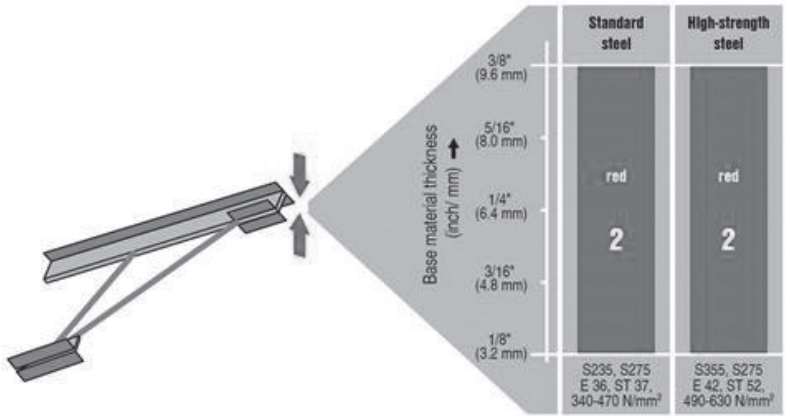


Figure 14: Cartridge and power regulation guidelines for bar joist deck fasteners installed with a DX 9-HSN[1]

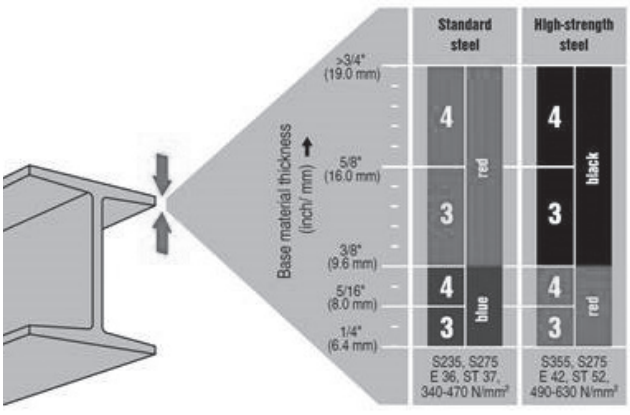


Figure 15: Cartridge and power regulation guidelines for structural steel deck fasteners[1]

1 Cartridge recommendations for the X-ENP-19 fastener are acceptable for all current Hilti Decking Tools for attachment to structural steel. Cartridge recommendations for the X-HSN 24 fasteners are for the DX 9-HSN. Cartridge recommendations for the DX 5-SM can be found in the tool operator manual. **Recommendations are guidelines only and require verification on each site.**

3.5.1.4 SUBMITTAL INFORMATION FOR ROOF DECK

To download and submit Decking Submittal Forms and, please visit
https://www.hilti.com/content/hilti/W1/US/en/engineering/design-centers/decking/decking-submittals.html

3.5.1.5 FASTENER QUANTITY ESTIMATION

Table 4 — Frame fasteners per square of roof[1,2,3]

Fastener pattern	Fastener spacing	Support spacing, ft									
		4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0	9.0	10.0
36/14	6"	107	95	87	79	73	68	64	57	51	47
36/11	6"	81	72	66	60	56	52	48	43	39	36
36/9	6"	63	57	52	47	44	41	38	34	31	28
36/7	6"	55	49	45	41	38	35	33	30	27	25
36/5	6-12-12-6	37	33	31	28	26	24	23	21	19	17
36/4	12"	29	26	24	22	20	19	18	16	15	14
32/5	8"	42	37	34	31	29	27	25	23	21	19
32/3	16"	22	20	18	17	16	15	14	13	12	11
30/4	6-18-6	34	30	28	26	24	22	21	19	17	16
30/3	12-18	23	21	19	18	17	16	15	13	12	11
24/5	6"	55	49	45	41	38	35	33	30	27	25
24/3	6"	29	26	24	22	20	19	18	16	15	14
24/4	8"	42	37	34	31	29	27	25	23	21	19

1 Hilti Profis DF Diaphragm software also estimates fastener quantities.
2 Estimated quantities are for one square of decking. A square of roof decking is an area of 100 ft². No provision is made for waste. Perimeter fastening spacing is based on 12" on-center assumption.
3 For interlocking sidelaps, add 15% to quantities in table.

Sidelap fastener estimation

To estimate the number of sidelap screws on a steel roof or floor deck project, multiply the total deck area in square feet times the number of required stitch screws per span and then divide by the sheet width times the joist spacing (both in feet). A 5% contingency is also recommended for waste and loss.

Example:

Total area: . . . . . 50,000 square feet

Sheet width:. . . . . 36" = 3 ft

Joist spacing:. . . . . 5 ft

No. of sidelap fasteners per span: 5

$$\#\text{ of screws needed} = \frac{50{,}000\ \text{ft}^2}{3\ \text{ft} \times 5\ \text{ft}} \times 5 \times 1.05 = 17{,}500$$

3.5.1.6 COMMON STEEL DECK DIMENSIONS

Table 5 — Common steel deck types and dimensions[1,3]

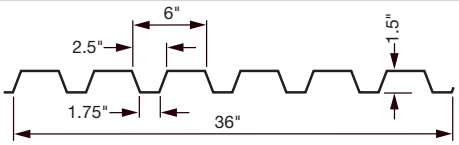
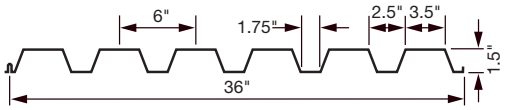
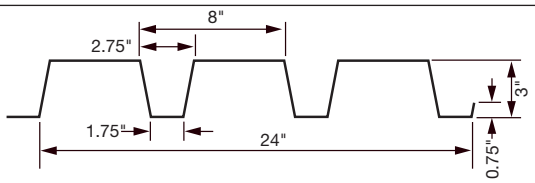
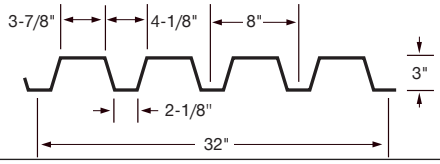
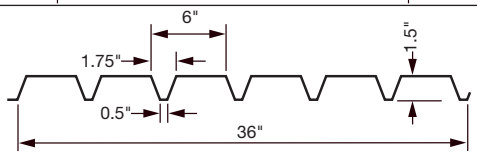
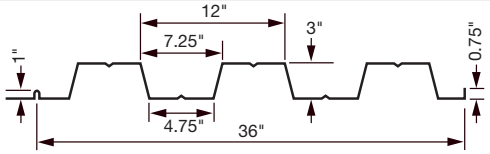
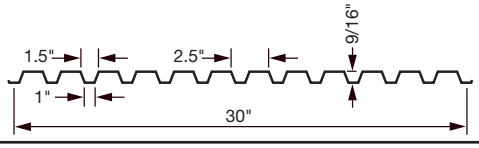
Deck type	Common thickness	Standard dimensions
B	16-24 GA	
BI	16-24 GA	
N	16-22 GA	
N-32	16-22 GA	
F	18-22 GA	
Composite Deck	16-22 GA	
Form Deck	24-28 GA	

Table 6 — Steel deck gauge (GA) inch and millimeter equivalent[2,3]

Gauge (GA)	Nominal sheet steel thickness, t **mils** (mm)
16	**54** (1.52)
18	**43** (1.21)
20	**33** (0.91)
22	**27** (0.76)

1 Dimensions shown are typical. However, the Structural Engineer should always consult with the steel deck manufacturer on the dimensions for the specific product as they can vary depending on the manufacturer.
2 Deck gauge inch equivalents taken from SDI Diaphragm Design Manual. Millimeter equivalents taken from CSSBI Design of Steel Deck Diaphragms.
3 Calculations to produce diaphragm shear values with the deck profiles and gauges shown are possible with Hilti Profis DF Diaphragm software.

THE ABOVE FOOTNOTES APPLY TO TABLES 5 AND 6.

3.5.1.7 DIAPHRAGM SHEAR AND STIFFNESS CALCULATIONS

Background: An extensive independent laboratory test program was conducted investigating the performance of steel deck diaphragms attached with Hilti fasteners. The program test scope consisted of full scale diaphragm system tests conducted in accordance with ICC-ES AC43 and AISI S907, as well as comparative small element lap-joint shear tests conducted in accordance with AISI S905 Test Methods for Mechanically Fastened Cold-Formed Steel Connections. The resulting full scale and small element test data was analyzed and predictive equations were developed for the steel deck diaphragm system strength and stiffness using specific combinations of Hilti fasteners.

The American Iron and Steel Institute (AISI) Standard for the Design of Profiled Steel Diaphragm Panels (S310) method equations are used as the basis for determining the steel deck diaphragm strength and stiffness. Specific Hilti fastener strength and stiffness values and test data correlation adjustment factors were developed to provide 95% or greater accuracy with test results per ICC-ES AC43 requirements.

The resulting design information is documented in this section and in ICC-ES ESR-2776 and ESR-2197.

Design: Design equations for calculating steel deck diaphragm strength (S) and stiffness (G') or flexibility factor (F) with Hilti X-HSN 24, X-ENP-19 L15 or S-MD 12-24x1-5/8 M HWH5 (RT5) frame fasteners and Hilti Sidelap Connectors (SLC) are provided. The equation numbers in parenthesis correspond to the equation numbers provided in the AISI S310. The design equation variables needed for common steel deck diaphragm applications are found in Tables 7 through 9. The conversion factors for Allowable Stress Design (ASD), Load Resistance Factor Design (LRFD) and Limit States Design (LSD) provided in Table 11 shall be applied to the values determined from the design equations in order to produce the final Allowable Diaphragm Shear, S_{ASD} or Factored Resistance Diaphragm Shear, S_{LRFD} or S_{LSD}, respectively. The calculated S_{ASD}, S_{LRFD} or S_{LSD} Diaphragm Shear values do not take into account steel deck buckling and must be checked against the appropriate buckling diaphragm shear value, $S_{buckling}$, found in Table 12. Reference Sections 3.5.2, 3.5.3, 3.5.4 and 3.5.5 for pre-calculated diaphragm shear and stiffness tables for the X-HSN 24, X-ENP-19, S-RT5+, and S-MD 12-24x1-5/8 M HWH5 fasteners, respectively.

The design equations and load values in this section are for 36" wide, 1-1/2" deep wide rib steel deck panels (B-Deck or BI-Deck types) and are limited to the fastener patterns shown in Figure 16 and sidelap connector spacings greater than 3" and in accordance with Table 10.

For other steel deck diaphragm conditions (e.g. deck profile, deck gauge, concrete-filled, etc.) not represented in the tables found in this section, use Hilti Profis DF Diaphragm software or reference ICC-ES ESR-2197.

AISI S310 steel deck diaphragm strength design equation

$$S_{ni} = [2 \times A \times (\lambda - 1) + \beta] \times \frac{P_{nf}}{L}, \text{ plf} \qquad \text{Eq. D1-1}$$

$$S_{nc} = P_{nf} \times \sqrt{\frac{N^2 \times \beta^2}{L^2 \times N^2 + \beta^2}}, \text{ plf} \qquad \text{Eq. D1-2}$$

$$S_{ne} = \frac{(2 \times \alpha_1 \times n_p \times \alpha_2) P_{nf} + n_e P_{nfs}}{L}, \text{ plf} \qquad \text{Eq. D1-3}$$

S_{nf} = min (S_{ni} , S_{nc} , and S_{ne}), plf

$S_{nf} = c \times S_{nf}$, plf

with:

$\beta = n_s \times \alpha_s + 2n_p X_p^2 + 4X_e^2$

$X_p^2 = \left(\frac{1}{w^2}\right) \Sigma x_p^2$

$X_p^2 = \left(\frac{1}{w^2}\right) \Sigma x_e^2$

$\lambda = 1 - \frac{D_d L_v}{240 \times \sqrt{t}} \geq 0.7 \quad \alpha_s = \frac{P_{ns}}{P_{nf}}$

where:

t = nominal steel deck thickness, in. (Reference Table 6)

w = deck width

N = number of fasteners per unit length across the width, ft^{-1}

$x_e = x_p$ = distance from panel centerline to any fastener in a panel at the end (x_e) or purlin (x_p) supports

S = nominal diaphragm shear strength, plf

L = span, ft L = panel length = 3 x L, ft

$n_e = n_s$ = 3 x L x 12 ÷ (sidelap connector spacing in inches)

c = correlation factor for diaphragm system effect

Reference Tables 7 and 8 for description and values of other variables for common conditions.

Uplift and combined loading: Allowable loads to resist uplift forces are provided in the individual sections for each frame fastener. Reference SDI DDM04 Section 4.7 or Section D3 of AISI S310 for combined tension uplift and diaphragm shear interaction.

AISI S310 steel deck diaphragm stiffness and flexibility factor design equations:

$$G' = \left(\frac{Et}{2\,(1+\mu)\frac{s}{d} + \gamma_c D_n + C}\right) \quad K = \left(\frac{Et}{3.78 + 0.9D + C}\right), \text{ kips/in.} \qquad \text{Eq. D5.1.1-1}$$

$$F = \frac{1{,}000}{G'}$$

E = modulus of elasticity of steel = 29,500 ksi

$$D_n = \frac{D}{L} \qquad \text{Eq. D5.1.1-1}$$

$$C = \left(\frac{Et}{w}\right)\left(\frac{2L}{2\alpha_3 + n_p\alpha_4 + 2n_s\frac{s_r}{s_s}}\right)S_f \qquad \text{Eq. D5.1.1-2}$$

Reference Tables 7 and 9 for description and values of other variables for common conditions.

Table 7 – Diaphragm strength (S) and stiffness factor (G') equation variable values[1]

Deck type	Fastener pattern	α_1 or α_3 – end distribution factor	α_2 or α_4 – purlin distribution factor	Σx_{ee}^2 or Σx_e^2, in.^{2}	Σx_{pe}^2 or Σx_{xp}^2, in.^{2}	A	N, ft	D-Warping constant, in.			
								22 GA	20 GA	18 GA	16 GA
1-1/2" Wide Rib B- or BI-Deck	**36/11**	3.667	3.667	1,944	1,944	2	3.000	1,235	924	606	428
	36/9	3.000	3.000	1,656	1,656	2	2.333	1,235	924	606	428
	36/7	2.000	2.000	1,008	1,008	1	2.000	1,235	924	606	428
	36/5	1.667	1.667	936	936	1	1.333	7,288	5,452	3,578	2,525
	36/4	1.333	1.333	720	720	1	1.000	10,315	7,715	5,064	3,574
	36/3	1.000	1.000	648	648	1	0.667	21,217	15,871	10,417	7,315

1 Reference ICC-ES ESR-2776 for Verco PLB deck and VSC2 sidelap connectors

Table 8 — Diaphragm strength (S) equation variable values

Configuration				Deck gauge (inches)							
				22 (0.0295)		20 (0.0358)		18 (0.0474)		16 (0.0598)	
Deck type[3]	Min. deck tensile (yield) strength, ksi	Frame fastener base material thickness, in.	Sidelap connector[1,2]	P_{nf}, lb	P_{ns}, lb	P_{nf}, lb	P_{ns}, lb	P_{nf}, lb	P_{ns}, lb	P_{nf}, lb	P_{ns}, lb
				Correlation factor, c		Correlation factor, c		Correlation factor, c		Correlation factor, c	
B	65 (50)[4]	X-HSN 24 $1/8 \le t_f < 3/16$	Hilti SLC	1357	844	1824	1260	1865	1701	-	-
				1.184		1.201		1.233		-	
		X-HSN 24 $3/16 \le t_f \le 3/8$	Hilti SLC	1590	844	2107	1260	2663	1701	3035	2024
				1.149		1.127		1.087		1.044	
		X-ENP-19 $t_f \ge 1/4$	Hilti SLC	1597	844	2112	1260	2764	1701	3079	2024
				1.315		1.259		1.156		1.046	
		S-RT5+ M9 $1/8 \le t_f < 3/16$	Hilti SLC	1357	844	1824	1260	1865	1701	-	-
				1.184		1.201		1.233		-	
		S-RT5+ M9 $3/16 \le t_f \le 3/8$	Hilti SLC	1590	844	2107	1260	2663	1701	3035	2024
				1.149		1.127		1.087		1.044	
		S-RT5+ M9 $1/8 \le t_f < 3/16$	Hilti #10 HWH Screw	1489	598[5]	1795	799[5]	2348	1217[5]	-	-
				1.000		1.000		1.000		-	
		S-RT5+ M9 $3/16 \le t_f \le 3/8$	Hilti #10 HWH Screw	1489	598[5]	1795	799[5]	2348	1217[5]	2924	1725[5]
				1.000		1.000		1.000		1.000	
	92 (80)	X-HSN 24 $1/8 \le t_f < 3/16$	Hilti SLC	1357	844	1712	1111	1865	1701	-	-
				1.155		1.172		1.203		-	
		X-HSN 24 $3/16 \le t_f \le 3/8$	Hilti SLC	1941	954	2208	1341	2698	1859	3095	2343
				1.052		1.054		1.058		1.062	
		X-ENP-19 $t_f \ge 1/4$	Hilti SLC	1964	954	2165	1341	3022	1859	3577	2343
				1.197		1.166		1.108		1.046	
BI	65 (50)[4]	X-HSN 24 $1/8 \le t_f < 3/16$	Hilti SLC	1357	844	1712	1111	1865	1591	-	-
				1.184		1.201		1.233		-	
		X-HSN 24 $3/16 \le t_f \le 3/8$	Hilti SLC	1516	882	1712	1111	2450	1591	2553	2051
				1.316		1.264		1.168		1.066	
		S-RT5+ M9 $1/8 \le t_f < 3/16$	Hilti SLC	1357	844	1712	1111	1865	1591	-	-
				1.184		1.201		1.233		-	
		S-RT5+ M9 $3/16 \le t_f \le 3/8$	Hilti SLC	1516	882	1712	1111	2450	1591	2553	2051
				1.316		1.264		1.168		1.066	
		S-RT5+ M9 $1/8 \le t_f < 3/16$	Hilti #10 HWH Screw	1489	598[5]	1795	799[5]	2348	1217[5]	-	-
				1.000		1.000		1.000		-	
		S-RT5+ M9 $3/16 \le t_f \le 3/8$	Hilti #10 HWH Screw	1489	598[5]	1795	799[5]	2348	1217[5]	2924	1725[5]
				1.000		1.000		1.000		1.000	
B or BI	45 or 92 (33 or 80)	S-MD 12-24x1-5/8 M HWH5 $0.0598 \le t_f < 1/8$	Hilti SLC	1016	844	1233	1260	1632	1701	1860	2024
				1.000		1.000		1.000		1.000	
		S-MD 12-24x1-5/8 M HWH5 $1/8 \le t_f \le 1/4$	Hilti SLC	1193	844	1661	1260	1860	1701	1860	2024
				1.000		1.000		1.000		1.000	
		X-HSN 24 $1/8 \le t_f \le 3/8$	Hilti #10 HWH Screw	1489	598[5]	1795	799[5]	2348	1217[5]	2924	1725[5]
				1.000		1.000		1.000		1.000	
		X-ENP-19 $t_f \ge 1/4$	Hilti #10 HWH Screw	1603	598[5]	1933	799[5]	2529	1217[5]	3149	1725[5]
				1.000		1.000		1.000		1.000	
		S-MD 12-24x1-5/8 M HWH5 $0.0598 \le t_f \le 1/4$	Hilti #10 HWH Screw	1193	633	1661	769	1860	1018	1860	1284
				1.000		1.000		1.000		1.000	

1 Sidelap connector spacing must meet the requirements of Table 10.
2 Reference Table 3 and Section 3.5.6 for more information on the proper selection of Hilti Sidelap Connectors (SLC).
3 Reference ICC-ES ESR-2776 for Verco PLB deck and VSC2 sidelap connectors
4 For steel deck with minimum deck strength of 55 (40) Tensile, F_u, (Yield, F_y) ksi, the corresponding correlation factors (c) must be calculated by applying a reduction factor of 0.989.
5 For steel deck with minimum deck strength of 55 (40) Tensile, F_u, (Yield, F_y) ksi, the corresponding sidelap connector strength must be calculated by applying a reduction factor of 0.85.

Table 9 — Diaphragm stiffness (G') and flexibility factor (F) equation variable values

Configuration				Deck gauge (inches)			
				22 (0.0295)	20 (0.0358)	18 (0.0474)	16 (0.0598)
Deck type[2]	Min. deck tensile (yield) strength, ksi	Frame fastener	Sidelap connector[1]	S_f, in./kip	S_f, in./kip	S_f, in./kip	S_f, in./kip
				S_s, in./kip	S_s, in./kip	S_s, in./kip	S_s, in./kip
B or BI	45 or 92 (33 or 80)	X-HSN 24 or S-RT5+ M9	Hilti SLC or Hilti #10 HWH Screw	0.0073	0.0066	0.0057	0.0051
				0.0175	0.0159	0.0138	0.0123
		X-ENP-19	Hilti SLC or Hilti #10 HWH Screw	0.0044	0.0040	0.0034	0.0030
				0.0175	0.0159	0.0138	0.0123
		S-MD 12-24x1-5/8 M HWH5	Hilti SLC or Hilti #10 HWH Screw	0.0076	0.0069	0.0060	0.0053
				0.0175	0.0159	0.0138	0.0123

1 Reference Table 3 and Section 3.5.6 for more information on the proper selection of Hilti Sidelap Connectors (SLC).

2 Reference ICC-ES ESR-2776 for Verco PLB deck and VSC2 sidelap connectors.

Table 10 — Minimum recommended sidelap connector spacing (Inches center-to-center) for X-HSN 24 and X-ENP-19 powder-actuated fasteners with B-Deck or BI-Deck type

Frame fastener base material thickness, in.	Deck gauge	Frame fastener pattern											
		36/3		36/4		36/5		36/7		36/9[2]		36/11[2]	
		SLC[1]	#10	SLC[1]	#10	SLC[1]	#10	SLC[1]	#10	SLC[1]	#10	SLC[1]	#10
X-HSN 24 $1/8 \le t_f < 3/16$	22	–	–	≥ 12	≥ 6	≥ 12	≥ 6	≥ 6	≥ 3	≥ 6	≥ 3	≥ 6	≥ 3
	20												
	18												
	16			–	–	–	–	–	–	–	–	–	–
X-HSN 24 $3/16 \le t_f \le 3/8$	22	≥ 12	≥ 3	≥ 6	≥ 3	≥ 6	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3
	20												
	18	–	–										
	16												
X-ENP-19 $t_f \ge 1/4$	22	≥ 6	≥ 3	≥ 6	≥ 3	≥ 6	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3
	20												
	18												
	16												

1 Hilti SLC spacings less than those tabulated may be used. The tabulated spacing should be used in the calculation of diaphragm shear strength when using the P_{nf}, P_{ns} and c values from Table 8. Alternatively, only when the SLC spacings are less than those tabulated, the P_{nf}, P_{ns} and c values found in Table 8 can be replaced by the following values.

X-HSN 24 – All deck types, strengths and base steel thicknesses listed in Table 8
22 Gauge (0.0295 in.) - P_{nf} = 1489 lb, P_{ns} = 716 lb, c = 1.000
20 Gauge (0.0358 in.) - P_{nf} = 1795 lb, P_{ns} = 869 lb, c = 1.000
18 Gauge (0.0474 in.) - P_{nf} = 2348 lb, P_{ns} = 1151 lb, c = 1.000
16 Gauge (0.0598 in.) - P_{nf} = 2924 lb, P_{ns} = 1452 lb, c = 1.000

2 For 36/9 and 36/11 patterns, when wind (or seismic) diaphragm shear capacities exceed the values shown below, the fastening pattern must be increased at the building perimeter, chords, collectors or other shear transfer elements to two fasteners per rib (i.e. 36/14 pattern). The wind (or seismic) diaphragm shear capacity must not be greater than that determined from the 36/9 and 36/11 patterns, as applicable.

X-HSN 24 with steel support framing thicknesses $1/8" \le t_f < 3/16"$

	ASD wind (seismic)	LRFD wind (seismic)	LSD wind (seismic)
22 Gauge (0.0295 in.) -	1275 plf (1200 plf)	2100 plf (1950 plf)	28.5 N/mm (26.3 N/mm)
20 Gauge (0.0358 in.) -	1600 plf (1500 plf)	2625 plf (2450 plf)	35.8 N/mm (32.8 N/mm)
18 Gauge (0.0474 in.) -	1825 plf (1700 plf)	3000 plf (2675 plf)	39.0 N/mm (37.2 N/mm)

X-HSN 24 with steel support framing thicknesses $3/16" \le t_f \le 3/8"$

	ASD wind (seismic)	LRFD wind (seismic)	LSD wind (seismic)
22 Gauge (0.0295 in.) -	1400 plf (1300 plf)	2300 plf (2125 plf)	31.0 N/mm (28.8 N/mm)
20 Gauge (0.0358 in.) -	1700 plf (1600 plf)	2800 plf (2600 plf)	37.9 N/mm (35.0 N/mm)
18 Gauge (0.0474 in.) -	2250 plf (2100 plf)	3700 plf (3425 plf)	50.0 N/mm (46.3 N/mm)
16 Gauge (0.0598 in.) -	2775 plf (2600 plf)	4550 plf (4225 plf)	61.7 N/mm (56.9 N/mm)

Table 11 — Safety factors for allowable stress design (ASD), load resistance factor design (LRFD) and limit states design (LSD)[1,2]

Load type or combinations	Frame fastener	Connection related limit state		
		Ω (ASD)	Φ (LRFD)	Φ (LSD)
Wind	X-HSN 24 or X-ENP-19 L15	2.00	0.80	0.75
Earthquake and all others		2.30	0.70	0.55
Wind	S-RT5 + M9	2.00	0.80	0.75
Earthquake and all others		2.30	0.70	0.55
Wind	S-MD 12-24 x 1-5/8 M HWH5	2.00	0.80	0.75
Earthquake and all others		2.30	0.70	0.55

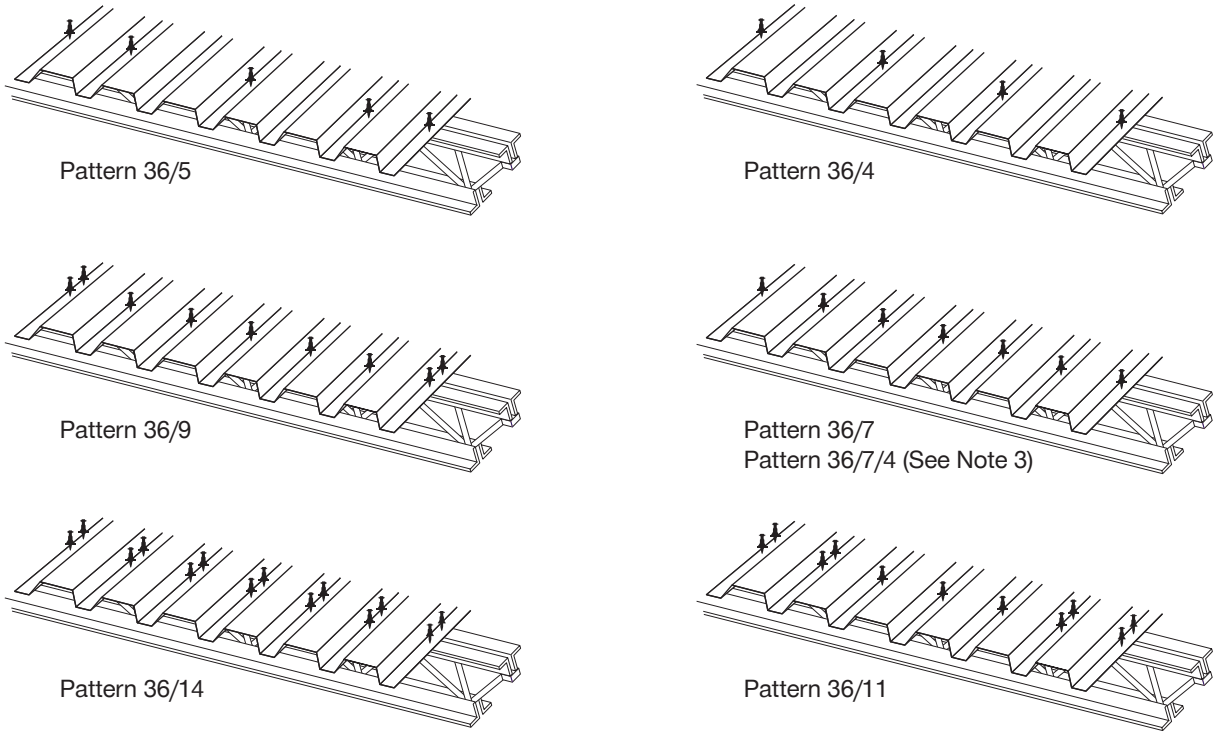
1 Safety factors based on AISI S310-13 and -16
2 Diaphragm capacities should be limited to the respective ASD, LRFD and LSD buckling diaphragm shear capacities found in Table 12

Table 12 — ASD and LRFD diaphragm shears (plf) and LSD diaphragm shears (N/mm) for buckling, $S_{buckling}$[1,2]

Deck type	Deck gauge no.	Minimum moment of inertia, I_{xg} in⁴/ft	Span, L_v (ft-in.)									
			3'-0"	4'-0"	5'-0"	6'-0"	7'-0"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"
ASD – S_{nb}/Ω_{nb} where Ω_{nb} = 2.00												
B, BI, and Verco PLB	22	0.173	7,750	4,360	2,790	1,938	1,424	1090	861	698	576	484
	20	0.210	10,363	5,829	3,731	2,591	1,903	1,457	1,151	933	771	648
	18	0.279	15,829	8,904	5,698	3,957	2,907	2,226	1,759	1,425	1,177	989
	16	0.353	22,479	12,644	8,092	5,620	4,129	3,161	2,498	2,023	1,672	1,405
LRFD - Φ S_{nb} where Φ_{nb} = 0.80												
B, BI, and Verco PLB	22	0.173	12,401	6,975	4,464	3,100	2,278	1,744	1,378	1,116	922	775
	20	0.210	16,581	9,327	5,969	4,145	3,046	2,332	1,842	1,492	1,233	1,036
	18	0.279	25,327	14,246	9,118	6,332	4,652	3,562	2,814	2,279	1,884	1,583
	16	0.353	35,966	20,231	12,948	8,992	6,606	5,058	3,996	3,237	2,675	2,248
Steel deck type	Deck gauge no.	Moment of inertia, I_{xg} in⁴/ft	Span, L_v (mm)									
			900	1200	1500	1800	2100	2400	2700	3000	3300	3600
LSD (N/mm)												
Standard 1-1/2-inch deep flutes, 6-inches center-to-center	22	208	192.6	108.3	69.3	48.1	35.4	27.1	21.4	17.3	14.3	12.0
	20	270	250.0	140.6	90.0	62.5	45.9	35.2	27.8	22.5	18.6	15.6
	18	388	359.3	202.1	129.3	89.8	66.0	50.5	39.9	32.3	26.7	22.5
	16	485	449.1	252.6	161.7	112.3	82.5	63.2	49.9	40.4	33.4	28.1

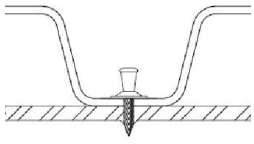
1 Load values based upon a safety factor (Ω) of 2.00 for ASD, a phi factor (Φ) of 0.80 for LRFD or a phi factor (Φ) of 0.75 for LSD.
2 Diaphragm shears in this table are for steel deck buckling failure mode only and are to be used as prescribed in Section 3.5.1.7. If design condition is not tabulated, diaphragm shears for buckling may be calculated using the following equations:

For ASD, $S_{buckling} = (I \times 10^6/(L_v)^2) / 2.0$, plf
For LRFD, $S_{buckling} = (I \times 10^6/(L_v)^2) \times 0.8$, plf
For LSD, $S_{buckling} = (I \times 10^6/(L_v)^2) \times 0.75$, N/mm

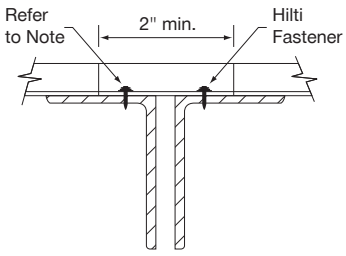


Note 1: Nestable B-Deck shown. Interlocking BI-Deck with screwable sidelap is also covered by the equations discussed in Section 3.5.1.7.
Note 2: Bar joist shown. Connection to structural steel members also covered by the equations discussed in Section 3.5.1.7.
Note 3: 36/7/4 attachment pattern utilizes 36/7 attachment at panel lap and panel end lap, 36/4 attachment at panel intermediate supports

Figure 16: Common frame fastener patterns

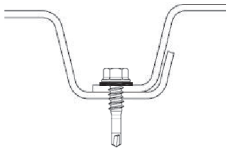


17a. Frame fastener attachment of steel deck to frame

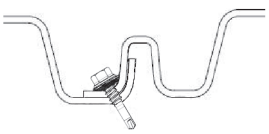


Note: Some patterns may require two fasteners in one flute. Fasteners may be installed on either side of the structural steel beam or bar joist.

17b. Steel deck endlap condition



17c. Sidelap connector with B-Deck



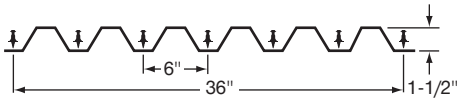
17d. Sidelap connector with screwable BI-Deck

Figure 17: Typical frame, endlap and sidelap connections

Example problem

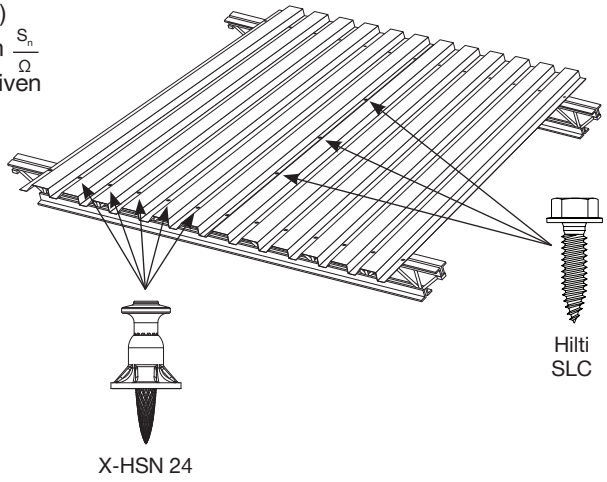
Design parameters:

Load type: Wind
Design method: ASD
Span, L_v: 6'-0"
No. of Spans: 3
Total Length, L: 18'-0"
Deck: No. 20 gage (0.0358 inch)
1-1/2" deep B-Deck (F_y = 50 ksi)
Support Framing: Steel Bar Joist with 1/4" Thick Top Chord
Frame Fastener: X-HSN 24
Frame Fastener Pattern: 36/7
Sidelap Fastener: Hilti SLC
Sidelap fastener spacing (SS): 12" o.c.



Design problem:

Determine Allowable (ASD) Diaphragm Shear Strength $\frac{S_n}{\Omega}$ and Stiffness (G') for the given steel deck diaphragm.



Step 1: Calculate nominal diaphragm shear strength limited by panel fasteners:

$$S_{ni} = \{2 \times A \times (\lambda - 1) + \beta\} \times \frac{P_{nf}}{L} = \{2 \times 1 \times (0.802 - 1) + 16.99\} \times \frac{2{,}107}{18} = 1{,}942 \text{ plf}$$ AISI S310 Eq. D1-1

Where:
A = 1 Technical Guide Table 7

$$\lambda = 1 - \frac{D_d \times L_v}{240 \times \sqrt{t}} = 1 - \frac{1.5 \times 6}{240 \times \sqrt{0.0358}} = 0.802 \geq 0.7$$ AISI S310 Eq. D1-4a

$$\beta = n_s \times \alpha_s + 2n_p \alpha_p^2 + 4\alpha_e^2$$ AISI S310 Eq. D1-5

$$\alpha_p^2 = \left(\frac{1}{w^2}\right) \Sigma x_p^2$$ AISI S310 Eq. D1-7

$$\alpha_e^2 = \left(\frac{1}{w^2}\right) \Sigma x_e^2$$ AISI S310 Eq. D1-8

$n_p = 2$

$$\beta = n_s \times \alpha_s + 2n_p \alpha_p^2 + 4\alpha_e^2 = \frac{1}{w^2} \times [2 \times 2.0 \times S(x_p^2) + 4 S(x_e^2)] =$$

$$18 \times 0.598 + \frac{[2 \times 2 \times 1{,}008 + 4 \times 1{,}008]}{36^2} = 16.99$$

$\Sigma(x_p^2) = \Sigma(x_e^2)] = 1{,}008$ Technical Guide Table 7

$$\alpha_s = \frac{P_{ns}}{P_{nf}} = \frac{1{,}260}{2{,}107} = 0.598$$ AISI S310 Eq. D1-5

Step 2: Calculate nominal diaphragm shear strength limited by corner fasteners:

$$S_{nc} = P_{nf} \times \sqrt{\frac{N^2 \times \beta^2}{L^2 \times N^2 + \beta^2}} = 2{,}107 \times \sqrt{\frac{2.00^2 \times 16.99^2}{18^2 \times 2.00^2 + 16.99^2}} = 1{,}798 \text{ plf}$$ AISI S310 Eq. D1-2

Where:
N = 2.00 Technical Guide Table 7
ß = same as in step 1

Step 3: Calculate nominal diaphragm shear strength limited by edge fasteners:

$$S_{ne} = \frac{\{2\alpha_1 + n_p \times \alpha_2\} P_{nf} + n_e P_{nfs}}{L} = \frac{\{2 \times 2 + 2 \times 2\} \times 2{,}107 + 18 \times 2{,}107}{18} = 3{,}043 \text{ plf}$$

AISI S310 Eq. D1-3

Where:

$\alpha_1 = \alpha_2 = 2$

$P_{nf} = P_{nfs}$

$$n_e = \frac{L \times 12}{SS} = \frac{18 \times 12}{12} = 18$$

Technical Guide Table 7

Step 4: Calculate nominal diaphragm shear strength controlled by connections and adjusted by the correlation factor: S_{nf} = min (S_{ni} , S_{nc} , and S_{ne}) c = 1,798 × 1.127 = 2,026 plf

Where:

c = 1.127

Technical Guide Table 8

Step 5: Calculation allowable diaphragm shear strength controlled:

$$\frac{S_{nf}}{\Omega_{nf}} = \frac{2{,}026}{2.30} = 881 \text{ plf}$$

Where:

$\Omega_{nf} = 2.30$

Technical Guide Table 11

Step 6: Select allowable diaphragm buckling strength:

$$\frac{S_{nb}}{\Omega_{nb}} = 2{,}591 \text{ plf}$$

Technical Guide Table 12

Step 7: Determine allowable diaphragm shear strength:

$$\frac{S_{nf}}{\Omega} = \left(\frac{S_{nf}}{\Omega_{nf}}, \frac{S_{nb}}{\Omega_{nf}}\right) = 881 \text{ plf}$$

AISI S310 Eq. D-1

Step 8: Determine diaphragm stiffness:

$$G' = \left(\frac{Et}{2\,(1+\mu)\frac{s}{d} + Y_c D_n + C}\right) \text{ K, kips / in.}$$

AISI S310 Eq. D5.1.1-1

$$G' = \left(\frac{Et}{2\,(1+\mu)\frac{s}{d} + Y_c D_n + C}\right) K = \left(\frac{Et}{3.78 + 0.9D + C}\right) = \frac{29{,}500 \times 0.0358}{3.78 + 0.9D_n + C} = 93.61 \text{ kips/in.}$$

AISI S310 Eq. D1-5

$$F = \frac{1{,}000}{G'} = \frac{1{,}000}{93.61} = 10.68 \text{ micro-inches/lb}$$

AISI S310 Eq. D1-7

Where:

$$D_n = \frac{D}{L} = \frac{924}{18 \times 12} = 4.28$$

AISI S310 Eq. D1-8

D = 1,164 in.

Technical Guide Table 7

$$C = \left(\frac{Et}{w}\right)\left(\frac{2L}{2\alpha_3 + n_p\alpha_4 + 2n_s\frac{s_r}{s_s}}\right) \quad S_f = \left(\frac{29{,}500 \times 0.0358}{36}\right) = \left(\frac{2 \times 18 \times 12}{2 \times 2 + 2 \times 2 + 2 \times 18 \times \frac{0.0066}{0.0159}}\right) 0.0066 = 5.65$$

AISI S310 Eq. D5.1.1-2

Where:

n_s = 18, same as Step 3

$n_p = 2$

$\alpha_3 = \alpha_4 = 2$ — Technical Guide Table 7

S_f =0.0066 — Technical Guide Table 9

S_s =0.0159 — Technical Guide Table 9

NOTE: Straight-line interpolation between different steel deck thicknesses and steel deck strengths for the calculation of diaphragm shear strength values is permitted. For example, to calculate the allowable diaphragm shear strength, $\frac{S_{nb}}{\Omega}$, for 65 ksi steel deck, the following formula would be used.

$$\frac{S_n}{\Omega}(80\text{ ksi}) = \frac{S_n}{\Omega}(65\text{ ksi}) + (80\text{ ksi} - 65\text{ ksi})\,x)\,\frac{\frac{S_n}{\Omega}(92\text{ ksi}) - \frac{S_n}{\Omega}(65\text{ ksi})}{92 - 65}$$

Where:

$\frac{S_n}{\Omega}$ (65 ksi) = Allowable diaphragm shear for 45 ksi steel deck.

$\frac{S_n}{\Omega}$ (92 ksi) = Allowable diaphragm shear for 92 ksi steel deck.

$\frac{S_n}{\Omega}$ (80 ksi) = Allowable diaphragm shear for 65 ksi steel deck.

Similarly, to calculate the allowable diaphragm shear, S_{ASD}, for 19 gauge (0.0418 in.) steel deck, the following formula would be used.

$$\frac{S_n}{\Omega}(19\text{ Ga.}) = \frac{S_n}{\Omega}(20\text{ Ga.}) + (0.0418\text{ in.} - 0.0358\text{ in.})\,x\,\frac{\frac{S_n}{\Omega}(18\text{ ga.}) - \frac{S_n}{\Omega}(20\text{ ga.})}{0.0474\text{ in.} - 0.0358\text{ in.}}$$

Where:

$\frac{S_n}{\Omega}$ (20 Ga.) = Allowable diaphragm shear for 20 gauge (0.0358 in.) steel deck.

$\frac{S_n}{\Omega}$ (18 Ga.) = Allowable diaphragm shear for 18 gauge (0.0474 in.) steel deck.

$\frac{S_n}{\Omega}$ (19 Ga.) = Allowable diaphragm shear for 19 gauge (0.0418 in.) steel deck.

Hilti is a leading manufacturer of direct fastening systems for steel and metal applications. As an associate member of the Steel Deck Institute (SDI), Hilti participates in and supports steel deck industry research at leading universities and test labs. Recent research projects with Hilti direct fastening systems have included inelastic seismic deck diaphragms and deep deck / cellular deck diaphragms.

Independent tests are the best guide to product performance and reliability, a philosophy to which Hilti and the SDI subscribe. The support for ongoing research programs is indicated by the number and scope of tests already performed and by the policy of sponsoring new tests when new products or applications are introduced. Hilti provides direct fastening system performance data, ICC-ES Evaluation Service Reports, design software, fire ratings and load test results for Hilti direct fastening systems used in steel deck applications.

Diaphragm data is calculated in accordance with AISI and SDI Diaphragm Design equations using specific Hilti fastener strength and stiffness values with data correlation adjustment factors in accordance with ICC-ES AC43 requirements.

3.5.1.8 HOW TO USE DIAPHRAGM SHEAR TABLES

General: The following Product Technical Guide Sections 3.5.2 to 3.5.5 provide Hilti fastener product technical data sheets and pre-calculated diaphragm shear and stiffness tables using the design equations provided in Section 3.5.1.7. Pre-calculated diaphragm shear and stiffness tables are provided in two formats.

Tables in Sections 3.5.2, 3.5.3, 3.5.4 and 3.5.5 are in a traditional design format with diaphragm shear and stiffness values within the table.

These tables do not take into account other design factors, such as gravity or wind uplift loads. These requirements should be checked separately by the Structural Engineer.

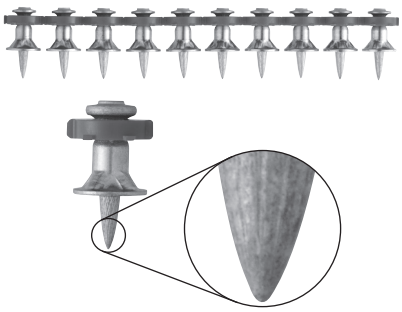
Traditional diaphragm shear tables: Sections 3.5.2, 3.5.3, 3.5.4 and 3.5.5 provide tables in a format similar to those published in the SDI DDM04, CSSBI and most steel deck manufacturers' catalogs.

As shown in Figure 18, these diaphragm shear tables are generally created with span across the heading and number of sidelap screws along the left margin or column. Along with other design variables such as deck gauge and fastener pattern, the tables are populated with the corresponding diaphragm shear and stiffness values.

Example table

Figure 18 — Allowable Stress Design (ASD) – Allowable diaphragm shears, SASD, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2'' deep flutes, 6'' center-to-center deck (F_y≥50ksi;F_u≥65 ksi) installed with Hilti X-HSN 24 fasteners with 36/11 or 36/9 end and interior support fastener patterns [1,2,3,4,5]

Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			11	9	11	9	11	9	11	9	11	9	11	9	11	9
22	2	S_{ASD}	1065	920	876	762	726	636	616	539	534	466	473	413	426	372
		G'	62.8	61.0	67.2	64.7	69.2	66.0	69.7	66.0	69.2	65.0	68.0	63.5	66.5	61.7
	3	S_{ASD}	1158	1006	957	840	807	717	685	608	594	527	527	467	474	420
		G'	64.2	62.7	69.1	67.0	71.7	69.1	72.7	69.5	72.6	69.0	71.7	67.8	70.4	66.2
	4	S_{ASD}	1246	1087	1036	913	883	783	755	677	655	587	581	521	523	469
		G'	65.3	64.1	70.8	69.0	73.9	71.6	75.3	72.5	75.5	72.4	74.9	71.5	73.8	70.1
	5	S_{ASD}	1329	1161	1111	983	950	847	824	742	715	648	635	575	571	517
		G'	66.2	65.2	72.2	70.7	75.7	73.7	77.5	75.1	78.1	75.3	77.8	74.7	76.9	73.6
	6	S_{ASD}	1408	1230	1184	1049	1016	908	887	798	776	708	689	628	620	566
		G'	67.0	66.2	73.4	72.1	77.3	75.6	79.4	77.3	80.3	77.9	80.3	77.6	79.7	76.7
	7	S_{ASD}	1482	1293	1253	1111	1080	967	945	852	837	760	743	682	668	614
		G'	67.7	67.0	74.4	73.3	78.7	77.2	81.2	79.3	82.4	80.2	82.6	80.2	82.2	79.5
20	2	S_{ASD}	1415	1225	1166	1017	976	859	829	729	719	631	633	555	569	499
		G'	86.8	83.8	90.1	86.0	90.6	85.7	89.4	83.8	87.2	81.2	84.5	78.2	81.5	75.1
	3	S_{ASD}	1549	1349	1283	1128	1091	965	930	830	808	720	712	634	640	570
		G'	89.2	86.7	93.3	89.9	94.5	90.3	93.8	89.0	92.0	86.8	89.6	84.1	86.9	81.1
	4	S_{ASD}	1675	1462	1396	1233	1192	1060	1032	927	896	808	791	713	711	641
		G'	91.1	89.0	96.0	93.1	97.8	94.2	97.7	93.5	96.3	91.7	94.2	89.3	91.7	86.5
	5	S_{ASD}	1793	1566	1505	1332	1289	1151	1125	1010	985	897	870	792	782	712
		G'	92.8	91.0	98.3	95.8	100.7	97.6	101.1	97.4	100.1	96.0	98.3	93.9	96.0	91.4
	6	S_{ASD}	1904	1662	1608	1425	1384	1238	1210	1091	1074	972	949	871	853	783
		G'	94.2	92.7	100.4	98.2	103.3	100.5	104.1	100.9	103.5	99.9	102.0	98.0	99.9	95.7
	7	S_{ASD}	2007	1748	1706	1511	1475	1321	1294	1168	1150	1044	1028	942	924	854
		G'	95.5	94.1	102.1	100.2	105.6	103.1	106.8	103.9	106.6	103.3	105.4	101.8	103.5	99.7



X-HSN 24

Approvals/Listings

ICC-ES (International Code Council)
ESR-2776 with LABC/LARC Supplement, ESR-2197 with LABC/LARC Supplement

IAPMO (Uniform Evaluation Service)
Co-listings ER-2018, ER-0161, ER-0329

FM (Factory Mutual)
For attaching Class 1 Steel Roof Decks with wind uplift ratings up to 1-330.

Refer to FM RoofNav for specific assembly listings.

UL (Underwriters Laboratories)
Fasteners for attaching steel roof deck (uplift and fire classification)

3.5.2. X-HSN 24 FOR FASTENING DECK TO BAR JOIST

3.5.2.1 PRODUCT DESCRIPTION

The Hilti bar joist deck fastening system consists of powder-actuated tools that are primarily used with the X-HSN 24 fasteners, which are available in a collated version.

For many bar joist decking projects, the tool of choice is the DX 9-HSN tool. This self-contained stand up decking tool is powered by 0.27 caliber short cartridges, which are loaded into the tool in strips of 40. The cartridges drive the X-HSN 24 fasteners into almost any type of steel deck profile and base steel thicknesses of 1/8" to 3/8". These fasteners are available in collated strips of 10. Four of these strips are loaded into the DX 9-HSN tool, along with the cartridge strip, and enable the operator to fasten at a rate of up to 1,000 quality fastenings per hour. Additionally, this tool offers punch through resistance in cases where the base material is inadvertently missed.

Other tools include the hand held DX 5-SM, a semi-automatic magazine tool for use on smaller jobs or in tandem with the DX 9-HSN.

Hilti X-HSN 24 steel deck fasteners comply with ANSI/SDI RD1.0, C1.0 and NC1.0 standards.

3.5.2.2 MATERIAL SPECIFICATIONS

Fastener designation	Fastener material	Fastener plating	Nominal fastener hardness
X-HSN 24	Carbon steel	5 µm zinc[1]	55.5 HRC

1 ASTM B633, SC 1, Type III. Reference Section 2.3.3.1 for more information.

3.5.2.3 TECHNICAL DATA

Allowable pullout loads for attachments to steel base material lb (kN)[1, 2, 3]

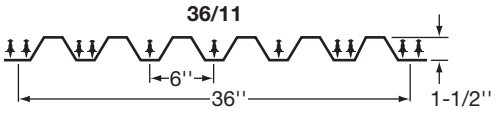
Fastener	Base material thickness (in.)			
	1/8	3/16	1/4	3/8
X-HSN 24	**435** (1.95)	**635** (2.82)	**750** (3.34)	**750** (3.34)

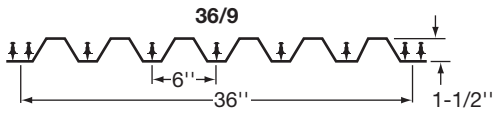
1 These values represent testing performed in ASTM A36 plate steel.
2 The values must be compared with allowable tensile pullover values.
3 Allowable values based on safety factor of 5.0.

Allowable pullover and shear bearing loads for attaching steel deck[1,2,3]

Fastener	Steel deck gauge (in.)											
	16 (0.0598)		**18** (0.0474)		**20** (0.0358)		**22** (0.0295)		**24** (0.0239)		**26** (0.0179)	
	Tension lb (kN)	**Shear lb** (kN)	**Tension lb** (kN)	**Shear lb** (kN)	**Tension lb** (kN)	**Shear lb** (kN)	**Tension lb** (kN)	**Shear lb** (kN)	**Tension lb** (kN)	**Shear lb** (kN)	**Tension lb** (kN)	**Shear lb** (kN)
X-HSN 24[1]	**865** (3.85)	**975** (4.29)	**725** (3.22)	**785** (3.45)	**560** (2.49)	**600** (2.64)	**500** (2.22)	**500** (2.20)	**450** (2.00)	**410** (1.80)	**415** (1.85)	**310** (1.36)

1 For base steel thickness 1/8" (3 mm) to 3/8" (10 mm).
2 Allowable values are based on a safety factor of 3.0.
3 Loads based on ASTM A1008, or minimum ASTM A653 SQ33 steel deck.

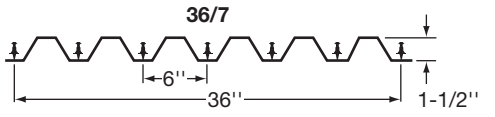


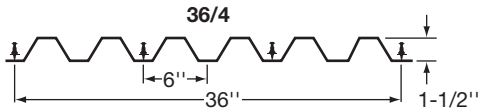


Allowable Stress Design (ASD) - Allowable diaphragm shears, S_{ASD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2" deep flutes, 6" center-to-center steel deck ($F_y \geq 50$ ksi; $F_u \geq 65$ ksi) installed with Hilti X-HSN 24 fasteners with 36/11 or 36/9 end and interior support fastener patterns[1,2,3,4,5,6,7]

Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			11	9	11	9	11	9	11	9	11	9	11	9	11	9
22	2	S_{ASD}	1065	920	876	762	726	636	616	539	534	466	473	413	426	372
		G'	62.8	61.0	67.2	64.7	69.2	66.0	69.7	66.0	69.2	65.0	68.0	63.5	66.5	61.7
	3	S_{ASD}	1158	1006	957	840	807	717	685	608	594	527	527	467	474	420
		G'	64.2	62.7	69.1	67.0	71.7	69.1	72.7	69.5	72.6	69.0	71.7	67.8	70.4	66.2
	4	S_{ASD}	1246	1087	1036	913	883	783	755	677	655	587	581	521	523	469
		G'	65.3	64.1	70.8	69.0	73.9	71.6	75.3	72.5	75.5	72.4	74.9	71.5	73.8	70.1
	5	S_{ASD}	1329	1161	1111	983	950	847	824	742	715	648	635	575	571	517
		G'	66.2	65.2	72.2	70.7	75.7	73.7	77.5	75.1	78.1	75.3	77.8	74.7	76.9	73.6
	6	S_{ASD}	1408	1230	1184	1049	1016	908	887	798	776	708	689	628	620	566
		G'	67.0	66.2	73.4	72.1	77.3	75.6	79.4	77.3	80.3	77.9	80.3	77.6	79.7	76.7
	7	S_{ASD}	1482	1293	1253	1111	1080	967	945	852	837	760	743	682	668	614
		G'	67.7	67.0	74.4	73.3	78.7	77.2	81.2	79.3	82.4	80.2	82.6	80.2	82.2	79.5
20	2	S_{ASD}	1415	1225	1166	1017	976	859	829	729	719	631	633	555	569	499
		G'	86.8	83.8	90.1	86.0	90.6	85.7	89.4	83.8	87.2	81.2	84.5	78.2	81.5	75.1
	3	S_{ASD}	1549	1349	1283	1128	1091	965	930	830	808	720	712	634	640	570
		G'	89.2	86.7	93.3	89.9	94.5	90.3	93.8	89.0	92.0	86.8	89.6	84.1	86.9	81.1
	4	S_{ASD}	1675	1462	1396	1233	1192	1060	1032	927	896	808	791	713	711	641
		G'	91.1	89.0	96.0	93.1	97.8	94.2	97.7	93.5	96.3	91.7	94.2	89.3	91.7	86.5
	5	S_{ASD}	1793	1566	1505	1332	1289	1151	1125	1010	985	897	870	792	782	712
		G'	92.8	91.0	98.3	95.8	100.7	97.6	101.1	97.4	100.1	96.0	98.3	93.9	96.0	91.4
	6	S_{ASD}	1904	1662	1608	1425	1384	1238	1210	1091	1074	972	949	871	853	783
		G'	94.2	92.7	100.4	98.2	103.3	100.5	104.1	100.9	103.5	99.9	102.0	98.0	99.9	95.7
	7	S_{ASD}	2007	1748	1706	1511	1475	1321	1294	1168	1150	1044	1028	942	924	854
		G'	95.5	94.1	102.1	100.2	105.6	103.1	106.8	103.9	106.6	103.3	105.4	101.8	103.5	99.7
18	2	S_{ASD}	1748	1515	1441	1258	1218	1072	1036	913	899	792	793	698	708	623
		G'	132.1	126.0	131.4	124.0	127.7	119.4	122.7	113.7	117.1	107.9	111.5	102.1	106.0	96.7
	3	S_{ASD}	1920	1673	1593	1402	1356	1200	1168	1045	1015	908	896	801	801	715
		G'	136.8	131.7	137.3	130.9	134.4	127.2	129.9	122.1	124.7	116.5	119.3	110.9	113.9	105.4
	4	S_{ASD}	2082	1818	1739	1537	1486	1323	1294	1158	1131	1023	999	903	893	808
		G'	140.8	136.5	142.4	136.9	140.3	134.0	136.4	129.4	131.5	124.2	126.3	118.7	121.1	113.3
	5	S_{ASD}	2233	1950	1878	1663	1611	1440	1407	1265	1246	1126	1101	1006	986	900
		G'	144.3	140.5	146.8	142.0	145.5	139.9	142.1	135.9	137.7	131.0	132.7	125.8	127.6	120.5
	6	S_{ASD}	2373	2070	2010	1781	1732	1551	1517	1369	1347	1221	1204	1101	1078	992
		G'	147.3	144.0	150.7	146.5	150.2	145.1	147.3	141.7	143.3	137.2	138.6	132.3	133.7	127.2
	7	S_{ASD}	2504	2178	2135	1890	1849	1656	1624	1467	1445	1313	1300	1186	1171	1080
		G'	149.9	147.0	154.2	150.4	154.3	149.8	152.0	147.0	148.3	142.9	144.0	138.2	139.2	133.2
16	2	S_{ASD}	1930	1674	1592	1392	1350	1186	1153	1019	1002	885	885	781	791	697
		G'	178.4	168.6	171.8	160.5	162.9	150.9	153.5	141.2	144.4	132.0	135.9	123.6	128.0	115.9
	3	S_{ASD}	2126	1853	1765	1555	1503	1332	1304	1162	1134	1017	1002	898	897	803
		G'	186.2	177.8	180.9	171.1	172.8	162.2	163.8	152.7	154.9	143.6	146.3	135.1	138.4	127.2
	4	S_{ASD}	2308	2017	1931	1707	1651	1471	1438	1289	1266	1144	1120	1015	1002	908
		G'	192.8	185.6	188.8	180.2	181.5	172.1	173.1	163.1	164.3	154.1	155.9	145.6	147.9	137.6
	5	S_{ASD}	2479	2165	2088	1850	1793	1604	1567	1410	1389	1256	1237	1130	1108	1014
		G'	198.7	192.4	195.8	188.3	189.4	180.9	181.4	172.4	173.0	163.7	164.7	155.2	156.7	147.2
	6	S_{ASD}	2637	2298	2237	1982	1931	1729	1692	1527	1503	1364	1350	1230	1214	1119
		G'	203.8	198.3	202.1	195.4	196.4	188.8	189.0	180.8	180.9	172.4	172.8	164.1	164.9	156.1
	7	S_{ASD}	2783	2419	2378	2104	2062	1847	1813	1638	1615	1468	1453	1327	1319	1209
		G'	208.3	203.5	207.7	201.7	202.8	196.0	195.9	188.5	188.2	180.4	180.3	172.2	172.5	164.3

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses 3/16" ≤ t_f ≤ 3/8". For attachment to base steel with range 1/8" ≤ t_f < 3/16", diaphragm shear values should be calculated in accordance with Section 3.5.1.7 with, or by using Hilti Profis DF software.
2 Tabulated ASD diaphragm shear loads are calculated with a safety factor (Ω) of 2.00 for wind loads. To calculate ASD values for load combinations involving earthquake, multiply S_{asd} values in table by 2.00 and divide by a safety factor (Ω) of 2.30. Panel buckling has been checked.
3 At diaphragm perimeter, Hilti frame fasteners should be spaced at identical spacing as sidelap connectors.
4 Interpolation of diaphragm shear strength values is allowed between span dimensions, sidelap spacings and deck gauge. Alternatively, use calculations as discussed in Section 3.5.1.7 to determine diaphragm shear capacities directly.
5 To convert from sidelaps per span (SPS) to sidelap spacing (SS), use the following formula: SS, in. ((span,ft) x 12)/(SPS).
6 For 16 gauge steel deck or for high tensile strength (Fu > 65 ksi) 18 gauge steel deck, use S-SLC 02 M HWH. For more information on Hilti Sidelap Connectors refer to Section 3.5.6.
7 For diaphragm shear load values using Hilti #10 HWH screws, use the Hilti Profis DF Diaphragm software or contact Hilti at 877-749-6337 or deck@hilti.com.





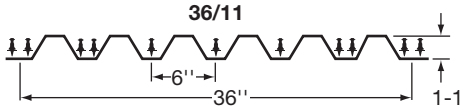
Allowable Stress Design (ASD) - Allowable diaphragm shears, S_{ASD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2" deep flutes, 6" center-to-center steel deck ($F_y \geq 50$ ksi; $F_u \geq 65$ ksi) installed with Hilti X-HSN 24 fasteners with 36/7 or 36/4 end and interior support fastener patterns[1,2,3,4,5,6,7]

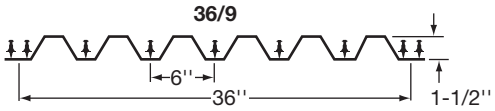
Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			7	4	7	4	7	4	7	4	7	4	7	4	7	4
22	2	S_{ASD}	667	490	547	414	455	356	387	310	336	268	298	238	268	214
		G'	57.3	11.9	59.6	14.2	59.8	16.1	58.8	17.8	57.2	19.1	55.2	20.1	53.0	20.9
	3	S_{ASD}	761	557	629	478	534	417	456	367	396	328	352	292	317	263
		G'	59.8	12.1	63.0	14.5	63.9	16.6	63.5	18.4	62.3	19.9	60.6	21.2	58.7	22.2
	4	S_{ASD}	849	612	707	534	603	470	525	418	457	375	406	340	365	310
		G'	61.8	12.2	65.7	14.7	67.3	16.9	67.5	18.8	66.7	20.5	65.3	21.9	63.6	23.1
	5	S_{ASD}	930	657	781	582	670	518	585	465	518	419	460	381	414	349
		G'	63.3	12.3	67.9	14.8	70.1	17.1	70.8	19.2	70.4	21.0	69.3	22.5	67.8	23.9
	6	S_{ASD}	1004	694	850	623	733	561	642	507	570	460	512	420	462	386
		G'	64.6	12.3	69.7	14.9	72.5	17.3	73.6	19.4	73.6	21.3	72.8	23.0	71.6	24.5
	7	S_{ASD}	1071	724	915	658	794	598	698	545	622	498	559	457	508	421
		G'	65.6	12.4	71.3	15.0	74.5	17.5	76.0	19.7	76.4	21.6	75.9	23.4	74.9	24.9
20	2	S_{ASD}	898	660	738	560	621	484	529	424	459	371	405	327	365	294
		G'	77.5	18.5	78.0	21.6	76.3	24.1	73.5	26.0	70.3	27.5	66.9	28.4	63.6	29.1
	3	S_{ASD}	1034	752	857	651	729	569	630	503	548	450	484	406	436	365
		G'	81.7	18.8	83.3	22.2	82.5	25.0	80.3	27.3	77.4	29.0	74.2	30.4	71.0	31.3
	4	S_{ASD}	1157	826	968	727	828	644	722	575	637	517	563	469	507	429
		G'	85.0	19.1	87.6	22.6	87.6	25.7	86.0	28.2	83.5	30.2	80.6	31.8	77.5	33.1
	5	S_{ASD}	1270	885	1073	791	923	709	808	639	717	579	642	528	578	485
		G'	87.6	19.2	91.2	22.9	91.9	26.1	90.9	28.9	88.8	31.1	86.2	33.0	83.3	34.4
	6	S_{ASD}	1372	932	1170	845	1013	766	890	696	792	636	713	583	647	537
		G'	89.8	19.4	94.2	23.2	95.6	26.5	95.1	29.4	93.5	31.9	91.2	33.9	88.5	35.5
	7	S_{ASD}	1463	970	1260	890	1098	815	969	747	865	686	780	633	709	585
		G'	91.7	19.5	96.8	23.4	98.8	26.8	98.8	29.8	97.6	32.4	95.6	34.6	93.1	36.5
18	2	S_{ASD}	1119	822	920	699	779	605	665	531	579	471	511	416	457	372
		G'	114.1	33.8	109.8	38.2	103.9	41.2	97.6	43.1	91.5	44.0	85.8	44.3	80.5	44.1
	3	S_{ASD}	1292	937	1073	813	913	713	793	632	694	566	614	511	550	464
		G'	121.9	34.8	119.1	39.8	114.0	43.5	108.0	46.0	102.0	47.6	96.3	48.5	90.8	48.7
	4	S_{ASD}	1450	1028	1216	909	1042	808	909	723	804	652	717	592	642	542
		G'	128.3	35.5	126.8	41.0	122.5	45.2	117.1	48.3	111.3	50.4	105.6	51.7	100.1	52.4
	5	S_{ASD}	1592	1100	1349	989	1164	890	1019	804	905	730	813	667	735	613
		G'	133.6	36.0	133.3	41.9	129.9	46.5	125.0	50.1	119.5	52.6	114.0	54.4	108.6	55.5
	6	S_{ASD}	1719	1156	1472	1054	1278	960	1125	875	1002	801	903	736	820	679
		G'	138.1	36.5	138.9	42.6	136.3	47.6	132.0	51.5	126.9	54.4	121.5	56.6	116.2	58.0
	7	S_{ASD}	1833	1201	1585	1108	1386	1019	1226	938	1096	864	989	798	900	740
		G'	141.9	36.8	143.8	43.2	142.0	48.4	138.2	52.7	133.5	55.9	128.4	58.4	123.2	60.2
16	2	S_{ASD}	1242	912	1022	777	866	673	744	591	648	526	573	469	513	419
		G'	149.9	53.7	139.8	58.5	129.2	61.0	119.3	61.8	110.4	61.5	102.5	60.4	95.4	58.9
	3	S_{ASD}	1438	1040	1196	905	1019	795	885	706	780	632	690	572	619	521
		G'	162.2	56.0	153.3	62.0	143.3	65.6	133.4	67.4	124.3	67.9	116.0	67.5	108.5	66.5
	4	S_{ASD}	1616	1141	1358	1012	1164	901	1016	808	900	729	807	663	724	607
		G'	172.4	57.7	164.9	64.6	155.5	69.2	145.9	71.8	136.7	73.1	128.2	73.3	120.5	72.7
	5	S_{ASD}	1775	1219	1507	1099	1302	992	1142	898	1015	817	912	747	827	687
		G'	181.0	58.9	174.8	66.6	166.2	72.0	156.9	75.4	147.9	77.3	139.3	78.1	131.4	78.0
	6	S_{ASD}	1916	1280	1645	1171	1431	1069	1261	977	1125	896	1013	824	921	762
		G'	188.4	59.9	183.5	68.2	175.7	74.2	166.9	78.3	158.0	80.8	149.5	82.2	141.5	82.6
	7	S_{ASD}	2042	1328	1771	1229	1552	1134	1375	1046	1230	966	1111	894	1012	830
		G'	194.8	60.7	191.1	69.5	184.1	76.1	175.8	80.7	167.2	83.8	158.8	85.7	150.8	86.5

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses 3/16" ≤ tf ≤ 3/8". For attachment to base steel with range 1/8" ≤ tf < 3/16", diaphragm shear values should be calculated in accordance with Section 3.5.1.7,or by using Hilti Profis DF software.

2 Tabulated ASD diaphragm shear loads are calculated with a safety factor (Ω) of 2.00 for wind loads. To calculate ASD values for load combinations involving earthquake, multiply S_{ASD} values in table by 2.00 and divide by a safety factor (Ω) of 2.30. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.





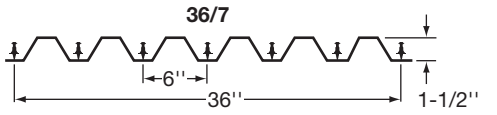
Load Resistance Factor Design (LRFD) - Factored resistance diaphragm shears, S_{LRFD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2" deep flutes, 6" center-to-center steel deck ($F_y \geq 50$ ksi; $F_u \geq 65$ ksi) installed with Hilti X-HSN 24 fasteners with 36/11 or 36/9 end and interior support fastener patterns[1,2,3,4,5,6,7]

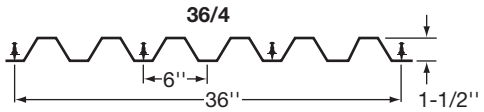
Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			11	9	11	9	11	9	11	9	11	9	11	9	11	9
22	2	S_{LRFD}	1704	1402	1162	986	854	757	681	1473	1220	1018	862	746	661	595
		G'	62.8	61.0	67.2	64.7	69.2	66.0	69.7	66.0	69.2	65.0	68.0	63.5	66.5	61.7
	3	S_{LRFD}	1852	1532	1291	1097	951	843	759	1610	1343	1147	973	843	747	672
		G'	64.2	62.7	69.1	67.0	71.7	69.1	72.7	69.5	72.6	69.0	71.7	67.8	70.4	66.2
	4	S_{LRFD}	1993	1657	1412	1208	1048	929	836	1739	1461	1253	1084	939	833	750
		G'	65.3	64.1	70.8	69.0	73.9	71.6	75.3	72.5	75.5	72.4	74.9	71.5	73.8	70.1
	5	S_{LRFD}	2126	1778	1520	1318	1145	1016	914	1857	1572	1355	1187	1036	919	827
		G'	66.2	65.2	72.2	70.7	75.7	73.7	77.5	75.1	78.1	75.3	77.8	74.7	76.9	73.6
	6	S_{LRFD}	2252	1894	1625	1419	1242	1102	992	1967	1678	1453	1276	1133	1006	905
		G'	67.0	66.2	73.4	72.1	77.3	75.6	79.4	77.3	80.3	77.9	80.3	77.6	79.7	76.7
	7	S_{LRFD}	2371	2006	1727	1512	1339	1188	1069	2069	1777	1546	1363	1216	1092	983
		G'	67.7	67.0	74.4	73.3	78.7	77.2	81.2	79.3	82.4	80.2	82.6	80.2	82.2	79.5
20	2	S_{LRFD}	2265	1865	1561	1326	1150	1013	911	1961	1627	1374	1166	1009	888	799
		G'	86.8	83.8	90.1	86.0	90.6	85.7	89.4	83.8	87.2	81.2	84.5	78.2	81.5	75.1
	3	S_{LRFD}	2478	2053	1746	1489	1292	1139	1025	2158	1805	1544	1328	1151	1014	912
		G'	89.2	86.7	93.3	89.9	94.5	90.3	93.8	89.0	92.0	86.8	89.6	84.1	86.9	81.1
	4	S_{LRFD}	2679	2234	1907	1651	1434	1266	1138	2339	1973	1696	1483	1293	1140	1026
		G'	91.1	89.0	96.0	93.1	97.8	94.2	97.7	93.5	96.3	91.7	94.2	89.3	91.7	86.5
	5	S_{LRFD}	2869	2407	2063	1800	1576	1392	1252	2506	2131	1842	1617	1435	1267	1139
		G'	92.8	91.0	98.3	95.8	100.7	97.6	101.1	97.4	100.1	96.0	98.3	93.9	96.0	91.4
	6	S_{LRFD}	3046	2573	2214	1937	1718	1518	1365	2658	2279	1981	1745	1555	1393	1253
		G'	94.2	92.7	100.4	98.2	103.3	100.5	104.1	100.9	103.5	99.9	102.0	98.0	99.9	95.7
	7	S_{LRFD}	3212	2730	2359	2070	1840	1644	1479	2797	2418	2113	1869	1670	1507	1367
		G'	95.5	94.1	102.1	100.2	105.6	103.1	106.8	103.9	106.6	103.3	105.4	101.8	103.5	99.7
18	2	S_{LRFD}	2797	2306	1948	1657	1439	1269	1133	2424	2014	1715	1461	1267	1117	996
		G'	132.1	126.0	131.4	124.0	127.7	119.4	122.7	113.7	117.1	107.9	111.5	102.1	106.0	96.7
	3	S_{LRFD}	3072	2549	2169	1869	1624	1434	1281	2677	2243	1921	1673	1452	1281	1144
		G'	136.8	131.7	137.3	130.9	134.4	127.2	129.9	122.1	124.7	116.5	119.3	110.9	113.9	105.4
	4	S_{LRFD}	3330	2782	2377	2070	1809	1598	1429	2909	2459	2117	1853	1637	1446	1292
		G'	140.8	136.5	142.4	136.9	140.3	134.0	136.4	129.4	131.5	124.2	126.3	118.7	121.1	113.3
	5	S_{LRFD}	3572	3004	2578	2251	1994	1762	1577	3120	2661	2304	2025	1802	1610	1440
		G'	144.3	140.5	146.8	142.0	145.5	139.9	142.1	135.9	137.7	131.0	132.7	125.8	127.6	120.5
	6	S_{LRFD}	3797	3216	2772	2428	2155	1927	1725	3312	2849	2482	2190	1954	1761	1588
		G'	147.3	144.0	150.7	146.5	150.2	145.1	147.3	141.7	143.3	137.2	138.6	132.3	133.7	127.2
	7	S_{LRFD}	4007	3416	2958	2599	2312	2080	1873	3485	3024	2650	2348	2101	1898	1729
		G'	149.9	147.0	154.2	150.4	154.3	149.8	152.0	147.0	148.3	142.9	144.0	138.2	139.2	133.2
16	2	S_{LRFD}	3089	2548	2161	1845	1604	1416	1266	2679	2227	1897	1630	1416	1249	1115
		G'	178.4	168.6	171.8	160.5	162.9	150.9	153.5	141.2	144.4	132.0	135.9	123.6	128.0	115.9
	3	S_{LRFD}	3401	2825	2405	2087	1815	1604	1435	2965	2487	2131	1859	1627	1437	1284
		G'	186.2	177.8	180.9	171.1	172.8	162.2	163.8	152.7	154.9	143.6	146.3	135.1	138.4	127.2
	4	S_{LRFD}	3693	3089	2641	2301	2026	1792	1604	3226	2732	2354	2062	1830	1625	1454
		G'	192.8	185.6	188.8	180.2	181.5	172.1	173.1	163.1	164.3	154.1	155.9	145.6	147.9	137.6
	5	S_{LRFD}	3966	3340	2870	2507	2222	1979	1773	3463	2959	2566	2257	2009	1808	1623
		G'	198.7	192.4	195.8	188.3	189.4	180.9	181.4	172.4	173.0	163.7	164.7	155.2	156.7	147.2
	6	S_{LRFD}	4219	3579	3089	2708	2405	2161	1942	3677	3171	2766	2443	2182	1968	1790
		G'	203.8	198.3	202.1	195.4	196.4	188.8	189.0	180.8	180.9	172.4	172.8	164.1	164.9	156.1
	7	S_{LRFD}	4453	3805	3299	2901	2583	2325	2111	3870	3366	2955	2621	2348	2123	1934
		G'	208.3	203.5	207.7	201.7	202.8	196.0	195.9	188.5	188.2	180.4	180.3	172.2	172.5	164.3

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses 3/16" ≤ t_t ≤ 3/8". For attachment to base steel with range 1/8" ≤ t_t < 3/16", diaphragm shear values should be calculated in accordance with Section 3.5.1.7, or by using Hilti Profis DF software.

2 Tabulated LRFD diaphragm shear loads are calculated with a phi factor (Φ) of 0.80 for wind loads. To calculate LRFD values for load combinations involving earthquake, divide values in table by 0.80 and multiply by a phi factor (Φ) of 0.70. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.





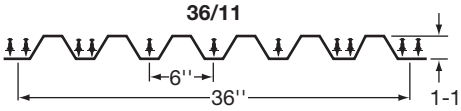
Load Resistance Factor Design (LRFD) - Factored resistance diaphragm shears, S_{LRFD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2" deep flutes, 6" center-to-center steel deck ($F_y \geq 50$ ksi; $F_u \geq 65$ ksi) installed with Hilti X-HSN 24 fasteners with 36/7 or 36/4 end and interior support fastener patterns[1,2,3,4,5,6,7]

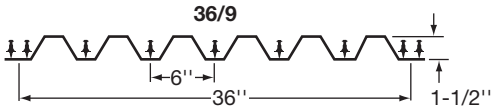
Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			7	4	7	4	7	4	7	4	7	4	7	4	7	4
22	2	S_{LRFD}	1067	784	875	663	728	570	619	496	537	429	477	381	429	342
		G'	57.3	11.9	59.6	14.2	59.8	16.1	58.8	17.8	57.2	19.1	55.2	20.1	53.0	20.9
	3	S_{LRFD}	1218	891	1006	765	854	666	730	588	634	524	563	467	507	420
		G'	59.8	12.1	63.0	14.5	63.9	16.6	63.5	18.4	62.3	19.9	60.6	21.2	58.7	22.2
	4	S_{LRFD}	1358	978	1131	855	965	753	839	669	731	600	649	543	584	496
		G'	61.8	12.2	65.7	14.7	67.3	16.9	67.5	18.8	66.7	20.5	65.3	21.9	63.6	23.1
	5	S_{LRFD}	1487	1051	1249	932	1072	829	935	743	828	671	735	610	662	559
		G'	63.3	12.3	67.9	14.8	70.1	17.1	70.8	19.2	70.4	21.0	69.3	22.5	67.8	23.9
	6	S_{LRFD}	1606	1110	1361	997	1173	897	1028	811	913	736	820	673	739	618
		G'	64.6	12.3	69.7	14.9	72.5	17.3	73.6	19.4	73.6	21.3	72.8	23.0	71.6	24.5
	7	S_{LRFD}	1714	1158	1465	1053	1270	957	1117	871	995	796	895	731	813	674
		G'	65.6	12.4	71.3	15.0	74.5	17.5	76.0	19.7	76.4	21.6	75.9	23.4	74.9	24.9
20	2	S_{LRFD}	1438	1057	1181	897	994	774	846	679	735	594	648	523	583	471
		G'	77.5	18.5	78.0	21.6	76.3	24.1	73.5	26.0	70.3	27.5	66.9	28.4	63.6	29.1
	3	S_{LRFD}	1654	1204	1371	1041	1166	910	1008	805	877	720	775	650	697	584
		G'	81.7	18.8	83.3	22.2	82.5	25.0	80.3	27.3	77.4	29.0	74.2	30.4	71.0	31.3
	4	S_{LRFD}	1852	1322	1549	1163	1325	1030	1155	920	1019	828	901	751	810	686
		G'	85.0	19.1	87.6	22.6	87.6	25.7	86.0	28.2	83.5	30.2	80.6	31.8	77.5	33.1
	5	S_{LRFD}	2032	1416	1716	1266	1477	1135	1292	1023	1146	927	1027	845	924	775
		G'	87.6	19.2	91.2	22.9	91.9	26.1	90.9	28.9	88.8	31.1	86.2	33.0	83.3	34.4
	6	S_{LRFD}	2195	1491	1872	1353	1621	1226	1425	1114	1267	1017	1140	932	1035	859
		G'	89.8	19.4	94.2	23.2	95.6	26.5	95.1	29.4	93.5	31.9	91.2	33.9	88.5	35.5
	7	S_{LRFD}	2341	1552	2016	1425	1757	1304	1551	1195	1384	1098	1248	1012	1135	937
		G'	91.7	19.5	96.8	23.4	98.8	26.8	98.8	29.8	97.6	32.4	95.6	34.6	93.1	36.5
18	2	S_{LRFD}	1790	1315	1472	1119	1246	967	1064	849	926	754	818	666	732	595
		G'	114.1	33.8	109.8	38.2	103.9	41.2	97.6	43.1	91.5	44.0	85.8	44.3	80.5	44.1
	3	S_{LRFD}	2067	1499	1717	1302	1461	1141	1270	1011	1111	905	982	818	880	743
		G'	121.9	34.8	119.1	39.8	114.0	43.5	108.0	46.0	102.0	47.6	96.3	48.5	90.8	48.7
	4	S_{LRFD}	2320	1645	1946	1455	1667	1293	1454	1157	1287	1043	1147	948	1028	867
		G'	128.3	35.5	126.8	41.0	122.5	45.2	117.1	48.3	111.3	50.4	105.6	51.7	100.1	52.4
	5	S_{LRFD}	2547	1760	2159	1582	1862	1423	1631	1286	1448	1168	1301	1068	1176	981
		G'	133.6	36.0	133.3	41.9	129.9	46.5	125.0	50.1	119.5	52.6	114.0	54.4	108.6	55.5
	6	S_{LRFD}	2751	1850	2355	1687	2045	1535	1800	1400	1604	1281	1444	1177	1312	1087
		G'	138.1	36.5	138.9	42.6	136.3	47.6	132.0	51.5	126.9	54.4	121.5	56.6	116.2	58.0
	7	S_{LRFD}	2933	1922	2536	1773	2218	1631	1962	1500	1754	1382	1583	1278	1441	1185
		G'	141.9	36.8	143.8	43.2	142.0	48.4	138.2	52.7	133.5	55.9	128.4	58.4	123.2	60.2
16	2	S_{LRFD}	1987	1459	1635	1244	1385	1077	1191	946	1037	841	917	750	821	670
		G'	149.9	53.7	139.8	58.5	129.2	61.0	119.3	61.8	110.4	61.5	102.5	60.4	95.4	58.9
	3	S_{LRFD}	2301	1664	1913	1449	1630	1272	1417	1129	1248	1012	1104	915	990	834
		G'	162.2	56.0	153.3	62.0	143.3	65.6	133.4	67.4	124.3	67.9	116.0	67.5	108.5	66.5
	4	S_{LRFD}	2585	1825	2172	1619	1863	1442	1626	1292	1440	1167	1291	1061	1159	971
		G'	172.4	57.7	164.9	64.6	155.5	69.2	145.9	71.8	136.7	73.1	128.2	73.3	120.5	72.7
	5	S_{LRFD}	2839	1950	2412	1758	2083	1587	1827	1437	1623	1307	1459	1196	1323	1100
		G'	181.0	58.9	174.8	66.6	166.2	72.0	156.9	75.4	147.9	77.3	139.3	78.1	131.4	78.0
	6	S_{LRFD}	3066	2048	2632	1873	2290	1710	2018	1563	1800	1433	1621	1319	1474	1219
		G'	188.4	59.9	183.5	68.2	175.7	74.2	166.9	78.3	158.0	80.8	149.5	82.2	141.5	82.6
	7	S_{LRFD}	3267	2125	2834	1967	2483	1814	2200	1673	1969	1545	1778	1430	1620	1328
		G'	194.8	60.7	191.1	69.5	184.1	76.1	175.8	80.7	167.2	83.8	158.8	85.7	150.8	86.5

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses 3/16" ≤ t_t ≤ 3/8". For attachment to base steel with range 1/8" ≤ t_t < 3/16", diaphragm shear values should be calculated in accordance with Section 3.5.1.7, or by using Hilti Profis DF software.

2 Tabulated LRFD diaphragm shear loads are calculated with a phi factor (Φ) of 0.80 for wind loads. To calculate LRFD values for load combinations involving earthquake, divide values in table by 0.80 and multiply by a phi factor (Φ) of 0.70. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.





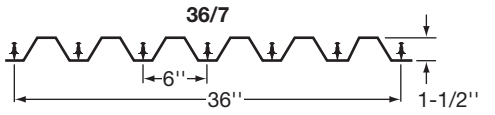
Limit States Design (LSD) – Factored resistance diaphragm shears, S_{LSD}, (N/mm) and stiffness factors, G', (10^3 N/mm) for standard 38mm deep flutes, 152mm center-to-center deck (F_y≥345 Mpa; F_u≥450 Mpa) installed with Hilti X-HSN 24 fasteners with 914/11 (36/11) or 914/9 (36/9) end and interior support fastener patterns[1,2,3,4,5,6,7]

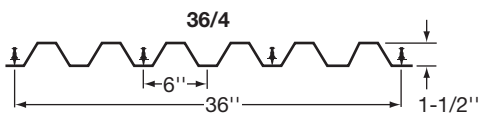
Gauge	Number of Hilti SLC per Span	Factor	Span (mm)													
			1200		1500		1800		2100		2400		2700		3000	
			Fasteners per sheet to support													
			11	9	11	9	11	9	11	9	11	9	11	9	11	9
22	2	S_{LSD}	23.6	20.4	19.5	16.9	16.2	14.2	13.7	12.0	11.9	10.4	10.5	8.0	9.5	8.3
		G'	10.9	10.6	11.7	11.3	12.1	11.6	12.2	11.6	12.2	11.4	12.0	10.3	11.7	10.9
	3	S_{LSD}	25.7	22.3	21.3	18.6	18.0	15.9	15.3	13.6	13.3	11.7	11.7	10.4	10.5	9.3
		G'	11.2	10.9	12.1	11.7	12.5	12.1	12.7	12.2	12.7	12.1	12.6	11.9	12.4	11.7
	4	S_{LSD}	27.6	24.1	23.0	20.2	19.6	17.4	16.8	15.1	14.6	13.1	12.9	11.6	11.6	10.4
		G'	11.4	11.2	12.3	12.0	12.9	12.5	13.2	12.7	13.2	12.7	13.2	12.6	13.0	12.3
	5	S_{LSD}	29.4	25.7	24.6	21.8	21.1	18.8	18.4	16.5	15.9	14.4	14.1	12.8	12.7	11.5
		G'	11.5	11.4	12.6	12.3	13.2	12.9	13.6	13.1	13.7	13.2	13.7	13.1	13.5	12.9
	6	S_{LSD}	31.2	27.2	26.3	23.2	22.5	20.1	19.7	17.7	17.3	15.8	15.3	14.0	13.8	12.6
		G'	11.7	11.5	12.8	12.6	13.5	13.2	13.9	13.5	14.1	13.7	14.1	13.6	14.0	13.5
	7	S_{LSD}	32.8	28.6	27.8	24.6	24.0	21.4	21.0	18.9	18.6	16.9	16.5	15.2	14.9	13.7
		G'	11.8	11.7	13.0	12.8	13.7	13.5	14.2	13.9	14.4	14.0	14.5	14.1	14.4	14.0
20	2	S_{LSD}	31.4	27.2	25.9	22.6	21.7	19.1	18.5	16.2	16.0	14.1	14.1	12.4	12.7	11.1
		G'	15.2	14.6	15.8	15.1	15.9	15.0	15.7	14.7	15.3	14.3	14.9	13.8	14.4	13.2
	3	S_{LSD}	34.3	29.9	28.5	25.0	24.2	21.4	20.7	18.5	18.0	16.0	15.9	14.1	14.2	12.7
		G'	15.6	15.1	16.3	15.7	16.5	15.8	16.5	15.6	16.2	15.3	15.8	14.8	15.3	14.3
	4	S_{LSD}	37.1	32.4	31.0	27.3	26.5	23.5	23.0	20.6	20.0	18.0	17.6	15.9	15.8	14.3
		G'	15.9	15.5	16.8	16.3	17.1	16.5	17.1	16.4	16.9	16.1	16.6	15.7	16.1	15.2
	5	S_{LSD}	39.7	34.7	33.4	29.5	28.6	25.5	25.0	22.4	22.0	19.9	19.4	17.6	17.4	15.8
		G'	16.2	15.9	17.2	16.7	17.6	17.1	17.7	17.1	17.6	16.9	17.3	16.5	16.9	16.1
	6	S_{LSD}	42.1	36.7	35.6	31.6	30.7	27.5	26.9	24.2	23.8	21.6	21.1	19.4	19.0	17.4
		G'	16.4	16.2	17.5	17.2	18.1	17.6	18.2	17.7	18.2	17.5	17.9	17.2	17.6	16.8
	7	S_{LSD}	44.4	38.6	37.8	33.4	32.7	29.3	28.7	25.9	25.5	23.2	22.9	20.9	20.6	19.0
		G'	16.6	16.4	17.8	17.5	18.5	18.0	18.7	18.2	18.7	18.1	18.5	17.9	18.2	17.5
18	2	S_{LSD}	38.8	33.6	32.0	27.9	27.1	23.8	23.1	20.4	20.0	17.7	17.7	15.6	15.8	13.9
		G'	23.1	22.0	23.0	21.7	22.4	20.9	21.5	20.0	20.6	19.0	19.6	18.0	18.7	17.0
	3	S_{LSD}	42.6	37.1	35.4	31.1	30.1	26.6	26.0	23.2	22.6	20.2	20.0	17.9	17.9	15.9
		G'	23.9	23.0	24.0	22.9	23.6	22.3	22.8	21.4	21.9	20.5	21.0	19.5	20.0	18.6
	4	S_{LSD}	46.1	40.2	38.6	34.1	33.0	29.4	28.7	25.7	25.2	22.8	22.3	20.1	19.9	18.0
		G'	24.6	23.8	24.9	24.0	24.6	23.5	23.9	22.7	23.1	21.8	22.2	20.9	21.3	20.0
	5	S_{LSD}	49.4	43.1	41.6	36.8	35.8	31.9	31.2	28.1	27.7	25.0	24.5	22.4	22.0	20.1
		G'	25.2	24.5	25.7	24.9	25.5	24.5	24.9	23.9	24.2	23.0	23.3	22.1	22.5	21.2
	6	S_{LSD}	52.5	45.8	44.5	39.4	38.4	34.4	33.7	30.4	29.9	27.1	26.8	24.4	24.0	22.1
		G'	25.7	25.1	26.4	25.6	26.3	25.4	25.8	24.9	25.2	24.1	24.4	23.3	23.5	22.4
	7	S_{LSD}	55.5	48.1	47.3	41.8	41.0	36.7	36.0	32.5	32.1	29.1	28.9	26.3	26.1	24.0
		G'	26.2	25.7	27.0	26.3	27.0	26.2	26.7	25.8	26.0	25.1	25.3	24.3	24.5	23.4
16	2	S_{LSD}	42.8	37.1	35.4	30.9	30.0	26.3	25.7	22.7	22.3	19.7	19.7	17.4	17.6	15.5
		G'	31.3	29.6	30.2	28.2	28.7	26.6	27.1	24.9	25.5	23.3	24.0	21.8	22.6	20.5
	3	S_{LSD}	47.1	41.1	39.2	34.5	33.4	29.6	29.0	25.8	25.3	22.7	22.3	20.0	20.0	17.9
		G'	32.6	31.2	31.8	30.1	30.4	28.5	28.9	26.9	27.3	25.3	25.8	23.9	24.4	22.5
	4	S_{LSD}	51.1	44.6	42.8	37.8	36.6	32.6	31.9	28.6	28.2	25.4	24.9	22.6	22.3	20.2
		G'	33.8	32.5	33.1	31.7	31.9	30.3	30.5	28.7	29.0	27.2	27.5	25.7	26.1	24.3
	5	S_{LSD}	54.9	47.9	46.3	41.0	39.8	35.6	34.8	31.3	30.9	27.9	27.6	25.1	24.7	22.6
		G'	34.8	33.7	34.4	33.1	33.3	31.8	31.9	30.4	30.5	28.9	29.0	27.4	27.7	26.0
	6	S_{LSD}	58.4	50.8	49.6	43.9	42.8	38.3	37.6	33.9	33.4	30.3	30.0	27.3	27.0	24.8
		G'	35.7	34.7	35.5	34.3	34.5	33.2	33.3	31.8	31.9	30.4	30.5	28.9	29.1	27.6
	7	S_{LSD}	61.6	53.4	52.7	46.5	45.7	40.9	40.2	36.3	35.8	32.6	32.3	29.4	29.3	26.8
			36.5	35.6	36.4	35.4	35.6	34.4	34.5	33.2	33.1	31.8	31.8	30.4	30.4	29.0

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses 5 mm ≤ t_t ≤ 10 mm. For attachment to base steel thickness with range 3 mm ≤ t_t < 5 mm, diaphragm shear values should be calculated in accordance with Section 3.5.1.7, or by using Hilti Profis DF software.

2 Tabulated LSD diaphragm shear loads are calculated with a phi factor (Φ) of 0.75 for wind loads. To calculate LSD values for load combinations involving earthquake, divide values in table by 0.75 and multiply by a phi factor (Φ) of 0.55. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.





Limit States Design (LSD) – Factored resistance diaphragm shears, S_{LSD}, (N/mm) and stiffness factors, G', (10^3 N/mm) for standard 38mm deep flutes, 152mm center-to-center deck ($F_y \geq 345$ Mpa; $F_u \geq 450$ Mpa) installed with Hilti X-HSN 24 fasteners with 914/7 (36/7) or 914/4 (36/4) end and interior support fastener patterns[1,2,3,4,5,6,7]

Gauge	Number of Hilti SLC per span	Factor	Span (mm)													
			1200		1500		1800		2100		2400		2700		3000	
			Fasteners per sheet to support													
			7	4	7	4	7	4	7	4	7	4	7	4	7	4
22	2	S_{LSD}	14.8	10.9	12.1	9.2	10.1	7.9	8.6	6.9	7.5	6.0	6.6	5.3	6.0	4.8
		G'	10.0	2.1	10.4	2.5	10.5	2.8	10.3	3.1	10.1	3.3	9.7	3.5	9.4	3.6
	3	S_{LSD}	16.9	12.3	14.0	10.6	11.9	9.2	10.2	8.1	8.8	7.3	7.8	6.5	7.0	5.8
		G'	10.4	2.1	11.0	2.5	11.2	2.9	11.2	3.2	11.0	3.5	10.7	3.7	10.3	3.9
	4	S_{LSD}	18.8	13.5	15.7	11.8	13.4	10.4	11.7	9.3	10.2	8.3	9.0	7.5	8.1	6.9
		G'	10.8	2.1	11.5	2.5	11.8	2.9	11.8	3.3	11.7	3.6	11.5	3.8	11.2	4.0
	5	S_{LSD}	20.6	14.5	17.3	12.9	14.9	11.5	13.0	10.3	11.5	9.3	10.2	8.5	9.2	7.7
		G'	11.0	2.1	11.8	2.6	12.3	3.0	12.4	3.3	12.4	3.6	12.2	3.9	11.9	4.1
	6	S_{LSD}	22.2	15.3	18.8	13.8	16.3	12.4	14.3	11.2	12.7	10.2	11.4	9.3	10.3	8.6
		G'	11.2	2.1	12.2	2.6	12.7	3.0	12.9	3.4	12.9	3.7	12.8	4.0	12.6	4.2
	7	S_{LSD}	23.7	15.9	20.3	14.5	17.6	13.2	15.5	12.0	13.8	11.0	12.4	10.1	11.3	9.3
		G'	11.4	2.1	12.4	2.6	13.0	3.0	13.3	3.4	13.4	3.7	13.3	4.1	13.2	4.3
20	2	S_{LSD}	19.9	14.6	16.4	12.4	13.8	10.7	11.8	9.4	10.2	8.3	9.0	7.3	8.1	6.5
		G'	13.6	3.2	13.7	3.7	13.4	4.2	12.9	4.5	12.4	4.8	11.8	5.0	11.2	5.1
	3	S_{LSD}	22.9	16.6	19.0	14.4	16.2	12.6	14.0	11.2	12.2	10.0	10.8	9.0	9.7	8.1
		G'	14.3	3.3	14.6	3.8	14.5	4.3	14.1	4.7	13.6	5.1	13.1	5.3	12.5	5.5
	4	S_{LSD}	25.6	18.2	21.5	16.1	18.4	14.3	16.0	12.7	14.2	11.5	12.5	10.4	11.3	9.5
		G'	14.8	3.3	15.3	3.9	15.4	4.4	15.1	4.9	14.7	5.3	14.2	5.5	13.7	5.8
	5	S_{LSD}	28.1	19.5	23.8	17.5	20.5	15.7	17.9	14.1	15.9	12.8	14.3	11.7	12.8	10.8
		G'	15.3	3.3	16.0	4.0	16.1	4.5	16.0	5.0	15.6	5.4	15.2	5.7	14.7	6.0
	6	S_{LSD}	30.3	20.5	25.9	18.6	22.5	16.9	19.8	15.4	17.6	14.1	15.8	12.9	14.4	11.9
		G'	15.7	3.3	16.5	4.0	16.8	4.6	16.7	5.1	16.4	5.5	16.0	5.9	15.6	6.2
	7	S_{LSD}	32.3	21.3	27.9	19.6	24.3	18.0	21.5	16.5	19.2	15.2	17.3	14.0	15.8	13.0
		G'	16.0	3.4	16.9	4.0	17.3	4.6	17.3	5.2	17.1	5.6	16.8	6.0	16.4	6.3
18	2	S_{LSD}	24.8	18.2	20.4	15.5	17.3	13.4	14.8	11.8	12.9	10.5	11.4	9.3	10.2	8.3
		G'	20.0	5.9	19.3	6.6	18.3	7.2	17.2	7.5	16.1	7.7	15.1	7.7	14.2	7.7
	3	S_{LSD}	28.6	20.7	23.8	18.0	20.3	15.8	17.6	14.0	15.5	12.6	13.7	11.3	12.3	10.3
		G'	21.3	6.0	20.9	6.9	20.0	7.6	19.0	8.0	18.0	8.3	17.0	8.5	16.0	8.5
	4	S_{LSD}	32.1	22.7	27.0	20.1	23.1	17.9	20.2	16.0	17.9	14.5	16.0	13.1	14.3	12.0
		G'	22.4	6.1	22.2	7.1	21.5	7.9	20.6	8.4	19.6	8.8	18.6	9.0	17.7	9.2
	5	S_{LSD}	35.2	24.2	29.9	21.8	25.8	19.7	22.6	17.8	20.1	16.2	18.1	14.8	16.4	13.6
		G'	23.4	6.2	23.4	7.3	22.8	8.1	22.0	8.7	21.0	9.2	20.1	9.5	19.1	9.7
	6	S_{LSD}	38.0	25.5	32.6	23.2	28.3	21.2	25.0	19.4	22.3	17.7	20.0	16.3	18.2	15.1
		G'	24.1	6.3	24.3	7.4	23.9	8.3	23.2	8.9	22.3	9.5	21.4	9.9	20.5	10.1
	7	S_{LSD}	40.5	26.4	35.1	24.4	30.7	22.5	27.2	20.7	24.3	19.1	22.0	17.7	20.0	16.4
		G'	24.8	6.4	25.2	7.5	24.9	8.4	24.3	9.1	23.5	9.7	22.6	10.2	21.7	10.5
16	2	S_{LSD}	27.6	20.2	22.7	17.2	19.2	14.9	16.6	13.1	14.4	11.7	12.8	10.4	11.4	9.3
		G'	26.3	9.3	24.6	10.2	22.8	10.7	21.1	10.8	19.5	10.8	18.1	10.6	16.9	10.4
	3	S_{LSD}	31.9	23.0	26.5	20.2	22.6	17.6	19.7	15.6	17.4	14.0	15.4	12.7	13.8	11.6
		G'	28.5	9.7	27.0	10.8	25.3	11.5	23.6	11.8	22.0	11.9	20.5	11.8	19.2	11.7
	4	S_{LSD}	35.8	25.2	30.1	22.4	25.8	19.9	22.6	17.9	20.0	16.2	17.9	14.7	16.1	13.5
		G'	30.3	10.0	29.0	11.2	27.4	12.1	25.7	12.5	24.1	12.8	22.7	12.8	21.3	12.8
	5	S_{LSD}	39.3	26.9	33.4	24.3	28.9	21.9	25.3	19.9	22.5	18.1	20.3	16.6	18.4	15.2
		G'	31.8	10.2	30.7	11.6	29.3	12.5	27.7	13.2	26.1	13.5	24.6	13.7	23.2	13.7
	6	S_{LSD}	42.4	28.2	36.4	25.8	31.7	23.6	28.0	21.6	25.0	19.8	22.5	18.3	20.5	16.9
		G'	33.0	10.4	32.2	11.9	30.9	12.9	29.4	13.7	27.9	14.1	26.4	14.4	25.0	14.5
	7	S_{LSD}	45.1	29.2	39.2	27.1	34.4	25.0	30.5	23.1	27.3	21.3	24.7	19.8	22.5	18.4
		G'	34.1	10.5	33.6	12.1	32.4	13.2	31.0	14.1	29.5	14.6	28.0	15.0	26.6	15.1

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses 5 mm ≤ t_i ≤ 10 mm. For attachment to base steel thickness with range 3 mm ≤ t_i < 5 mm, diaphragm shear values should be calculated in accordance with Section 3.5.1.7, or by using Hilti Profis DF software.

2 Tabulated LSD diaphragm shear loads are calculated with a phi factor (Φ) of 0.75 for wind loads. To calculate LSD values for load combinations involving earthquake, divide values in table by 0.75 and multiply by a phi factor (Φ) of 0.55. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.

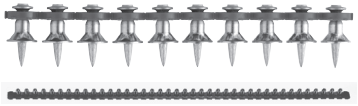
3.5.2.4 ORDERING INFORMATION

DX 9-HSN Decking System

Tools description	Notes	Qty
DX 9-HSN Stand-Up Decking Tool	Use-on-Demand service provides daily rental	1 pcs

Accessories description	Notes	Qty
HSN Piston and Brake Spares Pack	Replacement piston and brake for DX 9-HSN	1 pcs

Fasteners (Combos with 40-strip Cartridges) description	Base Steel Thickness	Qty
X-HSN 24 bulk fastener/cartridge combo	1/8” (3 mm) ≤ t_f ≤ 3/8” (10 mm)	2,000 pcs
X-HSN 24 pallet fastener/cartridge combo	1/8” (3 mm) ≤ t_f ≤ 3/8” (10 mm)	32,000 pcs



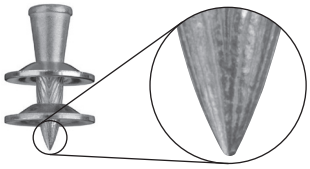
DX 5-SM Decking System

Tools description	Notes	Qty
DX 5-SM Hand Held Decking Tool		1 pcs

Accessories description	Notes	Qty
Magazine X-SM	Replacement magazine for DX 460-SM	1 pcs
Piston X-AP PSM	Replacement piston for DX 460-SM	1 pcs
Buffer (reinforced) X-5-B	Replacement buffer for DX-460-SM	1 pcs

Fasteners (Combos with 10-strip cartridges for DX 5-SM) description	Base steel thickness	Qty
X-HSN 24 bulk fastener/cartridge combo	3/16” (5 mm) ≤ t_f ≤ 3/8” (10 mm)	1,000 pcs
X-HSN 24 pallet fastener/cartridge combo	3/16” (5 mm) ≤ t_f ≤ 3/8” (10 mm)	32,000 pcs

X-ENP-19 L15 MX and MXR



X-ENP-19 L15

Approvals/Listings

ICC-ES (International Code Council)
ESR-2776 with LABC/LARC Supplement, ESR-2197 with LABC/LARC Supplement, ESR-1169, ESR-2657

IAPMO (Uniform Evaluation Service)
Co-listings ER-0217, ER-0161, ER-0329

FM (Factory Mutual)
For attaching Class 1 Steel Roof Decks with wind uplift ratings up to 1-330. Refer to FM RoofNav for specific assembly listings.

UL (Underwriters Laboratories)
Fasteners for attaching steel roof deck (uplift and fire classification)

ABS (American Bureau of Shipping)

3.5.3 X-ENP-19 FOR FASTENING DECK TO STRUCTURAL STEEL

3.5.3.1 PRODUCT DESCRIPTION

The Hilti structural steel deck fastening system consists of powder-actuated tools which are primarily used with one fastener: the X-ENP-19 L15, which is available either collated or non-collated.

For most structural steel decking jobs, the tool of choice is the DX 9-ENP tool. This self-contained stand up decking tool is powered by 0.27 caliber long cartridges, which are loaded into the tool in strips of 40. The cartridges drive the X-ENP-19 L15 MXR fastener (collated version) into almost any type of steel deck and base steel thicknesses greater than or equal to 1/4". These fasteners are available in collated strips of 10. Four of these strips are loaded into the DX 9-ENP tool along with the cartridge strip, and enable the operator to fasten at a rate of up to 1,000 quality fastenings per hour.

Other tools include the hand held DX 76-MX, a semi-automatic magazine tool. Other configurations of the DX 76 include a single fastener guide variation of the tool for miscellaneous use.

Hilti X-ENP-19 steel deck fasteners comply with ANSI/SDI RD1.0, C1.0 and NC1.0 standards.

3.5.3.2 MATERIAL SPECIFICATIONS

Fastener	Fastener material	Fastener plating	Nominal fastener hardness
X-ENP-19 L15	Carbon Steel	5 µm Zinc[1]	58 HRC

1 ASTM B633, SC 1, Type III. Reference Section 2.3.3.1 for more information.

3.5.3.3 TECHNICAL DATA

Allowable pullout loads for attachments to steel base material lb (kN)[1, 2, 3]

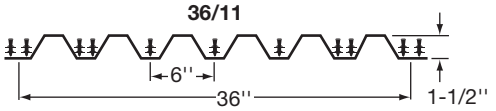
Fastener	Base material thickness (in.)			
	1/4	3/8	1/2[4]	≥ 5/8[4]
X-ENP-19 L15	**905** (4.03)	**1125** (5.00)	**1010** (4.49)	**965** (4.29)

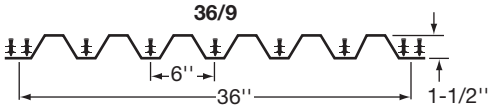
1 These values represent testing performed in ASTM A36 plate steel.
2 The values must be compared with allowable tensile pullover values.
3 Allowable values based on safety factor of 5.0.
4 Allowable values are based on minimum 1/2" penetration depth through or into base steel. For 3/8" penetration depth into 1/2" and thicker steels, reduce the allowable load capacity to 635 lb (2.79 kN).

Allowable pullover and shear bearing loads for attaching steel deck[1,2,3]

Fastener	Steel deck gauge (in.)											
	16 (0.0598)		18 (0.0474)		20 (0.0358)		22 (0.0295)		24 (0.0239)		26 (0.0179)	
	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
X-ENP-19 L15	**940** (4.14)	**1050** (4.62)	**875** (3.85)	**840** (3.70)	**755** (3.32)	**640** (2.82)	**665** (2.93)	**535** (2.35)	**400** (1.78)	**440** (1.94)	**185** (0.81)	**335** (1.47)

1 Minimum base steel thickness must be greater than or equal to 1/4" (6 mm).
2 Allowable values are based on a safety factor of 3.0.
3 Loads based on ASTM A1008, or minimum ASTM A653 SQ33 steel deck.





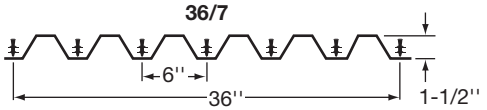
Allowable Stress Design (ASD)-Allowable diaphragm shears, S_{ASD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2" deep flutes, 6" center-to-center steel deck ($F_y \geq 50$ ksi; $F_u \geq 65$ ksi) installed with Hilti X-ENP-19 L15 fasteners with 36/11 or 36/9 end and interior support fastener patterns[1,2,3,4,5,6,7]

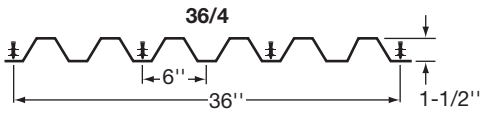
Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			11	9	11	9	11	9	11	9	11	9	11	9	11	9
22	2	S_{ASD}	1223	1057	1006	876	834	730	708	619	613	535	543	474	489	427
		G'	66.9	65.4	73.2	70.9	77.1	74.0	79.2	75.5	80.0	75.8	80.0	75.2	79.4	74.2
	3	S_{ASD}	1329	1156	1099	964	927	823	787	698	682	604	605	536	544	482
		G'	67.7	66.3	74.3	72.3	78.5	75.8	80.9	77.7	82.1	78.3	82.3	78.0	81.9	77.2
	4	S_{ASD}	1430	1247	1189	1048	1013	899	866	777	752	674	667	598	600	538
		G'	68.3	67.1	75.2	73.5	79.7	77.4	82.5	79.6	83.9	80.5	84.4	80.6	84.2	80.0
	5	S_{ASD}	1526	1333	1275	1128	1091	972	945	851	821	743	728	659	655	593
		G'	68.8	67.8	76.0	74.5	80.9	78.8	83.9	81.3	85.6	82.5	86.3	82.8	86.3	82.4
	6	S_{ASD}	1616	1411	1359	1203	1166	1042	1018	915	890	812	790	721	711	649
		G'	69.3	68.4	76.8	75.4	81.9	80.0	85.2	82.8	87.1	84.3	88.0	84.9	88.2	84.7
	7	S_{ASD}	1701	1484	1438	1275	1239	1109	1084	978	960	872	852	782	766	704
		G'	69.7	68.9	77.4	76.2	82.8	81.1	86.3	84.2	88.5	86.0	89.6	86.7	90.0	86.8
20	2	S_{ASD}	1584	1372	1305	1138	1092	961	928	815	804	706	709	621	637	558
		G'	94.0	91.2	100.0	96.2	102.9	98.0	103.6	97.9	103.0	96.6	101.4	94.5	99.3	92.0
	3	S_{ASD}	1733	1509	1436	1262	1221	1080	1041	929	904	805	797	709	717	638
		G'	95.3	92.9	101.8	98.5	105.2	100.9	106.4	101.3	106.1	100.3	104.8	98.6	102.9	96.3
	4	S_{ASD}	1874	1636	1562	1380	1334	1186	1154	1037	1003	904	885	797	796	717
		G'	96.4	94.3	103.4	100.5	107.2	103.4	108.8	104.3	108.9	103.7	107.9	102.2	106.3	100.2
	5	S_{ASD}	2006	1753	1683	1490	1443	1288	1259	1130	1102	1003	973	885	875	796
		G'	97.4	95.5	104.9	102.2	109.1	105.7	111.0	107.0	111.4	106.7	110.7	105.5	109.3	103.7
	6	S_{ASD}	2130	1859	1799	1594	1548	1385	1354	1220	1201	1087	1061	974	955	876
		G'	98.3	96.6	106.1	103.8	110.8	107.7	113.0	109.4	113.7	109.5	113.3	108.6	112.1	107.0
	7	S_{ASD}	2246	1956	1909	1691	1650	1478	1447	1306	1286	1168	1149	1054	1034	955
		G'	99.0	97.6	107.3	105.2	112.3	109.5	114.9	111.5	115.9	112.0	115.7	111.3	114.7	110.0
18	2	S_{ASD}	1915	1659	1578	1377	1332	1172	1133	997	983	865	867	762	775	680
		G'	147.3	141.5	150.7	143.3	150.2	141.4	147.3	137.6	143.3	132.8	138.6	127.7	133.7	122.4
	3	S_{ASD}	2099	1829	1740	1531	1481	1310	1273	1138	1106	988	977	871	873	778
		G'	149.9	144.9	154.2	147.6	154.3	146.5	152.0	143.2	148.4	138.8	144.0	133.9	139.2	128.9
	4	S_{ASD}	2272	1984	1896	1675	1619	1441	1410	1261	1229	1111	1086	981	971	876
		G'	152.2	147.8	157.3	151.4	158.1	151.0	156.3	148.3	153.0	144.3	148.9	139.7	144.4	134.8
	5	S_{ASD}	2435	2127	2045	1811	1754	1567	1531	1375	1352	1223	1195	1090	1069	975
		G'	154.3	150.4	160.1	154.8	161.5	155.1	160.2	152.9	157.3	149.3	153.5	145.0	149.2	140.3
	6	S_{ASD}	2587	2257	2187	1938	1883	1686	1649	1486	1463	1325	1304	1194	1168	1073
		G'	156.2	152.7	162.6	157.9	164.5	158.8	163.7	157.1	161.2	153.9	157.7	149.8	153.6	145.4
	7	S_{ASD}	2728	2375	2322	2056	2008	1799	1763	1592	1568	1424	1410	1286	1266	1170
		G'	157.9	154.7	164.9	160.6	167.4	162.1	167.0	160.9	164.8	158.1	161.6	154.3	157.7	150.1
16	2	S_{ASD}	1956	1696	1613	1410	1368	1201	1168	1031	1015	896	896	790	801	706
		G'	202.8	193.1	200.9	189.1	195.1	181.9	187.6	173.4	179.4	164.7	171.2	156.3	163.3	148.3
	3	S_{ASD}	2152	1876	1787	1573	1521	1348	1319	1175	1147	1028	1014	908	907	811
		G'	207.5	198.9	206.6	196.1	201.6	189.7	194.6	181.7	186.8	173.3	178.8	165.0	171.0	157.0
	4	S_{ASD}	2336	2041	1953	1727	1670	1488	1454	1303	1280	1156	1131	1025	1013	917
		G'	211.6	204.0	211.8	202.3	207.5	196.7	201.1	189.3	193.6	181.2	185.9	173.1	178.2	165.2
	5	S_{ASD}	2507	2190	2111	1870	1813	1621	1584	1425	1403	1268	1249	1141	1119	1023
		G'	215.3	208.5	216.5	207.9	212.9	203.1	207.0	196.2	199.9	188.5	192.5	180.6	184.9	172.8
	6	S_{ASD}	2667	2325	2261	2003	1951	1747	1709	1542	1518	1377	1364	1241	1224	1129
		G'	218.7	212.5	220.7	212.9	217.9	208.9	212.5	202.5	205.8	195.2	198.6	187.5	191.2	179.8
	7	S_{ASD}	2814	2447	2403	2127	2083	1866	1831	1654	1630	1482	1466	1339	1330	1220
		G'	221.7	216.2	224.6	217.5	222.4	214.1	217.5	208.3	211.2	201.4	204.3	193.9	197.1	186.4

1 Tabulated diaphragm shear values are for attachment of steel deck to a base steel thickness, $t_f \geq 1/4$".

2 Tabulated ASD diaphragm shear loads are calculated with a safety factor (Ω) of 2.00 for wind loads. To calculate ASD values for load combinations involving earthquake, multiply S_{asd} values in table by 2.00 and divide by a safety factor (Ω) of 2.30. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.





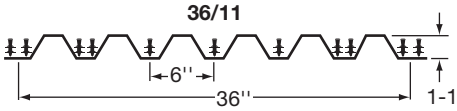
Allowable Stress Design (ASD)-Allowable diaphragm shears, S_{ASD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2" deep flutes, 6" center-to-center steel deck ($F_y \geq 50$ ksi; $F_u \geq 65$ ksi) installed with Hilti X-ENP-19 L15 fasteners with 36/7 or 36/4 end and interior support fastener patterns[1,2,3,4,5,6,7]

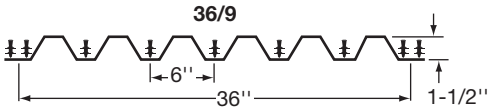
Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			7	4	7	4	7	4	7	4	7	4	7	4	7	4
22	2	S_{ASD}	765	563	627	475	522	409	444	355	385	308	342	273	308	246
		G'	61.9	65.9	67.6	67.9	67.1	65.8	64.0	12.1	14.6	16.7	18.6	20.2	21.5	22.6
	3	S_{ASD}	874	639	722	549	613	478	523	421	455	376	404	334	363	301
		G'	63.5	68.1	70.4	71.1	70.8	69.7	68.3	12.2	14.7	17.0	19.0	20.7	22.2	23.5
	4	S_{ASD}	974	702	811	613	692	540	602	480	524	430	465	390	419	355
		G'	64.7	69.9	72.7	73.9	73.9	73.2	72.0	12.3	14.9	17.2	19.3	21.1	22.7	24.1
	5	S_{ASD}	1067	754	896	668	768	595	670	533	594	481	527	437	474	400
		G'	65.7	71.4	74.7	76.3	76.7	76.2	75.3	12.4	15.0	17.4	19.5	21.5	23.2	24.7
	6	S_{ASD}	1151	796	975	715	841	643	737	581	654	528	588	482	530	443
		G'	66.6	72.7	76.4	78.4	79.1	79.0	78.2	12.4	15.1	17.5	19.7	21.7	23.5	25.1
	7	S_{ASD}	1229	831	1050	756	910	686	801	625	713	571	641	524	582	483
		G'	67.4	73.8	77.9	80.2	81.3	81.4	80.9	12.4	15.1	17.6	19.9	22.0	23.8	25.5
20	2	S_{ASD}	1005	739	826	627	695	541	591	475	514	415	453	366	408	329
		G'	85.2	88.0	88.0	86.5	84.0	81.1	78.1	18.9	22.4	25.3	27.7	29.5	31.0	32.0
	3	S_{ASD}	1156	842	958	728	815	636	705	563	613	503	542	454	487	408
		G'	87.9	91.5	92.3	91.3	89.3	86.7	83.8	19.1	22.8	25.9	28.5	30.6	32.3	33.6
	4	S_{ASD}	1295	924	1083	813	926	720	807	643	712	579	630	525	566	480
		G'	90.0	94.5	95.9	95.5	93.9	91.6	88.9	19.3	23.0	26.3	29.1	31.4	33.4	34.9
	5	S_{ASD}	1421	990	1200	885	1033	794	903	715	801	648	718	591	646	542
		G'	91.9	97.0	99.1	99.1	97.9	96.0	93.5	19.4	23.3	26.6	29.6	32.1	34.2	35.9
	6	S_{ASD}	1535	1043	1309	946	1133	857	996	779	886	711	797	652	723	600
		G'	93.4	99.2	101.8	102.4	101.6	99.9	97.7	19.5	23.4	26.9	30.0	32.6	34.9	36.8
	7	S_{ASD}	1637	1086	1409	996	1228	912	1084	836	968	768	872	708	793	655
		G'	94.8	101.1	104.3	105.2	104.8	103.4	101.5	19.6	23.6	27.2	30.3	33.1	35.5	37.5
18	2	S_{ASD}	1220	897	1003	762	848	658	724	577	629	511	556	451	497	403
		G'	129.4	128.1	124.0	118.6	112.9	107.2	101.8	35.1	40.4	44.3	47.1	49.0	50.0	50.5
	3	S_{ASD}	1406	1022	1166	885	992	775	862	686	752	614	665	554	596	501
		G'	134.5	134.4	131.1	126.4	121.0	115.4	110.0	35.8	41.4	45.9	49.2	51.5	53.0	53.9
	4	S_{ASD}	1576	1122	1320	989	1130	877	985	784	871	706	775	641	694	586
		G'	138.9	139.9	137.4	133.2	128.2	122.8	117.5	36.2	42.2	47.0	50.7	53.5	55.4	56.7
	5	S_{ASD}	1730	1201	1463	1076	1260	966	1103	872	979	791	879	722	792	663
		G'	142.6	144.6	143.0	139.3	134.6	129.6	124.4	36.6	42.9	48.0	52.0	55.2	57.4	59.0
	6	S_{ASD}	1868	1264	1596	1149	1384	1043	1217	950	1083	868	975	796	885	734
		G'	145.8	148.8	147.9	144.8	140.5	135.7	130.7	36.9	43.4	48.8	53.1	56.5	59.1	61.1
	7	S_{ASD}	1993	1314	1719	1209	1500	1109	1325	1018	1184	937	1068	864	971	800
		G'	148.6	152.5	152.3	149.7	145.8	141.3	136.5	37.2	43.8	49.4	54.0	57.7	60.6	62.8
16	2	S_{ASD}	1256	923	1034	786	875	680	752	597	655	531	579	473	518	423
		G'	173.1	165.7	156.3	146.7	137.6	129.1	121.3	56.7	63.1	67.1	69.3	70.0	69.9	69.0
	3	S_{ASD}	1454	1052	1208	915	1029	803	894	712	787	638	697	577	624	526
		G'	181.6	175.5	166.9	157.7	148.7	140.1	132.2	58.2	65.4	70.3	73.3	74.8	75.2	74.9
	4	S_{ASD}	1632	1154	1371	1023	1175	910	1026	815	908	736	814	669	730	612
		G'	188.9	184.1	176.3	167.6	158.7	150.2	142.2	59.3	67.3	72.9	76.6	78.7	79.7	79.8
	5	S_{ASD}	1793	1234	1522	1111	1314	1002	1152	907	1023	824	919	754	834	693
		G'	195.2	191.7	184.7	176.5	167.9	159.4	151.5	60.3	68.7	75.0	79.3	82.0	83.6	84.1
	6	S_{ASD}	1936	1296	1661	1184	1444	1080	1272	987	1134	904	1021	831	928	768
		G'	200.8	198.4	192.3	184.5	176.2	168.0	160.0	61.0	70.0	76.7	81.6	84.8	86.9	87.9
	7	S_{ASD}	2063	1345	1788	1244	1566	1146	1386	1056	1240	975	1120	902	1020	837
		G'	205.7	204.4	199.0	191.8	183.9	175.8	167.9	61.6	71.0	78.2	83.5	87.3	89.7	91.1

1 Tabulated diaphragm shear values are for attachment of steel deck to a base steel thickness, $t_t \geq 1/4$".

2 Tabulated ASD diaphragm shear loads are calculated with a safety factor (Ω) of 2.00 for wind loads. To calculate ASD values for load combinations involving earthquake, multiply S_{asd} values in table by 2.00 and divide by a safety factor (Ω) of 2.30. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.





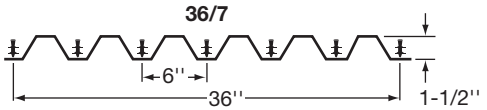
Load Resistance Factor Design (LRFD) – Factored resistance diaphragm shears, S_{LRFD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2" deep flutes, 6" center-to-center steel deck ($F_y \geq 50$ ksi; $F_u \geq 65$ ksi) installed with Hilti X-ENP-19 L15 fasteners with 36/11 or 36/9 end and interior support fastener patterns[1,2,3,4,5,6,7]

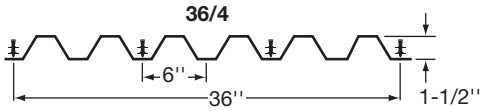
Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			11	9	11	9	11	9	11	9	11	9	11	9	11	9
22	2	S_{LRFD}	1957	1692	1610	1401	1334	1169	1132	990	980	856	869	759	782	683
		G'	66.9	65.4	73.2	70.9	77.1	74.0	79.2	75.5	80.0	75.8	80.0	75.2	79.4	74.2
	3	S_{LRFD}	2127	1849	1759	1542	1482	1317	1259	1117	1091	967	968	857	871	772
		G'	67.7	66.3	74.3	72.3	78.5	75.8	80.9	77.7	82.1	78.3	82.3	78.0	81.9	77.2
	4	S_{LRFD}	2288	1996	1902	1677	1621	1438	1386	1244	1202	1078	1067	956	960	860
		G'	68.3	67.1	75.2	73.5	79.7	77.4	82.5	79.6	83.9	80.5	84.4	80.6	84.2	80.0
	5	S_{LRFD}	2441	2132	2041	1805	1745	1555	1513	1362	1313	1189	1165	1055	1049	949
		G'	68.8	67.8	76.0	74.5	80.9	78.8	83.9	81.3	85.6	82.5	86.3	82.8	86.3	82.4
	6	S_{LRFD}	2585	2258	2174	1925	1865	1667	1629	1465	1424	1300	1264	1153	1138	1038
		G'	69.3	68.4	76.8	75.4	81.9	80.0	85.2	82.8	87.1	84.3	88.0	84.9	88.2	84.7
	7	S_{LRFD}	2722	2375	2302	2039	1982	1774	1735	1564	1535	1395	1363	1252	1226	1127
		G'	69.7	68.9	77.4	76.2	82.8	81.1	86.3	84.2	88.5	86.0	89.6	86.7	90.0	86.8
20	2	S_{LRFD}	2535	2194	2088	1821	1747	1537	1484	1304	1287	1130	1134	994	1020	894
		G'	94.0	91.2	100.0	96.2	102.9	98.0	103.6	97.9	103.0	96.6	101.4	94.5	99.3	92.0
	3	S_{LRFD}	2773	2415	2298	2020	1954	1727	1666	1486	1446	1288	1275	1135	1147	1020
		G'	95.3	92.9	101.8	98.5	105.2	100.9	106.4	101.3	106.1	100.3	104.8	98.6	102.9	96.3
	4	S_{LRFD}	2998	2618	2500	2208	2134	1898	1847	1659	1604	1447	1416	1276	1273	1147
		G'	96.4	94.3	103.4	100.5	107.2	103.4	108.8	104.3	108.9	103.7	107.9	102.2	106.3	100.2
	5	S_{LRFD}	3210	2804	2693	2384	2308	2061	2014	1808	1763	1606	1557	1417	1400	1274
		G'	97.4	95.5	104.9	102.2	109.1	105.7	111.0	107.0	111.4	106.7	110.7	105.5	109.3	103.7
	6	S_{LRFD}	3408	2975	2878	2550	2477	2216	2167	1952	1922	1740	1698	1558	1527	1401
		G'	98.3	96.6	106.1	103.8	110.8	107.7	113.0	109.4	113.7	109.5	113.3	108.6	112.1	107.0
	7	S_{LRFD}	3593	3130	3054	2705	2639	2364	2315	2090	2058	1868	1839	1686	1654	1528
		G'	99.0	97.6	107.3	105.2	112.3	109.5	114.9	111.5	115.9	112.0	115.7	111.3	114.7	110.0
18	2	S_{LRFD}	3064	2654	2525	2203	2131	1876	1812	1596	1574	1384	1388	1219	1239	1088
		G'	147.3	141.5	150.7	143.3	150.2	141.4	147.3	137.6	143.3	132.8	138.6	127.7	133.7	122.4
	3	S_{LRFD}	3359	2926	2785	2449	2369	2095	2037	1821	1770	1581	1563	1394	1397	1245
		G'	149.9	144.9	154.2	147.6	154.3	146.5	152.0	143.2	148.4	138.8	144.0	133.9	139.2	128.9
	4	S_{LRFD}	3636	3175	3034	2680	2591	2306	2255	2017	1967	1777	1737	1569	1554	1402
		G'	152.2	147.8	157.3	151.4	158.1	151.0	156.3	148.3	153.0	144.3	148.9	139.7	144.4	134.8
	5	S_{LRFD}	3896	3403	3272	2898	2806	2507	2449	2201	2163	1957	1912	1744	1711	1560
		G'	154.3	150.4	160.1	154.8	161.5	155.1	160.2	152.9	157.3	149.3	153.5	145.0	149.2	140.3
	6	S_{LRFD}	4138	3611	3499	3101	3014	2698	2638	2378	2341	2120	2087	1910	1868	1717
		G'	156.2	152.7	162.6	157.9	164.5	158.8	163.7	157.1	161.2	153.9	157.7	149.8	153.6	145.4
	7	S_{LRFD}	4365	3800	3715	3290	3214	2879	2821	2547	2508	2278	2255	2057	2026	1872
		G'	157.9	154.7	164.9	160.6	167.4	162.1	167.0	160.9	164.8	158.1	161.6	154.3	157.7	150.1
16	2	S_{LRFD}	3130	2714	2581	2256	2189	1921	1868	1650	1624	1433	1434	1264	1282	1129
		G'	202.8	193.1	200.9	189.1	195.1	181.9	187.6	173.4	179.4	164.7	171.2	156.3	163.3	148.3
	3	S_{LRFD}	3444	3002	2859	2517	2434	2156	2110	1881	1836	1645	1622	1452	1451	1298
		G'	207.5	198.9	206.6	196.1	201.6	189.7	194.6	181.7	186.8	173.3	178.8	165.0	171.0	157.0
	4	S_{LRFD}	3738	3265	3125	2763	2671	2380	2327	2084	2047	1850	1810	1640	1620	1468
		G'	211.6	204.0	211.8	202.3	207.5	196.7	201.1	189.3	193.6	181.2	185.9	173.1	178.2	165.2
	5	S_{LRFD}	4012	3504	3377	2992	2900	2593	2534	2280	2246	2029	1998	1826	1790	1637
		G'	215.3	208.5	216.5	207.9	212.9	203.1	207.0	196.2	199.9	188.5	192.5	180.6	184.9	172.8
	6	S_{LRFD}	4267	3720	3618	3205	3121	2795	2735	2467	2429	2203	2182	1986	1959	1806
		G'	218.7	212.5	220.7	212.9	217.9	208.9	212.5	202.5	205.8	195.2	198.6	187.5	191.2	179.8
	7	S_{LRFD}	4503	3915	3845	3402	3333	2985	2930	2647	2608	2370	2346	2142	2128	1952
		G'	221.7	216.2	224.6	217.5	222.4	214.1	217.5	208.3	211.2	201.4	204.3	193.9	197.1	186.4

1 Tabulated diaphragm shear values are for attachment of steel deck to a base steel thickness, $t_t \geq 1/4$".

2 Tabulated LRFD diaphragm shear loads are calculated with a phi factor (Φ) of 0.80 for wind loads. To calculate LRFD values for load combinations involving earthquake, divide values in table by 0.80 and multiply by a phi factor (Φ) of 0.70. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.





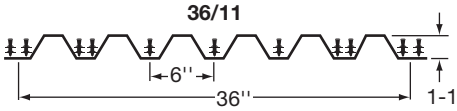
Load Resistance Factor Design (LRFD) – Factored resistance diaphragm shears, S_{LRFD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2" deep flutes, 6" center-to-center steel deck ($F_y \geq 50$ ksi; $F_u \geq 65$ ksi) installed with Hilti X-ENP-19 L15 fasteners with 36/7 or 36/4 end and interior support fastener patterns[1,2,3,4,5,6,7]

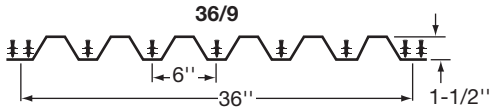
Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			7	4	7	4	7	4	7	4	7	4	7	4	7	4
22	2	S_{LRFD}	1225	900	1004	761	836	655	711	568	617	492	547	437	492	393
		G'	61.9	65.9	67.6	67.9	67.1	65.8	64.0	12.1	14.6	16.7	18.6	20.2	21.5	22.6
	3	S_{LRFD}	1398	1022	1155	878	980	765	838	674	728	601	646	535	581	482
		G'	63.5	68.1	70.4	71.1	70.8	69.7	68.3	12.2	14.7	17.0	19.0	20.7	22.2	23.5
	4	S_{LRFD}	1558	1123	1298	981	1107	864	963	768	839	689	744	623	670	568
		G'	64.7	69.9	72.7	73.9	73.9	73.2	72.0	12.3	14.9	17.2	19.3	21.1	22.7	24.1
	5	S_{LRFD}	1706	1206	1433	1069	1229	952	1073	853	950	770	843	700	759	641
		G'	65.7	71.4	74.7	76.3	76.7	76.2	75.3	12.4	15.0	17.4	19.5	21.5	23.2	24.7
	6	S_{LRFD}	1842	1274	1561	1144	1346	1029	1179	930	1047	845	940	771	848	709
		G'	66.6	72.7	76.4	78.4	79.1	79.0	78.2	12.4	15.1	17.5	19.7	21.7	23.5	25.1
	7	S_{LRFD}	1966	1330	1680	1209	1457	1098	1281	999	1140	913	1026	838	932	773
		G'	67.4	73.8	77.9	80.2	81.3	81.4	80.9	12.4	15.1	17.6	19.9	22.0	23.8	25.5
20	2	S_{LRFD}	1609	1182	1321	1003	1112	866	946	759	822	664	725	585	652	526
		G'	85.2	88.0	88.0	86.5	84.0	81.1	78.1	18.9	22.4	25.3	27.7	29.5	31.0	32.0
	3	S_{LRFD}	1850	1347	1533	1165	1304	1018	1127	901	981	805	866	726	779	653
		G'	87.9	91.5	92.3	91.3	89.3	86.7	83.8	19.1	22.8	25.9	28.5	30.6	32.3	33.6
	4	S_{LRFD}	2072	1479	1733	1302	1482	1153	1292	1029	1139	926	1007	840	906	767
		G'	90.0	94.5	95.9	95.5	93.9	91.6	88.9	19.3	23.0	26.3	29.1	31.4	33.4	34.9
	5	S_{LRFD}	2273	1584	1920	1417	1652	1270	1445	1144	1282	1037	1148	945	1033	867
		G'	91.9	97.0	99.1	99.1	97.9	96.0	93.5	19.4	23.3	26.6	29.6	32.1	34.2	35.9
	6	S_{LRFD}	2455	1669	2094	1513	1813	1372	1593	1246	1417	1137	1275	1043	1157	961
		G'	93.4	99.2	101.8	102.4	101.6	99.9	97.7	19.5	23.4	26.9	30.0	32.6	34.9	36.8
	7	S_{LRFD}	2619	1737	2255	1594	1965	1459	1734	1337	1548	1228	1396	1132	1269	1047
		G'	94.8	101.1	104.3	105.2	104.8	103.4	101.5	19.6	23.6	27.2	30.3	33.1	35.5	37.5
18	2	S_{LRFD}	1952	1435	1604	1219	1357	1053	1158	924	1007	818	890	721	796	644
		G'	129.4	128.1	124.0	118.6	112.9	107.2	101.8	35.1	40.4	44.3	47.1	49.0	50.0	50.5
	3	S_{LRFD}	2250	1635	1866	1416	1588	1240	1379	1097	1204	982	1065	886	953	802
		G'	134.5	134.4	131.1	126.4	121.0	115.4	110.0	35.8	41.4	45.9	49.2	51.5	53.0	53.9
	4	S_{LRFD}	2521	1794	2112	1583	1808	1404	1576	1255	1394	1130	1239	1026	1110	938
		G'	138.9	139.9	137.4	133.2	128.2	122.8	117.5	36.2	42.2	47.0	50.7	53.5	55.4	56.7
	5	S_{LRFD}	2768	1921	2341	1722	2017	1546	1765	1395	1567	1266	1407	1155	1268	1060
		G'	142.6	144.6	143.0	139.3	134.6	129.6	124.4	36.6	42.9	48.0	52.0	55.2	57.4	59.0
	6	S_{LRFD}	2989	2022	2554	1838	2214	1669	1947	1519	1733	1388	1560	1274	1416	1175
		G'	145.8	148.8	147.9	144.8	140.5	135.7	130.7	36.9	43.4	48.8	53.1	56.5	59.1	61.1
	7	S_{LRFD}	3188	2103	2750	1935	2401	1775	2121	1629	1894	1499	1708	1383	1554	1281
		G'	148.6	152.5	152.3	149.7	145.8	141.3	136.5	37.2	43.8	49.4	54.0	57.7	60.6	62.8
16	2	S_{LRFD}	2010	1476	1654	1258	1400	1088	1203	956	1048	850	926	757	829	677
		G'	173.1	165.7	156.3	146.7	137.6	129.1	121.3	56.7	63.1	67.1	69.3	70.0	69.9	69.0
	3	S_{LRFD}	2326	1684	1933	1464	1646	1285	1431	1140	1259	1021	1114	923	999	841
		G'	181.6	175.5	166.9	157.7	148.7	140.1	132.2	58.2	65.4	70.3	73.3	74.8	75.2	74.9
	4	S_{LRFD}	2612	1847	2193	1636	1880	1456	1641	1305	1453	1178	1303	1070	1168	980
		G'	188.9	184.1	176.3	167.6	158.7	150.2	142.2	59.3	67.3	72.9	76.6	78.7	79.7	79.8
	5	S_{LRFD}	2869	1974	2435	1778	2102	1603	1843	1451	1637	1319	1471	1206	1334	1109
		G'	195.2	191.7	184.7	176.5	167.9	159.4	151.5	60.3	68.7	75.0	79.3	82.0	83.6	84.1
	6	S_{LRFD}	3098	2074	2657	1895	2310	1728	2035	1578	1814	1446	1634	1330	1485	1229
		G'	200.8	198.4	192.3	184.5	176.2	168.0	160.0	61.0	70.0	76.7	81.6	84.8	86.9	87.9
	7	S_{LRFD}	3301	2153	2861	1990	2505	1834	2218	1690	1984	1559	1792	1443	1631	1339
		G'	205.7	204.4	199.0	191.8	183.9	175.8	167.9	61.6	71.0	78.2	83.5	87.3	89.7	91.1

1 Tabulated diaphragm shear values are for attachment of steel deck to a base steel thickness, $t_i \geq 1/4$".

2 Tabulated LRFD diaphragm shear loads are calculated with a phi factor (Φ) of 0.80 for wind loads. To calculate LRFD values for load combinations involving earthquake, divide values in table by 0.80 and multiply by a phi factor (Φ) of 0.70. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.





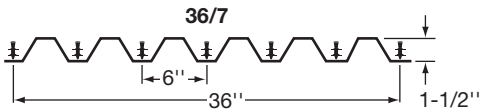
Limit States Design (LSD) – Factored resistance diaphragm shears, S_{LSD}, (N/mm) and stiffness factors, G', (10^3 N/mm) for standard 38mm deep flutes, 152mm center-to-center deck (F_y≥345 Mpa; F_u≥450 Mpa) installed with Hilti X-ENP-19 L15 fasteners with 914/11 (36/11) or 914/9 (36/9) end and interior support fastener patterns[1,2,3,4,5,6,7]

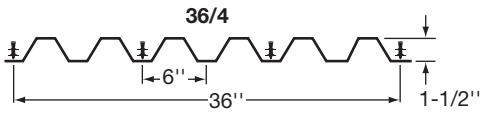
Gauge	Number of Hilti SLC per span	Factor	Span (mm)													
			1200		1500		1800		2100		2400		2700		3000	
			Fasteners per sheet to support													
			11	9	11	9	11	9	11	9	11	9	11	9	11	9
22	2	S_{LSD}	27.2	23.4	22.4	19.5	18.6	16.4	15.8	13.8	13.7	12.0	12.2	10.5	11.0	9.5
		G'	11.6	11.4	12.8	12.4	13.5	13.0	13.9	13.2	14.0	13.3	14.1	13.2	14.0	13.1
	3	S_{LSD}	29.6	25.7	24.5	21.5	20.7	18.3	17.6	15.6	15.2	13.5	13.5	11.9	12.2	10.8
		G'	11.8	11.5	12.9	12.6	13.7	13.3	14.2	13.6	14.4	13.7	14.5	13.7	14.4	13.6
	4	S_{LSD}	31.7	27.6	26.4	23.3	22.5	20.0	19.4	17.4	16.8	15.0	14.9	13.4	13.4	12.0
		G'	11.9	11.7	13.1	12.8	13.9	13.5	14.4	13.9	14.7	14.1	14.8	14.1	14.8	14.1
	5	S_{LSD}	33.8	29.6	28.4	25.1	24.2	21.6	21.0	18.9	18.3	16.5	16.2	14.7	14.6	13.2
		G'	12.0	11.8	13.2	13.0	14.1	13.8	14.7	14.2	15.0	14.5	15.1	14.5	15.2	14.5
	6	S_{LSD}	35.9	31.2	30.2	26.7	25.8	23.1	22.7	20.3	19.8	18.2	17.6	16.1	15.8	14.4
		G'	12.0	11.9	13.4	13.1	14.3	14.0	14.9	14.5	15.2	14.8	15.4	14.9	15.5	14.9
	7	S_{LSD}	37.7	32.9	32.0	28.2	27.5	24.6	24.0	21.8	21.3	19.4	18.9	17.4	16.1	15.6
		G'	12.1	12.0	13.5	13.3	14.4	14.1	15.1	14.7	15.5	15.0	15.7	15.2	15.8	15.2
20	2	S_{LSD}	35.1	30.5	29.0	25.2	24.3	21.5	20.7	18.2	18.0	15.8	15.8	13.8	14.1	12.5
		G'	16.4	15.9	17.5	16.8	18.0	17.2	18.2	17.2	18.1	17.0	17.9	16.7	17.5	16.2
	3	S_{LSD}	38.4	33.5	32.0	28.1	27.2	24.0	23.3	20.7	20.1	18.0	17.7	15.8	15.9	14.3
		G'	16.6	16.2	17.8	17.2	18.4	17.7	18.7	17.8	18.6	17.7	18.4	17.4	18.1	17.0
	4	S_{LSD}	41.6	36.3	34.7	30.6	29.6	26.3	25.7	23.0	22.4	20.1	19.8	17.9	17.7	15.9
		G'	16.8	16.4	18.1	17.6	18.8	18.1	19.1	18.3	19.1	18.2	19.0	18.0	18.7	17.7
	5	S_{LSD}	44.4	38.9	37.4	33.0	32.0	28.5	27.9	25.1	24.6	22.4	21.8	19.8	19.5	17.7
		G'	17.0	16.7	18.3	17.9	19.1	18.5	19.5	18.8	19.6	18.8	19.5	18.6	19.2	18.3
	6	S_{LSD}	47.1	41.1	39.9	35.3	34.4	30.8	30.0	27.0	26.7	24.2	23.7	21.8	21.3	19.5
		G'	17.1	16.8	18.5	18.1	19.4	18.8	19.8	19.2	20.0	19.2	19.9	19.1	19.7	18.8
	7	S_{LSD}	49.7	43.2	42.3	37.4	36.6	32.7	32.1	29.0	28.5	26.0	25.7	23.4	21.5	21.3
		G'	17.2	17.0	18.7	18.4	19.6	19.2	20.1	19.5	20.3	19.7	20.3	19.6	20.2	19.4
18	2	S_{LSD}	42.5	36.8	35.1	30.6	29.7	26.1	25.2	22.2	21.9	19.4	19.4	17.0	17.3	15.2
		G'	25.7	24.7	26.3	25.0	26.2	24.7	25.8	24.1	25.1	23.3	24.3	22.4	23.4	21.5
	3	S_{LSD}	46.5	40.5	38.7	33.9	32.9	29.1	28.4	25.4	24.6	22.1	21.8	19.5	19.5	17.4
		G'	26.1	25.3	26.9	25.8	27.0	25.6	26.6	25.1	26.0	24.3	25.2	23.5	24.4	22.6
	4	S_{LSD}	50.4	44.0	42.0	37.2	36.0	32.0	31.4	28.1	27.5	24.8	24.2	21.9	21.6	19.5
		G'	26.5	25.8	27.4	26.4	27.6	26.4	27.3	26.0	26.8	25.3	26.1	24.5	25.3	23.6
	5	S_{LSD}	54.0	47.1	45.3	40.1	38.9	34.8	34.1	30.6	30.2	27.2	26.7	24.3	23.9	21.8
		G'	26.9	26.2	27.9	27.0	28.2	27.1	28.0	26.8	27.5	26.2	26.9	25.4	26.1	24.6
	6	S_{LSD}	57.3	50.0	48.5	42.9	41.9	37.4	36.6	33.0	32.6	29.4	29.1	26.6	26.0	23.9
		G'	27.2	26.6	28.4	27.6	28.7	27.8	28.6	27.5	28.2	27.0	27.6	26.3	26.9	25.5
	7	S_{LSD}	60.3	52.5	51.5	45.5	44.6	39.9	39.2	35.3	34.8	31.7	31.4	28.5	28.2	26.0
		G'	27.5	27.0	28.8	28.0	29.2	28.3	29.2	28.2	28.9	27.7	28.3	27.1	27.7	26.3
16	2	S_{LSD}	43.4	37.7	35.9	31.4	30.5	26.7	26.0	23.0	22.7	20.0	20.0	17.6	17.9	15.8
		G'	35.6	33.9	35.4	33.3	34.4	32.1	33.1	30.7	31.8	29.2	30.3	27.7	29.0	26.3
	3	S_{LSD}	47.7	41.6	39.6	35.0	33.8	29.9	29.4	26.1	25.5	23.0	22.7	20.3	20.3	18.2
		G'	36.4	34.9	36.3	34.5	35.5	33.5	34.4	32.1	33.0	30.7	31.7	29.2	30.3	27.9
	4	S_{LSD}	51.8	45.2	43.4	38.3	37.1	33.0	32.3	29.0	28.5	25.7	25.2	22.8	22.5	20.4
		G'	37.1	35.8	37.2	35.6	36.6	34.7	35.5	33.4	34.2	32.0	32.9	30.6	31.6	29.3
	5	S_{LSD}	55.5	48.5	46.8	41.4	40.2	36.0	35.1	31.7	31.2	28.2	27.8	25.4	24.9	22.8
		G'	37.7	36.6	38.0	36.5	37.5	35.8	36.5	34.6	35.3	33.3	34.0	31.9	32.7	30.6
	6	S_{LSD}	59.0	51.5	50.1	44.4	43.2	38.7	38.0	34.2	33.8	30.6	30.3	27.6	27.3	25.1
		G'	38.3	37.2	38.8	37.4	38.3	36.8	37.4	35.7	36.3	34.5	35.1	33.1	33.8	31.8
	7	S_{LSD}	62.3	54.0	53.3	47.1	46.2	41.4	40.7	36.8	36.2	32.9	32.6	29.7	29.6	27.2
		G'	38.8	37.9	39.4	38.2	39.1	37.7	38.3	36.7	37.3	35.5	36.1	34.3	34.8	33.0

1 Tabulated diaphragm shear values are for attachment of steel deck to a base steel thickness, t_f≥ 6 mm.

2 Tabulated LSD diaphragm shear loads are calculated with a phi factor (Φ) of 0.75 for wind loads. To calculate LSD values for load combinations involving earthquake, divide values in table by 0.75 and multiply by a phi factor (Φ) of 0.55. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.





Limit States Design (LSD) – Factored resistance diaphragm shears, S_{LSD}, (N/mm) and stiffness factors, G', (10^3 N/mm) for standard 38mm deep flutes, 152mm center-to-center deck (F_y≥345 Mpa; F_u≥450 Mpa) installed with Hilti X-ENP-19 L15 fasteners with 914/7 (36/7) or 914/4 (36/4) end and interior support fastener patterns[1,2,3,4,5,6,7]

Gauge	Number of Hilti SLC per span	Factor	Span (mm)													
			1200		1500		1800		2100		2400		2700		3000	
			Fasteners per sheet to support													
			7	4	7	4	7	4	7	4	7	4	7	4	7	4
22	2	S_{LSD}	17.0	12.5	14.0	10.5	11.7	9.2	9.9	8.0	8.6	6.9	7.7	6.0	6.9	5.4
		G'	10.8	2.1	11.5	2.5	11.9	2.9	11.9	3.2	11.8	3.5	11.6	3.7	11.3	3.9
	3	S_{LSD}	19.4	14.1	16.1	12.2	13.7	10.7	11.7	9.3	10.2	8.4	9.0	7.5	8.1	6.8
		G'	11.1	2.1	11.9	2.6	12.3	2.9	12.5	3.3	12.4	3.6	12.3	3.9	12.0	4.1
	4	S_{LSD}	21.6	15.5	18.0	13.5	15.3	12.0	13.4	10.7	11.7	9.6	10.4	8.7	9.3	8.0
		G'	11.3	2.1	12.2	2.6	12.7	3.0	12.9	3.3	13.0	3.7	12.9	3.9	12.7	4.2
	5	S_{LSD}	23.6	15.5	19.8	14.7	17.1	13.2	14.9	11.9	13.2	10.7	11.7	9.8	10.5	8.9
		G'	11.4	2.1	12.5	2.6	13.1	3.0	13.4	3.4	13.5	3.7	13.4	4.0	13.2	4.2
	6	S_{LSD}	25.5	17.5	21.6	15.8	18.6	14.3	16.4	12.9	14.6	11.7	13.1	10.7	11.9	9.8
		G'	11.6	2.1	12.7	2.6	13.3	3.0	13.7	3.4	13.9	3.8	13.9	4.1	13.7	4.4
	7	S_{LSD}	27.2	18.3	23.3	16.7	20.3	15.2	17.7	13.8	15.8	12.6	14.3	11.6	12.9	10.7
		G'	11.7	2.1	12.9	2.6	13.6	3.0	14.0	3.4	14.2	3.8	14.3	4.1	14.2	4.4
20	2	S_{LSD}	22.4	16.4	18.3	14.0	15.5	12.0	13.2	10.5	11.4	9.3	10.1	8.1	9.0	7.4
		G'	14.9	3.3	15.4	3.9	15.5	4.4	15.2	4.8	14.8	5.1	14.3	5.4	13.8	5.6
	3	S_{LSD}	25.7	18.6	21.3	16.1	18.2	14.1	15.8	12.5	13.7	11.1	12.0	10.1	10.8	9.2
		G'	15.3	3.3	16.0	3.9	16.2	4.5	16.1	4.9	15.7	5.3	15.3	5.6	14.8	5.9
	4	S_{LSD}	28.7	20.4	24.0	18.0	20.6	15.9	18.0	14.3	15.9	12.9	14.1	11.7	12.6	10.7
		G'	15.7	3.3	16.5	4.0	16.8	4.6	16.8	5.0	16.5	5.5	16.1	5.8	15.7	6.1
	5	S_{LSD}	31.5	21.9	26.6	19.5	23.0	17.6	20.1	15.9	17.9	14.4	16.1	13.1	14.4	12.0
		G'	16.0	3.4	17.0	4.0	17.4	4.6	17.4	5.1	17.2	5.6	16.9	5.9	16.5	6.3
	6	S_{LSD}	33.9	23.0	29.0	20.9	25.2	18.9	22.1	17.3	19.7	15.8	17.7	14.4	16.1	13.4
		G'	16.3	3.4	17.3	4.1	17.8	4.7	18.0	5.2	17.9	5.7	17.6	6.1	17.2	6.4
	7	S_{LSD}	36.2	23.9	31.2	21.9	27.3	20.1	24.0	18.5	21.5	17.0	19.4	15.6	17.6	14.6
		G'	16.5	3.4	17.7	4.1	18.3	4.7	18.5	5.3	18.4	5.7	18.2	6.2	17.9	6.5
18	2	S_{LSD}	27.0	19.8	22.2	17.0	18.9	14.6	16.1	12.8	14.0	11.4	12.5	10.1	11.1	9.0
		G'	22.6	6.1	22.4	7.0	21.7	7.7	20.8	8.2	19.8	8.5	18.8	8.7	17.9	8.8
	3	S_{LSD}	31.2	22.7	26.0	19.7	22.1	17.1	19.2	15.2	16.8	13.7	14.9	12.3	13.2	11.1
		G'	23.5	6.2	23.5	7.2	23.0	8.0	22.1	8.5	21.2	9.0	20.3	9.2	19.3	9.4
	4	S_{LSD}	35.0	24.8	29.3	21.9	25.1	19.4	21.9	17.4	19.4	15.6	17.3	14.3	15.5	13.1
		G'	24.2	6.3	24.5	7.3	24.1	8.2	23.3	8.8	22.5	9.3	21.6	9.7	20.6	9.9
	5	S_{LSD}	38.3	26.4	32.4	23.7	27.9	21.3	24.5	19.4	21.8	17.6	19.5	16.1	17.7	14.7
		G'	24.9	6.3	25.3	7.4	25.0	8.3	24.4	9.0	23.6	9.6	22.7	10.0	21.9	10.3
	6	S_{LSD}	41.4	27.9	35.4	25.4	30.8	23.1	27.0	21.0	24.0	19.2	21.6	17.7	19.7	16.2
		G'	25.4	6.4	26.0	7.5	25.9	8.5	25.4	9.2	24.6	9.8	23.8	10.3	23.0	10.6
	7	S_{LSD}	44.1	29.0	38.1	26.7	33.3	24.5	29.4	22.5	26.3	20.7	23.7	19.2	21.6	17.7
		G'	25.9	6.4	26.6	7.6	26.6	8.6	26.2	9.4	25.6	10.0	24.8	10.5	24.0	10.9
16	2	S_{LSD}	27.9	20.4	23.0	17.4	19.5	15.2	16.8	13.2	14.6	11.9	12.9	10.5	11.6	9.5
		G'	30.5	9.9	29.2	11.0	27.7	11.7	26.0	12.1	24.4	12.3	22.9	12.3	21.6	12.2
	3	S_{LSD}	32.3	23.3	26.9	20.3	22.8	17.9	19.8	15.8	17.6	14.1	15.5	12.8	14.0	11.7
		G'	31.9	10.1	30.9	11.4	29.5	12.3	27.9	12.8	26.4	13.1	24.9	13.2	23.5	13.2
	4	S_{LSD}	36.2	25.5	30.5	22.7	26.1	20.1	22.8	18.0	20.3	16.4	18.2	14.9	16.2	13.7
		G'	33.2	10.3	32.4	11.7	31.1	12.7	29.6	13.4	28.1	13.8	26.6	14.0	25.2	14.0
	5	S_{LSD}	39.8	27.2	33.8	24.6	29.1	22.2	25.5	20.1	22.7	18.3	20.4	16.7	18.6	15.3
		G'	34.3	10.5	33.7	11.9	32.6	13.1	31.2	13.8	29.7	14.3	28.2	14.6	26.8	14.8
	6	S_{LSD}	42.8	28.5	36.8	26.1	32.0	23.9	28.2	21.8	25.2	20.0	22.7	18.5	20.6	17.0
		G'	35.2	10.6	34.9	12.2	33.9	13.4	32.6	14.2	31.1	14.8	29.7	15.2	28.3	15.4
	7	S_{LSD}	45.6	29.6	39.6	27.5	34.7	25.4	30.8	23.4	27.5	21.6	24.9	20.0	22.7	18.6
		G'	36.1	10.7	35.9	12.3	35.1	13.6	33.8	14.6	32.5	15.2	31.1	15.7	29.7	16.0

1 Tabulated diaphragm shear values are for attachment of steel deck to a base steel thickness, t_i ≥ 6 mm.

2 Tabulated LSD diaphragm shear loads are calculated with a phi factor (Φ) of 0.75 for wind loads. To calculate LSD values for load combinations involving earthquake, divide values in table by 0.75 and multiply by a phi factor (Φ) of 0.55. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.

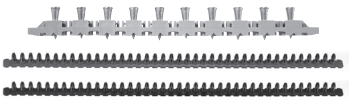
3.5.3.4 ORDERING INFORMATION

DX 9-ENP Decking System

Tools description	Notes	Qty
DX 9-ENP Stand-Up Decking Tool	Use-on-demand service provides daily rental	1 pcs

Accessories description	Notes	Qty
DX 9-ENP Piston and Brake Spares Pack	Replacement piston and brake for DX 9-ENP	1 pcs

Fasteners (combos with 40-strip cartridges) description	Base steel thickness	Qty
X-ENP-19 MXR bulk fastener/cartridge combo	$t_f \geq 1/4"$ (6 mm)	2,000 pcs
X-ENP-19 MXR pallet fastener/cartridge combo	$t_f \geq 1/4"$ (6 mm)	32,000 pcs

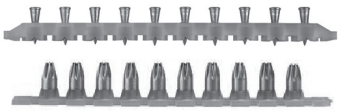


DX 76 Decking System

Tools description	Notes	Qty
DX 76 Hand Held Decking Tool with MX76 Magazine	Includes 10 fastener magazine	1 pcs

Accessories description	Notes	Qty
MX 76 Magazine	Replacement magazine for DX 76-MX	1 pcs
X-76-FN-15	Single fastener baseplate for DX 76	1 pcs
X-76-P-ENP Piston with stopper	Replacement piston and stopper for DX 76	1 pcs
X-76-PS Piston Stopper	Replacement stopper for DX 76	1 pcs

Fasteners (combos with 10-strip cartridges) description	Base steel thickness	Qty
X-ENP-19 MX bulk fastener/cartridge combo	$t_f \geq 1/4"$ (6 mm)	1,000 pcs
X-ENP-19 MX pallet fastener/cartridge combo	$t_f \geq 1/4"$ (6 mm)	32,000 pcs



Fasteners (non-combo) description	Base steel thickness	Qty
X-ENP-19 L15 Fastener (singles)	$t_f \geq 1/4"$ (6 mm)	100 pcs

S-RT5+ M9

SDT 9

Approvals/Listings

ICC-ES (International Code Council)
ESR-3693

FM (Factory Mutual)
For attaching Class 1 Steel Roof Decks with wind uplift ratings up to 1-330

3.5.4 S-RT5+ M9 SCREW FASTENING SYSTEM

3.5.4.1 PRODUCT DESCRIPTION

The Hilti S-RT5+ M9 fastening system consists of the new and improved SDT 9 stand-up screw fastening system and the new S-RT5+ fasteners in collated strips.

The SDT 9 decking system can be powered with either the ST 1800 Adjustable Torque Screwdriver or the ST 1800-A22 Cordless Adjustable Torque Screwdriver. This system can perform both metal deck to frame attachment and deck sidelap connections.

Hilti S-RT5+ steel deck fasteners comply with ANSI/SDI RD1.0, C1.0 and NC1.0 standards.

PRODUCT FEATURES AND BENEFITS

- Equivalent diaphragm shear performance as compared with the X-HSN power–actuated fastener, based on full scale diaphragm testing
- Improved pullover, leading to better performance under wind uplift thanks to large integrated washer
- S-RT5+ has Racing Tip technology provides best in class drill tip, optimized for fast drilling
- SDT 9 system provides ergonomics and balance and robust screw separation for a jam-free experience

3.5.4.2 MATERIAL SPECIFICATIONS

Fastener designation	Fastener material	Fastener plating
S-RT5+	Carbon steel	5 µm zinc

3.5.4.3 TECHNICAL DATA

Allowable pullout loads for attachments to steel base material lb (kN)[1,2,3]

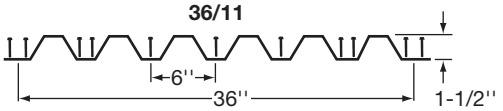
Fastener	Base material thickness in.			
	1/8	3/16	1/4	3/8
S-RT5+	**435** (1.95)	**635** (2.82)	**750** (3.34)	**750** (3.34)

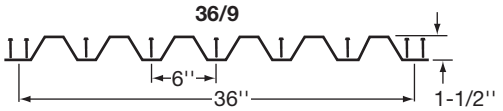
1 These values represent testing performed in ASTM A36 plate steel.
2 The values must be compared with allowable tensile pullover values.
3 Allowable values based on a minimum safety factor of 3.0.

Allowable tension pullover and shear bearing loads for attaching steel deck [1,2,3]

Fastener	Steel deck gauge (in.)											
	16 (0.0598)		18 (0.0474)		20 (0.0358)		22 (0.0295)		24 (0.0239)		26 (0.0179)	
	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
S-RT5+	**865** (3.85)	**957** (4.29)	**725** (3.22)	**785** (3.45)	**560** (2.49)	**600** (2.64)	**500** (2.22)	**500** (2.22)	**450** (2.00)	**410** (1.80)	**415** (1.85)	**310** (1.36)

1 For base steel thickness 1/8" (3 mm) to 3/8" (10 mm).
2 Allowable values are based on a safety factor of 3.0.
3 Loads based on ASTM A1008, or minimum ASTM A653 SQ33 steel deck.





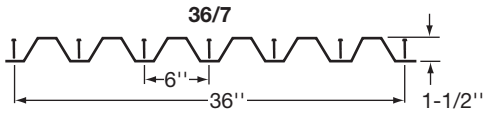
Allowable Stress Design (ASD) – Allowable diaphragm shears, S_{ASD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2'' deep flutes, 6'' center-to-center deck (F_y≥50ksi; F_u≥65 ksi) installed with Hilti S-RT5+ fasteners with 36/11 or 36/9 end and interior support fastener patterns[1,2,3,4,5,6,7]

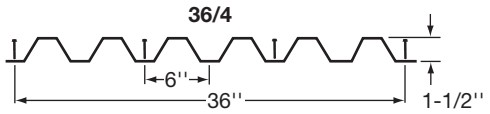
Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			11	9	11	9	11	9	11	9	11	9	11	9	11	9
22	2	S_{ASD}	1065	920	876	762	726	636	616	539	534	466	473	413	426	372
		G'	62.8	61.0	67.2	64.7	69.2	66.0	69.7	66.0	69.2	65.0	68.0	63.5	66.5	61.7
	3	S_{ASD}	1158	1006	957	840	807	717	685	608	594	527	527	467	474	420
		G'	64.2	62.7	69.1	67.0	71.7	69.1	72.7	69.5	72.6	69.0	71.7	67.8	70.4	66.2
	4	S_{ASD}	1246	1087	1036	913	883	783	755	677	655	587	581	521	523	469
		G'	65.3	64.1	70.8	69.0	73.9	71.6	75.3	72.5	75.5	72.4	74.9	71.5	73.8	70.1
	5	S_{ASD}	1329	1161	1111	983	950	847	824	742	715	648	635	575	571	517
		G'	66.2	65.2	72.2	70.7	75.7	73.7	77.5	75.1	78.1	75.3	77.8	74.7	76.9	73.6
	6	S_{ASD}	1408	1230	1184	1049	1016	908	887	798	776	708	689	628	620	566
		G'	67.0	66.2	73.4	72.1	77.3	75.6	79.4	77.3	80.3	77.9	80.3	77.6	79.7	76.7
	7	S_{ASD}	1482	1293	1253	1111	1080	967	945	852	837	760	743	682	668	614
		G'	67.7	67.0	74.4	73.3	78.7	77.2	81.2	79.3	82.4	80.2	82.6	80.2	82.2	79.5
20	2	S_{ASD}	1415	1225	1166	1017	976	859	829	729	719	631	633	555	569	499
		G'	86.8	83.8	90.1	86.0	90.6	85.7	89.4	83.8	87.2	81.2	84.5	78.2	81.5	75.1
	3	S_{ASD}	1549	1349	1283	1128	1091	965	930	830	808	720	712	634	640	570
		G'	89.2	86.7	93.3	89.9	94.5	90.3	93.8	89.0	92.0	86.8	89.6	84.1	86.9	81.1
	4	S_{ASD}	1675	1462	1396	1233	1192	1060	1032	927	896	808	791	713	711	641
		G'	91.1	89.0	96.0	93.1	97.8	94.2	97.7	93.5	96.3	91.7	94.2	89.3	91.7	86.5
	5	S_{ASD}	1793	1566	1505	1332	1289	1151	1125	1010	985	897	870	792	782	712
		G'	92.8	91.0	98.3	95.8	100.7	97.6	101.1	97.4	100.1	96.0	98.3	93.9	96.0	91.4
	6	S_{ASD}	1904	1662	1608	1425	1384	1238	1210	1091	1074	972	949	871	853	783
		G'	94.2	92.7	100.4	98.2	103.3	100.5	104.1	100.9	103.5	99.9	102.0	98.0	99.9	95.7
	7	S_{ASD}	2007	1748	1706	1511	1475	1321	1294	1168	1150	1044	1028	942	924	854
		G'	95.5	94.1	102.1	100.2	105.6	103.1	106.8	103.9	106.6	103.3	105.4	101.8	103.5	99.7
18	2	S_{ASD}	1748	1515	1441	1258	1218	1072	1036	913	899	792	793	698	708	623
		G'	132.1	126.0	131.4	124.0	127.7	119.4	122.7	113.7	117.1	107.9	111.5	102.1	106.0	96.7
	3	S_{ASD}	1920	1673	1593	1402	1356	1200	1168	1045	1015	908	896	801	801	715
		G'	136.8	131.7	137.3	130.9	134.4	127.2	129.9	122.1	124.7	116.5	119.3	110.9	113.9	105.4
	4	S_{ASD}	2082	1818	1739	1537	1486	1323	1294	1158	1131	1023	999	903	893	808
		G'	140.8	136.5	142.4	136.9	140.3	134.0	136.4	129.4	131.5	124.2	126.3	118.7	121.1	113.3
	5	S_{ASD}	2233	1950	1878	1663	1611	1440	1407	1265	1246	1126	1101	1006	986	900
		G'	144.3	140.5	146.8	142.0	145.5	139.9	142.1	135.9	137.7	131.0	132.7	125.8	127.6	120.5
	6	S_{ASD}	2373	2070	2010	1781	1732	1551	1517	1369	1347	1221	1204	1101	1078	992
		G'	147.3	144.0	150.7	146.5	150.2	145.1	147.3	141.7	143.3	137.2	138.6	132.3	133.7	127.2
	7	S_{ASD}	2504	2178	2135	1890	1849	1656	1624	1467	1445	1313	1300	1186	1171	1080
		G'	149.9	147.0	154.2	150.4	154.3	149.8	152.0	147.0	148.3	142.9	144.0	138.2	139.2	133.2
16	2	S_{ASD}	1930	1674	1592	1392	1350	1186	1153	1019	1002	885	885	781	791	697
		G'	178.4	168.6	171.8	160.5	162.9	150.9	153.5	141.2	144.4	132.0	135.9	123.6	128.0	115.9
	3	S_{ASD}	2126	1853	1765	1555	1503	1332	1304	1162	1134	1017	1002	898	897	803
		G'	186.2	177.8	180.9	171.1	172.8	162.2	163.8	152.7	154.9	143.6	146.3	135.1	138.4	127.2
	4	S_{ASD}	2308	2017	1931	1707	1651	1471	1438	1289	1266	1144	1120	1015	1002	908
		G'	192.8	185.6	188.8	180.2	181.5	172.1	173.1	163.1	164.3	154.1	155.9	145.6	147.9	137.6
	5	S_{ASD}	2479	2165	2088	1850	1793	1604	1567	1410	1389	1256	1237	1130	1108	1014
		G'	198.7	192.4	195.8	188.3	189.4	180.9	181.4	172.4	173.0	163.7	164.7	155.2	156.7	147.2
	6	S_{ASD}	2637	2298	2237	1982	1931	1729	1692	1527	1503	1364	1350	1230	1214	1119
		G'	203.8	198.3	202.1	195.4	196.4	188.8	189.0	180.8	180.9	172.4	172.8	164.1	164.9	156.1
	7	S_{ASD}	2783	2419	2378	2104	2062	1847	1813	1638	1615	1468	1453	1327	1319	1209
		G'	208.3	203.5	207.7	201.7	202.8	196.0	195.9	188.5	188.2	180.4	180.3	172.2	172.5	164.3

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses 3/16" ≤ tf ≤ 3/8". For attachment to base steel with range 1/8" ≤ tf < 3/16", diaphragm shear values should be calculated in accordance with Section 3.5.1.7, or by using Hilti Profis DF software.

2 Tabulated S_{ASD} diaphragm shear loads are calculated with a safety factor (Ω) of 2.00 for wind loads. To calculate S_{ASD} values for load combinations involving earthquake, multiply S_{ASD} values in table by 2.00 and divide by a safety factor (Ω) of 2.30. Panel buckling has been checked.

3 Please refer to footnote 3 through 7 on page 171 of Hilti North American Product Technical Guide Volume 1: Direct Fastening.





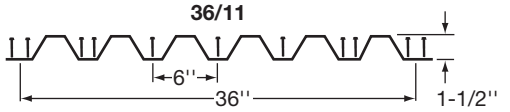
Allowable Stress Design (ASD) – Allowable diaphragm shears, S_{ASD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2'' deep flutes, 6'' center-to-center deck (F_y≥50 ksi; F_u≥65 ksi) installed with Hilti S-RT5+ fasteners with 36/7 or 36/4 end and interior support fastener patterns[1,2,3,4,5,6,7]

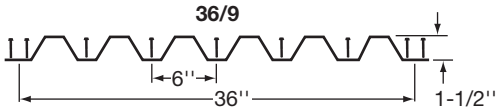
Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			7	4	7	4	7	4	7	4	7	4	7	4	7	4
22	2	S_{ASD}	667	490	547	414	455	356	387	310	336	268	298	238	268	214
		G'	57.3	11.9	59.6	14.2	59.8	16.1	58.8	17.8	57.2	19.1	55.2	20.1	53.0	20.9
	3	S_{ASD}	761	557	629	478	534	417	456	367	396	328	352	292	317	263
		G'	59.8	12.1	63.0	14.5	63.9	16.6	63.5	18.4	62.3	19.9	60.6	21.2	58.7	22.2
	4	S_{ASD}	849	612	707	534	603	470	525	418	457	375	406	340	365	310
		G'	61.8	12.2	65.7	14.7	67.3	16.9	67.5	18.8	66.7	20.5	65.3	21.9	63.6	23.1
	5	S_{ASD}	930	657	781	582	670	518	585	465	518	419	460	381	414	349
		G'	63.3	12.3	67.9	14.8	70.1	17.1	70.8	19.2	70.4	21.0	69.3	22.5	67.8	23.9
	6	S_{ASD}	1004	694	850	623	733	561	642	507	570	460	512	420	462	386
		G'	64.6	12.3	69.7	14.9	72.5	17.3	73.6	19.4	73.6	21.3	72.8	23.0	71.6	24.5
	7	S_{ASD}	1071	724	915	658	794	598	698	545	622	498	559	457	508	421
		G'	65.6	12.4	71.3	15.0	74.5	17.5	76.0	19.7	76.4	21.6	75.9	23.4	74.9	24.9
20	2	S_{ASD}	898	660	738	560	621	484	529	424	459	371	405	327	365	294
		G'	77.5	18.5	78.0	21.6	76.3	24.1	73.5	26.0	70.3	27.5	66.9	28.4	63.6	29.1
	3	S_{ASD}	1034	752	857	651	729	569	630	503	548	450	484	406	436	365
		G'	81.7	18.8	83.3	22.2	82.5	25.0	80.3	27.3	77.4	29.0	74.2	30.4	71.0	31.3
	4	S_{ASD}	1157	826	968	727	828	644	722	575	637	517	563	469	507	429
		G'	85.0	19.1	87.6	22.6	87.6	25.7	86.0	28.2	83.5	30.2	80.6	31.8	77.5	33.1
	5	S_{ASD}	1270	885	1073	791	923	709	808	639	717	579	642	528	578	485
		G'	87.6	19.2	91.2	22.9	91.9	26.1	90.9	28.9	88.8	31.1	86.2	33.0	83.3	34.4
	6	S_{ASD}	1372	932	1170	845	1013	766	890	696	792	636	713	583	647	537
		G'	89.8	19.4	94.2	23.2	95.6	26.5	95.1	29.4	93.5	31.9	91.2	33.9	88.5	35.5
	7	S_{ASD}	1463	970	1260	890	1098	815	969	747	865	686	780	633	709	585
		G'	91.7	19.5	96.8	23.4	98.8	26.8	98.8	29.8	97.6	32.4	95.6	34.6	93.1	36.5
18	2	S_{ASD}	1119	822	920	699	779	605	665	531	579	471	511	416	457	372
		G'	114.1	33.8	109.8	38.2	103.9	41.2	97.6	43.1	91.5	44.0	85.8	44.3	80.5	44.1
	3	S_{ASD}	1292	937	1073	813	913	713	793	632	694	566	614	511	550	464
		G'	121.9	34.8	119.1	39.8	114.0	43.5	108.0	46.0	102.0	47.6	96.3	48.5	90.8	48.7
	4	S_{ASD}	1450	1028	1216	909	1042	808	909	723	804	652	717	592	642	542
		G'	128.3	35.5	126.8	41.0	122.5	45.2	117.1	48.3	111.3	50.4	105.6	51.7	100.1	52.4
	5	S_{ASD}	1592	1100	1349	989	1164	890	1019	804	905	730	813	667	735	613
		G'	133.6	36.0	133.3	41.9	129.9	46.5	125.0	50.1	119.5	52.6	114.0	54.4	108.6	55.5
	6	S_{ASD}	1719	1156	1472	1054	1278	960	1125	875	1002	801	903	736	820	679
		G'	138.1	36.5	138.9	42.6	136.3	47.6	132.0	51.5	126.9	54.4	121.5	56.6	116.2	58.0
	7	S_{ASD}	1833	1201	1585	1108	1386	1019	1226	938	1096	864	989	798	900	740
		G'	141.9	36.8	143.8	43.2	142.0	48.4	138.2	52.7	133.5	55.9	128.4	58.4	123.2	60.2
16	2	S_{ASD}	1242	912	1022	777	866	673	744	591	648	526	573	469	513	419
		G'	149.9	53.7	139.8	58.5	129.2	61.0	119.3	61.8	110.4	61.5	102.5	60.4	95.4	58.9
	3	S_{ASD}	1438	1040	1196	905	1019	795	885	706	780	632	690	572	619	521
		G'	162.2	56.0	153.3	62.0	143.3	65.6	133.4	67.4	124.3	67.9	116.0	67.5	108.5	66.5
	4	S_{ASD}	1616	1141	1358	1012	1164	901	1016	808	900	729	807	663	724	607
		G'	172.4	57.7	164.9	64.6	155.5	69.2	145.9	71.8	136.7	73.1	128.2	73.3	120.5	72.7
	5	S_{ASD}	1775	1219	1507	1099	1302	992	1142	898	1015	817	912	747	827	687
		G'	181.0	58.9	174.8	66.6	166.2	72.0	156.9	75.4	147.9	77.3	139.3	78.1	131.4	78.0
	6	S_{ASD}	1916	1280	1645	1171	1431	1069	1261	977	1125	896	1013	824	921	762
		G'	188.4	59.9	183.5	68.2	175.7	74.2	166.9	78.3	158.0	80.8	149.5	82.2	141.5	82.6
	7	S_{ASD}	2042	1328	1771	1229	1552	1134	1375	1046	1230	966	1111	894	1012	830
		G'	194.8	60.7	191.1	69.5	184.1	76.1	175.8	80.7	167.2	83.8	158.8	85.7	150.8	86.5

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses 3/16" ≤ tf ≤ 3/8". For attachment to base steel with range 1/8" ≤ tf < 3/16", diaphragm shear values should be calculated in accordance with Section 3.5.1.7, or by using Hilti Profis DF software.

2 Tabulated S_{ASD} diaphragm shear loads are calculated with a safety factor (Ω) of 0.80 for wind loads. When a safety factor (Ω) of 2.00 for wind loads is used, the S_{ASD} diaphragm shear loads in this table can be increase by 17.5%. To calculate S_{ASD} values for load combinations involving earthquake, multiply S_{ASD} values in table by 0.80 and divide by a safety factor (Ω) of 2.50. Panel buckling has been checked.

3 Please refer to footnote 3 through 7 on page 171 of Hilti North American Product Technical Guide Volume 1: Direct Fastening





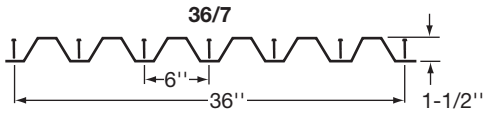
Load resistance Factor Design (LRFD) – Factored resistance diaphragm shears, S_{LRFD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2'' deep flutes, 6'' center-to-center deck (F_y≥50 ksi; F_u≥65 ksi) installed with Hilti S-RT5+ fasteners with 36/11 or 36/9 end and interior support fastener patterns[1,2,3,4,5,6,7]

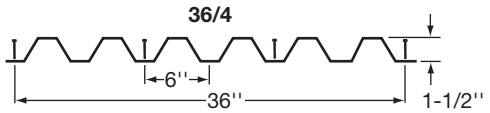
Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			11	9	11	9	11	9	11	9	11	9	11	9	11	9
22	2	S_{LRFD}	1704	1402	1162	986	854	757	681	1473	1220	1018	862	746	661	595
		G'	62.8	61.0	67.2	64.7	69.2	66.0	69.7	66.0	69.2	65.0	68.0	63.5	66.5	61.7
	3	S_{LRFD}	1852	1532	1291	1097	951	843	759	1610	1343	1147	973	843	747	672
		G'	64.2	62.7	69.1	67.0	71.7	69.1	72.7	69.5	72.6	69.0	71.7	67.8	70.4	66.2
	4	S_{LRFD}	1993	1657	1412	1208	1048	929	836	1739	1461	1253	1084	939	833	750
		G'	65.3	64.1	70.8	69.0	73.9	71.6	75.3	72.5	75.5	72.4	74.9	71.5	73.8	70.1
	5	S_{LRFD}	2126	1778	1520	1318	1145	1016	914	1857	1572	1355	1187	1036	919	827
		G'	66.2	65.2	72.2	70.7	75.7	73.7	77.5	75.1	78.1	75.3	77.8	74.7	76.9	73.6
	6	S_{LRFD}	2252	1894	1625	1419	1242	1102	992	1967	1678	1453	1276	1133	1006	905
		G'	67.0	66.2	73.4	72.1	77.3	75.6	79.4	77.3	80.3	77.9	80.3	77.6	79.7	76.7
	7	S_{LRFD}	2371	2006	1727	1512	1339	1188	1069	2069	1777	1546	1363	1216	1092	983
		G'	67.7	67.0	74.4	73.3	78.7	77.2	81.2	79.3	82.4	80.2	82.6	80.2	82.2	79.5
20	2	S_{LRFD}	2265	1865	1561	1326	1150	1013	911	1961	1627	1374	1166	1009	888	799
		G'	86.8	83.8	90.1	86.0	90.6	85.7	89.4	83.8	87.2	81.2	84.5	78.2	81.5	75.1
	3	S_{LRFD}	2478	2053	1746	1489	1292	1139	1025	2158	1805	1544	1328	1151	1014	912
		G'	89.2	86.7	93.3	89.9	94.5	90.3	93.8	89.0	92.0	86.8	89.6	84.1	86.9	81.1
	4	S_{LRFD}	2679	2234	1907	1651	1434	1266	1138	2339	1973	1696	1483	1293	1140	1026
		G'	91.1	89.0	96.0	93.1	97.8	94.2	97.7	93.5	96.3	91.7	94.2	89.3	91.7	86.5
	5	S_{LRFD}	2869	2407	2063	1800	1576	1392	1252	2506	2131	1842	1617	1435	1267	1139
		G'	92.8	91.0	98.3	95.8	100.7	97.6	101.1	97.4	100.1	96.0	98.3	93.9	96.0	91.4
	6	S_{LRFD}	3046	2573	2214	1937	1718	1518	1365	2658	2279	1981	1745	1555	1393	1253
		G'	94.2	92.7	100.4	98.2	103.3	100.5	104.1	100.9	103.5	99.9	102.0	98.0	99.9	95.7
	7	S_{LRFD}	3212	2730	2359	2070	1840	1644	1479	2797	2418	2113	1869	1670	1507	1367
		G'	95.5	94.1	102.1	100.2	105.6	103.1	106.8	103.9	106.6	103.3	105.4	101.8	103.5	99.7
18	2	S_{LRFD}	2797	2306	1948	1657	1439	1269	1133	2424	2014	1715	1461	1267	1117	996
		G'	132.1	126.0	131.4	124.0	127.7	119.4	122.7	113.7	117.1	107.9	111.5	102.1	106.0	96.7
	3	S_{LRFD}	3072	2549	2169	1869	1624	1434	1281	2677	2243	1921	1673	1452	1281	1144
		G'	136.8	131.7	137.3	130.9	134.4	127.2	129.9	122.1	124.7	116.5	119.3	110.9	113.9	105.4
	4	S_{LRFD}	3330	2782	2377	2070	1809	1598	1429	2909	2459	2117	1853	1637	1446	1292
		G'	140.8	136.5	142.4	136.9	140.3	134.0	136.4	129.4	131.5	124.2	126.3	118.7	121.1	113.3
	5	S_{LRFD}	3572	3004	2578	2251	1994	1762	1577	3120	2661	2304	2025	1802	1610	1440
		G'	144.3	140.5	146.8	142.0	145.5	139.9	142.1	135.9	137.7	131.0	132.7	125.8	127.6	120.5
	6	S_{LRFD}	3797	3216	2772	2428	2155	1927	1725	3312	2849	2482	2190	1954	1761	1588
		G'	147.3	144.0	150.7	146.5	150.2	145.1	147.3	141.7	143.3	137.2	138.6	132.3	133.7	127.2
	7	S_{LRFD}	4007	3416	2958	2599	2312	2080	1873	3485	3024	2650	2348	2101	1898	1729
		G'	149.9	147.0	154.2	150.4	154.3	149.8	152.0	147.0	148.3	142.9	144.0	138.2	139.2	133.2
16	2	S_{LRFD}	3089	2548	2161	1845	1604	1416	1266	2679	2227	1897	1630	1416	1249	1115
		G'	178.4	168.6	171.8	160.5	162.9	150.9	153.5	141.2	144.4	132.0	135.9	123.6	128.0	115.9
	3	S_{LRFD}	3401	2825	2405	2087	1815	1604	1435	2965	2487	2131	1859	1627	1437	1284
		G'	186.2	177.8	180.9	171.1	172.8	162.2	163.8	152.7	154.9	143.6	146.3	135.1	138.4	127.2
	4	S_{LRFD}	3693	3089	2641	2301	2026	1792	1604	3226	2732	2354	2062	1830	1625	1454
		G'	192.8	185.6	188.8	180.2	181.5	172.1	173.1	163.1	164.3	154.1	155.9	145.6	147.9	137.6
	5	S_{LRFD}	3966	3340	2870	2507	2222	1979	1773	3463	2959	2566	2257	2009	1808	1623
		G'	198.7	192.4	195.8	188.3	189.4	180.9	181.4	172.4	173.0	163.7	164.7	155.2	156.7	147.2
	6	S_{LRFD}	4219	3579	3089	2708	2405	2161	1942	3677	3171	2766	2443	2182	1968	1790
		G'	203.8	198.3	202.1	195.4	196.4	188.8	189.0	180.8	180.9	172.4	172.8	164.1	164.9	156.1
	7	S_{LRFD}	4453	3805	3299	2901	2583	2325	2111	3870	3366	2955	2621	2348	2123	1934
		G'	208.3	203.5	207.7	201.7	202.8	196.0	195.9	188.5	188.2	180.4	180.3	172.2	172.5	164.3

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses 3/16" ≤ tf ≤ 3/8". For attachment to base steel with range 1/8" ≤ tf < 3/16", diaphragm shear values should be calculated in accordance with Section 3.5.1.7, or by using Hilti Profis DF software.

2 Tabulated S_{LRFD} diaphragm shear loads are calculated with a phi factor (Φ) of 0.80 for wind loads. To calculate S_{LRFD} values for load combinations involving earthquake, divide S_{LRFD} values in table by 0.80 and multiply by a phi factor (Φ) of 0.70. Panel buckling has been checked.

3 Please refer to footnote 3 through 7 on page 171 of Hilti North American Product Technical Guide Volume 1: Direct Fastening.





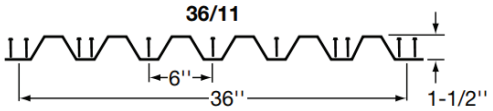
Load resistance Factor Design (LRFD) – Factored resistance diaphragm shears, S_{LRFD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2'' deep flutes, 6'' center-to-center deck (F_y≥50ksi; F_u≥65 ksi) installed with Hilti S-RT5+ fasteners with 36/7 or 36/4 end and interior support fastener patterns[1,2,3,4,5,6,7]

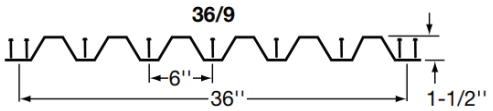
Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			7	4	7	4	7	4	7	4	7	4	7	4	7	4
22	2	S_{LRFD}	1067	784	875	663	728	570	619	496	537	429	477	381	429	342
		G'	57.3	11.9	59.6	14.2	59.8	16.1	58.8	17.8	57.2	19.1	55.2	20.1	53.0	20.9
	3	S_{LRFD}	1218	891	1006	765	854	666	730	588	634	524	563	467	507	420
		G'	59.8	12.1	63.0	14.5	63.9	16.6	63.5	18.4	62.3	19.9	60.6	21.2	58.7	22.2
	4	S_{LRFD}	1358	978	1131	855	965	753	839	669	731	600	649	543	584	496
		G'	61.8	12.2	65.7	14.7	67.3	16.9	67.5	18.8	66.7	20.5	65.3	21.9	63.6	23.1
	5	S_{LRFD}	1487	1051	1249	932	1072	829	935	743	828	671	735	610	662	559
		G'	63.3	12.3	67.9	14.8	70.1	17.1	70.8	19.2	70.4	21.0	69.3	22.5	67.8	23.9
	6	S_{LRFD}	1606	1110	1361	997	1173	897	1028	811	913	736	820	673	739	618
		G'	64.6	12.3	69.7	14.9	72.5	17.3	73.6	19.4	73.6	21.3	72.8	23.0	71.6	24.5
	7	S_{LRFD}	1714	1158	1465	1053	1270	957	1117	871	995	796	895	731	813	674
		G'	65.6	12.4	71.3	15.0	74.5	17.5	76.0	19.7	76.4	21.6	75.9	23.4	74.9	24.9
20	2	S_{LRFD}	1438	1057	1181	897	994	774	846	679	735	594	648	523	583	471
		G'	77.5	18.5	78.0	21.6	76.3	24.1	73.5	26.0	70.3	27.5	66.9	28.4	63.6	29.1
	3	S_{LRFD}	1654	1204	1371	1041	1166	910	1008	805	877	720	775	650	697	584
		G'	81.7	18.8	83.3	22.2	82.5	25.0	80.3	27.3	77.4	29.0	74.2	30.4	71.0	31.3
	4	S_{LRFD}	1852	1322	1549	1163	1325	1030	1155	920	1019	828	901	751	810	686
		G'	85.0	19.1	87.6	22.6	87.6	25.7	86.0	28.2	83.5	30.2	80.6	31.8	77.5	33.1
	5	S_{LRFD}	2032	1416	1716	1266	1477	1135	1292	1023	1146	927	1027	845	924	775
		G'	87.6	19.2	91.2	22.9	91.9	26.1	90.9	28.9	88.8	31.1	86.2	33.0	83.3	34.4
	6	S_{LRFD}	2195	1491	1872	1353	1621	1226	1425	1114	1267	1017	1140	932	1035	859
		G'	89.8	19.4	94.2	23.2	95.6	26.5	95.1	29.4	93.5	31.9	91.2	33.9	88.5	35.5
	7	S_{LRFD}	2341	1552	2016	1425	1757	1304	1551	1195	1384	1098	1248	1012	1135	937
		G'	91.7	19.5	96.8	23.4	98.8	26.8	98.8	29.8	97.6	32.4	95.6	34.6	93.1	36.5
18	2	S_{LRFD}	1790	1315	1472	1119	1246	967	1064	849	926	754	818	666	732	595
		G'	114.1	33.8	109.8	38.2	103.9	41.2	97.6	43.1	91.5	44.0	85.8	44.3	80.5	44.1
	3	S_{LRFD}	2067	1499	1717	1302	1461	1141	1270	1011	1111	905	982	818	880	743
		G'	121.9	34.8	119.1	39.8	114.0	43.5	108.0	46.0	102.0	47.6	96.3	48.5	90.8	48.7
	4	S_{LRFD}	2320	1645	1946	1455	1667	1293	1454	1157	1287	1043	1147	948	1028	867
		G'	128.3	35.5	126.8	41.0	122.5	45.2	117.1	48.3	111.3	50.4	105.6	51.7	100.1	52.4
	5	S_{LRFD}	2547	1760	2159	1582	1862	1423	1631	1286	1448	1168	1301	1068	1176	981
		G'	133.6	36.0	133.3	41.9	129.9	46.5	125.0	50.1	119.5	52.6	114.0	54.4	108.6	55.5
	6	S_{LRFD}	2751	1850	2355	1687	2045	1535	1800	1400	1604	1281	1444	1177	1312	1087
		G'	138.1	36.5	138.9	42.6	136.3	47.6	132.0	51.5	126.9	54.4	121.5	56.6	116.2	58.0
	7	S_{LRFD}	2933	1922	2536	1773	2218	1631	1962	1500	1754	1382	1583	1278	1441	1185
		G'	141.9	36.8	143.8	43.2	142.0	48.4	138.2	52.7	133.5	55.9	128.4	58.4	123.2	60.2
16	2	S_{LRFD}	1987	1459	1635	1244	1385	1077	1191	946	1037	841	917	750	821	670
		G'	149.9	53.7	139.8	58.5	129.2	61.0	119.3	61.8	110.4	61.5	102.5	60.4	95.4	58.9
	3	S_{LRFD}	2301	1664	1913	1449	1630	1272	1417	1129	1248	1012	1104	915	990	834
		G'	162.2	56.0	153.3	62.0	143.3	65.6	133.4	67.4	124.3	67.9	116.0	67.5	108.5	66.5
	4	S_{LRFD}	2585	1825	2172	1619	1863	1442	1626	1292	1440	1167	1291	1061	1159	971
		G'	172.4	57.7	164.9	64.6	155.5	69.2	145.9	71.8	136.7	73.1	128.2	73.3	120.5	72.7
	5	S_{LRFD}	2839	1950	2412	1758	2083	1587	1827	1437	1623	1307	1459	1196	1323	1100
		G'	181.0	58.9	174.8	66.6	166.2	72.0	156.9	75.4	147.9	77.3	139.3	78.1	131.4	78.0
	6	S_{LRFD}	3066	2048	2632	1873	2290	1710	2018	1563	1800	1433	1621	1319	1474	1219
		G'	188.4	59.9	183.5	68.2	175.7	74.2	166.9	78.3	158.0	80.8	149.5	82.2	141.5	82.6
	7	S_{LRFD}	3267	2125	2834	1967	2483	1814	2200	1673	1969	1545	1778	1430	1620	1328
		G'	194.8	60.7	191.1	69.5	184.1	76.1	175.8	80.7	167.2	83.8	158.8	85.7	150.8	86.5

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses 3/16" ≤ tf ≤ 3/8". For attachment to base steel with range 1/8" ≤ tf < 3/16", diaphragm shear values should be calculated in accordance with Section 3.5.1.7, or by using Hilti Profis DF software.

2 Tabulated S_{LRFD} diaphragm shear loads are calculated with a phi factor (Φ) of 0.75 for wind loads. When a phi factor (Φ) of 0.80 for wind loads is used, the S_{LRFD} diaphragm shear loads in this table can be increase by 15%. To calculate S_{LRFD} values for load combinations involving earthquake, divide S_{LRFD} values in table by 0.75 and multiply by a phi factor (Φ) of 0.55. Panel buckling has been checked.

3 Please refer to footnote 3 through 7 on page 171 of Hilti North American Product Technical Guide Volume 1: Direct Fastening.





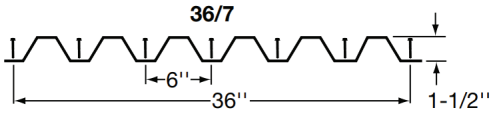
Limit States Design (LSD) – Factored resistance diaphragm shears, S_{LSD}, (N/mm) and stiffness factors, G', (10^3 N/mm) for standard 38mm deep flutes, 152mm center-to-center deck (F_y≥345 Mpa; F_u≥450 Mpa) installed with Hilti S-RT5+ fasteners with 914/11 (36/11) or 914/9 (36/9) end and interior support fastener patterns[1,2,3,4,5,6,7]

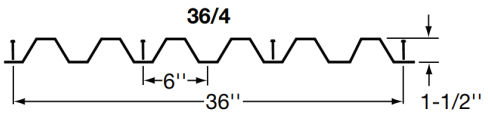
Gauge	Number of Hilti SLC per span	Factor	Span (mm)													
			1200		1500		1800		2100		2400		2700		3000	
			Fasteners per sheet to support													
			11	9	11	9	11	9	11	9	11	9	11	9	11	9
22	2	S_{LSD}	23.6	20.4	19.5	16.9	16.2	14.2	13.7	12.0	11.9	10.4	10.5	8.0	9.5	8.3
		G'	10.9	10.6	11.7	11.3	12.1	11.6	12.2	11.6	12.2	11.4	12.0	10.3	11.7	10.9
	3	S_{LSD}	25.7	22.3	21.3	18.6	18.0	15.9	15.3	13.6	13.3	11.7	11.7	10.4	10.5	9.3
		G'	11.2	10.9	12.1	11.7	12.5	12.1	12.7	12.2	12.7	12.1	12.6	11.9	12.4	11.7
	4	S_{LSD}	27.6	24.1	23.0	20.2	19.6	17.4	16.8	15.1	14.6	13.1	12.9	11.6	11.6	10.4
		G'	11.4	11.2	12.3	12.0	12.9	12.5	13.2	12.7	13.2	12.7	13.2	12.6	13.0	12.3
	5	S_{LSD}	29.4	25.7	24.6	21.8	21.1	18.8	18.4	16.5	15.9	14.4	14.1	12.8	12.7	11.5
		G'	11.5	11.4	12.6	12.3	13.2	12.9	13.6	13.1	13.7	13.2	13.7	13.1	13.5	12.9
	6	S_{LSD}	31.2	27.2	26.3	23.2	22.5	20.1	19.7	17.7	17.3	15.8	15.3	14.0	13.8	12.6
		G'	11.7	11.5	12.8	12.6	13.5	13.2	13.9	13.5	14.1	13.7	14.1	13.6	14.0	13.5
	7	S_{LSD}	32.8	28.6	27.8	24.6	24.0	21.4	21.0	18.9	18.6	16.9	16.5	15.2	14.9	13.7
		G'	11.8	11.7	13.0	12.8	13.7	13.5	14.2	13.9	14.4	14.0	14.5	14.1	14.4	14.0
20	2	S_{LSD}	31.4	27.2	25.9	22.6	21.7	19.1	18.5	16.2	16.0	14.1	14.1	12.4	12.7	11.1
		G'	15.2	14.6	15.8	15.1	15.9	15.0	15.7	14.7	15.3	14.3	14.9	13.8	14.4	13.2
	3	S_{LSD}	34.3	29.9	28.5	25.0	24.2	21.4	20.7	18.5	18.0	16.0	15.9	14.1	14.2	12.7
		G'	15.6	15.1	16.3	15.7	16.5	15.8	16.5	15.6	16.2	15.3	15.8	14.8	15.3	14.3
	4	S_{LSD}	37.1	32.4	31.0	27.3	26.5	23.5	23.0	20.6	20.0	18.0	17.6	15.9	15.8	14.3
		G'	15.9	15.5	16.8	16.3	17.1	16.5	17.1	16.4	16.9	16.1	16.6	15.7	16.1	15.2
	5	S_{LSD}	39.7	34.7	33.4	29.5	28.6	25.5	25.0	22.4	22.0	19.9	19.4	17.6	17.4	15.8
		G'	16.2	15.9	17.2	16.7	17.6	17.1	17.7	17.1	17.6	16.9	17.3	16.5	16.9	16.1
	6	S_{LSD}	42.1	36.7	35.6	31.6	30.7	27.5	26.9	24.2	23.8	21.6	21.1	19.4	19.0	17.4
		G'	16.4	16.2	17.5	17.2	18.1	17.6	18.2	17.7	18.2	17.5	17.9	17.2	17.6	16.8
	7	S_{LSD}	44.4	38.6	37.8	33.4	32.7	29.3	28.7	25.9	25.5	23.2	22.9	20.9	20.6	19.0
		G'	16.6	16.4	17.8	17.5	18.5	18.0	18.7	18.2	18.7	18.1	18.5	17.9	18.2	17.5
18	2	S_{LSD}	38.8	33.6	32.0	27.9	27.1	23.8	23.1	20.4	20.0	17.7	17.7	15.6	15.8	13.9
		G'	23.1	22.0	23.0	21.7	22.4	20.9	21.5	20.0	20.6	19.0	19.6	18.0	18.7	17.0
	3	S_{LSD}	42.6	37.1	35.4	31.1	30.1	26.6	26.0	23.2	22.6	20.2	20.0	17.9	17.9	15.9
		G'	23.9	23.0	24.0	22.9	23.6	22.3	22.8	21.4	21.9	20.5	21.0	19.5	20.0	18.6
	4	S_{LSD}	46.1	40.2	38.6	34.1	33.0	29.4	28.7	25.7	25.2	22.8	22.3	20.1	19.9	18.0
		G'	24.6	23.8	24.9	24.0	24.6	23.5	23.9	22.7	23.1	21.8	22.2	20.9	21.3	20.0
	5	S_{LSD}	49.4	43.1	41.6	36.8	35.8	31.9	31.2	28.1	27.7	25.0	24.5	22.4	22.0	20.1
		G'	25.2	24.5	25.7	24.9	25.5	24.5	24.9	23.9	24.2	23.0	23.3	22.1	22.5	21.2
	6	S_{LSD}	52.5	45.8	44.5	39.4	38.4	34.4	33.7	30.4	29.9	27.1	26.8	24.4	24.0	22.1
		G'	25.7	25.1	26.4	25.6	26.3	25.4	25.8	24.9	25.2	24.1	24.4	23.3	23.5	22.4
	7	S_{LSD}	55.5	48.1	47.3	41.8	41.0	36.7	36.0	32.5	32.1	29.1	28.9	26.3	26.1	24.0
		G'	26.2	25.7	27.0	26.3	27.0	26.2	26.7	25.8	26.0	25.1	25.3	24.3	24.5	23.4
16	2	S_{LSD}	42.8	37.1	35.4	30.9	30.0	26.3	25.7	22.7	22.3	19.7	19.7	17.4	17.6	15.5
		G'	31.3	29.6	30.2	28.2	28.7	26.6	27.1	24.9	25.5	23.3	24.0	21.8	22.6	20.5
	3	S_{LSD}	47.1	41.1	39.2	34.5	33.4	29.6	29.0	25.8	25.3	22.7	22.3	20.0	20.0	17.9
		G'	32.6	31.2	31.8	30.1	30.4	28.5	28.9	26.9	27.3	25.3	25.8	23.9	24.4	22.5
	4	S_{LSD}	51.1	44.6	42.8	37.8	36.6	32.6	31.9	28.6	28.2	25.4	24.9	22.6	22.3	20.2
		G'	33.8	32.5	33.1	31.7	31.9	30.3	30.5	28.7	29.0	27.2	27.5	25.7	26.1	24.3
	5	S_{LSD}	54.9	47.9	46.3	41.0	39.8	35.6	34.8	31.3	30.9	27.9	27.6	25.1	24.7	22.6
		G'	34.8	33.7	34.4	33.1	33.3	31.8	31.9	30.4	30.5	28.9	29.0	27.4	27.7	26.0
	6	S_{LSD}	58.4	50.8	49.6	43.9	42.8	38.3	37.6	33.9	33.4	30.3	30.0	27.3	27.0	24.8
		G'	35.7	34.7	35.5	34.3	34.5	33.2	33.3	31.8	31.9	30.4	30.5	28.9	29.1	27.6
	7	S_{LSD}	61.6	53.4	52.7	46.5	45.7	40.9	40.2	36.3	35.8	32.6	32.3	29.4	29.3	26.8
		G'	36.5	35.6	36.4	35.4	35.6	34.4	34.5	33.2	33.1	31.8	31.8	30.4	30.4	29.0

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses 5 mm ≤ tf ≤ 10 mm. For attachment to base steel thickness with range 3 mm ≤ tf < 5 mm, diaphragm shear values should be calculated in accordance with Section 3.5.1.7, or by using Hilti Profis DF software.

2 Tabulated S_{LSD} diaphragm shear loads are calculated with a phi factor (Φ) of 0.758 for wind loads. To calculate S_{LSD} values for load combinations involving earthquake, divide S_{LSD} values in table by 0.75 and multiply by a phi factor (Φ) of 0.55. Panel buckling has been checked.

3 Please refer to footnote 3 through 7 on page 171 of Hilti North American Product Technical Guide Volume 1: Direct Fastening.





Limit States Design (LSD) – Factored resistance diaphragm shears, S_{LSD}, (N/mm) and stiffness factors, G', (10^3 N/mm) for standard 38mm deep flutes, 152mm center-to-center deck (F_y≥345 Mpa; F_u≥450 Mpa) installed with Hilti S-MD 12-24 x 1-5/8 M HWH5 fasteners with 914/7 (36/7) or 914/4 (36/4) end and interior support fastener patterns[1,2,3,4,5,6,7]

Gauge	Number of Hilti SLC per span	Factor	Span (mm)													
			1200		1500		1800		2100		2400		2700		3000	
			Fasteners per sheet to support													
			7	4	7	4	7	4	7	4	7	4	7	4	7	4
22	2	S_{LSD}	10.6	7.7	8.7	6.6	7.4	5.8	6.3	5.1	5.5	4.5	4.8	4.0	4.4	3.6
		G'	9.9	2.1	10.3	2.5	10.4	2.8	10.2	3.1	9.9	3.3	9.6	3.5	9.2	3.6
	3	S_{LSD}	12.3	8.8	10.2	7.7	8.7	6.8	7.6	6.1	6.6	5.4	5.9	4.9	5.3	4.5
		G'	10.4	2.1	10.9	2.5	11.1	2.9	11.1	3.2	10.9	3.4	10.6	3.7	10.2	3.8
	4	S_{LSD}	13.8	9.6	11.6	8.6	10.0	7.7	8.8	6.9	7.8	6.3	6.9	5.7	6.2	5.2
		G'	10.7	2.1	11.4	2.5	11.7	2.9	11.8	3.3	11.6	3.6	11.4	3.8	11.1	4.0
	5	S_{LSD}	15.2	10.3	12.9	9.3	11.2	8.5	9.8	7.7	8.8	7.0	7.9	6.4	7.2	5.9
		G'	11.0	2.1	11.8	2.6	12.2	3.0	12.3	3.3	12.3	3.6	12.1	3.9	11.9	4.1
	6	S_{LSD}	16.3	10.8	14.1	9.9	12.3	9.1	10.9	8.3	9.7	7.7	8.8	7.1	8.0	6.6
		G'	11.2	2.1	12.1	2.6	12.6	3.0	12.8	3.4	12.8	3.7	12.7	4.0	12.5	4.2
	7	S_{LSD}	17.4	11.1	15.2	10.4	13.4	9.6	11.9	8.9	10.6	8.3	9.6	7.7	8.8	7.1
		G'	11.4	2.1	12.4	2.6	13.0	3.0	13.3	3.4	13.3	3.7	13.3	4.1	13.1	4.3
20	2	S_{LSD}	15.1	11.0	12.5	9.5	10.6	8.2	9.1	7.3	7.9	6.5	7.0	5.8	6.3	5.2
		G'	13.5	3.2	13.5	3.7	13.3	4.2	12.8	4.5	12.2	4.8	11.6	4.9	11.1	5.0
	3	S_{LSD}	17.6	12.6	14.7	11.0	12.6	9.8	10.9	8.7	9.7	7.8	8.5	7.1	7.7	6.5
		G'	14.2	3.3	14.5	3.8	14.4	4.3	14.0	4.7	13.5	5.0	12.9	5.3	12.4	5.4
	4	S_{LSD}	19.8	13.7	16.8	12.3	14.4	11.0	12.6	10.0	11.2	9.0	10.1	8.3	9.1	7.6
		G'	14.8	3.3	15.3	3.9	15.3	4.4	15.0	4.9	14.6	5.2	14.1	5.5	13.5	5.7
	5	S_{LSD}	21.7	14.6	18.6	13.3	16.2	12.1	14.2	11.1	12.7	10.1	11.4	9.3	10.4	8.6
		G'	15.2	3.3	15.9	4.0	16.0	4.5	15.9	5.0	15.5	5.4	15.1	5.7	14.6	6.0
	6	S_{LSD}	23.4	15.2	20.3	14.1	17.8	13.0	15.8	12.0	14.1	11.1	12.7	10.2	11.6	9.5
		G'	15.6	3.3	16.4	4.0	16.7	4.6	16.6	5.1	16.3	5.5	15.9	5.9	15.5	6.2
	7	S_{LSD}	24.9	15.7	21.8	14.7	19.3	13.7	17.2	12.8	15.4	11.9	14.0	11.1	12.8	10.3
		G'	16.0	3.4	16.9	4.0	17.2	4.6	17.3	5.2	17.1	5.6	16.7	6.0	16.3	6.3
18	2	S_{LSD}	18.1	13.1	15.0	11.4	12.8	10.0	11.1	8.8	9.7	7.9	8.6	7.1	7.7	6.5
		G'	19.8	5.8	19.1	6.6	18.0	7.1	16.9	7.5	15.9	7.6	14.9	7.7	14.0	7.6
	3	S_{LSD}	21.3	14.9	17.9	13.3	15.4	11.8	13.4	10.6	11.9	9.6	10.7	8.8	9.6	8.0
		G'	21.2	6.0	20.7	6.9	19.8	7.5	18.8	8.0	17.8	8.3	16.7	8.4	15.8	8.5
	4	S_{LSD}	24.0	16.2	20.5	14.7	17.8	13.4	15.6	12.2	13.9	11.1	12.5	10.2	11.4	9.4
		G'	22.3	6.1	22.1	7.1	21.3	7.8	20.4	8.4	19.4	8.8	18.4	9.0	17.5	9.1
	5	S_{LSD}	26.3	17.1	22.8	15.8	20.0	14.6	17.7	13.4	15.8	12.4	14.3	11.5	13.0	10.7
		G'	23.3	6.2	23.2	7.3	22.7	8.1	21.8	8.7	20.9	9.1	19.9	9.5	19.0	9.6
	6	S_{LSD}	28.2	17.7	24.8	16.6	22.0	15.5	19.6	14.5	17.6	13.5	16.0	12.6	14.6	11.8
		G'	24.0	6.3	24.2	7.4	23.8	8.2	23.1	8.9	22.2	9.5	21.2	9.8	20.3	10.1
	7	S_{LSD}	29.8	18.2	26.6	17.3	23.7	16.3	21.3	15.3	19.3	14.4	17.6	13.5	16.1	13.6
		G'	24.7	6.4	25.1	7.5	24.8	8.4	24.2	9.1	23.3	9.7	22.5	10.1	21.6	10.8

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses 5 mm ≤ tf ≤ 10 mm. For attachment to base steel thickness with range 3 mm ≤ tf < 5 mm, diaphragm shear values should be calculated in accordance with Section 3.5.1.7.

2 Tabulated S_{LSD} diaphragm shear loads are calculated with a phi factor (Φ) of 0.65 for wind loads. To calculate S_{LSD} values for load combinations involving earthquake,divide S_{LSD} values in table by 0.65 and multiply by a phi factor (Φ) of 0.60. Panel buckling has been checked.

3 Please refer to footnote 3 through 7 on page 171 of Hilti North American Product Technical Guide Volume 1: Direct Fastening.

3.5.4.4 ORDERING INFORMATION

S-RT5+ M9 Screw Fastening System

SDT 9 Stand Up Decking System* description	Package contents
ST 1800 Metal Construction Screwdriver	Includes tool with depth gauge, 13 ft supply cord and operating instructions in a cardboard box
SDT 9 Stand Up Decking Tool	Includes stand up tool, 2 grips, magazine, 5/16" nutsetter, supply cord strain relief clasp and operating instructions

* Additional tool and fastener packages available. Contact Hilti for more information.

Accessories description	Notes	Qty
SDT 9 Magazine	For use with the SDT 9 Stand Up Decking Tool	1
SDT Integrated Driver and Setter - 5/16"	For use with the SDT 9 or SDT 30 Stand Up Decking Tool	1

For attachment of metal deck to bar joist description	Max. drill capacity	Qty
S-RT5+ M9	0.590	250

S-MD 12-24 x 1-5/8 M HWH5

Approvals/Listings

ICC-ES (International Code Council)
ESR-3693 with LABC/LARC Supplement

FM (Factory Mutual)
For attaching Class 1 Steel Roof Decks with wind uplift ratings up to 1-330

UL (Underwriters Laboratories)
Fasteners for attaching steel roof deck (uplift and fire classification)

3.5.5 S-RT5 METAL DECK FASTENER (S-MD 12-24 x 1-5/8 M HWH5)

3.5.5.1 PRODUCT DESCRIPTION

The Hilti Racing Tip fastening system consists of the Hilti SDT 9 stand-up screw fastening system and the S-MD 12-24 x 1-5/8 M HWH5 Racing Tip fasteners, which are available in a collated version.

The SDT 9 Decking system can be powered with either the ST 1800 Adjustable Torque Screwdriver or the ST 1800-A22 Cordless Adjustable Torque Screwdriver. Loaded with up to 50 frame fasteners or sidelap connectors this system can perform frame attachment and sidelap connections. Contact Hilti for specific tool recommendations.

Hilti S-MD 12-24 x 1-5/8 M HWH5 Racing Tip steel deck fasteners comply with ANSI/SDI RD1.0, C1.0 and NC1.0 standards.

3.5.5.2 MATERIAL SPECIFICATIONS

Fastener designation	Fastener material	Fastener plating
S-MD 12-24 x 1-5/8 M HWH5	Carbon steel	5 µm zinc[1]

1 ASTM B633, SC 1, Type III. Reference Section 2.3.3.1 for more information.

3.5.5.3 TECHNICAL DATA

Allowable pullout loads for attachments to steel base material lb (kN)[1,3,4]

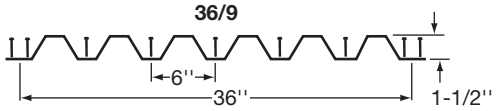
Fastener	Base material thickness in. (Gauge)				
	0.0598 (16)	**0.0747** (14)	**0.1046** (12)	**1/8**[2]	**1/4**[2]
S-MD 12-24 x 1-5/8 M HWH5	**215** (0.96)	**265** (1.18)	**370** (1.65)	**505** (2.25)	**505** (2.25)

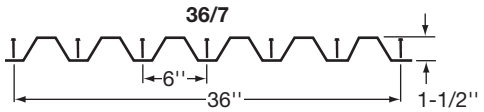
1 Unless otherwise noted, allowable load values based upon calculations done in accordance with AISI S100 with F_u = 58 ksi.
2 Allowable load values based upon testing performed in ASTM A36 (F_u ≥ 58 ksi) plate steel.
3 Allowable tension pullout load values must be compared with allowable tension pullover load values. Use lesser value.
4 Allowable load values based on safety factor of 3.0 per AISI S100.

Allowable tension pullover and shear bearing loads for attaching steel deck [1,2,3,4]

Fastener	Steel deck gauge (in.)									
	16 (0.0598)		**18** (0.0474)		**20** (0.0358)		**22** (0.0295)		**24** (0.0239)	
	Tension lb (kN)	**Shear**[5] **lb** (kN)	**Tension lb** (kN)	**Shear**[5] **lb** (kN)	**Tension lb** (kN)	**Shear lb** (kN)	**Tension lb** (kN)	**Shear lb** (kN)	**Tension lb** (kN)	**Shear lb** (kN)
S-MD 12-24 x 1-5/8 M HWH5	**560** (2.49)	**620** (2.76)	**445** (1.98)	**620** (2.76)	**335** (1.49)	**555** (2.47)	**275** (1.22)	**400** (1.78)	**225** (1.00)	**260** (1.16)

1 Allowable load values are based upon a safety factor of 3.0 per AISI S100.
2 Allowable load values based upon ASTM A1008, or minimum ASTM A653 SQ33 steel deck.
3 Allowable tension pullover load values based upon calculations done in accordance with AISI S100 with F_u = 45 ksi.
4 Allowable tension pullover load values must be compared with allowable tension pullout load values. Use lesser value.
5 Allowable load value limited by screw fastener shear strength.





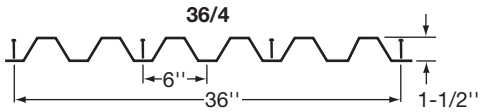
Allowable Stress Design (ASD) — Allowable diaphragm shears, S_{ASD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2" deep flutes, 6" center-to-center steel deck ($F_y \geq 33$ ksi; $F_u \geq 45$ ksi) installed with Hilti S-MD 12-24 x 1-5/8 M HWH5 fasteners with 36/9 or 36/7 end and interior support fastener patterns[1,2,3,4,5,6,7]

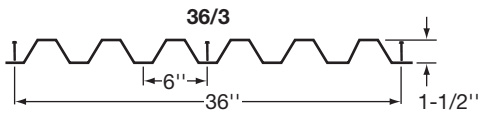
Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			9	7	9	7	9	7	9	7	9	7	9	7	9	7
22	2	S_{ASD}	639	477	532	393	450	332	382	283	331	246	293	218	264	196
		G'	60.7	57	64.1	59.1	65.4	59.2	65.2	58.1	64.2	56.4	62.6	54.4	60.8	52.3
	3	S_{ASD}	709	554	596	462	511	394	442	343	383	298	340	265	306	238
		G'	62.4	59.6	66.6	62.6	68.5	63.5	68.9	63	68.3	61.7	67	60	65.4	58
	4	S_{ASD}	773	623	656	525	566	451	497	394	436	350	387	312	348	281
		G'	63.9	61.5	68.7	65.4	71.1	66.9	72	67	71.8	66.2	70.8	64.7	69.4	63
	5	S_{ASD}	831	685	712	584	619	505	545	444	485	395	434	355	390	322
		G'	65	63.1	70.4	67.6	73.3	69.8	74.6	70.4	74.8	70	74.2	68.8	73	67.3
	6	S_{ASD}	882	739	763	637	668	556	590	491	528	438	477	395	433	359
		G'	66	64.4	71.8	69.5	75.2	72.2	76.9	73.3	77.4	73.2	77.1	72.4	76.2	71.1
	7	S_{ASD}	929	787	811	686	714	603	634	535	569	480	515	434	469	395
		G'	66.9	65.5	73.1	71.1	76.9	74.3	79	75.7	79.8	76.1	79.7	75.6	79	74.5
20	2	S_{ASD}	904	680	754	561	643	476	548	408	475	355	418	313	376	282
		G'	83.1	76.9	85.1	77.2	84.6	75.3	82.7	72.5	79.9	69.2	76.9	65.8	73.7	62.5
	3	S_{ASD}	1008	793	849	663	729	566	637	493	553	433	488	383	439	345
		G'	86.1	81.2	89.1	82.7	89.4	81.7	88	79.4	85.7	76.5	82.9	73.3	79.9	70
	4	S_{ASD}	1101	894	937	756	810	651	711	569	632	505	558	453	502	408
		G'	88.6	84.6	92.5	87.1	93.5	86.9	92.6	85.2	90.7	82.7	88.2	79.8	85.4	76.7
	5	S_{ASD}	1184	982	1018	841	886	730	782	642	697	572	628	515	565	468
		G'	90.6	87.3	95.3	90.8	96.9	91.4	96.7	90.2	95.2	88.1	93	85.5	90.4	82.6
	6	S_{ASD}	1257	1059	1092	917	958	803	849	711	760	635	687	574	626	522
		G'	92.4	89.6	97.7	93.8	100	95.1	100.2	94.6	99.1	92.9	97.2	90.5	94.8	87.8
	7	S_{ASD}	1323	1127	1160	987	1024	870	912	775	820	696	743	630	678	575
		G'	93.9	91.5	99.8	96.5	102.6	98.4	103.3	98.3	102.6	97	101	95	98.9	92.5
18	2	S_{ASD}	1062	816	889	676	760	575	660	500	573	436	506	386	451	345
		G'	124.5	112.6	122.1	108.2	117.3	102.1	111.5	95.8	105.6	89.6	99.9	83.9	94.4	78.7
	3	S_{ASD}	1194	960	1012	807	873	693	765	605	679	536	600	480	536	430
		G'	130.4	120.8	129.3	117.7	125.4	112.4	120.2	106.5	114.5	100.4	108.8	94.6	103.4	89.3
	4	S_{ASD}	1310	1083	1124	925	978	802	862	705	768	627	692	564	621	512
		G'	135.4	127.4	135.5	125.6	132.4	121.2	127.7	115.7	122.4	109.9	116.9	104.2	111.5	98.7
	5	S_{ASD}	1410	1189	1225	1030	1075	901	953	798	853	714	771	644	702	587
		G'	139.6	132.8	140.8	132.3	138.5	128.8	134.4	123.8	129.4	118.3	124.2	112.7	118.9	107.2
	6	S_{ASD}	1497	1278	1316	1122	1164	992	1038	884	933	795	846	720	773	658
		G'	143.2	137.4	145.5	138.1	143.9	135.4	140.4	130.9	135.8	125.8	130.8	120.4	125.6	115
	7	S_{ASD}	1572	1353	1396	1203	1245	1073	1117	963	1009	871	918	792	841	726
		G'	146.3	141.4	149.5	143.1	148.7	141.1	145.7	137.3	141.5	132.5	136.8	127.3	131.8	122.1

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses, t_t , with the range 1/8" ≤ t_t ≤ 1/4".

2 Tabulated ASD diaphragm shear loads are calculated with a safety factor (Ω) of 2.00 for wind loads. To calculate ASD values for load combinations involving earthquake, multiply values in table by 2.00 and divide by a safety factor (Ω) of 2.30. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.





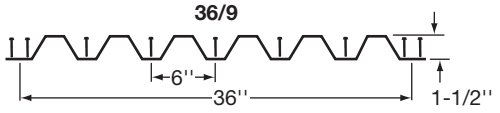
Allowable Stress Design (ASD) - Allowable diaphragm shears, S_{ASD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2" deep flutes, 6" center-to-center steel deck ($F_y \geq 33$ ksi; $F_u \geq 45$ ksi) installed with Hilti S-MD 12-24 x 1-5/8 M HWH5 fasteners with 36/4 or 36/3 end and interior support fastener patterns[1,2,3,4,5,6,7]

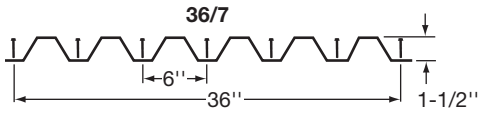
Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			4	3	4	3	4	3	4	3	4	3	4	3	4	3
22	2	S_{ASD}	350	285	299	253	259	225	228	202	201	182	179	166	161	152
		G'	11.9	6.1	14.2	7.4	16.1	8.7	17.7	9.7	19.0	10.7	20.0	11.5	20.8	12.3
	3	S_{ASD}	399	315	349	286	307	260	273	237	245	216	222	198	202	183
		G'	12.1	6.2	14.5	7.6	16.6	8.8	18.3	10.0	19.9	11.0	21.1	12.0	22.1	12.8
	4	S_{ASD}	437	335	390	311	348	287	313	265	283	245	258	227	236	211
		G'	12.2	6.2	14.7	7.6	16.9	8.9	18.8	10.1	20.5	11.3	21.9	12.3	23.1	13.2
	5	S_{ASD}	466	349	423	328	383	307	348	287	317	268	291	251	268	235
		G'	12.3	6.2	14.8	7.7	17.1	9.0	19.2	10.3	20.9	11.4	22.5	12.5	23.8	13.5
	6	S_{ASD}	489	359	449	341	412	323	378	305	347	288	320	271	296	255
		G'	12.3	6.3	14.9	7.7	17.3	9.1	19.4	10.4	21.3	11.6	23.0	12.7	24.4	13.7
	7	S_{ASD}	507	366	471	351	436	336	404	319	374	303	347	288	323	273
		G'	12.4	6.3	15.0	7.7	17.4	9.1	19.6	10.4	21.6	11.7	23.4	12.8	24.9	13.9
20	2	S_{ASD}	498	404	427	360	371	321	327	289	291	261	258	238	232	218
		G'	18.4	9.7	21.5	11.6	24.0	13.3	25.9	14.8	27.3	16.0	28.2	17.1	28.8	17.9
	3	S_{ASD}	569	445	499	407	441	371	393	339	353	310	320	285	292	264
		G'	18.8	9.8	22.2	11.9	24.9	13.7	27.2	15.3	28.9	16.8	30.2	18.0	31.1	19.0
	4	S_{ASD}	622	473	557	440	499	408	450	378	408	351	372	326	342	303
		G'	19.0	9.9	22.6	12.0	25.6	13.9	28.1	15.7	30.1	17.2	31.7	18.6	32.9	19.8
	5	S_{ASD}	662	491	603	464	548	437	500	410	457	384	420	360	387	338
		G'	19.2	9.9	22.9	12.1	26.1	14.1	28.8	15.9	31.1	17.6	32.9	19.1	34.3	20.4
	6	S_{ASD}	692	505	639	482	589	458	542	434	500	410	462	388	429	366
		G'	19.4	10.0	23.2	12.2	26.5	14.2	29.4	16.1	31.8	17.9	33.8	19.4	35.5	20.8
	7	S_{ASD}	716	514	669	495	622	474	578	453	537	432	500	411	467	391
		G'	19.5	10.0	23.4	12.3	26.8	14.3	29.8	16.3	32.4	18.1	34.6	19.7	36.4	21.2
18	2	S_{ASD}	593	474	513	427	449	385	398	348	356	316	321	289	290	266
		G'	33.6	18.4	38.0	21.6	40.9	24.2	42.7	26.1	43.6	27.6	43.8	28.6	43.5	29.3
	3	S_{ASD}	675	519	600	480	535	443	481	408	434	377	395	349	362	324
		G'	34.7	18.8	39.7	22.3	43.3	25.2	45.8	27.6	47.3	29.5	48.1	30.9	48.3	31.9
	4	S_{ASD}	734	547	667	516	605	484	550	453	503	424	461	397	425	372
		G'	35.4	19.1	40.9	22.8	45.1	25.9	48.1	28.6	50.1	30.8	51.4	32.6	52.1	33.9
	5	S_{ASD}	776	565	717	540	661	514	608	487	561	460	519	435	482	411
		G'	36.0	19.3	41.8	23.1	46.4	26.5	49.9	29.3	52.4	31.8	54.1	33.8	55.2	35.5
	6	S_{ASD}	807	578	756	557	705	535	656	512	611	489	569	466	532	443
		G'	36.4	19.4	42.5	23.3	47.5	26.9	51.3	29.9	54.3	32.6	56.4	34.8	57.8	36.7
	7	S_{ASD}	829	586	785	570	740	551	695	531	653	511	613	490	576	470
		G'	36.8	19.5	43.1	23.5	48.4	27.2	52.5	30.4	55.8	33.2	58.2	35.6	60.0	37.7

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses, t_t , with the range 1/8" ≤ t_t ≤ 1/4".

2 Tabulated ASD diaphragm shear loads are calculated with a safety factor (Ω) of 2.00 for wind loads. To calculate ASD values for load combinations involving earthquake, multiply values in table by 2.00 and divide by a safety factor (Ω) of 2.30. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.





Load Resistance Factor Design (LRFD) - Factored resistance diaphragm shears, S_{LRFD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2" deep flutes, 6" center-to-center steel deck ($F_y \geq 50$ ksi; $F_u \geq 65$ ksi) installed with Hilti S-MD 12-24 x 1-5/8 M HWH5 fasteners with 36/9 or 36/7 end and interior support fastener patterns[1,2,3,4,5,6,7]

Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			9	7	9	7	9	7	9	7	9	7	9	7	9	7
22	2	S_{LRFD}	1022	763	851	629	720	531	611	453	530	394	469	349	422	314
		G'	60.7	57	64.1	59.1	65.4	59.2	65.2	58.1	64.2	56.4	62.6	54.4	60.8	52.3
	3	S_{LRFD}	1134	886	954	739	818	630	707	549	613	477	544	424	490	381
		G'	62.4	59.6	66.6	62.6	68.5	63.5	68.9	63	68.3	61.7	67	60	65.4	58
	4	S_{LRFD}	1237	997	1050	840	906	722	795	630	698	560	619	499	557	450
		G'	63.9	61.5	68.7	65.4	71.1	66.9	72	67	71.8	66.2	70.8	64.7	69.4	63
	5	S_{LRFD}	1330	1096	1139	934	990	808	872	710	776	632	694	568	624	515
		G'	65	63.1	70.4	67.6	73.3	69.8	74.6	70.4	74.8	70	74.2	68.8	73	67.3
	6	S_{LRFD}	1411	1182	1221	1019	1069	890	944	786	845	701	763	632	693	574
		G'	66	64.4	71.8	69.5	75.2	72.2	76.9	73.3	77.4	73.2	77.1	72.4	76.2	71.1
	7	S_{LRFD}	1486	1259	1298	1098	1142	965	1014	856	910	768	824	694	750	632
		G'	66.9	65.5	73.1	71.1	76.9	74.3	79	75.7	79.8	76.1	79.7	75.6	79	74.5
20	2	S_{LRFD}	1446	1088	1206	898	1029	762	877	653	760	568	669	501	602	451
		G'	83.1	76.9	85.1	77.2	84.6	75.3	82.7	72.5	79.9	69.2	76.9	65.8	73.7	62.5
	3	S_{LRFD}	1613	1269	1358	1061	1166	906	1019	789	885	693	781	613	702	552
		G'	86.1	81.2	89.1	82.7	89.4	81.7	88	79.4	85.7	76.5	82.9	73.3	79.9	70
	4	S_{LRFD}	1762	1430	1499	1210	1296	1042	1138	910	1011	808	893	725	803	653
		G'	88.6	84.6	92.5	87.1	93.5	86.9	92.6	85.2	90.7	82.7	88.2	79.8	85.4	76.7
	5	S_{LRFD}	1894	1571	1629	1346	1418	1168	1251	1027	1115	915	1005	824	904	749
		G'	90.6	87.3	95.3	90.8	96.9	91.4	96.7	90.2	95.2	88.1	93	85.5	90.4	82.6
	6	S_{LRFD}	2011	1694	1747	1467	1533	1285	1358	1138	1216	1016	1099	918	1002	835
		G'	92.4	89.6	97.7	93.8	100	95.1	100.2	94.6	99.1	92.9	97.2	90.5	94.8	87.8
	7	S_{LRFD}	2117	1803	1856	1579	1638	1392	1459	1240	1312	1114	1189	1008	1085	920
		G'	93.9	91.5	99.8	96.5	102.6	98.4	103.3	98.3	102.6	97	101	95	98.9	92.5
18	2	S_{LRFD}	1699	1306	1422	1082	1216	920	1056	800	917	698	810	618	722	552
		G'	124.5	112.6	122.1	108.2	117.3	102.1	111.5	95.8	105.6	89.6	99.9	83.9	94.4	78.7
	3	S_{LRFD}	1910	1536	1619	1291	1397	1109	1224	968	1086	858	960	768	858	688
		G'	130.4	120.8	129.3	117.7	125.4	112.4	120.2	106.5	114.5	100.4	108.8	94.6	103.4	89.3
	4	S_{LRFD}	2096	1733	1798	1480	1565	1283	1379	1128	1229	1003	1107	902	994	819
		G'	135.4	127.4	135.5	125.6	132.4	121.2	127.7	115.7	122.4	109.9	116.9	104.2	111.5	98.7
	5	S_{LRFD}	2256	1902	1960	1648	1720	1442	1525	1277	1365	1142	1234	1030	1123	939
		G'	139.6	132.8	140.8	132.3	138.5	128.8	134.4	123.8	129.4	118.3	124.2	112.7	118.9	107.2
	6	S_{LRFD}	2395	2045	2106	1795	1862	1587	1661	1414	1493	1272	1354	1152	1237	1053
		G'	143.2	137.4	145.5	138.1	143.9	135.4	140.4	130.9	135.8	125.8	130.8	120.4	125.6	115
	7	S_{LRFD}	2515	2165	2234	1925	1992	1717	1787	1541	1614	1394	1469	1267	1346	1162
		G'	146.3	141.4	149.5	143.1	148.7	141.1	145.7	137.3	141.5	132.5	136.8	127.3	131.8	122.1

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses, t_t , with the range 1/8" ≤ t_t ≤ 1/4".

2 Tabulated LRFD diaphragm shear loads are calculated with a phi factor (Φ) of 0.70 for wind loads. To calculate LRFD values for load combinations involving earthquake, divide values in table by 0.70 and multiply by a phi factor (Φ) of 0.65. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.

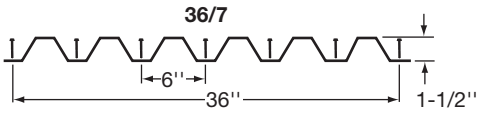
Load Resistance Factor Design (LRFD) - Factored resistance diaphragm shears, S_{LRFD}, (plf) and stiffness factors, G', (kips/in.) for standard 1-1/2" deep flutes, 6" center-to-center steel deck ($F_y \geq 33$ ksi; $F_u \geq 45$ ksi) installed with Hilti S-MD 12-24 x 1-5/8 M HWH5 fasteners with 36/4 or 36/3 end and interior support fastener patterns[1,2,3,4,5,6,7]

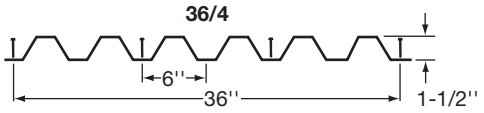
Gauge	Number of Hilti SLC per span	Factor	Span (ft- in.)													
			4'-0"		5'-0"		6'-0"		7'-0"		8'-0"		9'-0"		10'-0"	
			Fasteners per sheet to support													
			4	3	4	3	4	3	4	3	4	3	4	3	4	3
22	2	S_{LRFD}	560	456	478	405	414	360	365	323	322	291	286	266	258	243
		G'	11.9	6.1	14.2	7.4	16.1	8.7	17.7	9.7	19.0	10.7	20.0	11.5	20.8	12.3
	3	S_{LRFD}	638	504	558	458	491	416	437	379	392	346	355	317	323	293
		G'	12.1	6.2	14.5	7.6	16.6	8.8	18.3	10.0	19.9	11.0	21.1	12.0	22.1	12.8
	4	S_{LRFD}	699	536	624	498	557	459	501	424	453	392	413	363	378	338
		G'	12.2	6.2	14.7	7.6	16.9	8.9	18.8	10.1	20.5	11.3	21.9	12.3	23.1	13.2
	5	S_{LRFD}	746	558	677	525	613	491	557	459	507	429	466	402	429	376
		G'	12.3	6.2	14.8	7.7	17.1	9.0	19.2	10.3	20.9	11.4	22.5	12.5	23.8	13.5
	6	S_{LRFD}	782	574	718	546	659	517	605	488	555	461	512	434	474	408
		G'	12.3	6.3	14.9	7.7	17.3	9.1	19.4	10.4	21.3	11.6	23.0	12.7	24.4	13.7
	7	S_{LRFD}	811	586	754	562	698	538	646	510	598	485	555	461	517	437
		G'	12.4	6.3	15.0	7.7	17.4	9.1	19.6	10.4	21.6	11.7	23.4	12.8	24.9	13.9
20	2	S_{LRFD}	797	646	683	576	594	514	523	462	466	418	413	381	371	349
		G'	18.4	9.7	21.5	11.6	24.0	13.3	25.9	14.8	27.3	16.0	28.2	17.1	28.8	17.9
	3	S_{LRFD}	910	712	798	651	706	594	629	542	565	496	512	456	467	422
		G'	18.8	9.8	22.2	11.9	24.9	13.7	27.2	15.3	28.9	16.8	30.2	18.0	31.1	19.0
	4	S_{LRFD}	995	757	891	704	798	653	720	605	653	562	595	522	547	485
		G'	19.0	9.9	22.6	12.0	25.6	13.9	28.1	15.7	30.1	17.2	31.7	18.6	32.9	19.8
	5	S_{LRFD}	1059	786	965	742	877	699	800	656	731	614	672	576	619	541
		G'	19.2	9.9	22.9	12.1	26.1	14.1	28.8	15.9	31.1	17.6	32.9	19.1	34.3	20.4
	6	S_{LRFD}	1107	808	1022	771	942	733	867	694	800	656	739	621	686	586
		G'	19.4	10.0	23.2	12.2	26.5	14.2	29.4	16.1	31.8	17.9	33.8	19.4	35.5	20.8
	7	S_{LRFD}	1146	822	1070	792	995	758	925	725	859	691	800	658	747	626
		G'	19.5	10.0	23.4	12.3	26.8	14.3	29.8	16.3	32.4	18.1	34.6	19.7	36.4	21.2
18	2	S_{LRFD}	949	758	821	683	718	616	637	557	570	506	514	462	464	426
		G'	33.6	18.4	38.0	21.6	40.9	24.2	42.7	26.1	43.6	27.6	43.8	28.6	43.5	29.3
	3	S_{LRFD}	1080	830	960	768	856	709	770	653	694	603	632	558	579	518
		G'	34.7	18.8	39.7	22.3	43.3	25.2	45.8	27.6	47.3	29.5	48.1	30.9	48.3	31.9
	4	S_{LRFD}	1174	875	1067	826	968	774	880	725	805	678	738	635	680	595
		G'	35.4	19.1	40.9	22.8	45.1	25.9	48.1	28.6	50.1	30.8	51.4	32.6	52.1	33.9
	5	S_{LRFD}	1242	904	1147	864	1058	822	973	779	898	736	830	696	771	658
		G'	36.0	19.3	41.8	23.1	46.4	26.5	49.9	29.3	52.4	31.8	54.1	33.8	55.2	35.5
	6	S_{LRFD}	1291	925	1210	891	1128	856	1050	819	978	782	910	746	851	709
		G'	36.4	19.4	42.5	23.3	47.5	26.9	51.3	29.9	54.3	32.6	56.4	34.8	57.8	36.7
	7	S_{LRFD}	1326	938	1256	912	1184	882	1112	850	1045	818	981	784	922	752
		G'	36.8	19.5	43.1	23.5	48.4	27.2	52.5	30.4	55.8	33.2	58.2	35.6	60.0	37.7

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses, t_t, with the range 1/8" ≤ t_t ≤ 1/4".

2 Tabulated LRFD diaphragm shear loads are calculated with a phi factor (Φ) of 0.80 for wind loads. To calculate LRFD values for load combinations involving earthquake, divide values in table by 0.80 and multiply by a phi factor (Φ) of 0.683. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.





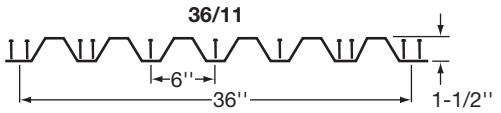
Limit States Design (LSD) – Factored resistance diaphragm shears, S_{LSD}, (N/mm) and stiffness factors, G', (103 N/mm) for standard 38mm deep flutes, 152mm center-to-center deck (F_y≥345 Mpa;F_u≥450 Mpa) installed with Hilti S-MD 12-24 x 1-5/8 M HWH5 fasteners with 914/7 (36/7) or 914/4 (36/4) end and interior support fastener patterns[1,2,3,4,5,6,7]

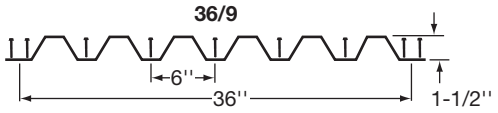
Gauge	Number of Hilti SLC per span	Factor	Span (mm)													
			1200		1500		1800		2100		2400		2700		3000	
			Fasteners per sheet to support													
			7	4	7	4	7	4	7	4	7	4	7	4	7	4
22	2	S_{LSD}	10.6	7.7	8.7	6.6	7.4	5.8	6.3	5.1	5.5	4.5	4.8	4.0	4.4	3.6
		G'	9.9	2.1	10.3	2.5	10.4	2.8	10.2	3.1	9.9	3.3	9.6	3.5	9.2	3.6
	3	S_{LSD}	12.3	8.8	10.2	7.7	8.7	6.8	7.6	6.1	6.6	5.4	5.9	4.9	5.3	4.5
		G'	10.4	2.1	10.9	2.5	11.1	2.9	11.1	3.2	10.9	3.4	10.6	3.7	10.2	3.8
	4	S_{LSD}	13.8	9.6	11.6	8.6	10.0	7.7	8.8	6.9	7.8	6.3	6.9	5.7	6.2	5.2
		G'	10.7	2.1	11.4	2.5	11.7	2.9	11.8	3.3	11.6	3.6	11.4	3.8	11.1	4.0
	5	S_{LSD}	15.2	10.3	12.9	9.3	11.2	8.5	9.8	7.7	8.8	7.0	7.9	6.4	7.2	5.9
		G'	11.0	2.1	11.8	2.6	12.2	3.0	12.3	3.3	12.3	3.6	12.1	3.9	11.9	4.1
	6	S_{LSD}	16.3	10.8	14.1	9.9	12.3	9.1	10.9	8.3	9.7	7.7	8.8	7.1	8.0	6.6
		G'	11.2	2.1	12.1	2.6	12.6	3.0	12.8	3.4	12.8	3.7	12.7	4.0	12.5	4.2
	7	S_{LSD}	17.4	11.1	15.2	10.4	13.4	9.6	11.9	8.9	10.6	8.3	9.6	7.7	8.8	7.1
		G'	11.4	2.1	12.4	2.6	13.0	3.0	13.3	3.4	13.3	3.7	13.3	4.1	13.1	4.3
20	2	S_{LSD}	15.1	11.0	12.5	9.5	10.6	8.2	9.1	7.3	7.9	6.5	7.0	5.8	6.3	5.2
		G'	13.5	3.2	13.5	3.7	13.3	4.2	12.8	4.5	12.2	4.8	11.6	4.9	11.1	5.0
	3	S_{LSD}	17.6	12.6	14.7	11.0	12.6	9.8	10.9	8.7	9.7	7.8	8.5	7.1	7.7	6.5
		G'	14.2	3.3	14.5	3.8	14.4	4.3	14.0	4.7	13.5	5.0	12.9	5.3	12.4	5.4
	4	S_{LSD}	19.8	13.7	16.8	12.3	14.4	11.0	12.6	10.0	11.2	9.0	10.1	8.3	9.1	7.6
		G'	14.8	3.3	15.3	3.9	15.3	4.4	15.0	4.9	14.6	5.2	14.1	5.5	13.5	5.7
	5	S_{LSD}	21.7	14.6	18.6	13.3	16.2	12.1	14.2	11.1	12.7	10.1	11.4	9.3	10.4	8.6
		G'	15.2	3.3	15.9	4.0	16.0	4.5	15.9	5.0	15.5	5.4	15.1	5.7	14.6	6.0
	6	S_{LSD}	23.4	15.2	20.3	14.1	17.8	13.0	15.8	12.0	14.1	11.1	12.7	10.2	11.6	9.5
		G'	15.6	3.3	16.4	4.0	16.7	4.6	16.6	5.1	16.3	5.5	15.9	5.9	15.5	6.2
	7	S_{LSD}	24.9	15.7	21.8	14.7	19.3	13.7	17.2	12.8	15.4	11.9	14.0	11.1	12.8	10.3
		G'	16.0	3.4	16.9	4.0	17.2	4.6	17.3	5.2	17.1	5.6	16.7	6.0	16.3	6.3
18	2	S_{LSD}	18.1	13.1	15.0	11.4	12.8	10.0	11.1	8.8	9.7	7.9	8.6	7.1	7.7	6.5
		G'	19.8	5.8	19.1	6.6	18.0	7.1	16.9	7.5	15.9	7.6	14.9	7.7	14.0	7.6
	3	S_{LSD}	21.3	14.9	17.9	13.3	15.4	11.8	13.4	10.6	11.9	9.6	10.7	8.8	9.6	8.0
		G'	21.2	6.0	20.7	6.9	19.8	7.5	18.8	8.0	17.8	8.3	16.7	8.4	15.8	8.5
	4	S_{LSD}	24.0	16.2	20.5	14.7	17.8	13.4	15.6	12.2	13.9	11.1	12.5	10.2	11.4	9.4
		G'	22.3	6.1	22.1	7.1	21.3	7.8	20.4	8.4	19.4	8.8	18.4	9.0	17.5	9.1
	5	S_{LSD}	26.3	17.1	22.8	15.8	20.0	14.6	17.7	13.4	15.8	12.4	14.3	11.5	13.0	10.7
		G'	23.3	6.2	23.2	7.3	22.7	8.1	21.8	8.7	20.9	9.1	19.9	9.5	19.0	9.6
	6	S_{LSD}	28.2	17.7	24.8	16.6	22.0	15.5	19.6	14.5	17.6	13.5	16.0	12.6	14.6	11.8
		G'	24.0	6.3	24.2	7.4	23.8	8.2	23.1	8.9	22.2	9.5	21.2	9.8	20.3	10.1
	7	S_{LSD}	29.8	18.2	26.6	17.3	23.7	16.3	21.3	15.3	19.3	14.4	17.6	13.5	16.1	13.6
		G'	24.7	6.4	25.1	7.5	24.8	8.4	24.2	9.1	23.3	9.7	22.5	10.1	21.6	10.8

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses, t_f, with the range 1/8" ≤ t_f ≤ 6 mm.

2 Tabulated LSD diaphragm shear loads are calculated with a phi factor (Φ) of 0.75 for wind loads. To calculate LSD values for load combinations involving earthquake, divide values in table by 0.75 and multiply by a phi factor (Φ) of 0.55. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.





Limit States Design (LSD) – Factored resistance diaphragm shears, S_{LSD}, (N/mm) and stiffness factors, G', (10^3 N/mm) for standard 38mm deep flutes, 152mm center-to-center deck (F_y≥345 Mpa;F_u≥450 Mpa) installed with Hilti S-MD 12-24 x 1-5/8 M HWH5 fasteners with 914/11 (36/11) or 914/9 (36/9) end and interior support fastener patterns[1,2,3,4,5,6,7]

Gauge	Number of Hilti SLC per span	Factor	Span (mm)													
			1200		1500		1800		2100		2400		2700		3000	
			Fasteners per sheet to support													
			11	9	11	9	11	9	11	9	11	9	11	9	11	9
22	2	S_{LSD}	16.3	14.2	13.5	11.8	11.4	10.0	9.6	8.5	8.4	7.4	7.4	6.5	6.7	5.9
		G'	10.9	10.6	11.6	11.2	12.0	11.5	12.1	11.5	12.0	11.3	11.8	11.0	11.5	10.7
	3	S_{LSD}	18.0	15.7	15.0	13.2	12.8	11.3	11.0	9.9	9.5	8.5	8.4	7.6	7.6	6.8
		G'	11.1	10.9	12.0	11.6	12.5	12.0	12.6	12.1	12.6	12.0	12.5	11.8	12.2	11.5
	4	S_{LSD}	19.6	17.1	16.4	14.5	14.1	12.6	12.3	11.0	10.7	9.7	9.5	8.6	8.5	7.7
		G'	11.3	11.1	12.3	12.0	12.8	12.4	13.1	12.6	13.1	12.6	13.0	12.4	12.9	12.2
	5	S_{LSD}	21.1	18.4	17.8	15.8	15.3	13.7	13.4	12.1	11.9	10.8	10.5	9.6	9.5	8.7
		G'	11.5	11.3	12.5	12.3	13.2	12.8	13.5	13.1	13.6	13.1	13.5	13.0	13.4	12.8
	6	S_{LSD}	22.4	19.5	19.1	16.9	16.5	14.8	14.5	13.1	12.9	11.7	11.6	10.6	10.4	9.6
		G'	11.6	11.5	12.7	12.5	13.4	13.1	13.8	13.5	14.0	13.6	14.0	13.5	13.9	13.4
	7	S_{LSD}	23.7	20.5	20.3	17.9	17.7	15.8	15.6	14.1	13.9	12.6	12.5	11.4	11.3	10.4
		G'	11.8	11.6	12.9	12.7	13.7	13.4	14.1	13.8	14.3	14.0	14.4	14.0	14.3	13.9
20	2	S_{LSD}	23.1	20.0	19.1	16.7	16.2	14.3	13.8	12.2	12.0	10.6	10.5	9.3	9.5	8.4
		G'	15.0	14.5	15.6	14.9	15.7	14.9	15.5	14.5	15.1	14.1	14.6	13.6	14.1	13.0
	3	S_{LSD}	25.6	22.3	21.3	18.8	18.2	16.2	15.8	14.1	13.7	12.3	12.1	10.9	10.9	9.8
		G'	15.5	15.0	16.2	15.6	16.4	15.7	16.3	15.5	16.0	15.1	15.6	14.6	15.1	14.1
	4	S_{LSD}	27.9	24.4	23.5	20.8	20.1	18.0	17.6	15.8	15.5	14.0	13.7	12.4	12.3	11.2
		G'	15.8	15.5	16.7	16.2	17.0	16.4	17.0	16.3	16.8	16.0	16.4	15.5	16.0	15.1
	5	S_{LSD}	30.0	26.2	25.5	22.5	22.0	19.6	19.2	17.3	17.1	15.5	15.2	14.0	13.7	12.6
		G'	16.1	15.8	17.1	16.7	17.5	17.0	17.6	17.0	17.4	16.7	17.1	16.4	16.7	15.9
	6	S_{LSD}	32.0	27.8	27.3	24.2	23.7	21.2	20.9	18.8	18.6	16.9	16.7	15.2	15.1	13.9
		G'	16.4	16.1	17.4	17.1	18.0	17.5	18.1	17.6	18.0	17.4	17.8	17.1	17.4	16.7
	7	S_{LSD}	33.8	29.2	29.1	25.6	25.4	22.7	22.4	20.2	20.0	18.2	18.0	16.5	16.4	15.1
		G'	16.6	16.4	17.8	17.4	18.4	18.0	18.6	18.1	18.6	18.0	18.4	17.8	18.1	17.4
18	2	S_{LSD}	27.0	23.5	22.4	19.7	19.1	16.9	16.5	14.7	14.3	12.8	12.6	11.3	11.3	10.1
		G'	22.9	21.8	22.7	21.5	22.1	20.7	21.2	19.7	20.3	18.7	19.3	17.7	18.3	16.7
	3	S_{LSD}	30.3	26.4	25.4	22.4	21.7	19.4	18.9	17.0	16.7	15.1	14.7	13.4	13.2	12.0
		G'	23.7	22.8	23.8	22.7	23.3	22.1	22.5	21.2	21.6	20.2	20.7	19.2	19.7	18.3
	4	S_{LSD}	33.2	29.0	28.1	24.9	24.2	21.7	21.2	19.1	18.8	17.1	16.8	15.4	15.1	13.9
		G'	24.4	23.7	24.7	23.8	24.4	23.3	23.7	22.5	22.8	21.6	21.9	20.6	21.0	19.7
	5	S_{LSD}	35.9	31.2	30.7	27.1	26.6	23.8	23.4	21.1	20.8	18.9	18.8	17.1	17.0	15.6
		G'	25.1	24.4	25.5	24.7	25.3	24.3	24.7	23.7	23.9	22.8	23.1	21.9	22.2	21.0
	6	S_{LSD}	38.2	33.0	33.0	29.1	28.8	25.8	25.5	23.0	22.8	20.7	20.5	18.8	18.7	17.2
		G'	25.6	25.0	26.2	25.5	26.1	25.3	25.6	24.7	24.9	23.9	24.1	23.1	23.3	22.2
	7	S_{LSD}	40.4	34.7	35.2	30.9	30.9	27.5	27.5	24.7	24.6	22.4	22.3	20.4	20.3	18.7
		G'	26.1	25.6	26.8	26.2	26.9	26.1	26.5	25.6	25.8	24.9	25.1	24.1	24.3	23.3

1 Tabulated diaphragm shear values are for attachment of steel deck to base steel thicknesses, t_f, with the range 1/8" ≤ t_f ≤ 6 mm.

2 Tabulated LSD diaphragm shear loads are calculated with a phi factor (Φ) of 0.75 for wind loads. To calculate LSD values for load combinations involving earthquake, divide values in table by 0.75 and multiply by a phi factor (Φ) of 0.55. Panel buckling has been checked.

3 Please refer to footnotes 3 through 7 on page 171.

3.5.5.4 ORDERING INFORMATION

Racing Tip Screw Fastening System

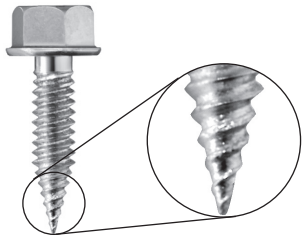
SDT 9 Stand Up Decking System* description	Package contents
ST 1800 Metal Construction Screwdriver	Includes tool with depth gauge, 13 ft supply cord and operating instructions in a cardboard box
SDT 9 Stand Up Decking Tool	Includes stand up tool, 2 grips, magazine, 5/16“ nutsetter, supply cord strain relief clasp and operating instructions

* Additional tool and fastener packages available. Contact Hilti for more information.

Accessories description	Notes	Qty
SDT 9 Magazine	For use with the SDT 9 Stand Up Decking Tool	1
SDT Integrated Driver and Setter - 5/16”	For use with the SDT 9 or SDT 30 Stand Up Decking Tools	1

For attachment of metal deck to bar joist description	Max. drill capacity	Qty
S-MD 12-24 x 1 5/8“ M HWH5	0.500”	250

S-SLC 01 M HWH
Collated Sidelap Connectors



S-SLC 01 M HWH
Sidelap Connector

S-SLC 02 M HWH
Collated Sidelap Connectors

S-SLC 02 M HWH
Sidelap Connectors

Approvals/Listings

ICC-ES (International Code Council)
ESR-2776 with LABC/LARC Supplement (AC43 for S-SLC 01 and S-SLC 02)
ESR-2197 with LABC/LARC Supplement (AC43 for #10 HWH Screws)
ESR-2196 with LABC/LARC Supplement (AC118 for S-SLC 02 and #10 HWH Screws)

FM (Factory Mutual)
S-SLC 01 M HWH and S-SLC 02 M HWH fasteners for securing Class 1 Steel Roof Deck sidelaps with wind uplift ratings up to 1-330.

3.5.6 SLC SIDELAP CONNECTORS FOR FASTENING DECK-TO-DECK

3.5.6.1 PRODUCT DESCRIPTION

The Hilti sidelap fastening system consists of a stand up tool (SDT 9), an electric screwdriver (ST 1800) or SD 4500 with SDT 9 Speed Kit) and collated sidelap connectors.

For nestable steel deck profiles, the tool of choice is the SDT 9. It uses the ST 1800 electric or ST 1800-A22 battery screwdriver to drive sidelap connectors through sidelaps ranging from 16 to 26 gauge in thickness. Featuring an adjustable torque clutch, the ST 1800 or ST 1800-A22 helps ensure proper fastening while minimizing overdrive. The SDT5 can also use SD 4500 electric or SD 4500-A22 battery screw drive with SDT 9 Speed Kit for driving through sidelaps ranging from 20 to 22 gauge using SLC 01 and HWH #10 screws.

When used with the SDT 9 and Hilti's DX 9 tools, the ST 1800-A22 or SD 4500-A22 with SDT 9 Speed Kit cordless screw drivers provides for a completely stand-up and cordless deck attachment.

When compared with fastening individual, non-collated, screws, the SDT 9 offers the installer the capability to work upright. By improving the comfort of the installer and productivity, helping keep the project on time and on budget.

Hilti steel deck sidelap fasteners comply with ANSI/SDI RD1.0, C1.0 and NC1.0 standards.

3.5.6.2 MATERIAL SPECIFICATIONS

Fastener	Fastener material	Fastener plating
S-SLC 01 M HWH	Carbon Steel	5 µm Zinc[1]
S-SLC 02 M HWH	Carbon Steel	5 µm Zinc[2]
Hilti #10 HWH Screw	Carbon Steel	5 µm Zinc[2]

1 EN/ISO 4042 A/3/E. Reference Section 2.3.3.1 for more information.
2 Minimum requirements of EN/ISO 4042 A3F. Reference Section 2.3.3.1 for more information.

3.5.6.3 TECHNICAL DATA

Allowable tension (pullout or pullover) and shear bearing loads for Hilti SLC Sidelap Connectors[1,2,3]

Fastener	Sheet steel gauge							
	22 to 22		20 to 20		18 to 18		16 to 16	
	Tension lb (kN)	**Shear lb** (kN)	**Tension lb** (kN)	**Shear lb** (kN)	**Tension lb** (kN)	**Shear lb** (kN)	**Tension lb** (kN)	**Shear lb** (kN)
S-SLC 01 M HWH[4,5]	**105** (0.47)	**148** (0.66)	**120** (0.53)	**198** (**0.88**)	**150** (0.67)	**302** (1.34)	–	–
S-SLC 02 M HWH[5]	**85** (0.38)	**148** (0.66)	**100** (0.44)	**198** (**0.88**)	**130** (0.58)	**302** (1.34)	**165** (0.73)	**428** (1.90)
Hilti #10 HWH Screw[6]	**70** (0.31)	**139** (**0.62**)	**85** (**0.38**)	**186** (**0.83**)	**115** (**0.51**)	**283** (**1.26**)	**145** (**0.64**)	**402** (**1.79**)

1 Based upon attachment of two-same thickness layers of ASTM A1008 or minimum ASTM A653 SQ33 steel deck.
2 Allowable capacities based on a safety factor of 3.0.
3 Allowable tension capacities based upon the controlling capacity of pullout, pullover or fastener tension strength.
4 Use of S-SLC 01 M HWH with 18 gauge steel deck is recommended only for standard tensile strength (45 ≤ F_u ≤ 65 ksi) steel deck. For high tensile strength (F_u > 65 ksi) 18 gauge steel deck, use S-SLC 02 M HWH.
5 Allowable shear capacities calculated according to Section J4.3 of AISI S100 for standard No. 12 screw. For shear capacities when used in diaphragm applications in combination with Hilti deck frame fasteners, reference P_{ns} values in Table 8 in Section 3.5.1.7.
6 Allowable shear capacities calculated according to Section J4.3 of AISI S100 for standard No. 10 screw.

3.5.6.4 ORDERING INFORMATION

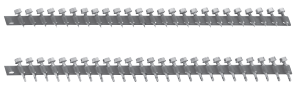
SDT Stand-Up Decking Tool System

Tools description	Notes	Qty
ST 1800 Adjustable Torque Screwdriver	Includes tool with depth gauge, 13 ft supply cord and operating instructions	1 pcs
ST 1800-A22 Adjustable Torque Cordless Screwdriver	Includes tools, (2) B 22 Li-Ion batteries, (1) C 4/36 90 charger and operating instruction sin a Hilti soft tool bag	1 pcs
SD 4500 Screwdriver	Includes tool with SDT 9 Speed Kit	1 pcs
SD 4500-A22 Cordless Screwdriver	Includes tool with SDT 9 Speed Kit	1 pcs
SDT 9 Stand Up Tool (for use with the ST 1800, ST 1800-A22 and SD 4500, SD 4500-A22)	Includes stand up tool, 2 grips, magazine, bit holder, nut setter, supply cord strain relief	1 pcs

Accessories description	Notes	Qty
SDT 9 Magazine	Replacement magazine for SDT 9	1 pcs
SDT Integrated Driver and Setter	Single piece design for SDT 9	1 pcs
SDT 9 Speed Kit	For use with SD 4500 or SD 4500-A22	1 pcs

Sidelap Connectors (combos including ST 1800 or ST 1800-A18 and SDT 30) description	Notes	Qty
SDT 9, ST 1800 and 10,000 Sidelap Connectors	Can include collated connector choices below	10,000 pcs
SDT 9, ST 1800 and 25,000 Sidelap Connectors	Can include collated connector choices below	25,000 pcs
SDT 9, ST 1800 and 50,000 Sidelap Connectors	Can include collated connector choices below	50,000 pcs
SDT 9, ST 1800 and 100,000 Sidelap Connectors	Can include collated connector choices below	100,000 pcs
SDT 9, ST 1800-A22 and 15,000 Sidelap Connectors	Can include collated connector choices below	15,000 pcs

Sidelap connectors (collated)* description	Deck thickness (GA)	Qty
S-SLC 01 M HWH	18[1], 20, 22, 24, 26	250
S-SLC 02 M HWH	16, 18, 20, 22	250
#10 HWH Screw	18, 20, 22, 24,26	250



1 Use of S-SLC 01 M HWH with 18 gauge steel deck is recommended only for standard tensile strength (45 ≤ F_u ≤ 65 ksi) steel deck. For high tensile strength (F_u > 65 ksi) 18 gauge steel deck, use S-SLC 02 M HWH.

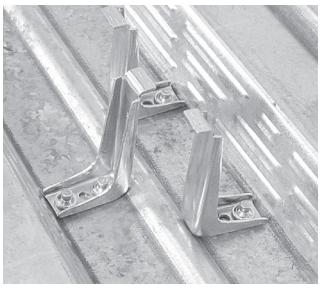
3.5.7 X-HVB SHEAR CONNECTOR

3.5.7.1 PRODUCT DESCRIPTION

The Hilti X-HVB Shear Connector is a shear transfer device mechanically attached with Hilti X-ENP-21 HVB powder-actuated fasteners (Note: Do not use Hilti X-ENP-19 L15 fasteners) for use in composite beam construction with steel beams and concrete slabs as an alternate to welded studs.

Product features

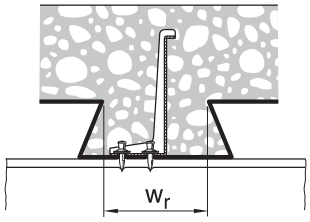
- Ductile connections
- Minimal damage to coatings
- Faster and simpler installation
- Install in virtually any weather
- No electrical power source required

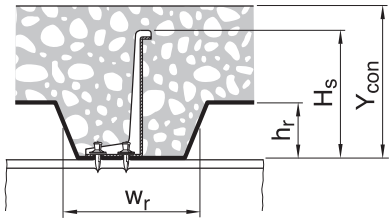


3.5.7.2 MATERIAL SPECIFICATION

X-HVB: Carbon Steel with F_u = 39,000 psi
Zinc plated for corrosion resistance in accordance with ASTM B633, SC 1, Type III. Reference Section 2.3.3.1 of Hilti North American Product Technical Guide Volume 1: Direct Fastening for more information.

3.5.7.3 TECHNICAL DATA





Product selection and performance in concrete over metal deck composite floor slabs[3,4]

X-HVB connector	Connector height, H_s in. (mm)	Minimum slab thickness, Y_{con} in. (mm)	Maximum rib height, h_r in. (mm) $w_r/h_r \geq 1.8$	Maximum rib height, h_r in. (mm) $w_r/h_r < 1.8$	Nominal shear strength[1], Q_n lb (kN)	Allowable shear strength[2], q lb (kN)
X-HVB80	**3-1/8** (80)	**3-11/16** (93)	**1-3/4** (45)	**1-3/4** (45)	7308 (32.5)	3654 (16.3)
X-HVB95	**3-3/4** (95)	**4-1/4** (108)	**2-3/8** (60)	**2-1/4** (57)	7868 (35.0)	3934 (17.5)
X-HVB110	**4-5/16** (110)	**4-13/16** (123)	**2-15/16** (75)	**2-5/8** (66)	7868 (35.0)	3934 (17.5)
X-HVB125	**4-15/16** (125)	**5-7/16** (138)	**3-1/8** (80)	**2-15/16** (75)	8430 (37.5)	4215 (18.7)
X-HVB140	**5-1/2** **(140)**	**6** (152)	**3-1/8** (80)	**3-1/8** (80)	8430 (37.5)	4215 (18.7)

1 Nominal shear strength to be used for designs per AISC-LRFD and unfactored shear resistance per AISC design formulas.
2 Allowable shear strength to be used for designs per AISC-ASD.
3 Nominal and allowable shear strength values may need to be reduced in certain cases, where the geometry of the connection and the shear demand dictate multiple shear connectors in a single deck rib. Please contact Hilti for additional information.
4 Tabulated load values based upon installation in base steel greater than or equal to 5/16".

Connector placement along the beams

The ductile performance of the Hilti X-HVB Shear Connector allows distribution of the calculated required number of X-HVB's uniformly between the points of zero and maximum moment.

Point loads

Application of large point loads causes abrupt changes in shear. To avoid excessive slip, additional X-HVB connectors may be necessary between the point load and the support.

Partial shear connection

AISC-LRFD and AISC-ASD both require that the capacity of the installed shear connectors must be no less than 25 to 50% of the calculated shear load for full composite design. This requirement is applicable, independent of whether welded studs or X-HVB's are used for the shear connection.

Deflections

Beam deflections are computed by conventional elastic formulas. For beams with partial shear connection, deflections may be estimated by using the following formula for the effective moment of inertia:

$I_{eff} = I_s + \sqrt{n} \times (I_{tr} - I_s)$

I_s = moment of inertia of steel section

n = connection fraction

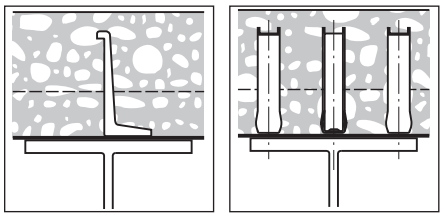
I_{tr} = moment of inertia with 100% connection

Continuous beams

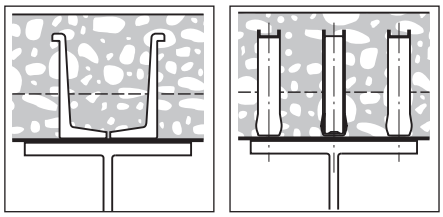
Hilti X-HVB Shear Connectors are also suitable for use in continuous composite beams. The connectors are distributed uniformly between the point of zero moment and the point of maximum moment.

3.5.7.4 CONNECTOR POSITIONING*

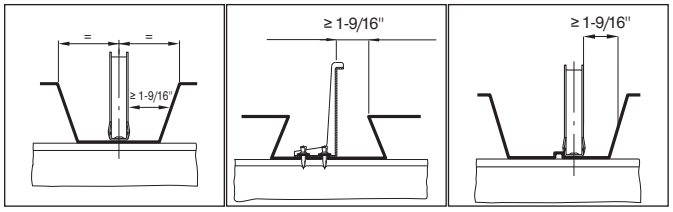
Connector positioning (metal decking ribs transverse to beam)



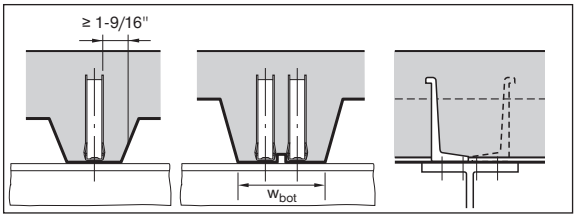
1. One to three X-HVB's per rib.



2. X-HVB's transverse or parallel to beam.



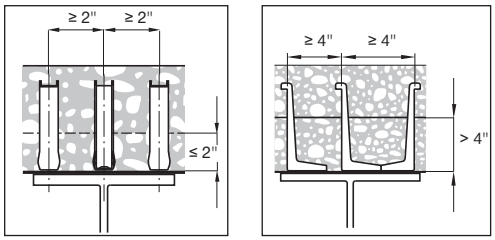
3. With one X-HVB per rib, the leg may be either centered in the rib or positioned to give a 1-9/16" (40 mm) clearance to the side of the rib.



w_{bot} = 5" for 2" U.S. composite floor deck (X-HVB 95, 110, 125, 140)

w_{bot} = 4.5" for 3" U.S. composite floor deck (X-HVB 125, 140)

4. With two or three X-HVB's per rib, the legs may be either centered in the rib or alternated about the center. If the decking has a stiffener in the bottom rib (as in case of 2" or 3" U.S: composite floor deck) position the X-HVB against the stiffener.

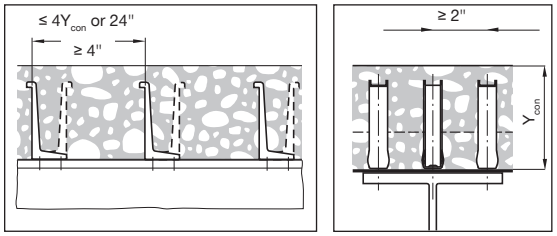


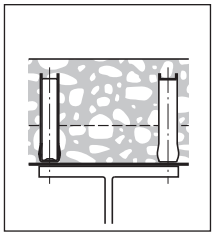
5a. Spacing along the ribs (2" and 3" U.S. composite floor deck profiles)

5b. Spacings along the ribs (other decking profiles)

Minimum spacing ≥ 2" (50 mm), however for decking profiles with: $w_r/h_r < 1.8$, the minimum spacing is increased from 2" to 4" (50 to 100 mm).

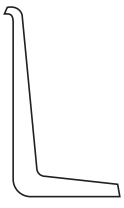
Connector positioning (ribs parallel to beam and solid slabs)





X-HVB's may be placed with zero clearance to edge of flange.

3.5.7.5 Ordering information



X-HVB Shear Connectors*

Description	Qty/Pkg
X-HVB80	250
X-HVB95	250
X-HVB110	250
X-HVB125	200
X-HVB140	120

Setting Equipment for X-HVB Shear Connectors

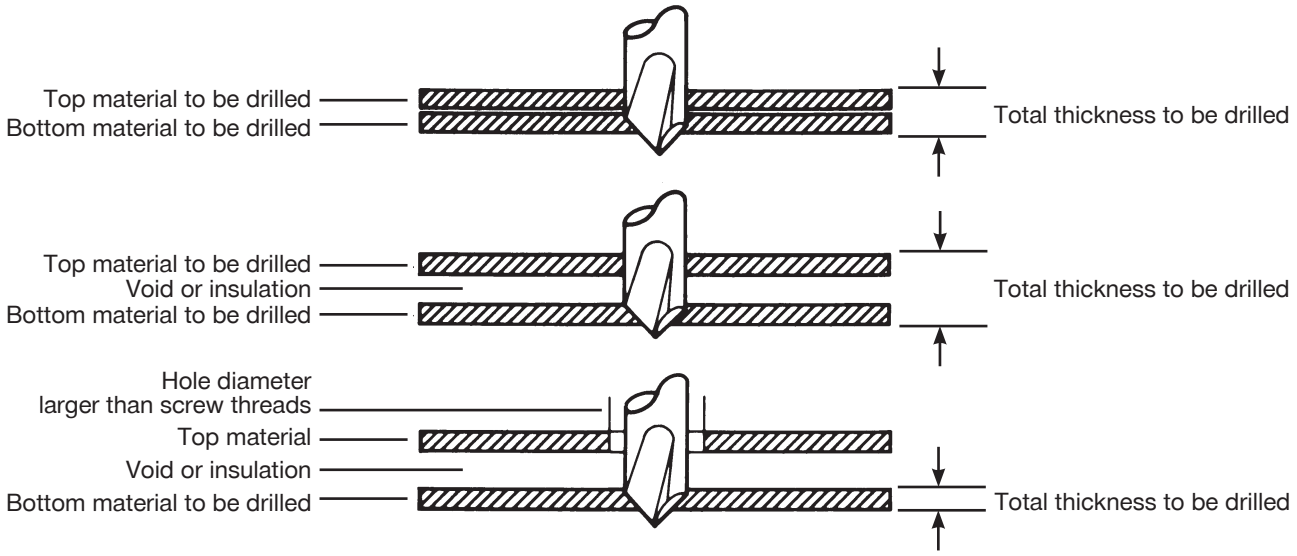
Description
DX-76
X-76-F-HVB Baseplate
X-76-P-HVB Piston
X-76-PS Stop Ring

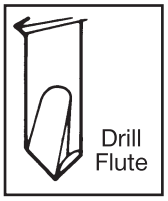
* X-HVB shear connectors must be fastened with the X-76-F-HVB fastener guide, the X-76-P-HVB piston and the X-ENP-21 HVB fastener.

3.6 SCREW FASTENING SYSTEMS

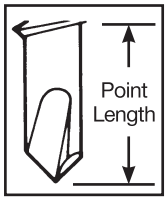
3.6.1 SELF-DRILLING SCREW FASTENER SELECTION AND DESIGN

3.6.1.1 DRILL POINT SELECTION





Drill Flute
The length of the drill flute determines the metal thickness that can be drilled. The flute itself provides a channel for chip removal during drilling action. If it becomes completely embedded in material, drill chips will be trapped in the flute and cutting action will cease. This will cause the point to burn up or break.



Point Length
The unthreaded section from the point to the first thread should be long enough to help assure the drilling action is complete before the first thread engages the drilled metal. Screw threads advance at a rate of up to ten times faster than the drill flute can remove metal. All drilling therefore should be complete before threads begin to form.

Drilling through wood to metal
If your application calls for drilling through wood over 1/2" thick, a clearance hole is required. Select a fastener with breakaway wings for this type of job. The wings will ream a clearance hole and break-off when they contact metal surface (minimum metal thickness 0.06") to be drilled.

Drilling capacity — material thickness recommendations (steel to steel)

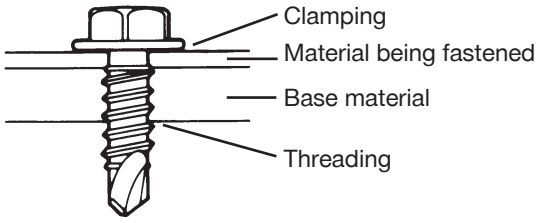
Thickness of material to be drilled (in.)	#2 Point		#3 Point				#4 Point		#5 Point
0.500									0.500
0.400									
0.300									
0.200					0.210	0.220	0.250	0.250	0.250
0.100	0.100	0.110	0.140	0.175			0.175	0.175	
0.035			0.100	0.110	0.110	0.110			
Screw Diameter	#6, #8	#10	#8	#10	#12	#14	#12	#14	#12

Note: Meets or exceeds ASTM C1513. Gray or black areas represent total thickness of all steel including any void spaces between layers.

3.6.1.2 THREAD SELECTION

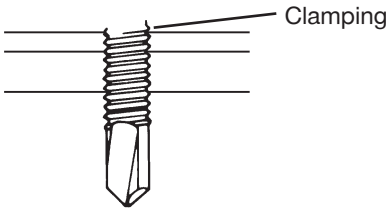
Thread length

Always choose a fastener with sufficient threads to fully engage in the base metal. For attachments to 1/4" base steel, a self-drilling screw should have at least 1/4" of threads. It is helpful, but not critical, that the threads also engage in the material being fastened. The head of the fastener provides the bearing force for the material being fastened, while the threads provide the clamping force in the base material.

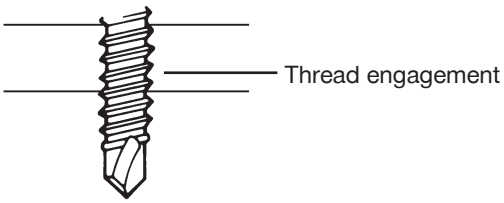


Thread pitch

The thickness of material being fastened and diameter of the screw determine the type of thread pitch to be used. In general, the thinner the fastened materials, the fewer the number of threads. The thicker the material, the greater the number of threads. This principle is due to two primary methods of thread engagement/holding power: **Clamping** and **Threading**. In light gauge metal, the materials are actually being clamped together by the upper and lower threads.



Thinner base material requires a coarser thread pitch to assure proper clamping. The thicker the material, the finer the threads must be. In very thick metal (3/8" to 1/2" thick), a fine thread is advisable. This will allow the thread to tap into the base material with less installation torque than a coarse thread.



Metal gauge

Gauge	Aluminum metal	Sheet
	(Approx. thickness in decimal parts of an inch)	
8	0.1285	0.1644
9	0.1144	0.1495
10	0.1019	0.1345
11	0.0907	0.1196
12	0.0808	0.1046
13	0.0720	0.0897
14	0.0641	0.0747
15	0.0571	0.0673
16	0.0508	0.0598
17	0.0493	0.0538
18	0.0403	0.0474
19	0.0359	0.0418
20	0.0320	0.0358
21	0.0285	0.0329
22	0.0253	0.0295
23	0.0226	0.0269
24	0.0201	0.0239
25	0.0179	0.0209
26	0.0159	0.0179
27	0.0142	0.0164
28	0.0126	0.0149

Fraction to decimal

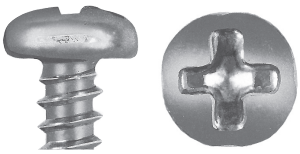
Fraction (in.)	Decimal equivalent (in.)
1/64	0.015
1/32	0.031
3/64	0.046
1/16	0.062
5/64	0.078
3/32	0.093
7/64	0.109
1/8	0.125
9/64	0.140
5/32	0.156
11/64	0.171
3/16	0.187
13/64	0.203
7/32	0.218
15/64	0.234
1/4	0.250

Screw diameter

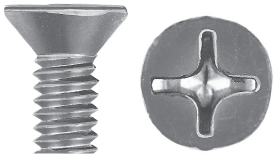
Number	Decimal equivalent (in.)
#6	0.1380
#7	0.1510
#8	0.1640
#10	0.1900
#12	0.2160
1/4	0.2500
5/16	0.3125

3.6.1.3 HEAD STYLE SELECTION

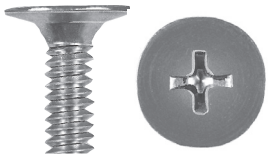
HWH (HHWH)
(High) Hex Washer Head : Washer face provides a bearing surface for the driving sockets.



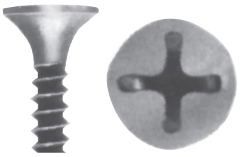
PPH (PPFH)
Phillips Pan (Framing) Head: Conventional head for general applications and provides low profile fastening.



PFH
Phillips Flat Head: Used primarily in wood to countersink and seat flush without splintering the wood.

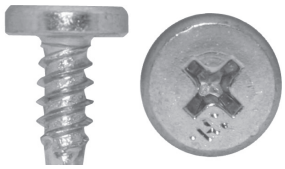


PWH
Phillips Wafer Head: Large head provides the bearing surface necessary to seat flush in soft materials.

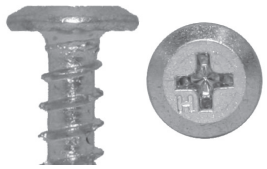


PBH
Phillips Bugle Head: Used primarily for fastening drywall, plywood or insulation board to steel studs.

PTH (MPTH)
(Modified) Phillips Truss Head: Large head and low profile provides surface area needed to attach wire lath to metal stud.

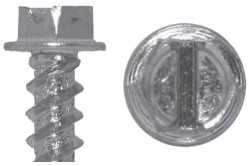


PPCH
Phillips Pancake Conventional Head: Head for general applications and provides low and flat profile.

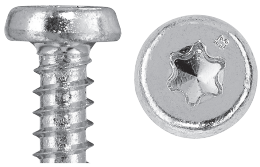


PFTH
Phillips Flat Truss Head: Lowest profile head available for attaching metal to metal.

PFHUC
Pancake Framing Head Undercut: Used for countersinking where a full head taper would cause stand-off of the screw.



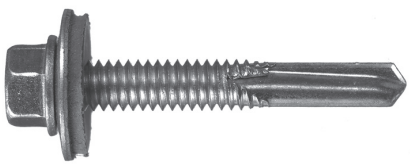
SHWH
Slotted Hex Washer Head: Hex washer head with slot in center to provide additional drive connection.



TPCH
Torx Pancake Head: Pancake head with a star drive to prevent strip during installation and provide a decorative drive finish.

3.6.1.4 SEALING CRITERIA

Sealing washer screws offer greater weather resistant fastenings where moisture or condensation is a factor. The washer helps seal the hole to better prevent moisture from dripping into the fastener threads from the fastened material side, reducing corrosive build-up. As added protection against corrosion, all sealing washer screws come standard with Kwik-Cote coating. The torque control or depth gauge of the electric screwdrivers help ensure that the optimal seal is applied (Reference Section 3.6.1.7).



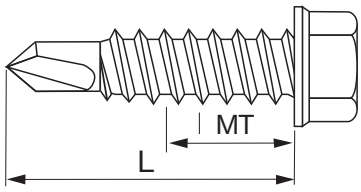
3.6.1.5 LENGTH SELECTION

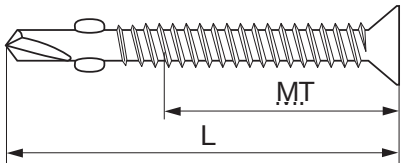
Length of the screw (L)

Depending on the screwhead, there are two different ways to measure the overall length of a screw.

For HWH/HHWH, PPH, PTH, PFTH, SHWH and PPCH screws, the overall length is measured from the bottom of the washer under the head to the point of the screw.

For PWH, PFH, PBH and PFHUC screws, the overall length is measured from the top of the head to the point of the screw.





Maximum total thickness (MT)

The maximum total thickness (MT) for all screws is the length of the threads reduced by the first three threads (protruding past the back-side of the base material). See drawings above and below.

The maximum total thickness (MT) describes the maximum thickness of all attachments to be fastened plus the base material.

3.6.1.6 CORROSION RESISTANCE GUIDELINES

Self-drilling screw fastener selection guidelines[1,2,3,6,7]

Environment	**Low** **indoor - dry:** no moisture exposure		**Medium** **indoor and exterior - dry:** minimal moisture exposure		**High** **indoor and exterior - wet:** Heavy industrial or coastal areas with high prolonged moisture levels but no direct exposure to chlorides, and average temperatures below 86 °F (30 °C).	
Connection type	Untreated lumber-to-steel, steel-to-steel, gypsum-to-steel applications	Pressure-treated[4] or fire-retardant lumber-to-steel; aluminum-to-steel; dissimilar metals	Untreated lumber-to-steel, steel-to-steel, gypsum-to-steel applications; cement board-to-steel	Pressure-treated[4] or fire-retardant lumber-to-steel; aluminum-to-steel; dissimilar metals	Untreated lumber-to-steel, steel-to-steel, gypsum-to-steel applications	Pressure-treated[4] or fire-retardant lumber-to-steel; aluminum-to-steel; dissimilar metals
Screw fastener descriptions	**Hardened carbon steel fasteners with electro-galvanized (min. 5 - 13 microns), black or grey phosphate coatings**	**Carbon steel, two-step heat treated fasteners with Kwik-Cote coating**	Hardened carbon steel fasteners with Kwik-Cote or Duplex coating	Carbon steel, two-step heat treated fasteners with Kwik-Cote coating	300 series[5] stainless steel fastener	
Screw fastener designation	**Hilti Zinc Plated Screws, Hilti Dark Grey Phosphate (DGP)**	**Hilti Kwik-Flex**	Hilti Self-Drilling Screws with Kwik-Cote, CRC, or Kwik-Seal designation	Hilti Kwik-Flex	Hilti Bi-Metal Kwik-Flex	
Product technical guide section	**Section 3.6.2 or 3.6.3**	**Section 3.6.4**	Section 3.6.2	Section 3.6.4	Section 3.6.5	

1 If the moisture content of Pressure-Treated Lumber is high (> 18%) or unknown, stainless steel fasteners are recommended. Select appropriate stainless steel grade for your application.
2 Guidelines based on fastener coating / material resistance to environmental corrosion (commonly called rusting) and fastener hardening process / resistance to hydrogen assisted stress corrosion cracking (HASCC). Evaluate site conditions which may affect these guidelines, such as: corrosive agents other than those listed; expected service life; other (non-environmental) types of corrosion, etc.
3 In highly corrosive environments (such as direct exposure to chlorides with average temperatures above 86 °F (30 °C)) it is generally recommended that a Highly Corrosive Resistant (HCR) fastener be used. Contact Hilti Technical Support at 877-749-6337 for more information.
4 Pressure treated lumber refers to lumber such as SBX/DOT, Zinc borated ACQ, CA-B, CBA-A treated lumber.
5 300 series recommended. Most 400 series stainless steels, such as 410 stainless steel, 410 super-passivated stainless steel and 400 modified stainless steel are generally considered susceptible to HASCC. Moreover, these grades of stainless steel are 18/0 – they contain chromium but no nickel which reduces corrosion resistance significantly when compared to 18/8 grades (302, 304) or 18/8/2 grade (316).
6 The decision as to which fastener optimally meets the demands of a specific application is ultimately the judgment of the Engineer of Record or other responsible person for the project.
7 Reference Section 2.3.3.1 for more information on corrosion resistance.

3.6.1.7 HILTI SCREW FASTENER INSTALLATION INSTRUCTIONS*

It is essential that proper rpm, setting depth and torque be utilized when installing Hilti screws.

Install self-drilling screws perpendicular to the work surface. The self-drilling feature of the screw will drill a hole completely through the base material before tapping the threads. Do not apply excessive pressure. Too much pressure will slow the speed of the screwdriver, increasing the installation time and possibly leading to drill tip failure. The variable speed motors of Hilti screwdrivers help enable the operator to start the screw in a precise position and drive it at the speed best suited for the application. The tables below provide additional suggested tools as well as common socket and bit sizes.

Common socket and bit sizes

Screw size	Magnetic nut setter size	Phillips bit size
#8	1/4"	2
#10	5/16"	2
#12	5/16"	3
1/4"	3/8"	3

fastening self-drilling screws in steel up to 1/4" (6 mm) thick. There is a depth gauge on the front of the tool for correct depth setting of screws.

The Hilti ST 1800 heavy duty torque adjustable screwdriver features a 1,800 rpm for fastening self-drilling screws in steel up 1/2" (12 mm) thick. There is a depth gauge on the front of the tool for correct depth setting of screws. There is also an 18 position adjustable torque clutch for correct torque release setting of screws. By avoiding overdriving, proper torque adjustment will deliver more consistent fastening quality.

The ST 1800 may also be operated with the SDT 9 for a stand-up decking system to fasten steel deck.

Please reference the table on torque considerations below for more information on proper installation of Hilti screw fasteners.

* These are abbreviated instructions which may vary by application. **ALWAYS** review/follow the instructions accompanying the product.

Torque Considerations for Screw Fastening Applications[3]

	Soft joint applications	Hard joint applications
Applications	These include, but are not limited to, typical applications involving interior drywall fastening, exterior sheathing, metal framing, HVAC duct and plywood to metal.	These include, but are not limited to, typical applications involving metal decking (both frame and sidelap), metal siding (both frame and sidelap), exterior façade and window glazing as well as any application where stripping of the base material may occur. Any application involving sealing washers requires a depth gauge or torque clutch to help ensure that an optimal seal is achieved.
Considerations[1,2]	Ideally, these applications should be carried out with a corded or cordless screwdriver that features either an adjustable torque clutch or a properly adjusted depth gauge. However, a tool without these features can often be used in soft joint applications. This is because the applications are considered non-structural and/or possess sufficient redundancy in fastening points that any impact of over-driving may be sufficiently mitigated.	These applications must utilize a corded or cordless screwdriver that features either an adjustable torque clutch, speed settings that have been verified for use in the specific application or a properly adjusted depth gauge in order to help ensure consistent fastening and achieve published connection capacities. This is because the applications are considered structural elements of the design. Over-driving may cause connection failures or fastener failures that possibly compromise the integrity of the connection.

1 Whether an application requires a depth gauge or torque clutch is the judgment of the person responsible for the project. If conditions are unknown or in doubt, use a screwdriver that features either an adjustable torque clutch or a properly adjusted depth gauge.
2 All screw fastening connection capacities published in this manual were developed using corded or cordless screwdriver tools with adjustable torque clutches. Over-driving a screw fastener can cause a connection failure in lighter gauge and lower strength steel base materials (the threads tapping the base material are stripped by excessive torque) or a fastener failure in heavier gauge and higher strength steel base materials (the screw is damaged or sheared by excessive torque). This type of damage is not always visually detectable. Regardless of the tool or its torque setting, test fastenings should always be performed to verify the appropriate torque is being applied.
3 For additional information, contact Hilti Technical Services at 877-749-6337.

Listings/Approvals

ICC-ES (International Code Council)
ESR-2196 with LABC/LARC Supplement (Steel and Metal Screws)
ESR-3891 with LABC/LARC Supplement (Interior Finishing/Drywall Screws)

ICC-ES ESR-2196 and ESR-3891 together, provide IBC recognition of Hilti's Self-Drilling Screw fasteners for most common applications (e.g. CFS connections, gypsum to CFS, etc.), including HWH, HHWH, PPH, PPFH, PBH, PWH, PTH, PPCH, TPCH and PFTH head style screws. Wood screws are not covered in the ICC-ESR's.

3.6.2 SELF-DRILLING SCREWS

3.6.2.1 PRODUCT DESCRIPTION

Hilti self-drilling screws are designed to drill their own hole in steel base materials up to 1/2" thick. These screws are available in a variety of head styles, thread lengths and drill-flute lengths for screw diameters #6 through 1/4". Hilti self-drilling screws meet ASTM C1513, ASTM C954 and SAE J78 standards, as applicable.

Product features:

- Hex head for metal-to-metal applications
- Flush head for wood-to-metal applications
- For metal from 0.035" to 0.500" thick
- Winged reamers for wood over 1/2" thick
- Stitch screws for light gauge metal-to-metal
- Sealing screws for water resistant fastenings

3.6.2.2 MATERIAL SPECIFICATIONS

Material	ASTM A510 Grade 1018-1022
Heat treatment	Case hardened and tempered • Sizes 8, 10 and 12: 0.004" to 0.009" case depth • Size 1/4": 0.005" to 0.011" case depth
Plating	Refer to Section 3.6.2.5 for screw coating information.

Warning: Because of the potential for delayed hydrogen assisted stress corrosion cracking, many hardened steel fasteners are not recommended for use with dissimilar metals or chemically treated wood when moisture may be present or in corrosive environments. For further information, contact Hilti Technical Support at 1-877-749-6337.

3.6.2.3 TECHNICAL DATA

Ultimate tensile strengths – pullout (tension), lb (kN)[1,2,3,4,5,6,7]

Screw designation	Nominal diameter in.	Thickness of steel member not in contact with the screw head, ga (in.)					
		20 (0.036)	18 (0.048)	16 (0.060)	14 (0.075)	12 (0.105)	10 (0.135)
#6	0.138	190 (0.85)	250 (1.11)	320 (1.42)	395 (1.76)	555 (2.47)	715 (3.18)
#7	0.151	210 (0.93)	275 (1.22)	345 (1.53)	435 (1.93)	605 (2.69)	780 (3.47)
#8	0.164	225 (1.00)	300 (1.33)	375 (1.67)	470 (2.09)	660 (2.94)	845 (3.76)
#10	0.190	260 (1.16)	350 (1.56)	435 (1.93)	545 (2.42)	765 (3.40)	980 (4.36)
#12	0.216	295 (1.31)	395 (1.76)	495 (2.20)	620 (2.76)	870 (3.87)	1120 (4.98)
1/4 in.	0.250	345 (1.53)	460 (2.05)	575 (2.56)	715 (3.18)	1000 (4.45)	1290 (5.74)

1 The lower of the ultimate pullout, pullover, and tension fastener strength of screw should be used for design.
2 Load values based upon calculations done in accordance with Section J4 of the AISI S100.
3 AISI S100 recommends a safety factor of 3.0 be applied for allowable strength design, a Φ factor of 0.5 be applied for LRFD design or a Φ factor of 0.4 be applied for LSD design.
4 ANSI/ASME standard screw diameters were used in the calculations and are listed in the tables.
5 The screw diameters in the table above are available in head styles of pan, hex washer, pancake, flat, wafer and bugle.
6 The load data in the table is based upon sheet steel with F_u = 45 ksi. For F_u = 55 ksi steel, multiply values by 1.22. For F_u = 65 ksi steel, multiply values by 1.44.
7 Refer to Section 3.6.2.5 to ensure drilling capacities.

Ultimate tensile strengths – pullover (tension), lb (kN)[1,2,3,4,5,6,7]

Screw designation	Washer or head diameter in.	Thickness of steel member in contact with the screw head, ga (in.)						
		22 (0.030)	20 (0.036)	18 (0.048)	16 (0.060)	14 (0.075)	12 (0.105)	10 (0.135)
Hex Washer Head (HWH)								
#8	0.335	675 (3.00)	815 (3.63)	1000 (4.45)	1000 (4.45)	1000 (4.45)	1000 (4.45)	1000 (4.45)
#10	0.399	805 (3.58)	970 (4.31)	1290 (5.74)	1370 (6.09)	1370 (6.09)	1370 (6.09)	1370 (6.09)
#12-14	0.415	835 (3.71)	1010 (4.49)	1340 (5.96)	1680 (7.47)	2100 (9.34)	2325 (10.34)	2325 (10.34)
#12-24	0.415	835 (3.71)	1010 (4.49)	1340 (5.96)	1680 (7.47)	2100 (9.34)	2940 (13.08)	3780 (16.81)
1/4 in.	0.500	1010 (4.49)	1220 (5.43)	1620 (7.21)	2030 (9.03)	2530 (11.25)	3540 (13.75)	4560 (20.28)
Phillips Pan Head (PPH)								
#7	0.303	615 (2.74)	735 (3.27)	980 (4.36)	1000 (4.45)	1000 (4.45)	1000 (4.45)	1000 (4.45)
#8	0.311	630 (2.80)	755 (3.36)	1000 (4.45)	1000 (4.45)	1000 (4.45)	1000 (4.45)	1000 (4.45)
#10	0.364	740 (3.29)	885 (3.94)	1180 (5.25)	1370 (6.09)	1370 (6.09)	1370 (6.09)	1370 (6.09)
Phillips Truss Head (PTH)								
#8	0.411	830 (3.69)	1000 (4.45)	1000 (4.45)	1000 (4.45)	1000 (4.45)	1000 (4.45)	1000 (4.45)
#10	0.433	875 (3.89)	1050 (4.67)	1390 (6.18)	1390 (6.18)	1390 (6.18)	1390 (6.18)	1390 (6.18)
Phillips Pancake Head (PPCH)								
#10, #12	0.409	830 (3.69)	995 (4.43)	1325 (5.89)	1370 (6.09)	1370 (6.09)	1370 (6.09)	1370 (6.09)
Phillips Flat Truss Head (PFTH)								
#10	0.364	740 (3.29)	885 (3.94)	1180 (5.25)	1475 (6.56)	1840 (8.18)	2170 (9.65)	2170 (9.65)

1 The lower of the ultimate pullout, pullover, and tension fastener strength of screw should be used for design.
2 Load values based upon calculations done in accordance with Section J4 of the AISI S100.
3 AISI S100 recommends a safety factor of 3.0 be applied for allowable strength design, a Φ factor of 0.5 be applied for LRFD design or a Φ factor of 0.4 be applied for LSD design.
4 ANSI/ASME standard screw head diameters were used in the calculations and are listed in the tables.
5 Phillips Bugle Head (PBH) and Phillips Wafer Head (PWH) styles are not covered by this table because they are not intended for attachment of steel to steel.
6 The load data in the table is based upon sheet steel with F_u = 45 ksi. For F_u = 55 ksi steel, multiply values by 1.22. For F_u = 65 ksi steel, multiply values by 1.44.
7 Refer to Section 3.6.2.5 for drilling capacities.

Nominal ultimate fastener strength of screw

Screw designation	Nominal diameter (in.)	Nominal fastener strength			
		Tension, P_{ts} lb (kN)[1]		Shear, P_{ss} lb (kN)[2,3]	
#6-20	0.138	1000	(4.45)	890	(3.96)
#7-18	0.151	1000	(4.45)	890	(3.96)
#8-18	0.164	1000	(4.45)	1170	(5.20)
#10-12	0.190	2170	(9.65)	1645	(7.32)
#10-16	0.190	1370	(6.09)	1215	(5.40)
#10-18	0.190	1390	(6.18)	1645	(7.32)
#12-14	0.216	2325	(10.34)	1880	(8.36)
#12-24	0.216	3900	(17.35)	2285	(10.16)
1/4 in.	0.250	4580	(20.37)	2440	(10.85)

1 The lower of the ultimate pullout, pullover, and tension fastener strength of screw should be used for design. The Pullout and Pullover tables in this section have already been adjusted where screw strength governs.
2 The lower of the ultimate shear fastener strength and shear bearing should be used for design. The Shear Bearing table in this section has already been adjusted where screw strength governs.
3 AISI S100 recommends a safety factor of 3.0 be applied for allowable strength design, a Φ factor of 0.5 be applied for LRFD design or a Φ factor of 0.4 be applied for LSD design.

Torsional strength[1,2]

Size	Min. torsional strength in-lb (Nm)	
6-20	24	(2.7)
7-18	38	(4.3)
8-18	42	(4.8)
10-12	61	(6.9)
10-16	61	(6.9)
10-18	61	(6.9)
10-24	65	(7.3)
12-14	92	(10.4)
12-24	100	(11.3)
1/4-14	150	(17.0)
1/4-20	156	(17.6)

1 Based on screw only. Does not consider base material limitations.
2 Values in table are ultimate torsional strengths. To obtain maximum setting torque, multiply values in table by 0.66.

Ultimate shear strengths – bearing (shear), lb (kN)[1,2,3,4,5,6,7]

Screw designation	Nominal diameter in.	Thickness of steel member in contact with screw head ga (in.)	Thickness of steel member not in contact with the screw head, ga (in.)				
			20 (0.036)	**18** (0.048)	**16** (0.060)	**14** (0.075)	≥ **12** (0.105)
#7	**0.151**	**20** (0.036)	**500** (2.22)	**660** (2.94)	**660** (2.94)	**660** (2.94)	**660** (2.94)
		18 (0.048)	**500** (2.22)	**770** (3.11)	**880** (3.91)	**880** (3.91)	**880** (3.91)
		≥ 16 (0.060)	**500** (2.22)	**770** (3.11)	**890** (3.96)	**890** (3.96)	**890** (3.96)
#8	**0.164**	**20** (0.036)	**525** (2.34)	**715** (3.18)	**715** (3.18)	**715** (3.18)	**715** (3.18)
		18 (0.048)	**525** (2.34)	**805** (3.58)	**955** (4.25)	**955** (4.25)	**955** (4.25)
		≥ 16 (0.060)	**525** (2.34)	**805** (3.58)	**1120** (4.98)	**1170** (5.20)	**1170** (5.20)
#10-12	**0.190**	**20** (0.036)	**565** (2.51)	**830** (3.69)	**830** (3.69)	**830** (3.69)	**830** (3.69)
		18 (0.048)	**565** (2.51)	**865** (3.85)	**1110** (4.94)	**1110** (4.94)	**1110** (4.94)
		16 (0.060)	**565** (2.51)	**865** (3.85)	**1210** (5.38)	**1390** (6.18)	**1390** (6.18)
		≥ 14 (0.075)	**565** (2.51)	**865** (3.85)	**1210** (5.38)	**1645** (7.32)	**1645** (7.32)
#10-16	**0.190**	**20** (0.036)	**565** (2.51)	**830** (3.69)	**830** (3.69)	**830** (3.69)	**830** (3.69)
		18 (0.048)	**565** (2.51)	**865** (3.85)	**1110** (4.94)	**1110** (4.94)	**1110** (4.94)
		≥ 16 (0.060)	**565** (2.51)	**865** (3.85)	**1210** (5.38)	**1215** (5.40)	**1215** (5.40)
#10-18	**0.190**	**20** (0.036)	**565** (2.51)	**830** (3.69)	**830** (3.69)	**830** (3.69)	**830** (3.69)
		18 (0.048)	**565** (2.51)	**865** (3.85)	**1110** (4.94)	**1110** (4.94)	**1110** (4.94)
		16 (0.060)	**565** (2.51)	**865** (3.85)	**1210** (5.38)	**1390** (6.18)	**1390** (6.18)
		≥ 14 (0.075)	**565** (2.51)	**865** (3.85)	**1210** (5.38)	**1645** (7.32)	**1645** (7.32)
#12-14	**0.216**	**20** (0.036)	**600** (2.67)	**930** (4.14)	**945** (4.20)	**945** (4.20)	**945** (4.20)
		18 (0.048)	**600** (2.67)	**925** (4.11)	**1260** (5.60)	**1260** (5.60)	**1260** (5.60)
		16 (0.060)	**600** (2.67)	**925** (4.11)	**1290** (5.74)	**1570** (6.98)	**1570** (6.98)
		≥ 14 (0.075)	**600** (2.67)	**925** (4.11)	**1290** (5.74)	**1800** (8.00)	**1880** (8.36)
#12-24	**0.216**	**20** (0.036)	**600** (2.67)	**930** (4.14)	**945** (4.20)	**945** (4.20)	**945** (4.20)
		18 (0.048)	**600** (2.67)	**925** (4.11)	**1260** (5.60)	**1260** (5.60)	**1260** (5.60)
		16 (0.060)	**600** (2.67)	**925** (4.11)	**1290** (5.74)	**1570** (6.98)	**1570** (6.98)
		14 (0.075)	**600** (2.67)	**925** (4.11)	**1290** (5.74)	**1800** (8.00)	**1970** (8.76)
		≥ 12 (0.090)	**600** (2.67)	**925** (4.11)	**1290** (5.74)	**1800** (8.00)	**2285** (10.16)
1/4 in.	**0.250**	**20** (0.036)	**645** (2.87)	**1020** (4.54)	**1090** (4.85)	**1090** (4.85)	**1090** (4.85)
		18 (0.048)	**645** (2.87)	**995** (4.43)	**1400** (6.23)	**1460** (6.49)	**1460** (6.49)
		16 (0.060)	**645** (2.87)	**995** (4.43)	**1390** (6.18)	**1820** (8.10)	**1820** (8.10)
		14 (0.075)	**645** (2.87)	**995** (4.43)	**1390** (6.18)	**1940** (8.63)	**2280** (10.14)
		≥ 12 (0.090)	**645** (2.87)	**995** (4.43)	**1390** (6.18)	**1940** (8.63)	**2440** (10.85)

1 The lower of the ultimate shear bearing and shear fastener strength of screw should be used for design.
2 Load values based upon calculations done in accordance with Section J4 of AISI S100.
3 AISI S100 recommends a safety factor of 3.0 be applied for allowable strength design, a Φ factor of 0.5 be applied for LRFD design or a Φ factor of 0.4 be applied for LSD design.
4 ANSI/ASME standard screw diameters were used in the calculations and are listed in the tables.
5 Load values in table are for Hex Washer Head (HWH and HHWH), Phillips Pan Head (PPH), Phillips Truss Head (PTH), Phillips Pancake Head (PPCH), and Phillips Flat Truss Head (PFTH) style screws. Phillips Bugle Head (PBH) and Phillips Wafer Head (PWH) styles are not covered by this table because they are not intended for attachment of steel to steel.
6 The load data in the table is based upon sheet steel with F_u = 45 ksi. For F_u = 55 ksi steel, multiply values by 1.22. For F_u = 65 ksi steel, multiply values by 1.44.
7 Refer to Section 3.6.2.5 to ensure drilling capacities.

3.6.2.4 INSTALLATION INSTRUCTIONS

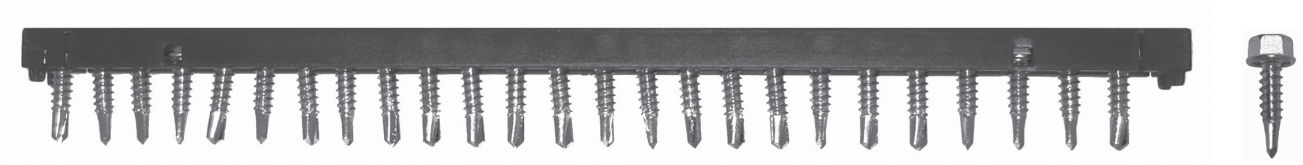
For general discussion of Hilti screw fastener installation, reference Section 3.6.1.7.

For allowable diaphragm shear loads and stiffness values for steel roof or floor deck utilizing Hilti self-drilling screws as frame or sidelap fasteners, reference Section 3.5 and download Hilti's Profis DF software at www.hilti.com/decking (US), or www.hilti.ca (Canada).

To estimate the number of sidelap screws on a steel roof or floor deck project, reference Section 3.5.1.5.

Warning: Because of the potential for delayed hydrogen assisted stress corrosion cracking, many hardened steel fasteners are not recommended for use with dissimilar metals or chemically treated wood when moisture may be present or in corrosive environments. For further information, contact Hilti Technical Support at 1-877-749-6337.

3.6.2.5 ORDERING INFORMATION



Collated self-drilling screws

Light/medium gauge metal applications (sidelap)

Description	Thread length	Drilling Capacity		Maximum Total Thickness (MT)[1]		Recess	Coating[2]	Box qty
		Min	Max					
S-SLC 01 M HWH Collated	5/8"	0.018"	0.095"	3/32"	0.100"	5/16"	Zinc-2	250
S-SLC 02 M HWH Collated	3/4"	0.028"	0.120"	3/8"	0.375"	5/16"	Zinc-1	250
S-MD 10-16 x 7/8 HWH Collated	3/8"	0.028"	0.120"	3/16"	0.188"	5/16"	Zinc-1	250

Medium/heavy gauge metal applications (frame fastener)

Description	Thread length	Drilling capacity		Maximum total thickness (MT)[1]		Recess	Coating[2]	Box qty
		Min	Max					
S-MD 10-16 x 3/4 HWH#3 Collated	1/2"	0.110"	0.175"	3/8"	0.375"	5/16"	Zinc-1	250
S-MD 12-24 x 7/8 HWH#4 Collated	1/2"	0.175"	0.312"	3/8"	0.375"	5/16"	Zinc-1	250

1 Refer to Figure in Section 3.6.1.5.

2 For coating abbreviations, Zinc-1 = EN/ISO 4042 A3F; Zinc-2 = Cr3 + (Cr6 + free) 8-14 µm. For more information on corrosion resistance, reference Section 3.6.1.6.

Single Self-Drilling Screws

Sidelap (unsupported metal sheets)

Description	Thread length	Drilling capacity		Maximum total thickness (MT)[1]		Recess	Coating[2]	Box qty
		Min	Max					
S-MD 12-14x1 HHWH Stitch	3/4"	0.028"	0.120"	3/8"	0.375"	5/16"	Zinc-1	3000
S-MD 10-16x7/8 HHWH Pilot Point	3/8"	0.028"	0.120"	3/16"	0.188"	5/16"	Zinc-1	6000
S-MD 1/4-14x7/8 HWH Stitch Kwik-Seal	1/2"	0.028"	0.140"	5/16"	0.313"	5/16"	Kwik-Cote	2500

1 Refer to Figure in Section 3.6.1.5.

2 For coating abbreviations, Zinc-1 = EN/ISO 4042 A3F; Kwik Cote = Proprietary Coating, Section 3.6.2.2 For more information on corrosion resistance, reference Section 3.6.1.6.

Light gauge applications: steel to steel

Description	Thread length	Drilling Capacity		Maximum Total Thickness (MT)[1]		Recess	Coating[2]	Box Qty
		Min	Max					
S-MD 8-18x1/2 HWH #2	1/4"	0.035"	0.100"	1/8"	0.125"	1/4"	Zinc-1	1000
S-MD 8-18x3/4 HWH #2	1/2"	0.035"	0.100"	3/8"	0.375"	1/4"	Zinc-1	1000
S-MD 8-18x1/2 PPH #2	1/4"	0.035"	0.100"	1/8"	0.125"	PHL #2	Zinc-1	1000
S-MD 10-16x1/2 HWH #2	5/16"	0.035"	0.110"	3/16"	0.188"	5/16"	Zinc-1	8500
S-MD 10-16x3/4 HWH #2	1/2"	0.035"	0.110"	5/16"	0.313"	5/16"	Zinc-1	6500
S-MD 10-16x1 HWH #2	3/4"	0.035"	0.110"	1/2"	0.500"	5/16"	Zinc-1	5000

1 Refer to Figure in Section 3.6.1.5.
2 For coating abbreviations, Zinc-1 = EN/ISO 4042 A3F For more information on corrosion resistance, reference Section 3.6.1.6.

Light/medium gauge metal applications

Description	Thread length	Drilling capacity		Maximum total thickness (MT)[1]		Recess	Coating[2]	Box Qty
		Min	Max					
S-MD 10-16x5/8 HWH #3	5/16"	0.110"	0.175"	3/16"	0.187"	5/16"	Zinc-1	7500
S-MD 10-16x3/4 HWH #3	1/2"	0.110"	0.175"	3/8"	0.375"	5/16"	Zinc-1	6500
S-MD 10-16x3/4 HHWH #3	1/2"	0.110"	0.175"	3/8"	0.375"	5/16"	Zinc-1	6500
S-MD 10-16x1 HWH #3	3/4"	0.110"	0.175"	5/8"	0.625"	5/16"	Zinc-1	5000
S-MD 10-16x1 1/4 HWH #3	1"	0.110"	0.175"	7/8"	0.875"	5/16"	Zinc-1	4000
S-MD 10-16x1 1/2 HWH #3	1-1/4"	0.110"	0.175"	1-1/8"	1.125"	5/16"	Zinc-1	4000
S-MD 10-16x5/8 PPH #3	5/16"	0.110"	0.175"	5/16"	0.313"	PHL #2	Zinc-1	7500
S-MD 10-16x3/4 PPH #3	1/2"	0.110"	0.175"	3/8"	0.375"	PHL #2	Zinc-1	6500
S-DD 10-16x5/8 PPCH #3	1/2"	0.110"	0.175"	5/16"	0.313"	PHL #2	Zinc-1	7500
S-DD 10-12x3/4 PFTH #3	9/16"	0.110"	0.175"	3/8"	0.375"	PHL #2	Zinc-1	7500
S-DD 10-18x3/4 PTH #3	9/16"	0.110"	0.175"	3/8"	0.375"	PHL #2	Zinc-1	5000
S-MD 12-14x3/4 HWH #3	1/2"	0.110"	0.210"	5/16"	0.313"	5/16"	Zinc-1	5000
S-MD 12-14x1 HWH #3	3/4"	0.110"	0.210"	9/16"	0.562"	5/16"	Zinc-1	3000
S-MD 12-14x1 1/2 HWH #3	1-1/4"	0.110"	0.210"	1-1/16"	1.062"	5/16"	Zinc-1	2500
S-MD 12-14x2 HWH #3	1-5/8"	0.110"	0.210"	1-9/16"	1.562"	5/16"	Zinc-1	2000
S-DD 12-14x1 TPCH #3	11/16"	0.110"	0.210"	1/2"	0.500"	TX 25 HF	Zinc-2	7500
S-MD 1/4-14x3/4 HWH #3	1/2"	0.110"	0.220"	5/16"	0.313"	3/8"	Zinc-1	4000
S-MD 1/4-14x1 HWH #3	3/4"	0.110"	0.220"	9/16"	0.562"	3/8"	Zinc-1	3000
S-MD 1/4-14x1 1/2 HWH #3	1-1/4"	0.110"	0.220"	1-1/16"	1.062"	3/8"	Zinc-1	2000
S-MD 1/4-14x2 HWH #3	1-5/8"	0.110"	0.220"	1-9/16"	1.562"	3/8"	Zinc-1	1000
S-MD 12-14x3/4 HWH #3 Kwik-Seal	1/4"	0.110"	0.210"	1/8"	0.125"	5/16"	Kwik-Cote	3000
S-MD 12-14x1 HWH #3 Kwik-Seal	5/8"	0.110"	0.210"	3/8"	0.375"	5/16"	Kwik-Cote	2500
S-MD 12-14x1 1/4 HWH #3 Kwik-Seal	1"	0.110"	0.210"	5/8"	0.625"	5/16"	Kwik-Cote	2000
S-MD 12-14x1 1/2 HWH #3 Kwik-Seal	1-1/4"	0.110"	0.210"	7/8"	0.875"	5/16"	Kwik-Cote	2000
S-MD 12-14x2 HWH #3 Kwik-Seal	1-1/2"	0.110"	0.210"	1-3/8"	1.375"	5/16"	Kwik-Cote	1500
S-MD 1/4-14x1 HWH #3 Kwik-Seal	5/8"	0.110"	0.220"	3/8"	0.375"	3/8"	Kwik-Cote	2000
S-MD 1/4-14x1 1/2 HWH #3 Kwik-Seal	1"	0.110"	0.220"	7/8"	0.875"	3/8"	Kwik-Cote	1500

1 Refer to Figure in Section 3.6.1.5.
2 For coating abbreviations, Zinc-1 = EN/ISO 4042 A3F; Zinc-2 = Cr3+ (Cr6+ free) 8-14 µm, Kwik-Cote = Proprietary Coating, Section 3.6.2.2. For more information on corrosion resistance, reference Section 3.6.1.6.

Warning: Because of the potential for delayed hydrogen assisted stress corrosion cracking, many hardened steel fasteners are not recommended for use with dissimilar metals or chemically treated wood when moisture may be present or in corrosive environments. For further information, contact Hilti Technical Support at 1-877-749-6337.

Single self-drilling screws – heavy gauge metal applications

Description	Thread length	Drilling capacity		Maximum total thickness (MT)[1]		Recess	Coating[2]	Box Qty
		Min	Max					
S-MD 12-24x7/8 HWH #4	1/2"	0.175"	0.250"	1/4"	0.250"	5/16"	Zinc-1	4500
S-MD 12-24x1 1/4 HWH #4	3/4"	0.175"	0.250"	5/8"	0.625"	5/16"	Zinc-1	3500
S-MD 12-24x1 1/4 HWH #5	1/2"	0.250"	0.500"	7/16"	0.437"	5/16"	Zinc-1	4000
S-MD 12-24x1 1/4 HWH #5 Kwik-Cote	1/2"	0.250"	0.500"	5/16"	0.313"	5/16"	KwikCote	4000
S-MD 12-24x2 HWH #5 Kwik-Cote	1-1/4"	0.250"	0.500"	1-3/16"	1.187"	5/16"	KwikCote	2000
S-MD 12-24x3 HWH #5 Kwik-Cote	2-1/4"	0.250"	0.500"	2-3/16"	2.187"	5/16"	KwikCote	1000
S-MD 12-24x1 1/4 HWH #5 Kwik-Cote Bond Washer	1/2"	0.250"	0.500"	5/16"	0.313	5/16''	KwikCote	2500

1 Refer to Figure in Section 3.6.1.5.
2 For coating abbreviations, Zinc-1 = EN/ISO 4042 A3F; Kwik Cote = Proprietary Coating, Section 3.6.2.2. For more information on corrosion resistance, reference Section 3.6.1.6.

Single self-drilling screws – heavy gauge metal applications

Description	Thread length	Drilling capacity		Maximum total thickness (MT)[1]		Recess	Coating[2]	Box Qty
		Min	Max					
Wood Drill Screws								
Decking Screws (Plywood to Framing)								
S-WD 8-18x1 5/16 PFH #3	1/2"	0.050"	0.140"	1/2"	0.500"	PHL #2	BP	6000
S-WD 8-18x1 15/16 PFH #3	5/8"	0.050"	0.140"	3/4"	0.750"	PHL #2	BP	4000
S-WD 10-24x1 PWH #3	3/4"	0.050"	0.175"	5/8"	0.625"	PHL #2	Zinc-1	6000
S-WD 10-24x1 1/4 PWH #3	1"	0.050"	0.175"	7/8"	0.875"	PHL #2	Zinc-1	5000
S-WD 10-24x1 1/2PWH #3	1-1/4"	0.050"	0.175"	1-1/8"	1.125"	PHL #2	Zinc-1	3500
Winged Reamer Wood Drill Screws								
S-WW 10-24x1 7/16 PWH #3 wings	1"	0.050"	0.175"	3/4"	0.750"	PHL #2	Zinc-1	4000
S-WW 12-24x2 PFH #4 wings	1-3/8"	0.050"	0.232"	1-1/4"	1.250"	PHL #2	Zinc-1	2000
S-WW 12-24x2 1/2 PFH #4 wings	2"	0.050"	0.232"	1-3/4"	1.750"	PHL #2	Zinc-1	1500
S-WW 14-20x2 3/4 PFH #4 wings	2-1/4"	0.050"	0.250"	2"	2.000"	PHL #2	Zinc-1	1000

1 Refer to Figure in Section 3.6.1.5.
2 For coating abbreviations, Zinc-1 = EN/ISO 4042 A3F; GP = Grey Phosphate. For more information on corrosion resistance, reference Section 3.6.1.6.

Warning: Because of the potential for delayed hydrogen assisted stress corrosion cracking, many hardened steel fasteners are not recommended for use with dissimilar metals or chemically treated wood when moisture may be present or in corrosive environments. For further information, contact Hilti Technical Support at 1-877-749-6337.

Drywall applications (drywall to steel, framing and lathing screws)

Description	Coating[1]	Box qty	Application
6 x 1 PBH SD[2]	DGP	10,000	Fastening Drywall, plywood, insulation, etc. to metal studs from 14 ga to 20 ga
6 x 1 PBH SD Z[2]	Zinc	10,000	
6 x 1-1/8 PBH SD[2]	DGP	10,000	
6 x 1-1/8 PBH SD Z[2]	Zinc	10,000	
6 x 1-1/4 PBH SD[2]	DGP	8,000	
6 x 1-1/4 PBH SD Z[2]	Zinc	8,000	
6 x 1-1/4 PBH SD CRC[2]	CRC	8,000	
6 x 1-5/8 PBH SD[2]	DGP	5,000	
6 x 1-5/8 PBH SD Z[2]	Zinc	5,000	
6 x 1-7/8 PBH SD[2]	DGP	4,000	
6 x 1-7/8 PBH SD Z[2]	Zinc	4,000	
6 x 1-7/8 PBH SD CRC[2]	CRC	4,000	
6 x 2 PBH SD[2]	GP/DGP	4,000	
6 x 2 PBH SD Z[2]	Zinc	4,000	
8 x 2-3/8 PBH SD	GP	2,500	
8 x 2-3/8 PBH SD zinc	Zinc	2,500	
8 x 2-5/8 PBH SD	GP	1,600	
8 x 2-5/8 PBH SD zinc	Zinc	1,600	
8 x 3 PBH SD	GP	1,400	
8 x 3 PBH SD zinc	Zinc	1,400	
7 x 7/16 PPFH SD Framer	GP	10,000	Fastening stud to track from 14 ga to 20 ga
7 x 7/16 PPFH SD Farmer Zinc	Zinc	10,000	
8 x 1/2 PPH SD Framer Zinc	Zinc	10,000	
10 x 5/8 PPCH SD Framer	Zinc	7,500	
10 x 3/4 PFTH SD Framer Zinc	Zinc	7,500	
10 x 3/4 PTH SD Framer Zinc	Zinc	5,000	
8 x 1/2 PTH SD Lathing Zinc	Zinc	10,000	Fastening wire lath to 14 ga to 20 ga
8 x 3/4 PTH SD Lathing Zinc	Zinc	10,000	
8 x 1 PTH SD Lathing Zinc	Zinc	8,000	
8 x 1-1/4 PTH SD Lathing Zinc	Zinc	8,000	
6 x 1-5/8 SFH SD	DGP	5,000	Fastening wood trim and base to 14 ga to 20 ga studs
6 x 2-1/4 SFH SD Zinc	Zinc	3,000	

1 For coating abbreviations, GP = Grey phosphate per EN ISO 3892; DGP = Dark Grey phosphate per EN ISO 3892; Zinc = electroplated zinc coating; CRC = Proprietary Duplex Coating. For more information on corrosion resistance, reference Section 3.6.1.6.
2 Available in both single screw and collated screws.

The importance of IBC compliant screws.

ICC-ES ESR-2196 (Steel and Metal screw report) and ESR-3891 (Interior Finish/Drywall screw report) provides IBC recognition of Hilti's Self-Drilling Screw Fasteners. This recognition was based on a comprehensive and rigorous independent evaluation of Hilti's Self-Drilling Screw Fasteners to the latest IBC code requirements in ICC-ES AC118 Acceptance Criteria for Self-Tapping Screw Fasteners, as well as the AISI S904 and AISI S905 test standards.

AC118 provides the IBC code recognition and quality assurance for screw fasteners. ICC-ES ESR-2196 recognizes Steel and Metal Hilti screws which are used to connect cold-formed steel members together. ICC-ES ESR-3891 recognizes Interior Finish/Drywall screws which are used to connect gypsum board materials to cold-formed steel base material cover the HWH, HHWH, PPH, PPFH, PBH, PWH, PTH, PPCH, TPCH and PFTH head style Hilti screws.

To ensure IBC compliance of screws on your next project, reference ESR-2196 and ESR-3891.

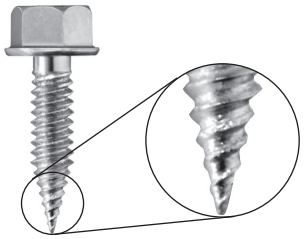
3.6.3 HVAC SCREWS

3.6.3.1 PRODUCT DESCRIPTION

For decades, the conventional screws utilized for HVAC duct fabrication and installation have gone unchanged. Many contractors prefer sharp point screws for their off angle fastening but the screws are limited to lighter gauge steel. Self-drilling screws cover heavier gauge steel but are prone to "walking." This can lead to lost productivity, especially when working in spaces with limited access.

Hilti has blended the best of both fasteners with the new S-MS HVAC zip screws. Although they function like and have the advantages of self-piercing screws, the sharp HVAC zip screws are engineered to handle heavier gauge steel, fastening sheet steel from 16 to 28 gauge with their innovative HyperThread technology. HVAC zip screws can draw the steel sheets together, pierce cleanly with almost no metal filings and feature high profile heads for secure driving.

Hilti also supplies high quality sharp point and self-drilling screws for HVAC applications.



S-MS HWH HVAC Zip Screws
(#8 and #10)

HWH HVAC Sharp Point Screws
(#8 and #10)

S-MD HWH HVAC
(#8, #10 and #12)

3.6.3.2 MATERIAL SPECIFICATIONS

Fastener	Fastener Material	Fastener Plating[4]
S-MS HWH HVAC Zip Screws (#8 Screw)	Carbon Steel	3 to 8 µm Zinc
S-MS HWH HVAC Zip Screws (#10 Screw)	Carbon Steel	5 µm Zinc[1]
HWH Sharp HVAC Screws (#8 and #10)	Carbon Steel	Zinc[3]
HWH Self-Drilling HVAC Screws (#8, #10 and #12)	Carbon Steel	5 µm Zinc[2]

1 EN/ISO 4042 A/3/E.
2 EN/ISO 4042 A3F.
3 Minimum 24 hours no red rust when tested in accordance with ASTM B117.
4 Reference Section 2.3.3.1 for more information on platings.

3.6.3.3 TECHNICAL DATA

Ultimate tensile strengths - pullout (tension), lb (kN)[1,2,4,5,6]

Screw designation	Thickness of member not in contact with the screw head, ga (in.)						
	28 (0.015)	26 (0.018)	24 (0.024)	22 (0.030)	20 (0.036)	18 (0.048)	16 (0.060)
S-MS 8-18x1/2 HWH	**110** (0.49)	**150** (0.67)	**200** (0.89)	**260** (1.16)	**330** (1.47)	–	–
S-MS 10-12x3/4 HWH	–	**160** (0.71)	**230** (1.02)	**305** (1.36)	**350** (1.56)	**450** (2.49)	–
#8 HWH Sharp	**110** (0.49)	**150** (0.67)	**200** (0.89)	**260** (1.16)	–	–	–
#10 HWH Sharp	**130** (0.58)	**160** (0.71)	**230** (1.02)	**305** (1.36)	**350** (1.56)	–	–
S-MD 8-18 HWH[3]	–	–	–	**190** (0.85)	**225** (1.00)	**300** (1.33)	**375** (1.67)
S-MD 10-16 HWH[3,7]	–	–	–	–	**260** (1.16)	**350** (1.56)	**435** (1.93)
S-MD 12-14 HWH[3,7]	–	–	–	–	**295** (1.31)	**395** (1.76)	**495** (2.20)

1 The lower of the ultimate pullout, pullover, and tension fastener strength of screw should be used for determination of allowable or factored resistance loads per footnote 4.
2 Unless otherwise noted, load values based upon testing completed in accordance with AISI S905.
3 Load values based upon calculations done in accordance with Section J4 of AISI S100. ANSI/ASME standard screw diameters were used in the calculations and are listed in the tables.
4 AISI S100 recommends a safety factor of 3.0 be applied for allowable strength design (ASD), a ϕ factor of 0.5 be applied for LRFD design or a Φ factor of 0.4 be applied for LSD design.
5 The load data in the table is based upon sheet steel with F_u = 45 ksi. For F_u = 55 ksi steel, multiply values by 1.22. For $F_u \geq 65$ ksi steel, multiply values by 1.44.
6 Refer to Section 3.6.3.5 to ensure optimal drilling capacities.
7 Load data for thicker steel connections available. Please reference Section 3.6.2.

Approvals/Listings

ICC-ES (International Code Council)
ESR-2196 with LABC/LARC Supplement (S-MD HWH Self-Drilling Screws)

Ultimate tensile strengths - pullover (tension), lb (kN)[1,2,4,5,6]

Screw designation	Washer or head diameter In.	Thickness of member in contact with the screw head, ga (in.)						
		28 (0.015)	26 (0.018)	24 (0.024)	22 (0.030)	20 (0.036)	18 (0.048)	16 (0.060)
S-MS 8-18x1/2 HWH[3]	0.335	335 (1.49)	405 (1.80)	540 (2.40)	675 (3.00)	815 (3.63)	–	–
S-MS 10-12x3/4 HWH[3]	0.399	–	480 (2.14)	645 (2.87)	805 (3.58)	970 (4.31)	1290 (5.74)	–
#8 HWH Sharp	0.335	335 (1.49)	405 (1.80)	540 (2.40)	675 (3.00)	–	–	–
#10 HWH Sharp	0.399	400 (1.78)	480 (2.14)	645 (2.87)	805 (3.58)	970 (4.31)	–	–
S-MD 8-18 HWH	0.335	–	–	–	675 (3.00)	815 (3.63)	1000 (4.45)	1000 (4.45)
S-MD 10-16 HWH[7]	0.399	–	–	–	805 (3.58)	970 (4.31)	1290 (5.74)	1370 (6.09)
S-MD 12-14 HWH[7]	0.415	–	–	–	835 (3.71)	1010 (4.49)	1340 (5.96)	1680 (7.47)

1 The lower of the ultimate pullout, pullover, and tension fastener strength of screw should be used for determination of allowable or factored resistance loads per footnote 4.
2 Unless noted otherwise, load values based upon calculations done in accordance with Section J4 of AISI S100. ANSI/ASME standard screw head diameters were used in the calculations and are listed in the tables.
3 Load values based upon testing completed in accordance with AISI S905.
4 AISI S100 recommends a safety factor of 3.0 be applied for allowable strength design (ASD), a Φ factor of 0.5 be applied for LRFD design and a Φ factor of 0.4 be applied for LSD design.
5 The load data in the table is based upon sheet steel with F_u = 45 ksi. For F_u = 55 ksi steel, multiply values by 1.22. For F_u ≥ 65 ksi steel, multiply values by 1.44.
6 Refer to Section 3.6.3.5 to ensure optimal drilling capacities.
7 Load data for thicker steel connections available. Please reference Section 3.6.2.

Nominal ultimate fastener strength of screw, lb (kN)[1,2,3]

Screw designation	Nominal diameter In.	Nominal fastener strength			
		Tension P_{ts}		Shear P_{ss}	
		lb	(kN)[1]	lb	(kN)[2,3]
S-MS 8-18x1/2 HWH	0.164	1915	(8.52)	1570	(6.98)
S-MS 10-12x3/4 HWH	0.190	1915	(8.52)	1905	(8.47)
#8 HWH Sharp	0.164	1610	(7.16)	860	(3.83)
#10 HWH Sharp	0.190	1915	(8.52)	1905	(8.47)
S-MD 8-18 HWH	0.164	1000	(4.45)	1170	(5.20)
S-MD 10-16 HWH	0.190	1370	(6.09)	1215	(5.40)
S-MD 12-14 HWH	0.216	2325	(10.34)	1880	(8.36)

1 The lower of the ultimate pullout, pullover, and tension fastener strength of screw should be used for design. The Pullout and Pullover tables in this section have already been adjusted where screw strength governs.
2 The lower of the ultimate shear fastener strength and shear bearing should be used for design. The Shear Bearing table in this section has already been adjusted where screw strength governs.
3 AISI S100 recommends a safety factor of 3.0 be applied for allowable strength design (ASD), a Φ factor of 0.5 be applied for LRFD design or a Φ factor of 0.4 be applied for LSD design.

Torsional strength[1,2]

Screw designation	Min. torsional strength in-lb (Nm)	
S-MS 8-18	57	(6.4)
S-MS 10-12	92	(10.4)
#8 HWH Sharp	42	(4.8)
#10 HWH Sharp	61	(6.9)
S-MD 8-18	42	(4.8)
S-MD 10-16	61	(6.9)
S-MD 12-14	92	(10.4)

1 Based on screw only. Does not consider base material limitations.
2 Values in table are ultimate torsional strengths. To obtain maximum setting torque, multiply values in table by 0.66.

Warning: Because of the potential for delayed hydrogen assisted stress corrosion cracking, many hardened steel fasteners are not recommended for use with dissimilar metals or chemically treated wood when moisture may be present or in corrosive environments. For further information, contact Hilti Technical Support at 1-877-749-6337.

Ultimate shear strengths - bearing (shear), lb (kN)[1,2,4,5,6]

Screw designation	Thickness of member in contact with screw head ga (In.)	Thickness of member not in contact with the screw head, ga (in.)						
		28 (0.015)	26 (0.018)	24 (0.024)	22 (0.030)	20 (0.036)	18 (0.048)	16 (0.060)
S-MS 8-18x1/2 HWH	28 (0.015)	220 (0.98)	260 (1.16)	315 (1.40)	320 (1.42)	320 (1.42)	–	–
	26 (0.018)	240 (1.07)	270 (1.20)	340 (1.51)	340 (1.51)	340 (1.51)	–	–
	24 (0.024)	245 (1.09)	270 (1.20)	445 (1.98)	475 (2.11)	475 (2.11)	–	–
	22 (0.030)	245 (1.09)	345 (1.53)	445 (1.98)	555 (2.47)	555 (2.47)	–	–
	20 (0.036)	320 (1.42)	345 (1.53)	555 (2.47)	710 (3.16)	860 (3.83)	–	–
S-MS 10-12x3/4 HWH	26 (0.018)	–	230 (1.02)	375 (1.67)	455 (2.02)	520 (2.31)	520 (2.31)	–
	24 (0.024)	–	230 (1.02)	410 (1.82)	570 (2.54)	660 (2.94)	760 (3.38)	–
	22 (0.030)	–	330 (1.47)	500 (2.22)	685 (3.05)	765 (3.40)	925 (4.11)	–
	20 (0.036)	–	365 (1.62)	500 (2.22)	685 (3.05)	895 (3.98)	1120 (4.98)	–
	18 (0.048)	–	365 (1.62)	570 (2.54)	725 (3.22)	895 (3.98)	1330 (5.92)	–
#8 HWH Sharp	28 (0.015)	115 (0.51)	115 (0.51)	115 (0.51)	115 (0.51)	–	–	–
	26 (0.018)	115 (0.51)	275 (1.22)	275 (1.22)	275 (1.22)	–	–	–
	24 (0.024)	115 (0.51)	275 (1.22)	425 (1.89)	425 (1.89)	–	–	–
	22 (0.030)	115 (0.51)	275 (1.22)	425 (1.89)	610 (2.71)	–	–	–
#10 HWH Sharp	28 (0.015)	115 (0.51)	115 (0.51)	115 (0.51)	115 (0.51)	115 (0.51)	–	–
	26 (0.018)	115 (0.51)	275 (1.22)	275 (1.22)	275 (1.22)	275 (1.22)	–	–
	24 (0.024)	115 (0.51)	275 (1.22)	440 (1.96)	440 (1.96)	440 (1.96)	–	–
	22 (0.030)	115 (0.51)	275 (1.22)	440 (1.96)	715 (3.18)	715 (3.18)	–	–
	20 (0.036)	115 (0.51)	275 (1.22)	440 (1.96)	715 (3.18)	895 (3.98)	–	–
S-MD 8-18 HWH[3,7]	22 (0.030)	–	–	–	400 (1.78)	525 (2.34)	600 (2.67)	600 (2.67)
	20 (0.036)	–	–	–	400 (1.78)	525 (2.34)	715 (3.18)	715 (3.18)
	18 (0.048)	–	–	–	400 (1.78)	525 (2.34)	805 (3.58)	955 (4.25)
	16 (0.060)	–	–	–	400 (1.78)	525 (2.34)	805 (3.58)	1120 (4.98)
S-MD 10-16 HWH[3,7]	22 (0.030)	–	–	–	–	565 (2.51)	695 (3.09)	695 (3.09)
	20 (0.036)	–	–	–	–	565 (2.51)	830 (3.69)	830 (3.69)
	18 (0.048)	–	–	–	–	565 (2.51)	865 (3.85)	1110 (4.94)
	≥ 16 (0.060)	–	–	–	–	565 (2.51)	865 (3.85)	1210 (5.38)
S-MD 12-14 HWH[3,7]	22 (0.030)	–	–	–	–	600 (2.67)	785 (3.49)	785 (3.49)
	20 (0.036)	–	–	–	–	600 (2.67)	930 (4.14)	945 (4.20)
	18 (0.048)	–	–	–	–	600 (2.67)	925 (4.11)	1260 (5.60)
	≥ 16 (0.060)	–	–	–	–	600 (2.67)	925 (4.11)	1290 (5.74)

1 The lower of the ultimate shear bearing and shear fastener strength of screw should be used for determination of allowable or factored resistance loads per footnote 4.

2 Unless otherwise noted, load values based upon testing completed in accordance with AISI S905.

3 Load values based upon calculations done in accordance with Section J4 of AISI S100. ANSI/ASME standard screw diameters were used in the calculations.

4 AISI S100 recommends a safety factor of 3.0 be applied for allowable strength design (ASD), a Φ factor of 0.5 be applied for LRFD design or a Φ factor of 0.4 be applied for LSD design.

5 The load data in the table is based upon sheet steel with F_u = 45 ksi. For F_u = 55 ksi steel, multiply values by 1.22. For F_u ≥ 65 ksi steel, multiply values by 1.44.

6 Refer to Section 3.6.3.5 to ensure optimal drilling capacities.

7 Load data for thicker steel connections available. Please reference Section 3.6.2.

3.6.3.4 INSTALLATION INSTRUCTIONS

For general discussion of Hilti screw fastener installation, reference Section 3.6.1.7.

Warning: Because of the potential for delayed hydrogen assisted stress corrosion cracking, many hardened steel fasteners are not recommended for use with dissimilar metals or chemically treated wood when moisture may be present or in corrosive environments. For further information, contact Hilti Technical Support at 1-877-749-6337.

3.6.3.5 ORDERING INFORMATION

S-MS HWH HVAC Zip Screws

Description[1]	Gauge range[2]	Maximum total thickness (MT), in.	Qty
S-MS 8-18 x 1/2" HWH HVAC Zip Screw (small)	20-28	0.072	1,000
S-MS 8-18 x 1/2" HWH HVAC Zip Screw (bulk)	20-28	0.072	10,000
S-MS 10-12 x 3/4" HWH HVAC Zip Screw (small)	18-26	0.100	1,000
S-MS 10-12 x 3/4" HWH HVAC Zip Screw (bulk)	18-26	0.100	4,500

HWH/SHWH HVAC Sharp Point Screws

Description[1]	Gauge range[2]	Maximum total thickness (MT), in.	Qty
#6 X 3/8" HWH Sheet Metal Screw	20-28	0.072	20,000
#7 X 1/2" SHWH Sheet Metal Screw	20-28	0.072	15,000
#8 X 1/2" SHWH Sheet Metal Screw	20-28	0.072	13,000
#8 X 3/4" SHWH Sheet Metal Screw	20-28	0.072	10,000
#8 X 1 1/2" SHWH Sheet Metal Screw	20-28	0.072	5,000
#8 X 2" SHWH Sheet Metal Screw	20-28	0.072	4,000
#10 X 3/4" HWH Sheet Metal Screw	20-28	0.072	9,000
#10 X 3/4" SHWH 1/4" Drive Sheet Metal Screw	20-28	0.072	9,000
#10 X 1" SHWH Sheet Metal Screw	20-28	0.072	6,000
#10 X 2" SHWH Sheet Metal Screw	20-28	0.072	3,000

S-MD HWH HVAC Self-Drilling Screws

Description[1]	Gauge range[2]	Maximum total thickness (MT), in.	Qty
Self-Drilling Screw S-MD 8-18x1/2 HWH2	16-22	0.125	1,000
Self-Drilling Screw S-MD 10-16X5/8 HWH 3	14-20	0.175	7,500
Self-Drilling Screw S-MD 10-16X3/4 HHWH3	14-20	0.175	6,500
Self-Drilling Screw S-MD 10-16X3/4 HWH3	14-20	0.175	6,500
Self-Drilling Screw S-MD 10-16X1 HWH 3	14-20	0.175	5,000
Self-Drilling Screw S-MD 10-16X1 1/4 HWH	14-20	0.175	4,000
Self-Drilling Screw S-MD 10-16X1 1/2 HWH	14-20	0.175	4,000

S-MD HWH HVAC Self-Drilling Screws with Kwik-Seal Washers

Description[1]	Gauge range[2]	Maximum total thickness (MT), in.	Qty
Self-Drilling Screw 12-14X3/4 HWH 3 KS	12-20	0.210	3,000
Self-Drilling Screw 12-14 X 1 HWH 3 KS	12-20	0.210	2,500
Self-Drilling Screw 12-14X1 1/4 HWH 3 KS	12-20	0.210	2,000
Self-Drilling Screw 12-14X1 1/2 HWH 3 KS	12-20	0.210	2,000
Self-Drilling Screw 12-14X2 HWH 3 KS	12-20	0.210	1,500

HWH Self-Drilling Screws in AISI 410 Stainless Steel

Description[1]	Gauge range[2]	Maximum total thickness (MT), in.	Qty
Self-Drilling Screw 10-16 x 3/4" HWH 410 SS	14-20	0.175	TBD

1 Other sizes available. Please contact Hilti Customer Service for details.
2 Gauge range is for 2 layers of the same gauge. For multiple layers of different gauges, use maximum total thickness and load tables to determine appropriate fastener.

3.6.4 KWIK-FLEX SELF-DRILLING SCREWS

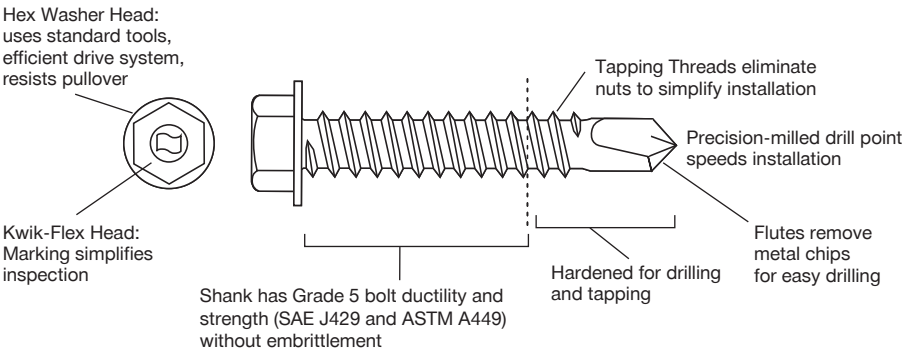
3.6.4.1 PRODUCT DESCRIPTION

Hilti Kwik-Flex fasteners combine the in-place economy of self-drilling screws with the strength and performance of bolted connections. The precision-milled point and lead threads of a Kwik-Flex fastener are selectively hardened for dependable self-drilling and tapping. The balance of the fastener retains the ductility. This results in superior resistance to embrittlement that can be caused by stress, dissimilar metals and moisture.

Product features

- Virtually immune to embrittlement failure
- Self-drilling for convenience, labor savings
- Kwik-Cote finish provides greater corrosion resistance than cadmium or zinc plating (reference Section 2.3.3.1)
- Complies with the Buy America Act
- Suitable for:

  Aluminum to steel
  Fire retardant plywood
  Corrosive environments
  (Reference Section 3.6.1.6)



Listings/Approvals

ICC-ES (International Code Council)
ESR-3332 with LABC/LARC Supplement

3.6.4.2 MATERIALSPECIFICATIONS

Mechanical properties			
Yield Strength, F_y **ksi** (MPa)		Yield Strength, F_u **ksi** (MPa)	
92	(634)	**120**	(828)

Note: These fasteners address delayed failure due to hydrogen assisted stress corrosion cracking. They are not any more resistant to other corrosion effects than standard Hilti Kwik-Cote screws.

3.6.4.3 TECHNICAL DATA

Ultimate tensile strengths - pullout (tension), lb (kN)[1,2,3,4,5,8]

Screw designation	Nominal diameter in.	Thickness of member not in contact with the screw head										
		Steel[6], ga (in.) or in.								Aluminum[7], in.		
		18 (0.048)	16 (0.060)	14 (0.075)	12 (0.105)	1/8	3/16	1/4	5/16	1/8	1/4	3/8
#10-16	0.190	410 (1.82)	580 (2.58)	710 (3.16)	920 (4.09)	890 (3.96)	–	–	–	920 (4.09)	–	–
#12-14	0.216	395 (1.76)	615 (2.74)	790 (3.51)	985 (4.38)	1530 (6.81)	1995 (8.87)	–	–	630 (2.80)	2745 (12.21)	–
1/4-14	0.250	395 (1.76)	620 (2.76)	765 (3.40)	1025 (4.56)	1685 (7.50)	2695 (11.99)	–	–	720 (3.20)	2905 (12.92)	
1/4-20	0.250	–	610 (2.71)	780 (3.47)	1270 (5.65)	1570 (6.98)	2740 (12.19)	3130 (13.92)	3620 (16.10)	690 (3.07)	2100 (9.34)	4365 (19.42)
5/16-18	0.313	–	–	–	1560 (6.94)	2120 (9.43)	–	–	–	–	–	–
5/16-24	0.313	–	–	–	1375 (6.12)	1910 (8.50)	2170 (9.65)	3565 (15.86)	4270 (18.99)	–	–	–

1 The lower of the ultimate pullout, pullover, and tension fastener strength of screw should be used for design.
2 Load values based upon testing completed in accordance with AISI S905.
3 AISI S100 recommends a safety factor of 3.0 be applied for allowable strength design, a Φ factor of 0.5 be applied for LRFD design and a Φ factor of 0.4 be applied for LSD design.
4 ANSI/ASME standard screw diameters were used in the calculations and are listed in the tables.
5 The screw diameters in the table above are available in head styles of pan, hex washer head, pancake, flat, wafer and bugle.
6 The load data in the table is based upon sheet steel with F_u = 45 ksi. For F_u = 55 ksi steel, multiply values by 1.22. For F_u = 65 ksi steel, multiply values by 1.44.
7 Load values based upon testing in 6063-T5 aluminum alloy.
8 Refer to Section 3.6.4.5 to ensure drilling capacities.

Ultimate tensile strengths - pullover (tension), lb (kN)[1,2,4,5,7]

Screw designation	Washer or head diameter in.	Thickness of member in contact with the screw head							
		Steel[6], ga (in.) or in.							
		18 (0.048)[3]	16 (0.060)	14 (0.075)	12 (0.105)	1/8	3/16	1/4	5/16
Hex Washer Head (HWH)									
#10-16	0.384	1245 (5.54)	1445 (6.43)	1445 (6.43)	1445 (6.43)	1445 (6.43)	–	–	–
#12-14 #12-24	0.398	1290 (5.74)	1610[3] (7.16)	2015[3] (8.96)	2200 (9.79)	2200 (9.79)	2200 (9.79)	–	–
1/4-14	0.480	1555 (6.92)	1945[3] (8.65)	2430[3] (10.81)	3380 (15.03)	3380 (15.03)	3380 (15.03)	–	–
1/4-20	0.480	–	1945[3] (8.65)	2430[3] (10.81)	3380 (15.03)	3380 (15.03)	3380 (15.03)	3380 (15.03)	3380 (15.03)
5/16-18	0.600	–	–	–	3505 (15.59)	3505 (15.59)	–	–	–
5/16-24	0.600	–	–	–	3980 (17.70)	3980 (17.70)	3980 (17.70)	3980 (17.70)	3980 (17.70)
Phillips Pan Head (PPH)									
#10	0.357	1160 (5.16)	1445 (6.43)	1805 (8.03)	2530 (11.25)	3010 (13.39)	–	–	–

1 The lower of the ultimate pullout, pullover, and tension fastener strength of screw should be used for design.
2 Unless otherwise noted, load values based upon testing completed in accordance with AISI S905.
3 Load values for 18 gauge and noted 16 and 14 gauge steel are based upon calculations done in accordance with Section J4 of AISI S100. ANSI/ASME standard screw head diameters were used in the calculations and are listed in the table.
4 AISI S100 recommends a safety factor of 3.0 be applied for allowable strength design, a Φ factor of 0.5 be applied for LRFD design and a Φ factor of 0.4 be applied for LSD design.
5 Pancake Framing Head Undercut (PFHUC) and Phillips Wafer Head (PWH) styles are not covered by this table because they are not used for attachment of steel to steel.
6 The load data in the table is based upon sheet steel with F_u = 45 ksi. For F_u = 55 ksi steel, multiply values by 1.22.
7 Refer to Section 3.6.4.5 to ensure drilling capacities.

Ultimate shear strengths – bearing (shear), lb (kN)[1,2,3,4,5,8]

Screw designation	Nominal diameter in.	Thickness of members, in contact with screw head - not in contact with screw head								
		Steel[6], ga (in.) or in.							Aluminum[7], in.	
		18 (0.048) - 18 (0.048	18 (0.048) - 14 (0.075)	16 (0.060) - 16 (0.060)	14 (0.075) - 14 (0.075)	1/8-3/16	3/16 – 1/4	1/4 - 12 (0.105)	1/8 – 1/8	1/8 – 1/4
#10-16 #2	0.190	865 (3.85)	865 (3.85)	1210 (5.38)	–	–	–	–	1760 (7.83)	–
#10-16 #3	0.190	1105 (4.92)	1185 (5.27)	1360 (6.05)	–	–	–	–	1760 (7.83)	–
#12-14	0.216	1070 (4.76)	1720 (7.65)	1540 (6.85)	1490 (6.63)	–	–	–	1005 (4.47)	1425 (6.34)
1/4-14	0.250	1130 (5.03)	1880 (8.36)	1560 (6.94)	1985 (8.83)	1915 (8.52)	–	–	1215 (5.40)	1770 (7.87)
1/4-20	0.250	1160 (5.16)	1580 (7.03)	1600 (7.12)	2010 (8.94)	1785 (7.94)	1870 (8.32)	1660 (7.38)	1185 (5.27)	1770 (7.87)
5/16-18	0.313	1225 (5.45)	1865 (8.30)	1685 (7.50)	2675 (11.90)	–	–	–	–	–
5/16-24	0.313	–	–	–	–	4040 (17.97)	2955 (13.14)	2660 (11.83)	2220 (9.88)	3440 (15.30)

1 The lower of the ultimate shear bearing and shear fastener strength of screw should be used for design.
2 Load values based upon testing completed in accordance with AISI S905.
3 AISI S100 recommends a safety factor of 3.0 be applied for allowable strength design, a Φ factor of 0.5 be applied for LRFD design and a Φ factor of 0.4 be applied for LSD design.
4 ANSI/ASME standard screw head diameters were used in the calculations and are listed in the tables.
5 Load values in table are for Hex Washer Head (HWH) and Phillips Pan Head (PPH). Pancake Framing Head Undercut (PFHUC) and Phillips Wafer Head (PWH) styles are not covered by this table because they are not used for attachment of steel to steel or aluminum to aluminum.
6 The load data in the table is based upon sheet steel with F_u = 45 ksi. For F_u = 55 ksi steel, multiply values by 1.22. For F_u = 65 ksi steel, multiply values by 1.44.
7 Load values based upon testing in 6063-T5 aluminum alloy.
8 Refer to Section 3.6.4.5 to ensure drilling capacities.

Nominal ultimate fastener strength of screw[3]

Screw designation	Nominal diameter in.	Nominal fastener strength			
		Tension, P_{ts} lb (kN)[1]		Shear, P_{ss} lb (kN)[2]	
#10-16	0.190	2275	(10.12)	1465	(6.52)
#12-14	0.216	3215	(14.30)	1990	(8.85)
#12-24	0.216	4175	(18.57)	2505	(11.14)
1/4-14	0.250	4365	(19.42)	2690	(11.97)
1/4-20	0.250	4365	(19.42)	2615	(11.63)
5/16-18	0.313	8070	(35.90)	4570	(20.33)
5/16-24	0.313	8755	(38.94)	5470	(24.33)

1 The lower of the ultimate pullout, pullover, and tension fastener strength of screw should be used for design. The Pullout and Pullover tables in this section have already been adjusted where screw strength governs.
2 The lower of the ultimate shear fastener strength and shear bearing should be used for design. The Shear Bearing table in this section has already been adjusted where screw strength governs.
3 AISI S100 recommends a safety factor of 3.0 be applied for allowable strength design, a Φ factor of 0.5 be applied for LRFD design and a Φ factor of 0.4 be applied for LSD design.

3.6.4.4 INSTALLATION INSTRUCTIONS

For general discussion of Hilti screw fastener installation, reference Section 3.6.1.7. For specific Kwik-Flex spacing and edge distance recommendations, reference the following table.

Kwik-flex screw specification table

Fastener size/diameter	Fastened material	Minimum spacing (in.)	Minimum edge distance (in.)
#10	Steel	5/8	9/32
	Aluminum	15/32	3/8
#12	Steel	11/16	3/8
	Aluminum	9/16	7/16
1/4 Inch	Steel	3/4	3/8
	Aluminum	5/8	1/2

3.6.4.5 ORDERING INFORMATION

Description	Maximum drilling capacity	Maximum total thickness (MT)	Recess	Box Qty
Countersinking head				
S-WD 10-24 x 1 1/4" PWH3 KF	0.175"	0.750"	PH2 TEK	5,000
S-WD 12-14 x 1" PFHUC3 KF	0.210"	0.500"	PH2 TEK	4,000
S-WD 12-14 x 1 1/2" PFHUC3 KF[1]	0.210"	1.000"	PH2 TEK	2,500
S-WD 14-20 x 3" PFHUC4 KF[1]	0.312"	2.500"	PH3	500
S-WD 14-20 x 4" PFHUC4 KF[1]	0.312"	3.500"	PH3	500
#10 Diameter				
S-MD 10-16 x 3/4" PPH3 KF[1]	0.175"	0.500"	PH2 TEK	6,000
S-MD 10-16 x 3/4" HWH3 KF	0.175"	0.500"	5/16"	6,000
#12 Diameter HWH				
S-MD 12-14 x 7/8" HWH3 KF	0.210"	0.470"	5/16"	5,000
S-MD 12-14 x 1" HWH3 KF	0.210"	0.500"	5/16"	4,000
S-MD 12-14 x 1 1/2" HWH3 KF	0.210"	1.000"	5/16"	2,500
S-MD 12-14 x 1 1/2" HWH4 KF[1]	0.312"	0.875"	5/16"	2,500
S-MD 12-14 x 2" HWH3 KF	0.210"	1.500"	5/16"	2,000
S-MD 12-14 x 3" HWH3 KF[1]	0.210"	2.500"	5/16"	1,000
S-MD 12-24 x 1 3/4" HWH5 KF[1]	0.500"	0.800"	5/16"	2,500
1/4 Diameter HWH				
S-MD 1/4-14 x 1" HWH3 KF	0.220"	0.450"	3/8"	3,000
S-MD 1/4-14 x 1 1/2" HWH3 KF	0.220"	0.950"	3/8"	2,000
S-MD 1/4-14 x 2" HWH3 KF	0.220"	1.450"	3/8"	1,500
S-MD 1/4-20 x 1 1/8" HWH4 KF[1]	0.312"	0.500"	3/8"	2,500
S-MD 1/4-20 x 1 1/2" HWH4 KF	0.312"	0.830"	3/8"	2,000
S-MD 1/4-20 x 1 3/4" HWH5 KF[1]	0.500"	0.800"	3/8"	1,000
S-MD 1/4-20 x 2" HWH4 KF	0.312"	1.330"	3/8"	1,500
S-MD 1/4-20 x 2 1/2" HWH4 KF	0.312"	1.830"	3/8"	1,000
S-MD 1/4-20 x 3 3/8" HWH4 KF[1]	0.312"	2.700"	3/8"	500
S-MD 1/4-20 x 4" HWH4 KF[1]	0.312"	3.500"	3/8"	500
5/16 Diameter HWH				
S-MD 5/16-18 x 1-1/2" HWH3 KF[1]	0.220"	0.850"	3/8"	1,000
S-MD 5/16-24 x 1-1/2" HWH4 KF[1]	0.312"	0.850"	3/8"	1,000
S-MD 5/16-24 x 2" HWH4 KF[1]	0.312"	1.350"	3/8"	1,000

1 Available only through special order.

3.6.5 BI-METAL KWIK-FLEX SELF-DRILLING SCREWS

3.6.5.1 PRODUCT DESCRIPTION

Owners, architects and design engineers expect longer life cycles from buildings. Extended warranties and use of more sustainable materials add up to greater expectations for performance — from structural integrity to the purely aesthetic — of all building components.

The solution: Bi-Metal Kwik-Flex Self-Drilling Fasteners

Made of 302/304 series (18/8) stainless steel alloy to provide unmatched corrosion resistance in your toughest applications

- Fused and hardened carbon steel drill point and lead threads quickly drill and tap structural steel and aluminum up 1/2" thick
- Coated with silver-colored Kwik-Cote, a galvanic barrier to help protect aluminum components from accelerated corrosion when in contact with 300 series stainless steel
- 300 series stainless alloy is virtually immune to delayed embrittlement failures seen with hardened 400 series stainless self-drilling fasteners

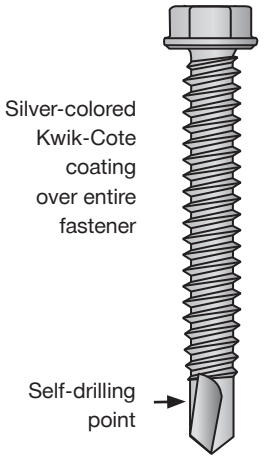
300 series stainless alloy is virtually immune to Hydrogen-Assisted Stress-Corrosion Cracking (HASCC). Hardened 410 stainless steel, 410 super-passivated stainless steel and 400 modified stainless steel self-drilling screws are generally considered susceptible to HASCC. Conventional hardened carbon steel screws with coatings that do not have Kwik-Flex technology (differential hardness) are also generally considered susceptible to HASCC.

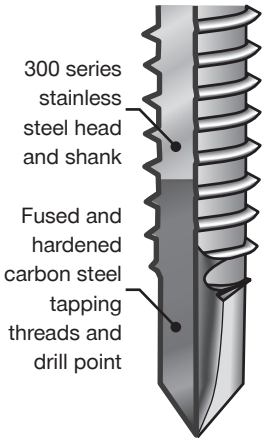
Minimize corrosion in your applications

- Exposed fastening/coastal/aggressive environments
- Curtain wall/window wall systems/ rain screen systems
- Windows/doors/awnings/storefronts
- Panel systems to steel or aluminum framing
- Aluminum enclosures
- ACQ-treated wood (especially for applications with unknown or uncontrolled moisture conditions)
- Brick veneer anchoring

Product features

- Bi-metal technology — 300 (18-8) stainless steel head and shank provides outstanding corrosion resistance and long service life
- Fused and hardened carbon steel drill point quickly drills and taps into steel or aluminum up to 1/2" thick
- Silver-colored Kwik-Cote coating provides greater galvanic compatibility in dissimilar metal applications involving aluminum
- High strength, ductility and reliability
- Virtually immune to delayed embrittlement or to Hydrogen-Assisted Stress-Corrosion Cracking (HASCC)
- Wide variety of sizes and head styles
- High in-place value over the life of structures, components and systems





Listings/Approvals

ICC-ES (International Code Council)
ESR-4374 with LABC/LARC Supplement

COLA (City of Los Angeles)
RR 25886

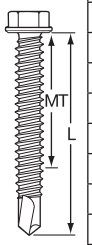
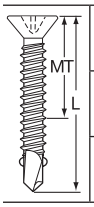
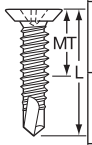
3.6.5.2 MATERIAL SPECIFICATIONS

Fastener designation	Fastener material[1]	Self-drilling point material	Fastener plating
Bi-Metal Kwik-Flex	Stainless steel	Carbon steel	Kwik-Cote

1 Bi-Metal Kwik-Flex Fasteners with HWH style are SAE 304 stainless steel, while the PFH and PFHUC style fasteners are SAE 302 stainless steel. All head styles can be custom ordered in SAE 316 stainless steel with sufficient lead time and quantities.

3.6.5.3 TECHNICAL DATA

Selection guide

	Description	Size	Length (L)	Drive recess	Drill point size	Maximum drilling capacity (DC)	Maximum total thickness[1] (MT)
hex washer head							
	S-MD 10-16 x 3/4" HWH #2 BM Kwik-Flex	10-16	3/4"	5/16" hex	2	0.110"	0.320"
	S-MD 12-14 x 1" HWH #3 BM Kwik-Flex	12-14	1"		3	0.210"	0.500"
	S-MD 12-14 x 1-1/2" HWH #3 BM Kwik-Flex		1-1/2"				1.00"
	S-MD 12-14 x 2-1/2" HWH #3 BM Kwik-Flex		2-1/2"				2.00"
	S-MD 12-24 x 2" HWH #5 BM Kwik-Flex	12-24	2"		5	0.500"	1.100"
	S-MD 14-20 x 1" HWH #3 BM Kwik-Flex	1/4-20	1"	3/8" hex	3	0.312"	0.500"
	S-MD 14-20 x 1-1/2" HWH #3 BM Kwik-Flex		1-1/2"				1.00"
	S-MD 14-20 x 2" HWH #3 BM Kwik-Flex		2"				1.500"
	S-MD 14-20 x 2-1/2" HWH #3 BM Kwik-Flex		2-1/2"				2.00"
	S-MD 14-20 x 3" HWH #3 BM Kwik-Flex		3"				2.50"
	S-MD 14-20 x 4" HWH #3 BM Kwik-Flex		4"				3.50"
	S-MD 14-20 x 2" HWH #5 BM Kwik-Flex		2"		5	0.500"	1.100"
Flat head reamers w/wings							
	S-WW 10-16 x 1-1/2" PFH #3 BM Kwik-Flex	10-16	1-1/2"	#2 phillips	3	0.140"	0.800"
	S-WW 12-24 x 2-13/16" PFH #5 BM Kwik-Flex	12-24	2-13/16"	#3 phillips	5	0.500"	1.710"
	S-WW 14-20 x 2-13/16" PFH #5 BM Kwik-Flex	1/4-20	2-13/16"				1.710"
Flat head undercut							
	S-WD 12-14 x 1" PFHUC #3 BM Kwik-Flex	12-14	1"	#3 phillips	3	0.140"	0.500"
	S-WD 12-14 x 1-1/2" PFHUC #3 BM Kwik-Flex		1-1/2"				1.00"
	S-WD 1/4 - 20 x 3" PFHUC #2 BM Kwik-Flex	1/4-20	3"		2	0.210"	2.500"
	S-WD 1/4 - 20 x4" PFHUC #2 BM Kwik-Flex		4"				3.500"

1 Maximum total thickness (MT) describes the maximum thickness of all attachments plus the base material thickness and is the load-bearing length of 300 series stainless under the hex head or including the flat head. Hardened carbon steel length (lead threads and point) should be completely through the base material and not in the load bearing section of the connection.

Ultimate tensile strengths — pullout (tension)[1,3]

Screw size	Drill point type	Drill cap (in.)	Pullout (lb)								
			Steel HRB = 60-75 F_u = 50 – 66 ksi							Aluminum 6063-T5 22 ksi	
			18 ga.	16 ga.	14 ga.	12 ga.	1/8"	3/16"	1/4"	1/8"	1/4"
10-16	2	0.150	455	677	793	1394	1906	–	–	994	–
10-16	3	0.187	–	616	684	1242	1605	1527	–	961	–
12-14	2	0.187	528	750	892	1536	2602	2514	–	1132	–
12-14	3	0.210	417	679	802	1371	2028	2499	–	974	–
12-24	5	0.500	–	–	–	–	–	2110	2781	538	1995
1/4-20	3	0.312	–	680	780	1442	2623	3684	4069	1037	2786
1/4-20	5	0.500	–	–	–	–	–	–	2622	–	1724

Ultimate fastener strength of screw[1,2,3]

Size	Tensile (lb)	Shear (lb)
10-16	1847	1282
12-14	2628	1950
12-24	2734	2284
1/4-20	4124	2860

1 All performance data shown is based on tests performed under laboratory conditions at independent construction testing facilities. The appropriate safety factor should be applied and code requirements factored into specification and use of these fasteners. A safety factor of 4:1 or 25% of the ultimate average values shown is generally accepted as an appropriate allowable load. Final determination of the appropriate safety factor and use of these fasteners is the sole responsibility of the person designing the connection. For additional product information and technical assistance, please contact Hilti directly at 1-877-749-6337.

2 Values are for 300 series stainless fastener threaded shank.

3 The lower of the ultimate pullout and tensile fastener strength of screw should be used for design. Pullover or shear bearing capacity of the material being fastened must be independently evaluated.

3.6.5.4 INSTALLATION INSTRUCTIONS

For general discussion of Hilti screw fastener installation, reference Section 3.6.1.7.

Installation recommendation — Since the Bi-Metal Kwik-Flex fasteners are 300 series (18-8) stainless steel and considered non-magnetic, conventional magnetic setters will not retain them. Hilti offers red ring setters to provide faster, more reliable, and more consistent driving of the Bi-Metal Kwik-Flex fasteners.

Identification

The head marking consists of the number “3” as shown below.

flat head

hex washer head

3.6.5.5 ORDERING INFORMATION

Description	Maximum drilling capacity	Maximum total thickness (MT)	Drive recess	Box qzty
Countersinking head - winged reamers				
S-WW 10-16 x 1 1/2" PFH # #3 BM KF	0.140"	0.800"	PH2 TEK	3,500
S-WW 12-24 x 2 13/16" PFH #5 BM KF	0.500"	1.710"	PH3	1,500
S-WW 14-20 x 2 13/16" PFH #5 BM KF	0.500"	1.710"	PH3	1,000
Countersinking head				
S-WD 12-14 x 1" PFHUC #2 BM KF	0.140"	0.500"	PH3	4,000
S-WD 12-14 x 1 1/2" PFHUC #2 BM KF	0.140"	1.000"	PH3	2,500
S-WD 1/4-20 x 3" PFHUC #2 BM KF	0.210"	2.500"	PH3	500
S-WD 1/4-20 x 4" PFHUC #2 BM KF	0.210"	3.500"	PH3	500
#10 diameter HWH				
S-MD 10-16 x 3/4" HWH #2 BM KF	0.110"	0.320"	5/16"	5,000
#12 diameter HWH				
S-MD 12-14 x 1" HWH #3 BM KF	0.210"	0.500"	5/16"	4,000
S-MD 12-14 x 1 1/2" HWH #3 BM KF	0.210"	1.000"	5/16"	2,500
S-MD 12-14 x 2 1/2" HWH #3 BM KF	0.210"	2.000"	5/16"	1,000
S-MD 12-24 x 2" HWH #5 BM KF	0.500"	1.100"	5/16"	2,000
1/4 diameter HWH				
S-MD 1/4-20 x 1" HWH #3 BM KF	0.312"	0.500"	3/8"	2,500
S-MD 1/4-20 x 1 1/2" HWH #3 BM KF	0.312"	1.000"	3/8"	1,000
S-MD 1/4-20 x 2" HWH #3 BM KF	0.312"	1.500"	3/8"	1,000
S-MD 1/4-20 x 2" HWH #5 BM KF	0.500"	1.100"	3/8"	1,500
S-MD 1/4-20 x 2 1/2" HWH #3 BM KF	0.312"	2.000"	3/8"	1,000
S-MD 1/4-20 x 3" HWH #3 BM KF	0.312"	2.500"	3/8"	500
S-MD 14-20 x 4" HWH #3 BMKF	0.312"	3.500"	3/8"	500

1 Bi-Metal Kwik-Flex screws are available by special order.

4.1 APPROVALS AND LISTINGS

4.1.1 ICC-ES (INTERNATIONAL CODE COUNCIL) EVALUATION REPORTS (INCLUDING LABC/LARC AND FBC SUPPLEMENTS)

Report No.	Title
ESR-1663	Hilti Low-Velocity Power-Driven Fasteners
ESR-1752	Low-Velocity Power-Driven Fasteners
ESR-2184	Hilti Low-Velocity Powder-Actuated X-CX Ceiling Clip Assemblies
ESR-2196	Hilti Self-Drilling Steel and Metal Screws
ESR-2197	Steel Deck and Concrete Filled Diaphragms Attached with Hilti Fasteners
ESR-2269	Hilti Low-Velocity X-U and X-U 15 Universal Fasteners and X-P Concrete Fasteners
ESR-2347	Hilti Low-Velocity Powder-Actuated Driven Threaded Studs for Attachment to Steel
ESR-2379	Exterior or Perimeter Sill and Interior Plate Anchorages
ESR-2776	Steel Deck Diaphragms attached with Hilti Powder-Actuated Fasteners and Hilti SLC Sidelap Connectors
ESR-2795	Hilti Low-Velocity Powder-Actuated X-HS Threaded Rod Hanger Assemblies
ESR-3059	Hilti X-PN 37 G3 MX Power- Driven Fasteners Used to Attach Wood Structural Panels to Cold Formed Steel Framing
ESR-3332	Hilti Kwik-Flex Self-Drilling Screws
ESR-3693	Steel Deck Diaphragms attached with S-MD 12-24 x 1 5/8 M HWH5 Frame Fasteners
ESR-3891	Hilti Self-Drilling Drywall Screws
ESR-4185	Hilti S-BT Screw-I123 Screw-In Fasteners
ESR-4374	Hilti Bi-Metal Kwik-Flex Self-Drilling Screws

4.1.2 COLA (CITY OF LOS ANGELES) APPROVALS

Report No.	Title
25886	Hilti Bi-Metal Kwik-Flex Screws

4.1.3 UL/CUL (UNDERWRITERS LABORATORIES) LISTINGS

File No.	Title
EX2258	Pipe Hangers Powder Actuated Fasteners EW10-30-15P10, W10-30-32P10 and W10-30-42P10
R13203	Roof Deck Construction Nos. 58, 87, 156, and 157 Powder Actuated Driven Fasteners
E217969	Power Driven Hangers Hilti X-HSW6, X-HSW10 and X-RH
E201485	Wire Positioning Devices Hilti X-ECH/FR-L, X-ECH/FR-M, X-ECH/FR-S
E257069	X-BT and S-BT Stud Type Fasteners for Grounding and Bonding

4.1.4 FMRC (FACTORY MUTUAL) APPROVALS

File No.	Application / Product
3049232	Examination of Expanded Approvals of Selected Hilti Steel Deck Frame and Sidelap Fasteners
3029102	X-ENP-19 L15, X-EDN19 THQ12, X-EDNK22 THQ12, S-MD 10-16x7/8 HHWH Pilot point and S-MD 12-14x1 HHWH Stitch for securement of steel form deck in lightweight concrete roof deck construction.
3011115	Steel Deck Roof Construction (Class 1-90) Extended Spans for Selected Hilti Steel Deck Fasteners and Hilti S-MD 12-14x1 Stitch and S-MD 10-16x7/8 Pilot Fasteners for Securing Steel Deck Side Laps
3026695	Pipe Hanger Components X-EW6H, X-EW10H
3054498	Certificate of Compliance for Hilti Steel Deck Frame and Sidelap Fasteners for Wind Rating Above Class 1-90 (Up to 1-330)

4.2 REFERENCE STANDARDS

4.2.1 ICC-ES ACCEPTANCE CRITERIA

Standard	Title
AC10	Acceptance Criteria for Quality Documentation
AC43	Acceptance Criteria for Steel Deck Roof and Floor Systems
AC70	Acceptance Criteria for Fasteners Power-Driven into Concrete, Steel and Masonry Elements
AC118	Acceptance Criteria for Tapping Screw Fasteners
AC230	Acceptance Criteria for Power-Driven Pins for Shear Wall Assemblies with Cold-Formed Steel Framing and Wood Structural Panels
AC368	Acceptance Criteria for Suspended Ceiling Framing Systems
AC499	Acceptance Criteria for Screw-in Fasteners installed into Steel Elements

4.2.2 ASTM STANDARDS

Standard	Title
A36	Specification for Structural Steel
A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A449	Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
A493	Specification for Stainless and Heat-resisting Steel for Cold Heading and Cold Forging Bar and Wire
A510	Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
A572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
A641	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process
A992	Standard Specification for Steel for Structural Shapes For Use in Building Framing
A1003	Standard Specification for Steel Sheet, Carbon, Metallic and Nonmetallic Coated for Cold Formed Framing Members
A1008	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened and Bake Hardenable.
B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
B633	Electrodeposited Coatings of Zinc on Iron and Steel
B695	Coatings of Zinc Mechanically Deposited on Iron and Steel

Standard	Title
B695	Coatings of Zinc Mechanically Deposited on Iron and Steel
C33	Specification for Concrete Aggregates
C36	Standard Specification for Gypsum Wallboard
C90	Specification for Load-Bearing Concrete Masonry Units
C150	Standard Specification for Portland Cement
C270	Standard Specification for Mortar for Unit Masonry
C330	Specification for Lightweight Aggregates for Structural Concrete
C332	Specification for Lightweight Aggregates for Insulating Concrete
C476	Specification for Grout for Masonry
C635	Standard Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
C636	Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
C954	Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
C1002	Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
C1396	Standard Specification for Gypsum Board
C1513	Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
D1761	Standard Test Methods for Mechanical Fasteners in Wood
E380	Standard Practice for Use of the International System of Units, SI (The Modernized Metric System)
E455	Standard Specification for Pressure Vessel Plates, Carbon Steel, High-Strength Manganese
E1190	Test Methods for Strength of Powder-Actuated Fasteners Installed in Structural Members
E2126	Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings
F594	Standard Specification for Stainless Steel Nuts
F844	Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
F1941	Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Screw Threads, UN/UNR)

Standard	Title
G15	Standard Terminology Relating to Corrosion and Corrosion Testing
G85	Standard Practice for Modified Salt Spray (Fog) Testing
G87	Standard Practice for Conducting Moist SO_2 Tests

4.2.3 AISI STANDARDS

Standard	Title
S100	North American Specification for the Design of Cold-Formed Steel Structural Members
S213	North American Standard for Cold-Formed Steel Framing - Lateral Design
S310	North American Standard for the Design of Profiled Steel Diaphragm Panels
S904	Standard Test Methods for Determining the Tensile and Shear Strength of Screws
S905	Test Methods for Cold-Formed Steel Connections
S907	Test Standard for Cantilever Test Method for Cold-Formed Steel Diaphragms

4.2.4 ANSI STANDARDS

Standard	Title
A10.3	Powder-Actuated Fastening Systems – Safety Requirements
B1.1	Unified Inch Screw Thread Series
B1.13M	Metric Screw Threads: M Profile
B18.12	Glossary of Terms for Fasteners
B18.22	Plain Washers

4.2.5 SAE STANDARDS

Standard	Title
SAE J78	Steel Self-Drilling Tapping Screws
SAE J405	Chemical Compositions of SAE Wrought Stainless Steels
SAE J429	Mechanical and Material Requirements for Externally Threaded Fasteners

4.2.6 UL/FM STANDARDS

Standard	Title
UL 203	Pipe Hanger Equipment for Fire Protection Service
UL 467	Grounding and Bonding Equipment
UL 580	Tests for Uplift Resistance of Roof Assemblies
UL 2239	Hardware for the Support of Conduit Tubing and Cable
UL 1565	Positioning Devices

4.2.7 FEDERAL SPECIFICATIONS

Standard	Title
US-DOC	PS-1 Construction and Industrial Plywood
US DOC	PS-2 Performance Standard for Wood-Based Structural-Use Panels

4.2.8 ISO STANDARDS

Standard	Title
ISO 3768	Metallic Coatings - Neutral Salt Spray Tests
EN/ISO 4042	Fasteners - Electroplated Coatings
ISO 6988	Metallic and Other Non-Organic Coatings - Sulfur Dioxide Test with General Condensation of Moisture

4.2.9 DIN STANDARDS

Standard	Title
DIN 50021	Spray Tests with Different Sodium Chloride Solutions
DIN 50018/2.0	Sulfur Dioxide Corrosion Testing in a Saturated Atmosphere

4.2.10 IEC STANDARDS

Standard	Title
IEC60947-7-2	Low-voltage switchgear and controlgear – Part 7-2: Ancillary equipment – Protective conductor terminal blocks for copper conductors

4.3 TECHNICAL REFERENCES

4.3.1 METRIC CONVERSIONS AND EQUIVALENTS

The Metric Conversion Act of 1975, as amended by the Omnibus Trade and Competitiveness Act of 1988, establishes the SI (System International) metric system as the preferred system of measurement in the United States.

Many products are currently manufactured and supplied in SI or “hard” metric sizes such as anchor bolts of 10 mm, 12 mm, 26 mm, etc. diameter. Where the inch-pound system is given or used, “soft” metric conversion can sometimes be used (but specifically not when selecting a drill bit for installing mechanical anchors, where it is critical to only use the specified Imperial or metric diameter bit). The soft conversion diameters for anchor bolts is given by Table 1. Standard metric conversion factors commonly used for fastening products are given in Tables 2 and 3.

Table 1 : Diameters

Inch-pound system In.	Hard metric conversion mm	Use for soft metric mm
1/4	6.35	6
5/16	7.94	8
3/8	9.52	10
1/2	12.70	12
5/8	15.88	16
3/4	19.05	20
1	25.40	25
1-1/4	31.75	32

Table 2 : Imperial units to SI units

To convert	Into	Multiply by
Length		
inch (in.)	millimeter (mm)	25.4000
foot (ft)	meter (m)	0.3048
Area		
square inch (in^2)	square millimeter (mm^2)	645.1600
square inch (in^2)	square centimeter (cm^2)	6.4516
square foot (ft^2)	square meter (m^2)	0.0929
Volume		
cubic inch (in^3)	cubic centimeter (cm^3)	16.3871
cubic foot (ft^3)	cubic meter (m^3)	0.0283
gallon (US gal)	liter (L)	3.7854
Force		
pound force (lbf)	newton (N)	4.4482
pound force (lbf)	kilonewton (kN)	0.0044
Pressure		
pound/square inch (psi)	newton/square millimeter (N/mm^2)	0.0069
pound/square inch (psi)	mega pascal (MPa)	0.0069
KIP/square inch (ksi)	mega pascal (MPa)	6.8946
pounds/square foot (psf)	newton/square meter (N/m^2)	47.8801
Torque or bending moment		
foot pound (ft-lb)	newton meter (Nm)	1.3558
inch pound (in-lb)	newton meter (Nm)	0.1130
Diaphragm shear		
pounds/foot (plf)	newton/meter (N/m)	14.5939

Table 3 : SI Units to Imperial Units

To convert	Into	Multiply by
Length		
millimeter (mm)	inch (in.)	0.0394
meter (m)	foot (ft)	3.2808
Area		
square millimeter (mm^2)	square inch (in^2)	0.0016
square centimeter (cm^2)	square inch (in^2)	0.1550
square meter (m^2)	square foot (ft^2)	10.7639
Volume		
cubic centimeter (cm^3)	cubic inch (in^3)	0.0610
cubic meter (m^3)	cubic foot (ft^3)	35.3147
liter (L)	gallon (US gal)	0.2642
Force		
newton (N)	pound force (lbf)	0.2248
kilonewton (kN)	pound force (lbf)	224.8089
Pressure		
newton/square millimeter (N/mm^2)	pound/square inch (psi)	145.0400
mega pascal (MPa)	pound/square inch (psi)	145.0400
mega pascal (MPa)	KIP/square inch (ksi)	0.1450
newton/square meter (N/m^2)	pounds/square foot (psf)	0.0209
Torque or bending moment		
newton meter (Nm)	foot pound (ft-lb)	0.7376
newton meter (Nm)	inch pound (in-lb)	8.8496
Diaphragm shear		
newton/meter (N/m)	pounds/lineal foot (plf)	0.0685

TERMS AND CONDITIONS OF SALE (U.S.)

US:

https://www.hilti.com/content/hilti/W1/US/en/company/legal-and-footer-information/terms-conditions/terms-and-conditions-of-sales.html

TERMS AND CONDITIONS OF SALE (CANADA)

Canadian English:

https://www.hilti.ca/content/hilti/W1/CA/en/company/legal-and-footer-information/terms-conditions/terms-and-conditions-of-sales.html

Canadian French:

https://www.hilti.ca/content/hilti/W1/CA/fr/entreprise/information-legale/conditions-generales-ventes/terms-and-conditions-of-sales.html

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The data contained in this literature was current as of the date of publication. Updates and changes may be made based on later testing. If verification is needed that the data is still current, please contact the Hilti Technical Support Specialists at 1-800-879-8000 (U.S.) or 1-800-363-4458 (Canada). All published load values contained in this literature represent the results of testing by Hilti or test organizations. Local base materials were used. Because of variations in materials, on-site testing is necessary to determine performance at any specific site.

DBS • 04/24