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Pure110+® Epoxy Adhesive Anchoring System and Installations with Core Drilled Holes into Concrete

DEWALT has conducted supplemental testing on the Pure110+ for use with threaded rods and rebars into diamond core drilled holes. Up until now, the Pure110+ has had published performance data in holes drilled with a hammer-drill into concrete (i.e. rotary impact drills or rock drills with a carbide drill bit). This information is provided in our published information and included in ICC-ES ESR-3298.

DEWALT has performed additional testing with Pure110+ in holes drilled into concrete with a diamond core bit to also offer bond strength performance data for this drilling method. The information presented below is based on test results and assessment of data in accordance with ICC-ES AC308 and ACI 355.4. The tabulated information is provided with the intention it will be considered for use to determine adhesive anchor design strengths in concrete in accordance with ACI 318 Chapter 17 and CSA A23.3 Annex D.

See the Pure110+ technical pages and ESR-3298 at www.DEWALT.com for additional design information, including steel strength and concrete breakout strength design information which may be needed to complete a full anchor design.

BOND STRENGTH DESIGN INFORMATION FOR COMMON FRACTIONAL THREADED RODS AND REINFORCING BARS IN HOLES DRILLED WITH A CORE DRILL AND DIAMOND CORE BIT¹

DESIGN INFORMATION		SYMBOL	UNITS	NOMINAL ROD DIAMETER (inch)							
				3/8	1/2	5/8	3/4	7/8	1	1 1/4	
Minimum embedment		$h_{ef,min}$	inch (mm)	2 3/8 (60)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 1/2 (89)	4 (102)	5 (127)	
Maximum embedment		$h_{ef,max}$	inch (mm)	7 1/2 (191)	10 (254)	12 1/2 (318)	15 (381)	17 1/2 (445)	20 (508)	25 (635)	
110°F (43°C) Maximum long-term service temperature; 140°F (60°C) maximum short-term service temperature^{3,4}	Characteristic bond strength in cracked concrete ^{5,8}	$\tau_{k,cr}$	psi (N/mm ²)	Not Applicable	491 (3.4)	488 (3.4)	460 (3.3)	443 (3.1)	443 (3.1)	443 (3.1)	
	Characteristic bond strength in uncracked concrete ^{5,7}	$\tau_{k,uncr}$	psi (N/mm ²)	1,141 (7.9)	973 (6.7)	805 (5.6)	805 (5.6)	805 (5.6)	805 (5.6)	805 (5.6)	
DESIGN INFORMATION		SYMBOL	UNITS	NOMINAL REINFORCING BAR SIZE							
				#3	#4	#5	#6	#7	#8	#9	#10
Minimum embedment		$h_{ef,min}$	inch (mm)	2 3/8 (60)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 1/2 (89)	4 (102)	4 1/2 (114)	5 (127)
Maximum embedment		$h_{ef,max}$	inch (mm)	7 1/2 (191)	10 (254)	12 1/2 (318)	15 (381)	17 1/2 (445)	20 (508)	22 1/2 (572)	25 (635)
110°F (43°C) Maximum long-term service temperature; 140°F (60°C) maximum short-term service temperature^{3,4}	Characteristic bond strength in cracked concrete ^{5,8}	$\tau_{k,cr}$	psi (N/mm ²)	Not Applicable	491 (3.4)	488 (3.4)	460 (3.3)	443 (3.1)	443 (3.1)	443 (3.1)	443 (3.1)
	Characteristic bond strength in uncracked concrete ^{5,7}	$\tau_{k,uncr}$	psi (N/mm ²)	1,141 (7.9)	973 (6.7)	805 (5.6)	805 (5.6)	805 (5.6)	805 (5.6)	805 (5.6)	805 (5.6)
Permissible installation conditions ⁶	Dry concrete	Anchor Category		1							
		ϕ_a		0.65							
	Water-saturated concrete	Anchor Category		2							
		ϕ_{ws}		0.55							
Reduction factor for seismic tension		$\alpha_{N,seis}$		1.0							

For SI: 1 inch = 25.4 mm, 1 psi = 0.006894 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

¹Bond strength values correspond to a normal-weight concrete compressive strength $f_c = 2,500$ psi (17.2 MPa). For concrete compressive strength, f_c between 2,500 psi and 8,000 psi (17.2 MPa and 55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f_c / 2,500)^{0.10}$ [For SI: $(f_c / 17.2)^{0.10}$].

²The modification factor for bond strength of adhesive anchors in lightweight concrete shall be taken as given in ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable, where applicable.

³The maximum short-term service temperature may be increased to 162°F (72°C) provided characteristic bond strengths are reduced by 3 percent. Long-term and short-term temperatures meet the requirements of Section 8.5 of ACI 355.4 and Table 8.1, Temperature Category B.

⁴Short-term base material service temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling. Long-term base material service temperatures are roughly constant over significant periods of time.

⁵Characteristic bond strengths are for sustained loads including dead and live loads. Characteristic bond strengths are also applicable for short-term loading.

⁶Permissible installation conditions include dry concrete and water-saturated concrete.

⁷Bond strength values for uncracked concrete are applicable for structures assigned to Seismic Design Categories A and B only.

⁸For structures assigned to Seismic Design Categories C, D, E or F, the tabulated bond strength values for cracked concrete do not require an additional reduction factor applied for seismic tension ($\alpha_{N,seis} = 1.0$), where seismic design is applicable.

INSTALLATION SPECIFICATIONS FOR PURE110+ ADHESIVE ANCHORS IN CORE DRILLED HOLES

The diamond core drill bit nominal size is the same as the existing carbide drill bit nominal size for each respective threaded rod and reinforcing bar diameter. See the Pure110+ technical pages at www.DEWALT.com for any additional installation information.

PARAMETER	SYMBOL	UNITS	FRACTIONAL NOMINAL ROD DIAMETER (inch) / REINFORCING BAR SIZE									
			3/8 or #3	1/2 #4	5/8 or #5	3/4 or #6	7/8 or #7	1 or #8	#9	1 1/4	#10	
Threaded rod outside diameter	d	inch (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	-	1.250 (31.8)	-	
Rebar nominal outside diameter	d	inch (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.7)	-	1.250 (31.8)	
Drill bit nominal size ³	$d_{bit} (d_o)$	inch	7/16	9/16 5/8	1 1/16 or 3/4	7/8	1	1 1/8	1 3/8	1 3/8	1 1/2	
Minimum embedment	$h_{ef,min}$	inch (mm)	2 3/8 (60)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 1/2 (89)	4 (102)	4 1/2 (114)	5 (127)	5 (127)	
Maximum embedment	$h_{ef,max}$	inch (mm)	7 1/2 (191)	10 (254)	12 1/2 (318)	15 (381)	17 1/2 (445)	20 (508)	22 1/2 (572)	25 (635)	25 (635)	
Minimum member thickness	h_{min}	inch (mm)	$h_{ef} + 1 1/4 (h_{ef} + 30)$			$h_{ef} + 2d_o$						
Minimum anchor spacing	s_{min}	inch (mm)	1 7/8 (48)	2 1/2 (64)	3 1/8 (79)	3 3/4 (95)	4 3/8 (111)	5 (127)	5 5/8 (143)	6 1/4 (159)	6 1/4 (159)	
Minimum edge distance	c_{min}	inch (mm)	1 7/8 (48)	2 1/2 (64)	3 1/8 (79)	3 3/4 (95)	4 3/8 (111)	5 (127)	5 5/8 (143)	6 1/4 (159)	6 1/4 (159)	
Max. torque ¹	T_{max}	ft-lbs	11 [7] ²	20	40	60	90	115	-	195	-	
Minimum edge distance, reduced ⁴	$c_{min,red}$	inch (mm)	1 3/4 (45)	1 3/4 (45)	1 3/4 (45)	1 3/4 (45)	1 3/4 (45)	1 3/4 (45)	2 3/4 (70)	2 3/4 (70)	2 3/4 (70)	
Max. torque, reduced ¹	$T_{max,red}$	ft-lbs	7	14	27	47	56	74	-	126	-	

For **pound-inch** units: 1 mm = 0.03937 inch, 1 N-m = 0.7375 ft-lbf. For **SI**: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

¹Torque may not be applied to the anchors until the full cure time of the adhesive has been achieved.

²These torque values apply to ASTM A36 / F1554 Grade 36 carbon steel threaded rods and ASTM A193 Grade B8/B8M (Class 1) stainless steel threaded rods.

³For any case, it must be possible for the steel anchor element to be inserted into the cleaned drill hole without resistance.

⁴For installations below the minimum edge distance, c_{min} , down to the reduced minimum edge distance, $c_{min,red}$, the reduced maximum torque is $T_{max,red}$.

SUPPLEMENTAL INSTALLATION INSTRUCTIONS FOR PURE110+ ADHESIVE ANCHORS IN CORE DRILLED HOLES

The following supplements the existing published installation instructions to provide directions for installations into core drilled holes. Steps 1 and 2 are replaced with the information shown and illustrated below. An instruction card is provided with each unit cartridge.

CORE DRILLING		<p>1. Drill a hole into the base material with core drill to the size and embedment required by the selected steel hardware element.</p> <p>Precaution: Wear suitable eye and skin protection. Avoid inhalation of dusts during drilling and/or removal.</p>
HOLE CLEANING CORE DRILLED HOLES	Rinse	<p>2a. Starting from the bottom or back of the drilled hole, rinse/flush the hole clean with air/water (air/water line pressure) until clear water comes out.</p>
	Brush 2x	<p>2b. Determine wire brush diameter (see Table VII) for the drilled hole and attach the brush with adaptor to a rotary drill tool. Brush the hole with the selected wire brush a minimum of two times (2x).</p> <p>A brush extension (supplied by DEWALT) must be used for holes drilled deeper than the listed brush length. The wire brush diameter must be checked periodically during use; The brush should resist insertion into the drilled hole, if not the brush is too small and must be replaced with the proper brush diameter (i.e. new wire brush).</p>
	Repeat Rinsing	<p>2c. Repeat Step 2a again by rinse/flushing the hole clean with air/water.</p>
	Blow 2x	<p>2d. Starting from the bottom or back of the drilled hole, blow the hole clean a minimum of two times (2x). Use a compressed air nozzle (min. 90 psi) for all sizes of reinforcing bar (rebar). When finished the hole should be clean and free of water, debris, oil or other foreign material.</p>
	Repeat Brushing 2x	<p>2e. Repeat Step 2b again by brushing the hole with a wire brush a minimum of two times (2x).</p>
	Repeat Blowing 2x	<p>2f. Repeat Step 2d again by blowing the hole clean a minimum of two times (2x). When finished the hole should be clean and free of dust, debris, oil or other foreign material.</p> <p>→ Next go to Step 3.</p>

For the more information about the Pure110+ Epoxy Adhesive Anchoring System including cartridges, mixing nozzles, dispensing tools, and other installation accessories, see the published technical pages for the product at anchors.DEWALT.com.