TECHNICAL DATA SHEET:

WEDGE ANCHORS - ICC APPROVED

ZINC

The **Allfasteners Wedge Anchor** is a torque-controlled, wedge expansion anchor for heavy duty fastening applications where high pull out values in concrete are needed. The anchor and the hole diameter are the same, simplifying the anchor installation by placing the anchor through the existing hole in the material to be fastened. Used in fastening sheet metal, steel and aluminum angles, or wood to concrete. Due to its high resistance to vibratory loads, this anchor is ideal for installing machinery, hand rails, dock bumpers, storage racks, etc.

ICC-ESR 4346

KEY BENEFITS

- Solid Concrete (Normal-Weight and Light-Weight)
- Grout-Filled Concrete Block
- Concrete-Filled Metal Deck
- Structural Anchorage
- Machinery, Hand rail, dock bumper installation
- Storage racking anchorage

1.0 RECOGNITION & CERTIFICATIONS

ICC Wedge Anchors evaluated in this report shows compliance to the following codes and regulations:

- ICC-ESR 43456
- 2015, 2012, 2009, and 2006 International Building Code® (IBC)
- 2015, 2012, 2009, and 2006 International Residential Code® (IRC)

Property Evaluated: Structural

2.0 USES

- The ETB Wedge Anchor is used as anchorage to resist static, wind, and seismic (Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normal-weight and light weight concrete having a specified compressive strength, f'c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).
- The ETB Wedge Anchors comply with Section 1901.3 of 2015 IBC, Section 1909 of the 2012 IBC and Section 1912 of the 2009 and 2006 IBC. The anchor system is an alternative to cast-in-place anchors described in Section 1901.3 of the 2015 IBC, Section 1908 of the 2012 IBC, and Section 1911 of the 2009 and 2006 IBC. The anchors 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

ETB Wedge Anchors are torque-controlled, mechanical expansion anchors consisting of an anchor body, expansion clip, nut and washer. A typical anchor is shown in Figure 3 of this report. The anchor body has a tapered mandrel formed on the installed end of the anchor and a threaded section at the opposite end. The taper of the mandrel increases in diameter towards the installed end of the anchor. The three-segment expansion clip wraps around the tapered mandrel. Before installation, this expansion clip is free to rotate about the mandrel. The anchor is set by applying torque to the hex nut; the mandrel is drawn into the expansion clip, which engages the drilled hole and transfers the load to the base material. Pertinent dimensions are given in Table 1 of this report.

3.2. MATERIALS

The anchor bodies are manufactured by cold forming from carbon steel materials conforming to JIS G 3507. The zinc plating on the anchor body complies with ASTM B633 SC1 type III, with a minimum 0.0002 inch (5μm) thickness. The expansion clip is fabricated from low carbon steel conforming to JIs G 3141. The sherardized coating of the clips complies with EN 13811 Class 15 with a minimum 0.0006 inch (15μm) thickness. The hex nut for the carbon steel ETB anchor conforms to ASME B18.2.2 The washer for the carbon steel ETB anchor conforms to ASME B18.21.1 The available anchor diameters under this report are: 3/8 inch, 1/2 inch, and 3/4 inch.

3.3 CONCRETE

Normal-weight and lightweight concrete must conform to Sections 1903 and 1905 of the IBC, as applicable.

4.0 DESIGN & INSTALLATION

4.1 STRENGTH DESIGN

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

Design strength of anchors complying with the 2012 IBC, and the 2012 IRC, must be in accordance with ACI 318-11 Appendix D and this report.

Design strength of anchors complying with the 2009 IBC, and the 2009 IRC, must be in accordance with ACI 318-08 Appendix D and this report.

Design strength of anchors complying with the 2006 IBC, and the 2006 IRC, must be in accordance with ACI 318-05 Appendix D and this report.

Design parameters are based on the 2015 IBC (ACI318-14) and the 2012 IBC (ACI318-11) unless noted otherwise in Sections 4.1.1 through 4.1.12 of this report. The strength design of 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. Strength reduction factors, Ø, as given in ACI 318-14 17.3.3 or ACI 318-11 D4.3, as applicable, must be used for load combinations calculated in accordance with Section 1605.2 of the IBC and Section 5.3 of ACI 318-4 or Section 9.2 of ACI 318-11, as applicable. Strength reduction factors, Ø, as given in ACI 318-11 D4.4 must be used for load combinations calculated in accordance with ACI 318-11 Appendix C.

The value of f'c used in the calculations must be limited to a maximum of 8,000 psi (55.2 MPa), 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, Nsa, must be calculated in accordance with ACI 318-11 D5.1.2, as applicable. The values of Nsa are given in Table 3 of this report. Strength reduction factors, Ø, corresponding to ductile steel elements may be used for ETB.

4.1.3 **Static Concrete Breakout Strength in Tension:** The nominal static concrete breakout strength of a single anchor or group of anchors in tension, Ncb or Ncbg, 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, Nb, 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 selected values of hef and kcr as given in Table 3 of this report. The nominal concrete breakout strength in tension, in regions 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, must be calculated with ψ_{cp}=1.0 and using the value of k_{uncr} as given in Table 3.

4.1.4 **Static Pullout Strength:** The nominal pullout strength of a single anchor, in accordance with ACI 318-14 17.4.3.1 and 17.4.3.2 or ACI 318-11 D.5.3.1 and D.5.3.2, as applicable, in cracked and uncracked concrete, Np,cr and Np,uncr, respectively, is given in Table 3. In lieu of ACI 318-14 17.4.3.6

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4.1 STRENGTH DESIGN (CONTINUED)

or ACI 318-11 D.5.3.6, as applicable, ψ_{cp} =1.0 for all design cases. In accordance with ACI 318-14 17.4.3.2 or ACI 318-11 D.5.3.2, as applicable, the nominal pullout strength in cracked concrete must be adjusted by calculation according to the following equation:

$$N_{p,f'c} = N_{p,cr}\left(\frac{f'_c}{2{,}500}\right)^n \quad \text{(lb, psi)} \quad \text{(Eq-1)}$$

$$N_{p,f'c} = N_{p,cr}\left(\frac{f'_c}{17.2}\right)^n \quad \text{(N, MPa)}$$

In regions where analysis indicates no cracking in accordance with ACI 318-14 17.4.3.6 or ACI 318-11 D.5.3.6, as applicable, the nominal pullout strength in tension must be calculated according to the following equation:

$$N_{p,f'c} = N_{p,uncr}\left(\frac{f'_c}{2{,}500}\right)^n \quad \text{(lb, psi)} \quad \text{(Eq-2)}$$

$$N_{p,f'c} = N_{p,uncr}\left(\frac{f'_c}{17.2}\right)^n \quad \text{(N, MPa)}$$

n= normalization exponent given in Table 3.

Where values for $N_{p,cr}$ or $N_{p,uncr}$ are not provided in Table 3, the pullout strength in tension need not be evaluated.

4.1.5 **Static Steel Strength in Shear:** The nominal static strength of a single anchor in shear as governed by the steel, Vsa, in accordance with ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, is given in Table 3 and must be in lieu of the value derived by calculation from ACI 318-14 Eq 17.5.1.2b or ACI 318-11 Eq D-29, as applicable. Strength reduction factors, Ø, corresponding to ductile steel elements may be used for the ETB.

4.1.6 **Static Concrete Breakout Strength in Shear:** The nominal 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, with modifications as provided in tis section. 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 values of l_e and d_a (d_o) given in Table 3.

4.1.7 **Static Concrete Pryout Strength in Shear:** The nominal static concrete pryout strength of a single anchor or group of anchors in shear, V_{cp} or V_{cpg}, must be calculated in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, modified by using the value of k_{cp} provided in Table 3 and the value of N_{cb} or N_{cbg} as calculated in accordance with Section 4.1.3 of this report.

4.1.8 **Requirements for Seismic Design:**

4.1.8.1 **General:** For load combinations including seismic, the design must be performed in accordance with ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable. Modifications to ACI 318-14 17.2.3 shall be applied under Section 1905.1.8 of the 2015 IBC. For the 2012 IBC, Section 1905.1.9 shall be omitted. Modifications to ACI 318 (-08, -05) D3.3 shall be applied under Section 1908.1.9 of the 2009 IBC, or Section 1908.1.16 of the 2006 IBC as applicable.

4.1.8.2 **Seismic Tension:** The nominal steel strength and the nominal concrete breakout strength for anchors in tension must be calculated according to ACI 318-14 17.4.1 and 17.4.2 or ACI 318-11 D.5.1 and D.5.2, respectively, as described in Sections 4.1.2 and 4.1.3 of this report. In accordance with ACI 318-14 17.4.3.2 or ACI 318-11 D.5.3.2, as applicable, the appropriate pullout strength in tension for seismic loads, $N_{p,eq}$ may be adjusted by calculation for concrete strength in accordance with Eq-1 and Section 4.1.4 whereby the value of $N_{p,eq}$ must be substituted for $N_{p,cr}$. If no values for $N_{p,eq}$ are given in Table 3, the static design values govern.

4.1.8.3 **Seismic Shear:** The nominal breakout strength and pryout strength for anchors in shear must be calculated according to AC! 318-14 17.5.2 and 17.5.3 or ACI 318-11 D.6.2 and D.6.3, respectively, as described in Sections 4.1.6 and 4.1.7 of this report. In accordance with ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2 the appropriate value for nominal steel strength for seismic loads, $V_{sa,eq}$ described in Table 3 must be used in lieu of V_{sa}.

4.1.9 **Interaction of Tensile and Shear Forces:** For anchors or groups of anchors that are subject to the effects of combined tensile and shear forces, the design must be performed in accordance with ACI 318-14 17.6 or ACi 318-11 D.7, as applicable.

4.1.10 **Critical Edge Distance c_{ac} and $\psi_{cp,N}$:** In applications where $c < c_{ac}$ and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout strength in tension for uncracked concrete, calculated according to

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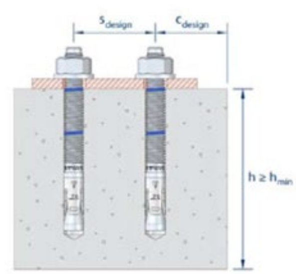
4.1 STRENGTH DESIGN (CONTINUED)

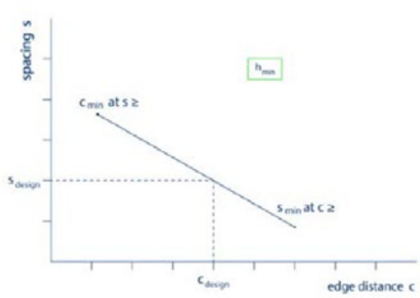
ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, must be further multiplied by factor $\psi_{cp,N}$ as given by the following equation:

$$\psi_{cp,N} = \frac{c}{c_{ac}} \qquad \text{(Eq-3)}$$

Where the factor need not be taken as less than $1.5h_{ef} / c_{ac}$. For all other cases, $\psi_{cp,N} = 1.0$. In lieu of ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable, values for the critical edge distance c_{ac} must be taken from Table 1 of this report.

4.1.11 Minimum Member Thickness, Anchor Spacing and Edge Distance: In lieu of ACI 318-14 17.7.1 and 17.7.3 or ACI 318-11 D.8.1 and D.8.3, respectively, values of s_{min} and c_{min} as given in Table 1 must be used. In Lieu of ACI 318-14 17.7.5 or ACI 318-11 D.8.5, as applicable, minimum member thickness h_{min} as given in Table 1 must be used. Additional combinations may be derived by linear interpolation between the given boundary values as shown in the following figures.





4.1.12 Lightweight Concrete: For the use of anchors in lightweight concrete, the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'_c}$, affecting N_n and V_n.

For ACI 318-14 (2015 IBC), AI 318-11 (2012 IBC) and ACI318-08 (2009 IBC), λ shall be determined in accordance with the corresponding version of ACI 318.

For ACI 318-05 (2006 IBC), λ shall be taken as 0.75 for all lightweight concrete and 0.85 for sand-lightweight concrete. Linear interpolation shall be permitted if partial sand replacement is used. In addition, the pullout strengths $N_{p,uncr}$, $N_{p,cr}$ and $N_{p,eq}$ shall be multiplied by the modification factor, λ_a, as applicable.

4.2 ALLOWABLE STRESS DESIGN (ASD)

4.2.1 General: Design values for use with allowable stress design load combinations calculated in accordance with Section 1605.3 of the IBC shall be established as follows:

$T_{allowable,ASD} = ØN_n/α$ Eq. (4)

$V_{allowable,ASD} = ØV_n/α$ Eq. (5)

Where

$T_{allowable,ASD}$ = Allowable tension load (lbf or kN)

$V_{allowable,ASD}$ = Allowable shear load (lbf or kN)

$ØN_n$ = The lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318-14 Chapter 17 and 2015 IBC Section 1905.1.8; ACI 318-11 Appendix D as amended in this report; ACI 318-08 Appendix D and 2009 IBC Sections 1908.1.9, ACI 318-05 Appendix D and 2006 IBC Section 1908.1.16, and Section 4.1 of this report, as applicable.

$ØV_n$ = The lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-14 Chapter 17 and 2015 IBC Section 1905.1.8; ACI 318-11 Appendix D; ACI 318-08 Appendix D and 2009 IBC Section 1908.1.9; ACI 318-05 Appendix D and 2006 IBC Section 1908.1.16, and Section 4.1 of this report, as applicable.

α = Conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition, α shall include all appropriate factors to account for nonductile failure modes and required over-strength.

The requirements for member thickness, edge distance and spacing, as described in this report, must apply. An example of allowable stress design values for illustrative purposes is shown Table 4.

Interaction of Tensile and Shear Forces: The interaction must be calculated and consistent with ACI 318-14 17.6 or ACI 318 (-11, -08, -05) D.7, as applicable, as follows:

For tension loads $T_{applied} \leq 0.2T_{allowable,ASD}$, the full allowable strength in shear, $V_{allowable,ASD}$, shall be permitted.

For shear loads $V_{applied} \leq 0.2V_{allowable,ASD}$, the full allowable load in tension, $T_{allowable,ASD}$ shall be permitted.

For all other cases:

$$\frac{T_{applied}}{T_{allowable,ASD}} + \frac{V_{applied}}{V_{Vallowable,ASD}} \leq 1.2 \qquad \text{Eq. (6)}$$

4.3 INSTALLATION

Installation parameters are provided in Tables 1 and Figures 1 and 2. Anchors must be installed per the manufacturer's published instructions and this report. Anchor locations must comply with this report and the plans and specifications approved by the code official. Anchors must be installed in holes drilled into concrete using carbide-tipped drill bits complying with ANSI B212.15-1994. The nominal drill diameter must be equal to the nominal diameter of the anchor. Prior to anchor installation, the hole must be cleaned in accordance with the manufacturer's published installation instructions. The anchor must be hammered into the predrilled hole until the embedment depth ring mark flushes with the concrete surface. The nut must be tightened against the washer until the torque value, T_{inst}, specified in Table 1, is achieved.

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4.4 SPECIAL INSPECTION

Periodic special inspection is required, in accordance with Section 1705.1.1 and Table 1705.3 of 2015 IBC and 2012 IBC; Section 1704.15 and Table 1704.4 of the 2009 IBC; or Section 1704.13 of the 2006 IBC, as applicable. The special inspector must make periodic inspections during anchor installation to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, anchor spacing, edge distances, concrete thickness, anchor embedment, installation torque, and adherence to the manufactuer's published installation instructions. The special inspector must be present as oftern as required in accordance with the "statement of special inspection". Under the IBC, additional requirements as set forth in Sections 1705, 1706 and 1707 must be observed, where applicable.

5.0 CONDITIONS OF USE

The ETB Wedge Anchors 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 Anchor sizes, dimensions and minimum embedment depths are as set forth in the tables of this report.

5.2 The anchors must be installed in cracked or uncracked normal-weight and lightweight concrete having a specified compressive strength, f'c = 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

5.3 The values of f'c used for calculation purposes must not exceed 8,000 psi (55.1 MPa).

5.4 The concrete shall have attained its minimum design strength prior to installation of the anchors.

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

5.6 Allowable stress design values are established in accordance with Section 4.2 of this report.

5.7 Anchor spacing and edge distance as well as minimum member thickness must comply with Table 1 of this report.

5.8 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 statues of the jurisdiction in which the project is to be constructed.

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

5.10 Anchors may be installed in regions of concrete where cracking has occurred or where analysis indicates cracking may occur ($f_t > f_r$), subject to th conditions of the report.

5.11 Anchors may be used to resist short-term loading due to wind or seismic forces in locations designated as Seismic Design Categories A through F under the IBC, subject to the conditions of this report.

5.12 Where not otherwise prohibited in the code, anchors are permitted for use with fire-resistance-rated 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 a fire-resistance-rated envelope or fire-resistance-rated membrane, are protected by approved fire-resistance-rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Anchors are used to support nonstructural elements.

5.13 Use of zinc-coated carbon steel anchors is limited to dry, interior locations.

5.14 Special inspection must be provided in accordance with Section 4.4 of this report.

5.15 Anchors are manufactured under an approved quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), dated October 2017, which incorporates requirements in ACI 355.2-07, for use in cracked and uncracked concrete; and quality control document

7.0 IDENTIFICATION

The anchors are identified by packaging labeled with the evaluation report holder's name (allfasteners USA LLC), anchor name, anchor diameter size, anchor length and evaluation report number (ESR-4346). The anchors have the letters ETB and the anchor diameter size embossed on the sleeve.

INSTALLATION INFORMATION

Table 1: ANCHOR INSTALLATION PARAMETERS*

Characteristic	Symbol	Units	Nominal Anchor Diameter						
			3/8"	1/2"		5/8"		3/4"	
Outside Diameter	d_o[2]	in (mm)	3/8 (9.5)	1/2 (12.7)	1/2 (12.7)	5/8 (15.9)	5/8 (15.9)	3/4 (19.1)	3/4 (19.1)
Nominal Embedment Depth	h_{nom}	in (mm)	2.33 (59)	2.33 (59)	3.59 (91)	3.23 (82)	4.49 (114)	3.74 (95)	5.26 (134)
Effective Embedment Depth	h_{ef}	in (mm)	2 (51)	2 (51)	3-1/4 (83)	2-3/4 (70)	4 (102)	3-1/4 (83)	4-3/4 (121)
Minimum Hole Depth	h_{hole}	in (mm)	2-5/8 (67)	2-5/8 (67)	4 (102)	3-1/2 (89)	4-3/4 (121)	4 (102)	5-3/4 (146)
Clearance Hole Diameter	d_r	in (mm)	7/16 (11.1)	9/16 (14.3)		11/16 (17.5)		7/8 (22.2)	
Recommended Installation Torque	T_{inst}	ft.lb (Nm)	30 (41)	45 (61)	45 (61)	75 (102)	75 (102)	150 (203)	150 (203)
Minimum Concrete Thickness	h_{min}	in (mm)	4 (102)	4 (102)	6 (152)	5-1/2 (140)	6-1/2 (165)	6 (152)	8 (203)
Criteria Edge Distance	c_{ac}	in (mm)	6 (152)	6 (152)	7-1/2 (191)	7 (178)	8-1/2 (216)	9 (229)	12 (305)
Minimum Edge Distance (c) for Spacing (s_{min}≥)	c_{min}	in (mm)	2-1/2 (64)	3 (76)	2-1/2 (64)	3-1/2 (89)	3-1/2 (89)	5 (127)	4-1/2 (114)
	s≥	in (mm)	6-1/2 (165)	6 (152)	6 (152)	8 (203)	6 (152)	10-1/2 (267)	9-1/2 (241)
Minimum Spacing (s_{min}) for Edge Distance (c≥)	s_{min}	in (mm)	2-1/2 (64)	2-3/4 (70)	2-1/2 (64)	4-1/2 (114)	4 (102)	5 (127)	4 (102)
	c≥	in (mm)	4 (102)	6 (152)	4 (102)	6 (152)	5 (127)	10-1/2 (267)	8-1/2 (216)
Minimum Overall Anchor Length	ℓ_{anch}	in (mm)	3 (76)	3-1/2 (89)	4-1/2 (114)	4-1/4 (108)	5-1/2 (140)	5 (127)	6-1/2 (165)
Torque Wrench Socket Size	-	in	9/16	3/4		15/16		1-1/8	

* The tabulated data is to be used in conjunction with the design criteria given in ACI 318-14 Chapter 17 or ACI 318-11 Appendix D. For the 2006 IBC: d_o replaces d_a and $A_{se,N}$ replaces A_{se}.

Length identification indicates overall length of anchor. Stamp is visible before and after installation.

Table 2: ETB WEDGE ANCHOR LENGTH INDENTIFICATION SYSTEM

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Mark From	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"
Up to*	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"	10"

* Up to but not including

INSTALLATION INFORMATION (CONTINUED)

Figure 1 : ANCHOR DIMENSIONS

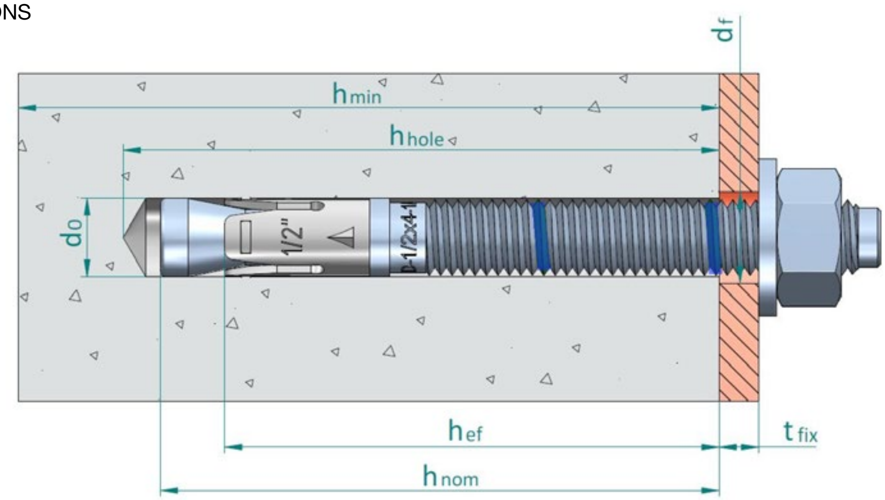


Table 3: ANCHOR DESIGN INFORMATION[1,3,4,5]

Characteristic	Symbol	Units	Nominal Anchor Diameter						
			3/8"	1/2"		5/8"		3/4"	
Outside Diameter	d_o [2]	in (mm)	3/8 (9.5)	1/2 (12.7)	1/2 (12.7)	5/8 (15.9)	5/8 (15.9)	3/4 (19.1)	3/4 (19.1)
Nominal Embedment Depth	h_{nom}	in (mm)	2.33 (59)	2.33 (59)	3.59 (91)	3.23 (82)	4.49 (114)	3.74 (95)	5.26 (134)
Effective Embedment Depth	h_{ef}	in (mm)	2 (51)	2 (51)	3-1/4 (83)	2-3/4 (70)	4 (102)	3-1/4(83)	4-3/4 (121)
Effective Steel Stress Area (Threads)	A_{se} [2]	in² (mm²)	0.077 (49.7)	0.141 (91.0)	0.141 (91.0)	0.226 (145.8)	0.226 (145.8)	0.334 (215.5)	0.334 (215.5)
Effective Steel Stress Area (Neck)	A_{se} [2]	in² (mm²)	0.0562 (36.3)	0.100 (64.5)	0.100 (64.5)	0.160 (103.2)	0.160 (103.2)	0.238 (153.5)	0.238 (153.5)
Steel Strength in Tension and Shear									
Minimum Specified Yield Strength (Threads)	f_y	psi (N/mm²)	69,500 (480)						
Minimum Specified Yield Strength (Neck)	f_y	psi (N/mm²)	85,000 (585)			81,000 (560)		77,000 (530)	
Minimum Specified Ultimate Strength	f_{ut}	psi (N/mm²)	87,000 (600)						
Steel Strength in Tension	N_{sa}	lb(kN)	6,125 (27.2)	10,600 (47.2)	10,600 (47.2)	16,240 (72.2)	16,240 (72.2)	22,730 (101.1)	22,730 (101.1)
Strength Reduction Factor for Tension Steel Failure	$Ø_{sa}$	-	0.75						
Steel Strength in Shear	V_{sa}	lb(kN)	2,860 (12.7)	4,820 (21.4)	4,820 (21.4)	9,040 (40.2)	9,040 (40.2)	12,300 (54.7)	12,300 (54.7)
Steel Strength in Shear, Seismic	$V_{sa,eq}$	lb(kN)	2,720 (12.1)	4,045 (17.9)	4,045 (17.9)	7,700 (34.2)	7,700 (34.2)	8,870 (39.4)	8,870 (39.4)
Strength Reduction Factor for Steel Failure in Shear	$Ø_{sa}$	-	0.65						

1. The tabulated data is to be used in conjunction with the design criteria given in ACI 318-14 Chapter 17 or ACI 318-11 Appendix D.
2. For the 2006 IBC: d_o replaces d_a and $A_{se,N}$ replaces A_{se}.
3. The tabulated values of $Ø_{sa}$ are applicable when the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of $Ø_{sa}$ must be determined in accordance with ACI 318-11 D.4.4.
4.The tabulated values of $Ø_{sa}$ are applicable when the load combinations of Section 1605.2 of IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used and the requirements of ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable. For Condition B are met. Condition B applies where supplementary reinforcement is not supplied.
5.Where no value is reported for pullout strength, this resistance does not need to be considered.

CONTINUED ON NEXT PAGE

INSTALLATION INFORMATION (CONTINUED)

Table 3: ANCHOR DESIGN INFORMATION (CONTINUED)[1,3,4,5]

Characteristic	Symbol	Units	NOMINAL ROD DIAMETER, d_o						
			3/8"	1/2"		5/8"		3/4"	
Pullout Strength in Tension									
Pullout Strength in Uncracked Concrete	$N_{p,uncr}$	lb(kN)	3,325 (14.79)	3,394 (15.10)	5,723 (25.46)	-	-	-	-
Pullout Strength in Cracked Concrete	$N_{p,cr}$	lb(kN)	2,163 (9.62)	-	4,252 (18.91)	-	-	-	-
Pullout Strength in Cracked Concrete, Seismic	N_{eq}	lb(kN)	2,115 (9.41)	-	4,252 (18.91)	-	-	-	-
Anchor Category	1,2 or 3	-	1	1	1	1	1	1	1
Strength Reduction Factor for Pullout Strength in Tension	$Ø_p$	-	0.65						
Concrete Breakout Strength in Tension									
Effectiveness Factor for Uncracked Concrete	k_{uncr}	-	24	24	24	24	24	27	24
Effectiveness Factor for Cracked Concrete	k_{cr}	-	17	17	17	21	17	21	21
Strength Reduction Factor for Concrete Breakout Strength in Tension	$Ø_{cb}$	-	0.65						
Axial Stiffness in Service Load Range in Uncracked Concrete	$β_{uncr}$	lb/in (N/mm)	169,540 (29,690)	296,770 (51,972)	129,020 (22,594)	134,210 (23,503)	88,970 (15,580)	165,900 (29,053)	138,430 (24,242)
Axial Stiffness in Service Load Range in Cracked Concrete	$β_{cr}$	lb/in (N/mm)	74,240 (13,001)	76,285 (13,359)	52,680 (9,225)	48,940 (8,570)	61,430 (10,758)	75,610 (13,241)	90,400 (15,830)
Normalization Exponent, Uncracked Concrete	n	-	0.38	0.39	0.50	0.50	0.50	0.50	0.50
Normalization Exponent, Cracked Concrete	n	-	0.50	0.50	0.46	0.50	0.50	0.50	0.50
Concrete Breakout Strength in Shear									
Nominal Diameter	d_o [2]	in (mm)	3/8 (9.5)	1/2 (12.7)	1/2 (12.7	5/8 (15.9)	5/8 (15.9)	3/4 (19.1)	3/4 (19.1)
Load Bearing Length of Anchor	l_e	in (mm)	2 (51)	2 (51)	3-1/4 (83)	2-3/4 (70)	4 (102)	3-1/4 (83)	4-3/4 (121)
Reduction Factor for Concrete Breakout Strength in Shear	$Ø_{cb}$	0.70							
Concrete Pryout Strength in Shear									
Coefficient for Pryout Strength	k_{cp}	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0
Reduction Factor for Pryout Strength in Shear	$Ø_{cp}$	0.70							

1. The tabulated data is to be used in conjunction with the design criteria given in ACI 318-14 Chapter 17 or ACI 318-11 Appendix D.

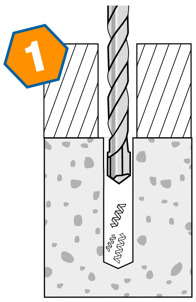
2. For the 2006 IBC: d_o replaces d_a and $A_{se,N}$ replaces $A_{se.}$

3. The tabulated values of $Ø_{sa}$ are applicable when the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of $Ø_{sa}$ must be determined in accordance with ACI 318-11 D.4.4.

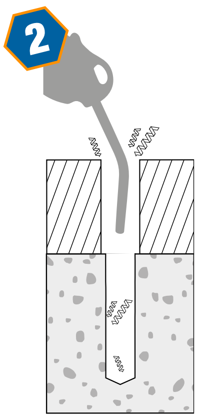
4.The tabulated values of $Ø_{sa}$ are applicable when the load combinations of Section 1605.2 of IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used and the requirements of ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable. For Condition B are met. Condition B applies where supplementary reinforcement is not supplied.

5.Where no value is reported for pullout strength, this resistance does not need to be considered.

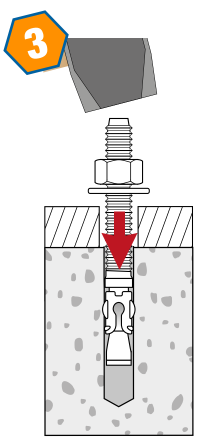
INSTALLATION GUIDE



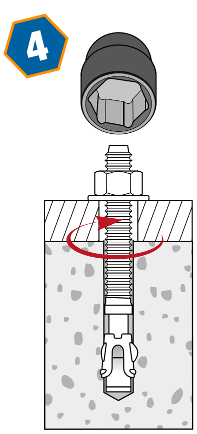
1. Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



2. Remove dust and debris from hole using a hand pump, compressed air or a vacuum to remove loose particles left from drilling



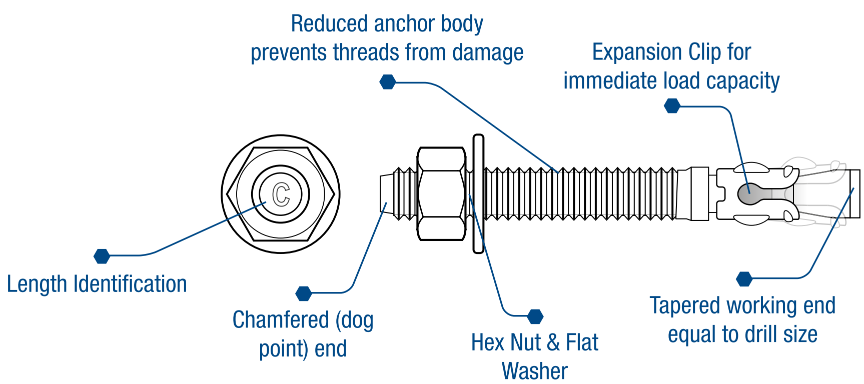
3. Remove dust and debris from hole using a hand pump, compressed air or a vacuum to remove loose particles left from drilling.



4. Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}

Note: the threaded stud will draw up during tightening of the nut; the expansion wedge (clip) remains in original position.

MATERIAL SPECIFICATIONS



COMPONENTS	HOT DIPPED GALVANIZED
Body	C1010 Carbon Steel
Expanding Clip	Type 304 Stainless
Hex Nut	ASTM A563 Grade A Carbon Steel
Flat Washer	Carbon Steel
Plating/Finish	Hot Dipped Galvanized

Description	A four piece assembly consisting of (1) anchor bolt threaded at one end with a unified pitch, a shoulder at the opposite end which retains a free-spinning clip, (2) a clip with three lateral slits and projections designed to exert greater holding power the greater the load that is applied, (3) a hex nut, and (4) a flat washer.	
Applications/Advantages	These are heavy-duty, non-bottom bearing anchors of greater shear strength than other light and medium-duty expansion anchors. The design of the expansion clip assures full contact with the masonry. Wedge anchors withstand temperature fluctuations well. For best performance, minimum anchor spacing should be 10 hole diameters and minimum edge distance be 5 hole diameters.	
Material	**CARBON STEEL**	
	ANCHOR BODY	AISI 1018 - 12L14 or equivalent free-machining carbon steel
	EXPANSION WEDGE	AISI C1008 - 1010 or equivalent carbon steel
	NUT	ASTM A-563 Grade A Carbon Steel
	WASHER	Carbon Steel
Ultimate Shear Strength	See average test values as listed in the tables on pages 8-9. **IMPORTANT:** The maximum working loads should not exceed 1/4 of the average ultimate values for a specific size.	
Plating	Steel wedge anchors are typically zinc or mechanically galvanized plated.	

MATERIAL SPECIFICATIONS (CONTINUED)

Table 4: EXAMPLE ALLOWABLE STRESS DESIGN VALUES FOR ILLUSTRATIVE PURPOSES [1,2,3,4,5,6,7,8,9,10]

Nominal Anchor Diameter: d_o (inch)	Effective Embedment Depth: h_{ef} (inch)	$T_{allowable,ASD}$ (lb)
3/8	2	1,460
1/2	2	1,491
1/2	3-1/4	2,513
5/8	2-3/4	2,403
5/8	4	4,216
3/4	3-1/4	3,474
3/4	4-3/4	5,456

1. Single anchor
2. Static tension loading only
3. Concrete determined to remain uncracked for the life of the anchorage
4. Load combinations taken from ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable with no seismic loading.
5. 30% Dead Load (D) and 70% Live Load (L), controlling load combination 1.2D + 1.6L.
6. Calculation of the weighted average for $\alpha = 1.2 \times 0.3 + 1.6 \times 0.7 =$ **1.48**
7. Normal weight concrete, $f'_c = 2{,}500$psi.
8. $c_{a1} = c_{a2} \geq c_{ac}$
9. Concrete thickness $h \geq h_{min}$
10. Values are for Condition B (supplementary reinforcement in accordance with ACI 318-14 7.3.3 or ACI 318-11 D.4.3 is not provided).

Table 5: ILLUSTRATIVE PROCEDURE:

1/2" diameter ETB anchor with effective embedment depth, h_{ef}=3-1/4"		
Step 1	Calculate steel strength in tension according to ACI 318-14 17.4.1 or ACI 318-11 D.5.1, as applicable.	$\varnothing_{sa} N_{sa} = 0.75 \times 10{,}600 = 7{,}950$lb
Step 2	Calculate concrete breakout strength in tension according to ACI 318-14 17.4.1.1 or ACI 318-11 D.5.2, as applicable.	$\varnothing_{cb} N_{cb} = 0.65 \times 7{,}031 = 4{,}570$lb
Step 3	Calculate pullout strength in tension according to ACI 318-14 17.4.1.1 or ACI 318-11 D.5.3, as applicable.	$\varnothing_p N_{p,uncr} = 0.65 \times 5{,}723 = 3{,}719$lb
Step 4	Controlling value from steps 1, 2 and 3 above:	$\varnothing N_n = 3{,}719$lb
Step 5	Divide the controlling value by the conversion factor, α, as determined in design assumption 5 and in accordance with Section 4.2.1 of this report.	$T_{allowable,ASD} = 3{,}719/1.48 = 2{,}513$lb

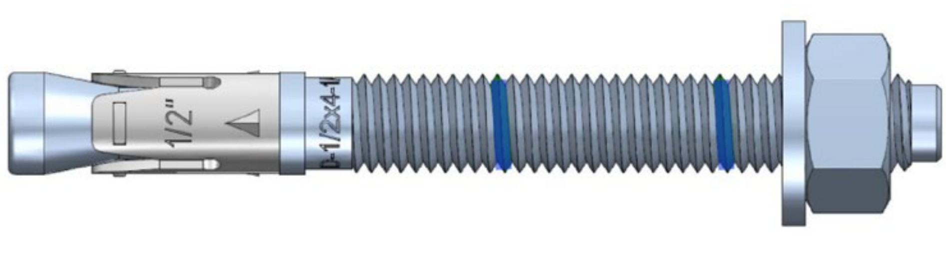


FIGURE 3—ETB WEDGE ANCHOR

LOS ANGELES BUILDING CODE

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:

ALLFASTENERS USA LLC

EVALUATION SUBJECT:

ETB WEDGE ANCHOR FOR CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the ETB Wedge Anchor for cracked and uncracked concrete, described in ICC-ES master evaluation report ESR-4346, has also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2017 *City of Los Angeles Building Code* (LABC)
- 2017 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The ETB Wedge Anchor for cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the master evaluation report ESR-4346, complies with LABC Chapter 19, and the LARC, and is subjected to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The ETB Wedge Anchor for cracked and uncracked concrete described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the master evaluation report ESR-4346.
- The design, installation, conditions of use and identification of the anchors are in accordance with the 2015 *International Building Code*® (2015 IBC) provisions noted in the master evaluation report ESR-4346.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable strength and design strength values listed in the master evaluation report and tables are for the connection of the anchors to the concrete. The connection between the anchors and the connected members shall be checked for capacity (which may govern).

This supplement expires concurrently with the master report, issued February 2019 and revised April 2019.

CALIFORNIA BUILDING CODE

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:

ALLFASTENERS USA LLC

EVALUATION SUBJECT:

ETB WEDGE ANCHOR FOR CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the ETB Wedge Anchor for cracked and uncracked concrete, recognized in ICC-ES master evaluation report ESR-4346, has also been evaluated for compliance with the codes noted below.

Applicable code editions:

- *2016 California Building Code* (CBC)
- *2016 California Residential Code* (CRC)

2.0 CONCLUSIONS

2.1 CBC:

The ETB Wedge Anchor for cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the master evaluation report ESR-4346, complies with CBC Chapters 19 and 19A, provided the design and installation are in accordance with the 2015 *International Building Code*® (IBC) provisions noted in the master report and the additional requirements of CBC Chapters 16, 16A, 17, 17A, 19 and 19A, as applicable.

2.2 CRC:

The ETB Wedge Anchor for cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the master evaluation report ESR-4346, complies with the CRC, provided the design and installation are in accordance with the 2015 *International Building Code*® (IBC) provisions noted in the master report, and the additional requirements of CBC Chapters 16, 17 and 19, as applicable.

This supplement expires concurrently with the master report, issued February 2019 and revised April 2019.

FLORIDA BUILDING CODE

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:

ALLFASTENERS USA LLC

EVALUATION SUBJECT:

ETB WEDGE ANCHOR FOR CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the ETB Wedge Anchor for cracked and uncracked concrete, recognized in ICC-ES master evaluation report ESR-4346, has also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2017 *Florida Building Code—Building*
- 2017 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The ETB Wedge Anchor for cracked and uncracked concrete, described in master evaluation report ESR-4346, complies with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, when designed and installed in accordance with the 2015 *International Building Code*® provisions noted in the master report.

Use of ETB Wedge Anchor for cracked and uncracked concrete for compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and *Florida Building Code—Residential* has not been evaluated, and is outside the scope of this supplemental report.

This supplement expires concurrently with the master report, issued February 2019 and revised April 2019.

WEDGE ANCHORS - ICC APPROVED

ZINC

ORDERING INFORMATION

Part No.	Approval	Size	Drill Size	Max. Fixture Thickness		
1ETB14134	-	1/4 x 1-3/4	1/4	3/8	100	1000
1ETB14214	-	1/4 x 2-1/4	1/4	7/8	100	800
1ETB14314	-	1/4 x 3-1/4	1/4	1-7/8	100	500
1ETB38214	-	3/8 x 2-1/4	3/8	3/8	50	400
1ETB38234	-	3/8 x 2-3/4	3/8	7/8	50	250
1ETB28300	ICC ESR-4346	3/8 x 3	3/8	1-1/8	50	250
1ETB38312	ICC ESR-4346	3/8 x 3-1/2	3/8	1-5/8	50	250
1ETB38334	ICC ESR-4346	3/8 x 3-3/4	3/8	1-7/8	50	250
1ETB38500	ICC ESR-4346	3/8 x 5	3/8	3-1/8	50	250
1ETB12234	ICC ESR-4346	1/2 x 2-3/4	1/2	3/8	50	200
1ETB12334	-	1/2 x 3-3/4	1/2	1-1/8	25	125
1ETB12414	ICC ESR-4346	1/2 x 4-1/4	1/2	1-1/4	25	125
1ETB12412	ICC ESR-4346	1/2 x 4-1/2	1/2	1-1/2	20	100
1ETB12512	ICC ESR-4346	1/2 x 5-1/2	1/2	2-3/4	20	100
1ETB12700	ICC ESR-4346	1/2 x 7	1/2	4-1/4	20	80
1ETB58312	-	5/8 x 3-1/2	5/8	3/8	25	100
1ETB58412	ICC ESR-4346	5/8 x 4-1/2	5/8	1-1/8	25	100
1ETB58500	ICC ESR-4346	5/8 x 5	5/8	1-5/8	25	100
1ETB58600	ICC ESR-4346	5/8 x 6	5/8	2-5/8	10	50
1ETB58700	ICC ESR-4346	5/8 x 7	5/8	3-5/8	10	40
1ETB58812	ICC ESR-4346	5/8 x 8-1/2	5/8	5-1/8	10	40
1ETB34414	-	3/4 x 4-1/4	3/4	5/8	10	50
1ETB34434	-	3/4 x 4-3/4	3/4	1-1/8	10	50
1ETB34512	ICC ESR-4346	3/4 x 5-1/2	3/4	1-3/4	10	40
1ETB34614	ICC ESR-4346	3/4 x 6-1/4	3/4	2-1/4	10	40
1ETB34700	ICC ESR-4346	3/4 x 7	3/4	3	10	40
1ETB812	ICC ESR-4346	3/4 x 8-1/2	3/4	4-1/2	10	40

DISCLAIMER

IMPORTANT: Information, specifications, procedures and recommendations provided ("information") are based on our experience and we believe this to be accurate. No representation, guarantee or warranty is made as to the accuracy or completeness of the information or that use of the product will avoid losses or damages or give desired results. It is purchaser's sole responsibility to test and determine the suitability of any product for the intended use. Tests should be repeated if materials or conditions change in any way. No employee, distributor or agent has any right to change these facts and offer a guarantee of performance.

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