ICC EVALUATION SERVICE®

ICC-ES Evaluation Report

ESR-2786

Reissued April 2020
Revised January 2021
This report is subject to renewal April 2022.

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DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

fischerwerke GmbH & Co. KG

EVALUATION SUBJECT:

fischer FIS V / FIS V PLUS ADHESIVE ANCHORING SYSTEMS FOR UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2018, 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2018, 2015, 2012 and 2009 *International Residential Code*® (IRC)
- 2013 *Abu Dhabi International Building Code* (ADIBC)†

†The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

Property evaluated:

Structural

2.0 USES

Adhesive anchors installed using the fischer FIS V / FIS V Plus Adhesive Anchoring Systems are used as anchorage to resist static, wind, or earthquake (Seismic Design Categories A and B), tension and shear loads in uncracked normal-weight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1].

The adhesive anchors comply with anchors as described in Section 1903.1 of the 2018 and 2015 IBC, Section 1909 of the 2012 IBC and is an alternative to cast-in-place anchors described in Section 1908 of the 2012 IBC, and Sections 1911 and 1912 of the 2009 IBC. The anchoring system may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 General:

The fischer FIS V / FIS V Plus Adhesive Anchoring Systems are comprised of the following components:

- Adhesive packaged in cartridges: fischer FIS V / FIS V Plus
- Adhesive mixing and dispensing equipment
- Equipment for hole cleaning and adhesive injection
- An anchor element (continuously threaded steel rod)

Fischer FIS V / FIS V Plus adhesives may be used with continuously threaded rods. The primary components of the fischer Adhesive Anchoring System, including the fischer FIS V / FIS V Plus Adhesives, static mixer FIS MR Plus and anchoring elements, are shown in Figure 2 of this report.

The manufacturer's printed installation instructions (MPII), included with each adhesive unit package, are replicated in Figure 3 of this report. The adhesive is referred to as "mortar" in the installation instructions.

3.2 Materials:

3.2.1 fischer FIS V / FIS V Plus Adhesives: fischer FIS V / FIS V Plus Adhesives are an injectable, vinylester adhesive. The two components are contained in a dual-chambered cartridge. The two components combine and react when dispensed through a static mixer attached to the manifold. The systems are labeled fischer FIS V 300, fischer FIS V 300 T, fischer FIS V 360 S, fischer FIS V 380 C, fischer FIS V 410 C, fischer FIS V 950 S, fischer FIS V Plus 300, fischer FIS V Plus 300 T, fischer FIS V Plus 360 S, fischer FIS V Plus 380 C, fischer FIS V Plus 410 C or fischer FIS V Plus 825 S. The numerical value in the labels correspond to the volume of the adhesives in milliliter. In this report, all systems are denoted fischer FIS V / FIS V Plus. The cartridge is stamped with the adhesive expiration date. The shelf life, as indicated by the expiration date, assumes an unopened pack stored in a dry, dark environment. Storage temperature of the adhesive 41°F to 77°F (5°C to 25°C). Under these conditions the shelf life is 18 months.

3.2.2 Hole Cleaning Equipment and Installation Accessories: Hole cleaning equipment must be in accordance with Figure 3 of this report.

3.2.3 Dispensers: fischer FIS V / FISV Plus adhesives must be dispensed with manual dispensers or pneumatic dispensers provided by fischerwerke.

3.2.4 Steel Anchor Elements:

3.2.4.1 Standard Threaded Steel Rods: Threaded steel rods must be clean, continuously threaded rods (all-thread) in diameters noted in Table 4 of this report. Specifications for permissible grades of threaded rods and associated nuts are provided in Table 2 and Table 3. Carbon steel threaded rods must be furnished with a 5 µm thick zinc electroplate

coating complying with ASTM B633 SC 1. Threaded steel rods must be straight and free of indentations or other defects along their length. The end may be stamped with identifying marks and the embedded end may be flat cut or cut on the bias (chisel point).

3.2.4.2 fischer Threaded Steel Rods FIS A and RG M: fischer FIS A and RG M anchor rods are threaded rods. The fischer FIS A is a threaded rod with flat shape on both ends. The fischer RG M is a threaded rod with a chamfer shape on the embedded section and flat or hexagonal end on the concrete surface side. Mechanical properties for the fischer FIS A and RG M are provided in Tables 2 and 3 of this report. The anchor rods are available in diameters as shown in Table 4. fischer FIS A and RG M anchor rods are produced from carbon steel and furnished with a 0.0002-inch-thick (0.005 mm) zinc electroplated coating or fabricated from stainless steel. Steel grade and type (carbon, stainless) for the washers and nuts must match the threaded rods. The threaded rods are marked on the head with an identifying mark. The fischer threaded steel rods FIS A and RG M described in this section are considered ductile.

3.2.4.3 Ductility of Anchor Elements: In accordance with ACI 318-14 2.3 or ACI 318-11 D.1, in order for a steel element to be considered ductile, the tested elongation must be at least 14 percent and reduction of area must be at least 30 percent. Steel elements with a tested elongation of less than 14 percent or a reduction of area of less than 30 percent, or both, are considered brittle. Values for various common steel materials are provided in Table 2 and Table 3. Where values are nonconforming or unstated, the steel must be considered brittle.

3.3 Concrete:

Normal-weight concrete must comply with Sections 1903 and 1905 of the IBC. The specified compressive strength of the concrete must be from 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1].

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: The design strength of adhesive anchors complying with the 2018 and 2015 IBC, as well as Section R301.1.3 of the 2018 and 2015 IRC, must be determined in accordance with ACI 318-14 Chapter 17 and this report.

The design strength of adhesive anchors under the 2012 and 2009 IBC, as well as the 2012 and 2009 IRC, must be determined in accordance with ACI 318-11 Appendix D and this report. See Table 1 for design table index.

The strength design of adhesive anchors must comply with ACI 318-14 17.3.1 or ACI 318-11 D.4.1 as applicable, except as required in ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable.

Design parameters are based on ACI 318-14 for use with the 2018 and 2015 IBC and ACI 318-11 for use with the 2012 and 2009 IBC unless noted otherwise in Sections 4.1.1 through 4.1.11 of this report.

Design parameters are provided in Tables 4 through Table 6. Strength reduction factors, ϕ, as given in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, must be used for load combinations calculated in accordance with Section 1605.2 of the IBC and ACI 318-14 5.3 or ACI 318-11 9.2, as applicable. Strength reduction factors, ϕ, as given in ACI 318-11 D.4.4 must be used for load combinations calculated in accordance with ACI 318-11 Appendix C.

4.1.2 Static Steel Strength in Tension: The nominal static steel strength of a single anchor in tension, N_{sa}, in accordance with ACI 318-14 17.4.1.2 or ACI 318-11 D.5.1.2, as applicable, and the associated strength reduction factors, ϕ, in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable are provided in Table 4 for the corresponding anchor steel.

4.1.3 Static Concrete Breakout Strength in Tension: The nominal static concrete breakout strength of a single anchor or a group of anchors in tension, N_{cb} *or* N_{cbg}, must be calculated in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, with the following addition:

The basic concrete breakout strength of a single anchor in tension, N_b, must be calculated in accordance with ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable, using the values of $k_{c,uncr}$ as provided in Table 5 of this report. Where analysis indicates no cracking in accordance with ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, N_b must be calculated using $k_{c,uncr}$ and $\Psi_{c,N}$ = 1.0. For anchors in lightweight concrete see ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable. The value of f'_c used for calculation must be limited to 8,000 psi (55 MPa) in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable. Additional information for the determination of nominal bond strength in tension is given in Section 4.1.4 of this report.

4.1.4 Static Bond Strength in Tension: The nominal static bond strength of a single adhesive anchor or group of adhesive anchors in tension, N_a or N_{ag}, must be calculated in accordance with ACI 318-14 17.4.5 or ACI 318-11 D.5.5, as applicable. Bond strength values are a function of the concrete compressive strength, the concrete temperature range, and the installation conditions (dry, water-saturated concrete). The resulting characteristic bond strength shall be multiplied by the associated strength reduction factor ϕ_{nn} as follows:

CONCRETE TYPE	PERMISSIBLE INSTALLATION CONDITIONS	BOND STRENGTH	ASSOCIATED STRENGTH REDUCTION FACTOR
Uncracked	Dry	$\tau_{k,uncr}$	ϕ_d
	Water-saturated	$\tau_{k,uncr}$	ϕ_{ws}

Strength reduction factors for determination of the bond strength are given in Table 6 of this report. Adjustments to the bond strength may also be taken for increased concrete compressive strength as noted in the footnotes to the corresponding tables.

4.1.5 Static Steel Strength in Shear: The nominal static strength of an anchor in shear as governed by the steel, V_{sa}, in accordance with ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable and strength reduction factor, ϕ, in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are given in Table 4 for the corresponding anchor steel.

4.1.6 Static Concrete Breakout Strength in Shear: The nominal static concrete breakout strength of a single anchor or group of anchors in shear, V_{cb}, or V_{cbg} must be calculated in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, based on information given in Table 5.

The basic concrete breakout strength of a single anchor in shear, V_b, must be calculated in accordance with ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable, using the values of d_a given in Table 5 of this report for the corresponding anchor steel. In addition, h_{ef} must be substituted for ℓ_e. In no case shall ℓ_e exceed *8d*. The value of f'_c shall be limited to a maximum of 8,000 psi (55 MPa) in

accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

4.1.7 Static Concrete Pryout Strength in Shear: The nominal static pryout strength of a single anchor or group of anchors in shear, V_{cp} or V_{cpg}, shall be calculated in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable.

4.1.8 Interaction of Tensile and Shear Forces: For designs that include combined tension and shear, the interaction of tension and shear must be calculated in accordance with ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

4.1.9 Minimum Member Thickness h_{min}, Anchor Spacing s_{min} and Edge Distance c_{min}: In lieu of ACI 318-14 17.7.1 and 17.7.3 or ACI 318-11 D.8.1 and D.8.3, as applicable, values of s_{min} and c_{min} described in this report (see Table 5) must be observed for anchor design and installation. The minimum member thickness, h_{min}, described in this report (see Table 5), must be observed for anchor design and installation. For adhesive anchors that will remain untorqued, ACI 318-14 17.7.4 or ACI 318-11 D.8.4, as applicable, applies.

4.1.10 Critical Edge Distance c_{ac} and $\psi_{cp,Na}$: The modification factor $\psi_{cp,Na}$, must be determined in accordance with ACI 318-14 17.4.5.5 or ACI 318-11 D.5.5.5, as applicable, except as noted below:

For all cases where $c_{Na}/c_{ac}<1.0$, $\psi_{cp,Na}$ determined from ACI 318-14 Eq. 17.4.5.5b or ACI 318-11 Eq. D-27, as applicable, need not be taken less than c_{Na}/c_{ac}. For all other cases, $\psi_{cp,Na}$ shall be taken as 1.0.

The critical edge distance, c_{ac} must be calculated according to Eq. 17.4.5.5c for ACI 318-14 or Eq. D-27a for ACI 318-11, in lieu of ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable.

$$c_{ac}=h_{ef}\cdot\left(\frac{\tau_{k,\,uncr}}{1160}\right)^{0.4}\cdot\left[3.1-0.7\frac{h}{h_{ef}}\right]$$

(Eq. 17.4.5.5c for ACI 318-14 or Eq. D-27a for ACI 318-11)

where

$\left[\frac{h}{h_{ef}}\right]$ need not be taken as larger than 2.4; and

$\tau_{k,uncr}$ = the characteristic bond strength stated in the tables of this report whereby $\tau_{k,uncr}$ need not be taken as larger than:

$$\tau_{k,uncr}=\frac{k_{uncr}\sqrt{h_{ef}f_c'}}{\pi\cdot d_a} \qquad \text{Eq. (4-1)}$$

4.1.11 Design Strength in Seismic Design: The anchors may be used to resist seismic loads for structures classified under Seismic Design Categories A and B of the IBC and IRC only.

4.2 Installation:

Installation parameters are illustrated in Figure 1. Installation must be in accordance with ACI 318-14 17.8.1 and 17.8.2 or ACI 318-11 D.9.1 and D.9.2, as applicable. Anchor locations must comply with this report and the plans and specifications approved by the code official. Installation of the fischer FIS V / FIS V Plus Adhesive Anchoring System must conform to the manufacturer's printed installation instructions (MPII) included in each unit package, as described in Figure 3 of this report.

The adhesive anchoring system may be used for upwardly inclined orientation applications (e.g. overhead). Upwardly inclined, horizontal, and drill depths deeper than 10 inches (250 mm) are to be installed using injection adaptors in accordance with the MPII as shown in Figure 3 of this report. The injection adaptor corresponding to the hole diameter must be attached to the static mixer and extension tube supplied by fischerwerke GmbH & Co. KG.

Installation of anchors in horizontal or upwardly inclined (overhead) orientations shall be fully restrained from movement throughout the specified curing period through the use of temporary wedges, external supports, or other methods. Where temporary restraint devices are used, their use shall not result in impairment of the anchor shear resistance.

4.3 Special Inspection:

Periodic special inspection must be performed where required in accordance with Sections 1705.1.1 and Table 1705.3 of the 2018, 2015 and 2012 IBC or Section 1704.15 and Table 1704.4 of the 2009 IBC and this report.

The special inspector must be on the jobsite initially during anchor installation to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, adhesive identification and expiration date, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete thickness, anchor embedment, tightening torque and adherence to the manufacturer's published installation instructions. The special inspector must verify the initial installations of each type and size of adhesive anchor by construction personnel on-site. Subsequent installations of the same anchor type and size by the same construction personnel are permitted to be performed in the absence of the special inspector. Any change in the anchor product being installed or the personnel performing the installation requires an initial inspection. For ongoing installations over an extended period, the special inspector must make regular inspections to confirm correct handling and installation of the product.

Continuous special inspection of adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be performed in accordance with ACI 318-14 17.8.2.4, 26.7.1(h) and 26.13.3.2(c) or ACI 318-11 D.9.2.4, as applicable.

Under the IBC, additional requirements as set forth in Sections 1705, 1706 or 1707 must be observed, where applicable.

5.0 CONDITIONS OF USE

The fischer FIS V / FIS V Plus Adhesive Anchoring Systems described in this report complies with or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 fischer FIS V / FIS V Plus adhesive anchors must be installed in accordance with the manufacturer's printed installation instructions included in the adhesive packaging and provided in Figure 3 of this report.

5.2 Anchors are limited to installation in concrete that is uncracked and may be expected to remain uncracked for the service life of the anchor. The anchors must be installed in uncracked normal-weight or lightweight concrete having a specified compressive strength f'_c = 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1].

5.3 The values of f'_c used for calculation purposes must not exceed 8,000 psi (55 MPa).

5.4 Anchors must be installed in concrete base materials in holes predrilled in accordance with the instructions provided in Figure 3 of this report.

5.5 Loads applied to the anchors must be adjusted in accordance with Section 1605.2 of the IBC for strength design.

5.6 fischer FIS V / FIS V Plus adhesive anchors are recognized for use as anchorage to resist short- and long-term loads, including wind and earthquake (Seismic Design Categories A and B only), subject to the conditions of this report.

5.7 Strength design values are established in accordance with Section 4.1 of this report.

5.8 Minimum anchor spacing and edge distance as well as minimum member thickness must comply with the values provided in this report.

5.9 Prior to installation, calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.10 Anchors are not permitted to support fire-resistive construction. Where not otherwise prohibited by the code, fischer FIS V / FIS V Plus adhesive anchors are permitted for installation 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.

5.11 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 such conditions is beyond the scope of this report.

5.12 Use of zinc-plated carbon steel threaded rods or steel reinforcing bars is limited to dry, interior locations.

5.13 Use of hot-dipped galvanized carbon steel and stainless steel rods is permitted for exterior exposure or damp environments.

5.14 Steel anchoring materials in contact with preservative-treated and fire-retardant-treated wood must be of zinc-coated carbon steel or stainless steel. The minimum coating weights for zinc-coated steel must comply with ASTM A153.

5.15 Periodic special inspection must be provided in accordance with Section 4.3 of this report. Continuous special inspection for anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be provided in accordance with Section 4.3 of this report.

5.16 Installation of anchors in horizontal or upwardly inclined orientations to resist sustained tension loads shall be performed by personnel certified by an applicable certification program in accordance with ACI 318-14 17.8.2.2 or 17.8.2.3 or ACI 318-11 D.9.2.2 or D.9.2.3, as applicable.

5.17 fischer FIS V / FIS V Plus Adhesive Anchoring Systems are manufactured by fischerwerke GmbH & Co KG under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Post-installed Adhesive Anchors in Concrete (AC308), dated June 2019.

7.0 IDENTIFICATION

7.1 fischer FIS V / FIS V Plus adhesives are identified by packaging labeled with the manufacturer's name (fischerwerke) and address, product name, lot number, expiration date, and evaluation report number (ESR-2786).

7.2 Threaded rods, nuts, washers, bolts, and cap screws are standard elements and must conform to applicable national or international specifications as set forth in Tables 2 and 3 of this report.

7.3 The report holder's contact information is the following:

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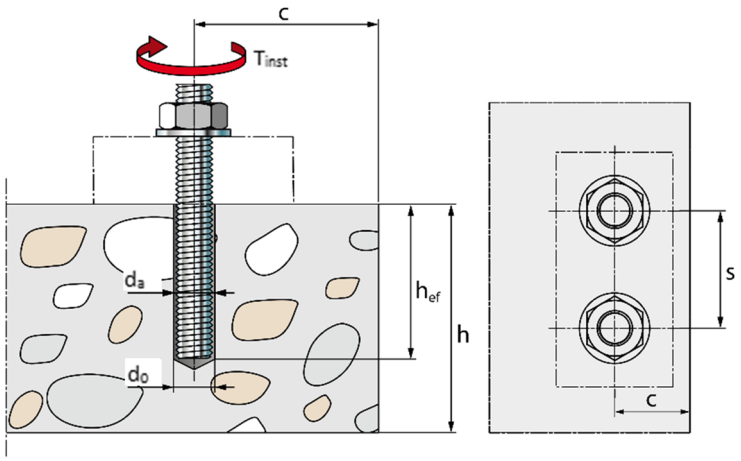


FIGURE 1—INSTALLATION PARAMETERS

TABLE 1—DESIGN TABLE INDEX

DESIGN STRENGTH[1]		THREADED ROD
		metric
Steel	N_{sa}, V_{sa}	Table 4
Concrete	N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	Table 5
Bond[2]	N_a, N_{ag}	Table 6

[1]Ref. ACI 318-14 17.3.1.1 or ACI 318-11 D.4.1.1, as applicable
[2]See Section 4.1 of this evaluation report

TABLE 2—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON CARBON STEEL THREADED ROD MATERIALS[1]

THREADED ROD SPECIFICATION		MINIMUM SPECIFIED ULTIMATE STRENGTH f_{uta}	MINIMUM SPECIFIED YIELD STRENGTH 0.2% OFFSET f_{ya}	f_{uta}/f_{ya}	ELONGATION, MIN.[4]	REDUCTION OF AREA, MIN.	SPECIFICATION FOR NUTS[5]
ASTM F568M[5] Class 5.8 (equivalent to ISO 898-1[2] Class 5.8)	MPa (psi)	500 (72,500)	400 (58,000)	1.25	10	35	DIN 934 Grade 6 (8-A2K) (Metric) ASTM A563 Grade DH
ISO 898-1[3] Class 8.8	MPa (psi)	800 (116,000)	640 (92,800)	1.25	12	52	DIN 934 (8-A2K)

[1]fischer FIS V / FIS V Plus must be used with continuously threaded carbon steel rod (all-thread) have thread characteristics comparable with ANSI B1.1 UNC Coarse Thread Series or ANSI B1.13M M Profile Metric Thread Series. Values for threaded rod types and associated nuts supplied by fischer are provided in this table.

[2]Standard Specifications for Carbon and Alloy Steel Externally Threaded Metric Fasteners.

[3]Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs.

[4]Based on 2-in. (50 mm) gauge length which are based on the gauge length of 4d and ISO 898, which is based on 5d.

[5]Nuts of other grades and styles having specified proof load stresses greater than the specified grade and style are also suitable. Nuts must have specified proof load stresses equal or greater than the minimum tensile strength of the specific threaded rods.

TABLE 3—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON STAINLESS STEEL THREADED ROD MATERIALS[1]

THREADED ROD SPECIFICATION		MINIMUM SPECIFIED ULTIMATE STRENGTH f_{uta}	MINIMUM SPECIFIED YIELD STRENGTH 0.2% OFFSET f_{ya}	f_{uta}/f_{ya}	ELONGATION, MIN.	REDUCTION OF AREA, MIN.	SPECIFICATION FOR NUTS[4]
ISO 3506-1[2] stainless A4-80 M8-M30	MPa (psi)	800 (116,000)	600 (87,000)	1.34	12	-	ISO 4032
ISO 3506-1[2] stainless A4-70 M8-M30	MPa (psi)	700 (101,500)	450 (65,250)	1.56	16	-	ISO 4032

[1]fischer FIS V / FIS V Plus must be used with continuously threaded stainless steel rod (all-thread) have thread characteristics comparable with ANSI B1.1 UNC Coarse Thread Series or ANSI B1.13M M Profile Metric Thread Series. Values for threaded rod types and associated nuts supplied by fischer are provided in this table.

[2]Standard Steel Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

[3]Mechanical properties of corrosion resistant stainless steel fasteners – Part 1: Bolts, screws and studs.

[4]Nuts of other grades and styles having specified proof load stresses greater than the specified grade and style are also suitable. Nuts must have specified proof load stresses equal or greater than the minimum tensile strength of the specific threaded rods.

TABLE 4—STEEL DESIGN INFORMATION FOR METRIC THREADED ROD[1]

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (mm)							
				M8	M10	M12	M16	M20	M24	M27	M30
ROD OUTSIDE DIAMETER		d_a	mm	8	10	12	16	20	24	27	30
			(in.)	(0.31)	(0.39)	(0.47)	(0.63)	(0.79)	(0.94)	(1.06)	(1.18)
ROD effective cross-sectional area		A_{se}	mm²	36.6	58.0	84.3	156.7	244.8	352.5	459	560.7
			(in².)	(0.057)	(0.090)	(0.131)	(0.243)	(0.379)	(0.546)	(0.711)	(0.869)
ISO 898-1 Class 5.8	Nominal strength as governed by steel strength	N_{sa}	kN	18.3	29.0	42.2	78.4	122.4	176.3	230	280.4
			(lb)	(4,114)	(6,520)	(9,476)	(17,615)	(27,518)	(39,625)	(51,709)	(63,028)
		V_{sa}	kN	11.0	17.4	25.3	47.0	73.4	105.8	137.6	168.2
			(lb)	(2,469)	(3,912)	(5,686)	(10,569)	(16,511)	(23,775)	(30,929)	(37,817)
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65							
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60							
ISO 898-1 Class 8.8	Nominal strength as governed by steel strength	N_{sa}	kN	29.3	46.4	67.4	125.4	195.8	282.0	368	448.6
			(lb)	(6,583)	(10,432)	(15,162)	(28,183)	(44,029)	(63,399)	(82,734)	(100,845
		V_{sa}	kN	17.6	27.8	40.5	75.2	117.5	169.2	220.1	269.1
			(lb)	(3,950)	(6,259)	(9,097)	(16,910)	(26,417)	(38,040)	(49,486)	(60,507)
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65							
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60							
ISO 3506-1 Class A4-70 and stainless C-70	Nominal strength as governed by steel strength	N_{sa}	kN	25.6	40.6	59.0	109.7	171.4	246.8	322	392.5
			(lb)	(5,760)	(9,128)	(13,267)	(24,661)	(38,525)	(55,474)	(72,392)	(88,240)
		V_{sa}	kN	15.4	24.4	35.4	65.8	102.8	148.1	192.7	235.5
			(lb)	(3,456)	(5,477)	(7,960)	(14,796)	(23,115)	(33,285)	(43,300)	(52,944)
	Strength reduction factor ϕ for tension[2]	ϕ		0.65							
	Strength reduction factor ϕ for shear[2]	ϕ		0.60							
ISO 3506-1 Class A4-80 and stainless C-80	Nominal strength as governed by steel strength	N_{sa}	kN	29.3	46.4	67.4	125.4	195.8	282.0	368	448.6
			(lb)	(6,583)	(10,432)	(15,162)	(28,183)	(44,029)	(63,399)	(82,734)	(100,845
		V_{sa}	kN	17.6	27.8	40.5	75.2	117.5	169.2	220.1	269.1
			(lb)	(3,950)	(6,259)	(9,097)	(16,910)	(26,417)	(38,040)	(49,486)	(60,507)
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65							
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60							

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch-units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1]Values provided for common rod material types are based on specified strength and calculated in accordance with ACI 318-14 Eq. (17.4.1.2) and Eq. (17.5.1.2b) or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable. Nuts and washers must be appropriated for the rod.

[2]For use with load combinations of IBC Section 1605.2, ACI 318-14 5.3 or ACI 318-11 Section 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

TABLE 5—CONCRETE BREAKOUT DESIGN INFORMATION FOR METRIC THREADED ROD

DESIGN INFORMATION	SYMBOL	UNITS	NOMINAL ROD DIAMETER (MM)							
			M8	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth	$h_{ef,min}$	mm	64	80	96	128	160	192	216	240
		(in.)	(2.52)	(3.15)	(3.78)	(5.04)	(6.30)	(7.56)	(8.50)	(9.45)
	$h_{ef,max}$	mm	96	120	144	192	240	288	324	360
		(in.)	(3.78)	(4.72)	(5.67)	(7.56)	(9.45)	(11.34)	(12.76)	(14.17)
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI	10							
		(in.-lb)	(24)							
Minimum anchor spacing	s_{min}	mm (in.)	$s_{min} = c_{min}$							
Minimum edge distance	c_{min}	mm	40	45	55	65	85	105	120	140
		(in).	(2.00)	(1.77)	(2.17)	(2.56)	(3.35)	(4.13)	(4.72)	(5.51)
Minimum member thickness	h_{min}	mm	h_{ef} + 30 (≥ 100)			$h_{ef} + 2d_0$[2)]				
		(in.)	h_{ef} + 1.25 (≥ 3.937)							
Critical edge distance – splitting (uncracked concrete)	c_{ac}	mm	See Section 4.1.10 of this report.							
		(in.)								
Strength reduction factor for tension, concrete failure modes, Condition B[1]	ϕ	-	0.65							
Strength reduction factor for shear, concrete failure modes, Condition B[1]	ϕ	-	0.70							

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch-units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1MPa = 145.0 psi

[1] Values provided for post-installed anchors with category as determined from ACI 355.4 given for Condition B. Condition B applies without supplementary reinforcement or where pullout (bond) or pryout govern, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, while condition A requires supplemental reinforcement. Values are for use with the load combinations of IBC Section 1605.2., ACI 318-14 5.3 or ACI 318-11 Section 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11, Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D4.4.

[2] d_0 = drill hole diameter

TABLE 6—BOND STRENGTH DESIGN INFORMATION FOR METRIC THREADED ROD[1]

DESIGN INFORMATION		SYMBOL	UNITS	NOMINAL ROD DIAMETER (MM)							
				M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth		$h_{ef,min}$	mm	64	80	96	128	160	192	216	240
			(in.)	(2.52)	(3.15)	(3.78)	(5.04)	(6.30)	(7.56)	(8.50)	(9.45)
		$h_{ef,max}$	mm	96	120	144	192	240	288	324	360
			(in.)	(3.78)	(4.72)	(5.67)	(7.56)	(9.45)	(11.34)	(12.76)	(14.17)
Temperature range A[3]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm²	12.3	12.3	11.7	10.7	10.0	9.5	9.1	8.8
			(psi)	(1,784)	(1,784)	(1,697)	(1,552)	(1,450)	(1,378)	(1,320)	(1,276)
Temperature range B[3]	Characteristic bond strength in uncracked concrete[2]	$\tau_{k,uncr}$	N/mm²	9.5	9.5	8.9	8.2	7.6	7.3	7.0	6.8
			(psi)	(1,378)	(1,378)	(1,291)	(1,189)	(1,102)	(1,059)	(1,015)	(986)
Strength reduction factor for permissible installation conditions	Dry concrete	ϕ_{dry}	-	0.65							
	Water saturated concrete	ϕ_{ws}	-	0.55			0.65				

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 Mpa.
For pound-inch-units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1MPa = 145.0 psi

[1]Bond strength values correspond to concrete compressive strength in the range 2,500 psi≤f'_c≤4,500 psi [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1]. For the range 4,500 psi≤ f'_c ≤6,500 psi tabulated characteristic bond strength may be increased by 9 percent and range 6,500 psi≤ f'_c ≤8,000 psi tabulated characteristic bond strength may be increased by 15 percent.

[2]Characteristic bond strengths are for sustained loads including dead and live loads. For short-term loads including wind, bond strength may be increased 7 percent for temperature range B.

[3]Temperature range A: Maximum short term temperature = 176°F (80°C), Maximum long term Temperature = 122°F (50°C). Temperature range B: Maximum short term temperature = 248°F (120°C), Maximum long term Temperature = 162°F (72°C). Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a results of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

FIGURE 2—EXAMPLE OF FIS V / FIS V PLUS ANCHORING SYSTEMS, STATIC MIXER, DISPENSER AND STEEL ELEMENTS

Installation instruction

see ICC-ES Evaluation Report No. 2786
at www.icc-es.org

fischer FIS V/FIS V Plus Adhesive Anchoring System

A Preparing the cartridge

1. Remove the cap by turning it to left and pulling it off.
2. Insert the static mixer and lock it in place (turn to the right). **The spiral mixer in the static mixer must be clearly visible.** Never use without the static mixer!
3. Place the cartridge in the dispenser.
4. Press approx 10 cm of material out **until the resin mortar comes out evenly grey in colour.** Mortar which is not grey colour will not cure and must be disposed of.
5. The temperature of the concrete must be at least 23 °F (5 °C) and at most 104 °F (40 °C) **(see Table III).** The temperature of the cartridge must be at least ϑ = 41 °F (5 °C).
6. After finishing work, leave the static mixer attached to the cartridge.

Important: If the processing time is exceeded, use a new static mixer and if necessary remove encrusted material in the cartridge mouth.

B Installation

Important: Installation instructions - follow the pictograms 1-7 for the sequence of operating and refer to **Tables I–III** for setting details. The construction drawings must be adhered. For any applications not covered by this document or by any problems with installation contact fischer.

1. Drill hole with a hammer drill set. Observe the correct hole diameter and depth according to **Table I and Table II.**

2.1/2.2/2.3. Standing water in bore holes must be completely removed by blowing out before cleaning the bore hole. The drill hole must blown out four times with compressed air (oil-free ≥ 87 psi (6 bar)), brushed four times (minimal by hand) starting from the bottom of the hole and then again blown out four times with compressed air (oil-free ≥ 87 psi (6 bar)). For drill holes d_0 < 18 mm it is allowed to use hand pump. The diameters of the brushes are given in **Table I.** Clean dirty brushes. Check brushes for wear with brush gauge (brush Ø ≥ drill hole Ø). If required use brush extension.

3. Fill approx. ⅔ of the hole with mortar starting from the bottom of the hole. For drill hole depth > 150 mm use an extension tube. Observe processing time.
4. Anchoring element must be straight and free of oil and other contaminants. Mark the anchor with correct embedment depth. Press the anchoring element down to the bottom of the hole, turning it slightly while so doing. After insert the anchoring element, excess mortar must emerge from the mouth of the hole.
5. For overhead installations and applications between horizontal and overhead use the appropriate injection adapter and wedges to support the anchor during curing time. Also use an injection adapter for all applications with a drill hole depth > 250 mm or a drill hole diameter d_0 ≥ 30 mm. Use appropriate accessories to capture excess adhesive during installation of the anchor element in order to protect the unbonded portion of the anchor element from adhesive.
6. Do not disturb the anchoring element until cure time has elapsed. Do not apply load or installation torque moment to the anchor until the prescribed curing times are elapsed. The allowable working time and the minimum curing time are given in **Table III.**
7. The installation torque moments are given in **Table II.**

Store mortar in a cool dry place

Table III Processing and curing times

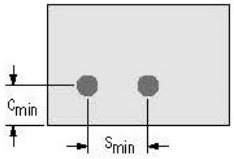
Temperature range °C	Temperature range °F	Working time/ processing time	Curing time
- 5 to ± 0	+23 to + 32	-	24 h
> ± 0 to + 5	> +32 to + 41	13 min	180 min
> + 5 to +10	> +41 to + 50	9 min	90 min
> +10 to +20	> +50 to + 68	5 min	60 min
> +20 to +30	> +68 to + 86	4 min	45 min
> +30 to +40	> +86 to +104	2 min	36 min

Storage temperature: +5 °C - +25 °C / +41 °F - +77 °F

FIGURE 3—FIS V / FIS V PLUS INSTALLATION INFORMATION

Table I Drill hole diameter / Accessories

Drill bit		Rods		Brush		Injection adapter	
Ø [mm]	Ø [inch]	Ø [mm]	Ø [inch]	Ø [mm]	item No.	size	colour
10	3/8	M 8	-	11	78178	–	–
12	7/16	M10	3/8"	14	78179	12	nature
14	9/16	M12	1/2"	16	78180	14	blue
18	3/4	M16	5/8"	20	78181	18	yellow
24	1	M20	7/8"	26	78182	24	brown
28	1 1/8	M24	1"	30	78183	30	grey
30	1 1/4	M27	-	40	78184	30	grey
35	1 3/8	M30	1 1/4"	40	78184	35	brown



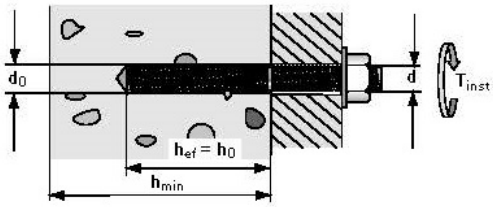
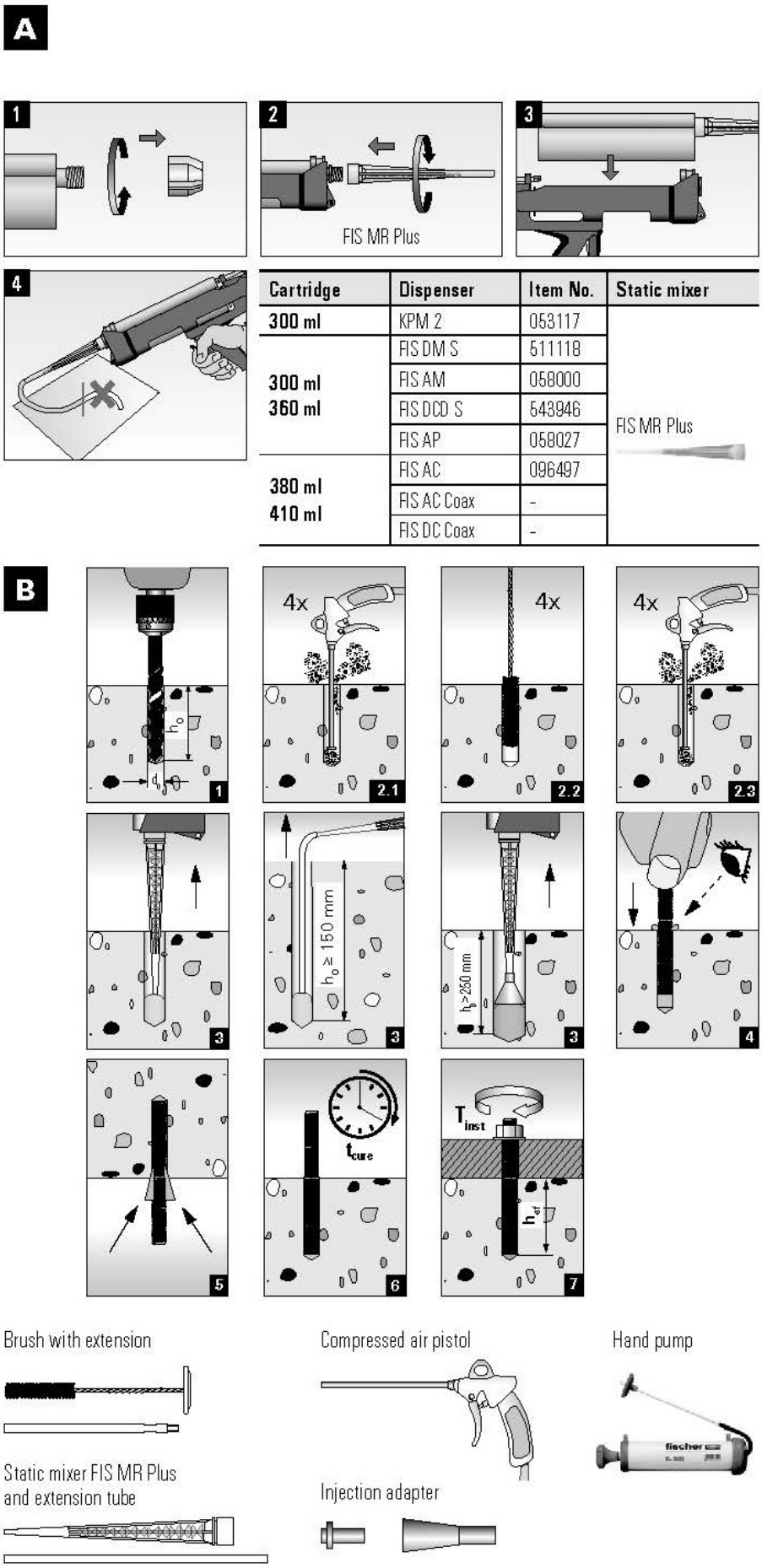


Table II Threaded rod, metric

d	d_o		$h_{ef,min}$		$h_{ef,max}$		h_{min}		$s_{min} = c_{min}$		T_{inst}	
[mm]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[Nm]	[ft-lb]
M 8	10	3/8	60	2,36	96	3,78	$h_{ef}+30$	$h_{ef}+1,25$	40	1,57	10	7,37
M10	12	7/16	60	2,36	120	4,72			45	1,77	20	14,75
M12	14	9/16	72	2,83	144	5,67			55	2,17	40	29,50
M16	18	3/4	96	3,78	192	7,56	$h_{ef}+2d_o$	$h_{ef}+2d_o$	65	2,56	60	44,25
M20	24	1	120	4,72	240	9,45			85	3,35	120	88,50
M24	28	1 1/8	144	5,67	288	11,34			105	4,13	150	110,62
M27	30	1 1/4	162	6,38	324	12,76			120	4,72	200	147,49
M30	35	1 3/8	180	7,09	360	14,17			140	5,51	300	221,24

FIGURE 3—FIS V / FIS V PLUS INSTALLATION INFORMATION (Continued)



Cartridge	Dispenser	Item No.	Static mixer
300 ml	KPM 2	053117	FIS MR Plus
300 ml 360 ml	FIS DM S	511118	
	FIS AM	058000	
	FIS DCD S	543946	
	FIS AP	058027	
380 ml 410 ml	FIS AC	096497	
	FIS AC Coax	-	
	FIS DC Coax	-	

FIGURE 3—FIS V / FIS V PLUS INSTALLATION INFORMATION (Continued)