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DIVISION: 04—MASONRY
Section: 04081—Masonry Anchorage

REPORT HOLDER:

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EVALUATION SUBJECT:

HILTI HIT HY 150 MAX ADHESIVE ANCHOR SYSTEMS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2006 *International Building Code*® (2006 IBC)
- 2006 *International Residential Code*® (2006 IRC)
- 2003 *International Building Code*® (2003 IBC)
- 2000 *International Building Code*® (2000 IBC)
- 2003 *International Residential Code*® (2003 IRC)
- 2000 *International Residential Code*® (2000 IRC)
- 1997 *Uniform Building Code*™ (UBC)

Properties evaluated:

Structural

2.0 USES

The Hilti HIT HY 150 MAX Adhesive Anchor Systems are used to resist static tension and shear loads in uncracked fully grouted concrete masonry construction. Table 1 provides general application descriptions for use of the Hilti HIT HY 150 MAX adhesive anchor systems. The anchor systems are an alternative to cast-in-place anchors under the IRC, where an engineered design is submitted in accordance with Section R301.1.3 of the 2006 and 2003 IRC or Section R301.1.2 of the 2000 IRC.

3.0 DESCRIPTION

3.1 General:

The Hilti HY 150 MAX Adhesive Anchor Systems consist of the HIT HY 150 MAX adhesive and threaded steel rods.

3.2 Materials:

3.2.1 Hilti HIT HY 150 MAX Adhesive: Hilti HIT HY 150 MAX adhesive is a hybrid adhesive mortar consisting of urethane methacrylate resin, hardener, cement and water. The resin and cement are separated from the hardener and water by means of a dual-cylinder foil cartridge attached to a manifold. The volume ratio between the large and small cylinders is 3:1. An injection nozzle equipped with an internal mixing element is attached to the manifold, and the adhesive components are dispensed through the injection nozzle to ensure proper mixing of the separate adhesive components. The injection nozzle may be replaced to permit multiple uses of the cartridges. Available cartridge sizes include total mixed volumes of 11.1 ounces (330 ml), 16.9 ounces (500 ml), and 47.3 ounces (1400 ml).

The shelf life of unopened adhesive cartridges is nine months when the cartridges are stored in a dry, dark environment. Each cartridge is stamped with an adhesive expiration date. Temperatures during short-term (less than 48 hours) storage of the adhesive must be between 32°F and 104°F (0°C and 40°C). Temperatures during long-term storage of the adhesive must be between 41°F and 77°F (5°C and 25°C). Hilti, Inc., must be contacted regarding suitability of adhesive for which the storage history is unknown.

3.2.2 Threaded Steel Rods: The threaded steel rods must be all-thread rods in diameters described in Table 5 or 6 of this report. The rods, with nut and washer, must comply with the four steel specifications shown in Table 2. The standard threaded rod and high-strength threaded rod must be furnished with a 5 µm thick zinc electroplate coating in accordance with ASTM B 633 SC 1 or must be hot-dipped galvanized in accordance with ASTM A 153, Class C or D.

3.2.3 Grouted Concrete Masonry Units: Concrete masonry construction must be fully grouted and have minimum prism strength of 1,500 psi (9.58 MPa) at the time of anchor installation. Concrete masonry units must be Grade N, Type I, in accordance with ASTM C 90 (2003 IBC, 2000 IBC, 2003 IRC, or 2000 IRC) or UBC Standard 21-4. Mortar must be Type N (minimum) in accordance with Section 2103.7 of the 2003 IBC and the 2000 IBC, or Section R607 of the 2003 IRC and the 2000 IRC, or Section 2103.3 of the UBC. Mortar must have a minimum compressive strength of 750 psi (5.72 MPa). Grout must comply with Section 2103.10 of the 2003 IBC or the 2000 IBC, Section R609.1.1 of the 2003 IRC or the 2000 IRC, or Section 2103.4 of the UBC.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 General: Tension and shear loads for threaded steel rods in masonry are intended for allowable stress design and are described in Tables 5 and 6. The allowable tension and shear values based on adhesive bond and masonry capacity must be adjusted in accordance with Figure 2 for in-service base-material temperatures in excess of 70°F (21°C). Allowable tension and shear loads for threaded steel rods are described in Table 7.

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4.1.2 Combined Loading: Allowable loads for anchors subjected to combined shear and tension forces must be determined by the following formula:

$$(P_s/P_t) + (V_s/V_t) \leq 1$$

where:

P_s = Applied service tension load, pounds (N).

P_t = Allowable service tension load, pounds (N).

V_s = Applied service shear load, pounds (N).

V_t = Allowable service shear load, pounds (N).

4.1.3 Design of Anchors for Short-term Loads: Allowable stress design tension and shear loads in Tables 5 and 6 may be used for resistance to short-term loads such as wind and seismic, when design is in accordance with Sections 5.3 and 5.4 and Table 3 of this report.

4.2 Installation:

4.2.1 General: Installation of the HILTI HIT HY 150 MAX system must conform to the manufacturer's published installation instructions included in each unit package, and the requirements of this evaluation report. Installation parameters are summarized further in Tables 1 and 2 and the corresponding load data tables.

4.2.1.1 Threaded Steel Rods: Holes for installation of the threaded rod into grouted concrete masonry must be drilled using an electro-pneumatic hammer drill set in rotation-hammer mode and a carbide-tipped drill bit complying with ANSI B212.15-1994. Holes must be cleaned of dust and debris by blowing with oil-free compressed air, brushing with a wire brush three times, and again blowing with compressed air to achieve a relatively dust-free wall surface. Holes may be dry or damp but must not contain any water at the time of anchor installation. The dual cartridge is self-opening, and the adhesive is dispensed through an injection nozzle equipped with an internal mixing element that is attached to the cartridge manifold to ensure proper mixing of the components; material from the first two "trigger pulls" must be discarded to ensure that only properly mixed products are used. The injection nozzle may be replaced to permit multiple uses of the cartridge. The injection nozzle must always be equipped with the internal mixing element. The injection nozzle must be as manufactured by Hilti for the HIT HY 150 MAX Adhesive Anchor System. Holes must be filled approximately two-thirds full with the mixed adhesive, with injection from the bottom of the hole toward the top. The threaded rod or deformed bar must be twisted in a clockwise motion as it is inserted into the hole to the required embedment depth. The anchor position may be adjusted only during the gel time shown in Table 4. Anchors are permitted to be loaded to the design load only after the cure time shown in Table 4 has passed. Sections 5.13 and 5.14 of this evaluation report describe limitations on base-material temperature during installation.

4.2.2 Special Inspection: All adhesive anchors must be installed with special inspection in accordance with Section 1704 of the 2006 IBC, 2003 IBC and the 2000 IBC, or Section 1701 of the UBC. The code official must receive a report, from an approved special inspector, that includes the following details:

1. Anchor description, including the adhesive product name, anchor type, nominal anchor diameter, and anchor length.
2. Hole description, including verification of drill bit compliance with ANSI B212.15-1994, hole depth and cleanliness.
3. Installation description, including verification of masonry compressive strength and verification of anchor installation and location (spacing and edge distance) in accordance with the manufacturer's published instructions and this report.

5.0 CONDITIONS OF USE

The Hilti HIT HY 150 MAX Adhesive Anchor Systems described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Anchor sizes, dimensions, and installation comply with this report and Hilti's published installation instructions. If a conflict occurs between this report and the Hilti instructions, this report shall govern.

5.2 Allowable tension and shear loads must be as shown in Tables 5 and 6 of this report.

5.3 Seismic or wind load in grouted concrete masonry under the 2006, 2003 and 2000 IBC or the 2006, 2003 and 2000 IRC: The adhesive anchors described in the evaluation report installed in grouted concrete masonry are capable of resisting seismic and wind loads. When using the basic load combinations in accordance with 2006 and 2003 IBC Section 1605.3.1.1, allowable loads must not be increased for seismic or wind loading, but applied loads must be decreased by the factor in Table 3. When using the alternative basic load combinations in 2006 and 2003 IBC Section 1605.3.2 that include seismic or wind loads, the allowable loads may be increased in accordance with Table 3, or the alternative basic load combinations may be decreased by the factor in Table 3.

5.4 Seismic or wind load in grouted concrete masonry under the UBC: When using the basic load combinations in accordance with UBC Section 1612.3.1, allowable loads are not permitted to be increased for wind or seismic loading, but applied loads must be decreased by the factor in Table 3. When using the alternative basic load combinations in UBC Section 1612.3.2 that include wind or seismic loads, the allowable loads may be increased in accordance with Table 3 or the alternative basic load combinations may be decreased by the factor in Table 3.

5.5 Calculations and details demonstrating compliance with this report must be submitted to the code official for approval.

5.6 The HIT HY 150 MAX Adhesive Anchor Systems must be installed in holes using a carbide-tipped masonry drill bit manufactured within the range of the maximum and minimum dimensions of ANSI B212.15-1994.

5.7 Special inspection in accordance with Section 4.2.2 of this report must be provided for all anchor installations.

5.8 Anchors must not be permitted to support fire-resistive-rated construction. Where not otherwise prohibited by the applicable code, anchors may be used in fire-resistive construction provided that at least one of the following conditions is fulfilled:

- Anchors are used to resist wind or seismic forces only.
- Anchors that support gravity load-bearing structural elements are within a fire-resistive envelope or a fire-resistive membrane, are protected by approved fire-resistive materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Anchors are used to support nonstructural elements.

5.9 The Hilti HIT HY 150 MAX Adhesive Anchor System may be used to resist tension and shear forces in wall installations only if consideration is given to the effects of elevated temperature conditions on anchor performance. Figure 2 describes load reduction factors for elevated temperatures.

5.10 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of adhesive anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under these conditions is beyond the scope of this report.

5.11 Since an ICC-ES acceptance criteria for evaluating the performance of adhesive anchors in cracked masonry is unavailable at this time, the use of anchors is limited to installation in uncracked masonry. Cracking occurs when $f_t > f_r$ due to service loads or deformations.

5.12 Use of the HIT HY 150 MAX Adhesive Anchor System in conjunction with uncoated carbon steel threaded rods, HIT-TZ rods, and/or reinforcing bars, must be limited to interior exposure. Installations exposed to severe, moderate or negligible exterior weathering conditions, as defined in Table 1 of ASTM C 62 or Figure 21-1-1 of UBC Standard 21-1, are permitted where stainless steel (AISI 304 or 316) anchors or hot dip galvanized anchors with a zinc coating conforming to ASTM A 153, Class C or D, are used.

5.13 HIT HY 150 MAX adhesive may be used in base materials having interior temperatures between 14°F (-10°C) and 110°F (43°C) at the time of installation. Installation of HIT HY 150 MAX adhesive in base materials having temperatures beyond this range is outside the scope of this report. The temperature of the HIT HY 150 MAX adhesive must be between 32°F (0°C) and 104°F (40°C) at the time of installation.

5.14 When anchors are located where the base-material temperature may exceed 70°F (21°C), allowable tension and shear loads in this report must be adjusted for in-service temperatures in accordance with Figure 2. The use of HIT HY 150 MAX adhesive in base materials having interior temperatures exceeding 180°F (82°C) during their service life is outside the scope of this report.

5.15 For threaded rods standing water must be removed from holes before placement of the adhesive. In applications where the concrete-masonry has been exposed to water for extended periods, the holes must be made damp by applying oil-free compressed air for at least five seconds, then applying a wire brush for three strokes, then blowing again for five seconds with oil-free compressed air; or otherwise preparing the hole so as to achieve an equivalent damp surface condition prior to anchor installation.

5.16 Threaded rods may be installed with HIT HY 150 MAX adhesive in oversized carbide-drilled holes that have diameters up to $^1/_4$ inch larger than the anchor rod diameter.

5.17 Steel anchoring materials in contact with preservative-treated wood or fire-retardant-treated wood must be stainless steel or hot-dipped galvanized in accordance with ASTM A 153 Class C or D.

5.18 The HIT HY 150 MAX adhesive is manufactured by Hilti GmbH at their facilities in Kaufering, Germany; and the HIT-TZ, and HIT-RTZ rods are manufactured by Hilti Aktengielltenschaft at their facilities in Schaan, Liechtenstein, under a quality control program with inspections by Underwriters Laboratories Inc. (AA-668).

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Adhesive Anchors in Masonry Elements (AC58), dated January 2008, including test reports for the following tests: axial tension testing of single anchors, establishing minimum edge distance, $c = c_{min}$ (AC58 Test Series 5); axial tension testing of a group of two anchors, establishing minimum spacing distance, $s = s_{min}$ (AC58 Test Series 9); shear testing of single anchors, establishing critical edge distance, $c = c_{cr}$ (AC58 Test Series 13); shear testing of single anchors, establishing minimum edge distance, $c = c_{min}$ (AC58 Test Series 14); creep testing (AC58 Test Series 17); in-service temperature (AC58 Test Series 18); dampness testing (AC58 Test Series 19); freezing and thawing testing (AC58 Test Series 20); seismic testing of threaded rods and rebar (AC58 Test Series 21) in single anchor tensile testing of reinforcing bars (AC58 Test Series 1); single anchor shear testing of reinforcing bars (AC58 Test Series 13).

6.2 Quality control manuals for HIT HY 150 MAX adhesive.

7.0 IDENTIFICATION

The Hilti HIT HY 150 MAX adhesive is identified in the field by labels on, or in, the packaging that include the manufacturer's name (Hilti), product name, lot number, expiration date, evaluation report number (ESR-1967), and installation instructions. The container for the adhesive also includes the name of the inspection agency (Underwriters Laboratories Inc.).

TABLE 1—APPLICATION DESCRIPTIONS FOR HILTI HIT HY 150 MAX ADHESIVE ANCHOR SYSTEMS

BASE MATERIAL	ADHESIVE ANCHOR PRODUCT	ELEMENT	SPECIFICATION DATA	LOAD DATA
Grouted concrete block masonry	HIT HY 150 MAX	Threaded rod	Tables 2, 4	Tables 5, 6

TABLE 2—STEEL SPECIFICATIONS FOR THREADED ROD, NUT AND WASHER

ALL-THREAD ROD				NUT SPECIFICATION	WASHER SPECIFICATION
Description	Specification	f_y (ksi)	f_u (ksi)		
	ISO 898 Class 5.8	58.0	72.5	ASTM A 563, Grade DH	ASTM F 436
High-strength rod[1]	ASTM A 193 B7	105.0	125.0	ASTM A 563, Grade DH	ASTM F 436
Stainless steel rod (316/304) $^3/_8$" - $^5/_8$"	ASTM F 593, CW	65.0	100.0	ASTM F 594, Alloy Group 1	ANSI B18.22.1, Type A, plain
Stainless steel rod (316/304) $^3/_4$" - $1^1/_4$"		45.0	85.0		

For **SI:** 1 inch = 25.4 mm, 1 ksi = 6.89 MPa.

[1]The rods are normally zinc-coated. For exterior use in severe or damp applications, hot dipped galvanized carbon steel rods complying with ASTM A 153, Class C or D, must be used.

TABLE 3—ALTERNATIVE BASIC LOAD COMBINATIONS ADJUSTMENT FACTORS[4,5]

STEEL TYPE[1]	MODIFICATION FACTORS			
	Reductions for Basic and Alternate Basic Load Combinations		Increase Factor for Short-term Loading Conditions	
	Tension	Shear	Tension	Shear
Standard threaded rods[2]	0.75	0.75	1.33	1.33
High-strength rods[3]	0.75	1	1.33	1
Stainless rods[3]	0.75	0.87	1.33	1.14

[1]When using the basic load combinations in accordance with IBC Section 1605.3.1 or UBC Section 1612.3.1, allowable loads shall not be increased for wind or seismic loading.
[2]When using the alternative basic load combinations in IBC Section 1605.3.2 or UBC Section 1612.3.2 that include wind or seismic loads, the allowable shear and tension loads for anchors may be increased by $33^1/_3$ percent. Alternatively, the alternative basic load combinations may be reduced by a factor of 0.75 when using IBC Section 1605.3.2.
[3]When using the alternative basic load combinations in IBC Section 1605.3.2 or UBC Section 1612.3.2 that include wind or seismic loads, the allowable shear loads for anchors may be increased by the tabulated percentage increases. Alternatively, the alternate basic load combinations may be reduced by multiplying them by the inverse of the tabulated percent increase, for example, for stainless steel rods, 1/1.14 = 0.87 for shear loading as applicable.
[4]When using the alternative basic load combinations in IBC Section 1605.3.2 or UBC Section 1612.3.2 that include wind or seismic loads, the allowable tension loads for anchors may be increased by $33^1/_3$ percent. Alternatively, the alternate basic load combinations may be reduced by multiplying by 0.75.
[5]The above modification factors are applicable to Tables 5 and 6.

TABLE 4—HILTI, INC., RECOMMENDED CURE TIMES FOR HIT HY 150 MAX ADHESIVE

MINIMUM BASE-MATERIAL TEMPERATURE		APPROXIMATE GEL TIME[1]	APPROXIMATE CURE TIME[2]
°F	°C		
14	-10	100 min	12 hours
23	-5	40 min	4 hours
32	0	20 min	2 hours
50	10	8 min	1 hour
68	20	6 min	30 min
86	30	3 min	25 min
104	40	2 min	20 min

For **SI:** t°C = (°F - 32) ÷ 1.8.

[1]Section 4.2.1.1 of this report describes significance of gel time and gel time in anchor installations.

TABLE 5—ALLOWABLE TENSION AND SHEAR VALUES FOR THREADED RODS INSTALLED USING HILTI HIT HY 150 MAX ADHESIVE IN GROUT-FILLED CONCRETE MASONRY CONSTRUCTION (pounds)[1,2,3,4,8,9]

Anchor diameter (inches)	$^3/_8$		$^1/_2$		$^5/_8$		$^3/_4$	
Embedment (inches)[5]	$3^3/_8$		$4^1/_2$		$5^5/_8$		$6^3/_4$	
Minimum anchor spacing (inches) s_{min}[1]	8		8		8		8	
Load direction	**Tension**	**Shear[7]**	**Tension**	**Shear[7]**	**Tension**	**Shear[7]**	**Tension**	**Shear[7]**
4-inch end distance, c_{min}[6]	880	1,135	1,055	1,745	1,370	2,120	1,580	2,205
End distance ≥ 20 inches[6]	950		1,265	1,870	1,850	2,590	2,440	2,785

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Anchors are limited to one per masonry cell. Anchors in adjacent cells may be spaced as close as 4 inches with a load reduction of 30%. For anchors in adjacent cells spaced between 4 inches and 8 inches, use linear interpolation.
[2]Anchors may be installed in any location in the face of the masonry wall (cell, bed joint, or web) as shown in Figure 1, except anchor must not be installed in or within 1 inch of a head joint.
[3]Allowable load values are for use in any masonry construction complying with Section 3.2.3 of this report.
[4]When anchors are used to resist short-term loads such as wind or seismic, allowable loads must be calculated in accordance with Sections 5.4 and 5.3 or 5.4, and Table 3, of this report, but the loads cannot exceed 2,400 pounds for tension and 3,000 pounds for shear.
[5]Embedment depth is measured from the outside face of the masonry.
[6]Edge distances of less than 4 inches are outside the scope of this table. Linear interpolation for edge distances between 4 inches and 20 inches is allowed. Edge distance at top of wall is greater than 12 inches.
[7]Allowable shear loads must be the lesser of the adjusted masonry or bond tabulated values and the steel values given in Table 7.
[8]The tabulated allowable loads have been calculated based on a safety factor of 5.0. These values may be increased 25% (safety factor of 4.0) under the UBC only.
[9]Concrete masonry thickness must be equal to or greater than 1.5 times the anchor embedment depth.

EXCEPTION: The $^5/_8$-inch- and $^3/_4$-inch-diameter anchors may be installed in minimum nominally 8-inch-thick concrete masonry.

TABLE 6—ALLOWABLE TENSION AND SHEAR VALUES FOR SILL PLATE AND OTHER ATTACHMENTS TO TOPS OF GROUT-FILLED MASONRY WALLS AT MINIMUM EDGE DISTANCES AND USING HILTI HIT HY 150 MAX ADHESIVE (pounds)[1,2,3,4,5,6]

ANCHOR DIAMETER (inch)	EMBEDMENT DEPTH (inches)	EDGE DISTANCE (inches)	TENSION	SHEAR	
				Load Applied Perpendicular to Edge	Load Applied Parallel to Edge
$^1/_2$	$4^1/_2$	$1^3/_4$	1,095	295	815
$^5/_8$	$5^5/_8$	$1^3/_4$	1,240	400	965

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N, 1 psi = 6.89 kPa.

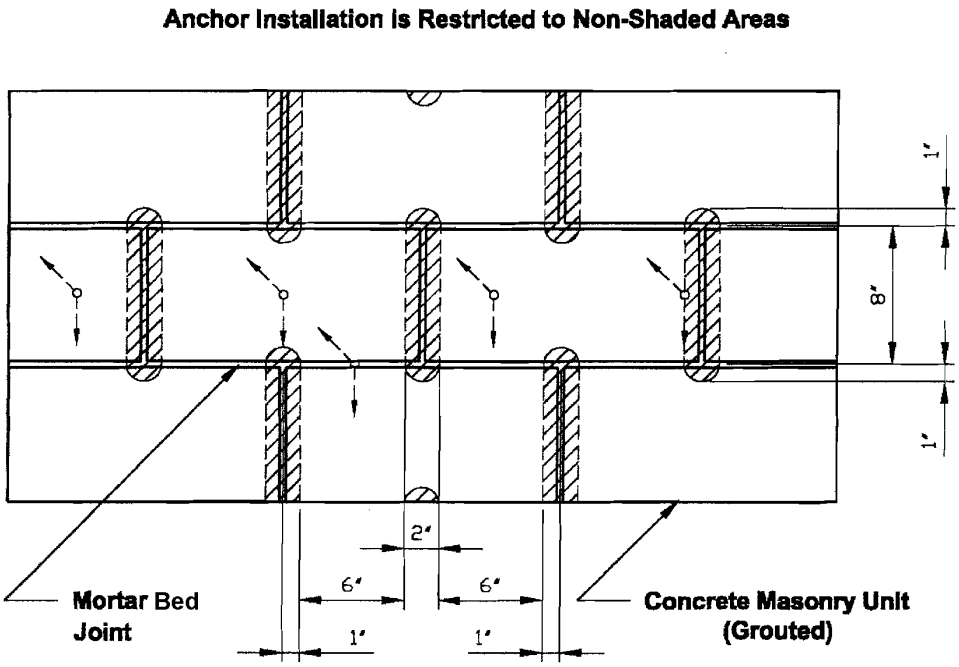
[1]Loads in this table are for threaded rod complying with Section 3.2.2 installed in the masonry at the edge distance shown in this table. No reductions for edge distance are required when anchors are installed with the minimum edge distance specified in the table. Capacity of attached sill plate or other material to resist loads in this table must comply with the applicable code.
[2]Edge distances are given in this table. Anchor spacing must conform to the dimensions given in Table 5.
[3]When anchors are used to resist short-term loads such as wind or seismic, allowable loads must be adjusted in accordance with Sections 5.3 and 5.4 and Table 3, of this report.
[4]Masonry thickness must be equal to or greater than 1.5 times the anchor embedment depth.
[5]The tabulated values are for anchors installed in any masonry complying with Section 3.2.3 of this report.
[6]Allowable loads calculated using a safety factor of 5.0. These values may be increased by 25% (safety factor of 4.0) under the UBC only.

TABLE 7—ALLOWABLE TENSION AND SHEAR VALUES FOR THREADED RODS (pounds)[1,2]

ANCHOR DIAMETER (inches)	TENSION			SHEAR		
	BASED ON STEEL STRENGTH			BASED ON STEEL STRENGTH		
	ISO 898 Class 5.8	ASTM A 193 B7	AISI 304 SS	ISO 898 Class 5.8	ASTM A 193 B7	AISI316/304 SS
$^3/_8$	2,640	4,555	3,645	1,360	2,345	1,875
$^1/_2$	4,700	8,100	6,480	2,420	4,170	3,335
$^5/_8$	7,340	12,655	10,125	3,780	6,520	5,215
$^3/_4$	10,570	18,225	12,390	5,445	9,390	6,385

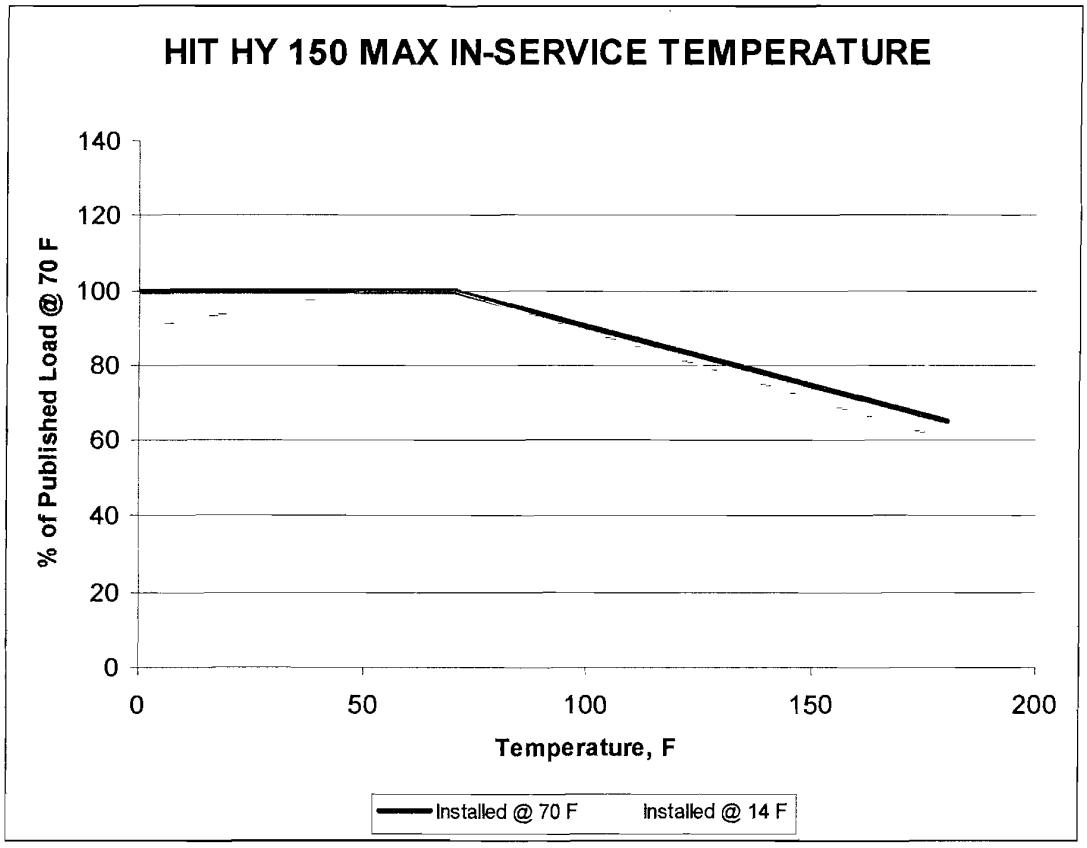
For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N, 1 psi = 6.89 kPa.

[1]Allowable load must be the lesser of bond values given in Table 5 and tabulated steel values.
[5]The allowable tension and shear values for threaded rods to resist short-term loads, such as wind or seismic, must be calculated in accordance with Sections 5.3 and 5.4 Table 3, of this report.



For **SI:** 1 inch = 25.4 mm.

FIGURE 1—LOCATIONS FOR HIT HY 150 MAX ANCHOR IN GROUT-FILLED CONCRETE MASONRY UNITS



For **SI:** t°C = (°F – 32) ÷ 1.8.

FIGURE 2—INFLUENCE OF BASE-MATERIAL TEMPERATURE ON ALLOWABLE TENSION AND SHEAR LOADS FOR HILTI HIT HY 150 MAX ADHESIVE