ULTRABOND 1

High-Strength Anchoring Epoxy

STATE DOT LISTED

LEED CERTIFIED

Product Description

ULTRABOND® 1 is a two-component, 1:1 mix ratio by weight and by volume, structural anchoring epoxy system offering exceptional strength in anchoring and doweling applications. It may be used in temperatures between 40 °F and 110 °F (4 °C and 43 °C).

General Uses & Applications

- Anchoring threaded rods, bolts and rebar dowels into uncracked concrete
- Short term tensile and shear loading in accordance with allowable stress design (ASD)
- Grouting dowel bars and tie bars for full depth concrete pavement repairs
- Bonding agent for fresh to hardened concrete, and hardened to hardened concrete

Advantages & Features

- ULTRABOND 1 contributes toward satisfying credits for Indoor Environmental Quality for Low-Emitting Materials under LEED®
- Available in numerous cartridge sizes and in bulk
- Moisture insensitive allowing installation and curing in damp environments
- Little or no odor
- High modulus

Availability: Adhesives Technology Corp. (ATC) products are available online and through select distributors serving all your construction needs. Please contact ATC for a distributor near you or visit www.atcepoxy.com for online purchasing options or to search for a distributor by zip code.

STANDARDS & APPROVALS

ASTM C881-20 / AASHTO M235
Type I, II, IV & V Grade 3 Class A, B & C

(See ATC website for Department of Transportation approvals throughout the United States)

Color & Ratio: Part A (Resin) White: Part B (Hardener) Gray, Mixed Ratio: 1:1 by volume, Mixed Color - Gray

Storage & Shelf Life: 28 months when stored in unopened containers in dry conditions. Store between 40 °F (4 °C) and 95 °F (35 °C).

Installation & Estimation: Manufacturer's Printed Installation Instructions (MPII) are available within this Technical Data Sheet (TDS). Due to occasional updates and revisions, always verify the most current MPII usage. In order to achieve maximum results, proper installation is imperative. An estimating guide for product usage may be found on the product's estimation guide.

Clean-Up: Always wear appropriate personal protective equipment such as safety glasses and gloves. Clean uncured materials from tools and equipment using a mild solvent, such as INDUSTRIAL CITRUS CLEANER from Adhesives Technology Corp. Cured material may only be removed mechanically using a sander or grinder. Collect with absorbent material. Flush area with water. Dispose of in accordance with local, state and federal disposal regulations.

Limitations & Warnings:

- Do not thin with solvents, as this will prevent cure
- Not recommended for any overhead application where there may be a sustained tensile load
- For anchoring applications, concrete must be a minimum of 21 days old prior to anchor installation
- Always consult with the Engineer of Record, or a design professional, prior to use to ensure product applicability

Safety: Please refer to the Safety Data Sheet (SDS) for ULTRABOND 1. Call ATC for more information at 1 -800-892-1880.

Specification: Anchoring adhesive shall be a two-component, 1:1 ratio, solvent free epoxy system supplied in pre-measured containers. After a 7 day cure and at a temperature of 75 °F (24 °C), the anchoring adhesive shall have a compressive yield strength of 12,850 psi (88.6 MPa) per ASTM D695. The anchoring adhesive shall be ULTRABOND 1 from Adhesives Technology Corp., Pompano Beach, Florida. Anchors shall be installed per the Manufacturer's Printed Installation Instructions (MPII) for ULTRABOND 1 anchoring system.

Ordering Information

TABLE 1: ULTRABOND 1 Adhesive Packaging, Dispensing Tools and Mixing Nozzles[1,2]

Package Size	8.6 fl. oz. (254 ml) Cartridge	21.2 fl. oz. (627 ml) Cartridge	53 fl. oz. (1.6 L) Cartridge	10 Gallon (38 L) Kit	100 Gallon (379 L) Kit
Part #	A9-112PK	A22-1N	A53-1N	B5G-1S-A B5G-1S-B	B50G-1S-A B50G-1S-B
Recommended Mixing Nozzle	T12			T34HF[3]	
Manual Dispensing Tool	TM9HD	TM22HD	N/A		
Pneumatic Dispensing Tool	N/A	TA22HD-N	TA53HD-A	Pump[4]	
Case Qty.	12		6	1	
Pallet Qty.	1,116	432	252	12 kits	2 kits
Pallet Weight (lb.)	1,167	1,036	1,378	1,724	2,886
SDS Brush Adaptor	BR-SDS				
Brush Extension	BR-EXT				
Nozzle Extension Tubing	TUBE916-EXT				
Retention Wedge	WEDGE				

1. Each cartridge is packaged with one mixing nozzle.
2. Call for bulk packaging availability and lead times.
3. T34HF mixing nozzle may be used as an alternate nozzle, but may result in reduced property results.
4. For bulk dispensing pumps, contact ATC for recommended manufacturers.


A9-112PK


A22-1N


A53-1N


B5G-1S-A B5G-1S-B


T12

T34HF


Small Wire Brush


Large Wire Brush


Manual Brush Handle


BR-SDS


Retention Wedge
WEDGE


Brush Extension
BR-EXT


TM9HD


TM22HD


TA22HD-A


TA53HD-A


Nozzle Extension Tubing
TUBE916-EXT

Ordering Information

In order to reduce the risks to respirable crystalline silica, ULTRABOND 1 has been tested and approved for use in conjunction with Milwaukee Tool's OSHA compliant, commercially available dust extraction products in dry condition installations (see Table 2 for details). When used in accordance with the manufacturer's instructions, and in conjunction with ULTRABOND 1, these Vacuum Drill Bits along with the Dust Extractor with HEPA filter as specified by Milwaukee Tool, can completely replace the traditional blow-brush-blow cleaning method used to install threaded rod (see Installation Instructions (MPII) for more detail). **Important:** Prior to injecting the adhesive, the hole must always be clean, either by using self-cleaning vacuum bits or by using the blow-brush-blow cleaning method with a traditional hammer drill bit and dust shroud. Only vacuuming out a hole drilled with a standard masonry bit is NOT acceptable and will yield lower performance than published for the anchoring/doweling adhesive. For more information, see Respirable Crystalline Silica White Paper at www.atcepoxy.com/resources.

Milwaukee Tool Dust Extraction System

TABLE 2: Milwaukee Vacuum Drill Components[1]

Part #	Drill Type	Drill Bit Size in.	Overall Length in.	Useable Length in.
48-20-2102	SDS+	7/16	13	7-7/8
48-20-2106		1/2		
48-20-2110		9/16	14	9-1/2
48-20-2114		5/8		
48-20-2118		3/4		
48-20-2152	SDS-Max	5/8	23	15-3/4
48-20-2156		3/4		
48-20-2160		7/8		
48-20-2164		1	25	17-1/2
48-20-2168		1-1/8	35	27
48-20-2172		1-3/8		
8960-20	8 Gallon Dust Extractor Vacuum			

1. Vacuum drill accessories available from Milwaukee distributors nationwide.

TABLE 3: ULTRABOND 1 Installation Parameters and Brushes

Threaded Rod in.	Rebar	Drill Bit Diameter in.	Maximum Installation Torque ft-lbs. (N-m)	Brush Part #	Brush Length in.
3/8	----	7/16	15 (20)	B716	6
1/2	----	9/16	30 (41)	B916	
----	#4	5/8	----	B58	
5/8	#5	3/4	60 (82)	B34	
3/4	#6	7/8	105 (142)	B78	
7/8	#7	1	125 (170)	B100	9
1	#8	1 1/8	165 (224)	B118	
1 1/4	----	1 3/8	280 (381)	B112	

Material Specifications

TABLE 4: ULTRABOND 1 performance to **ASTM C881-20**[1,2,3]

Property	Cure Time	ASTM Standard	Units	Sample Conditioning Temperature		
				Class A	Class B	Class C
				38 °F (3) °C	50 °F (10) °C	75 °F (24) °C
Gel Time 60 Gram Mass[4]	----	C881	min	31	28	22
Pot Life[5,6]				13		
Consistency or Viscosity			----	Non-sag		
Compressive Yield Strength	7 day	D695	psi (MPa)	12,180 (84.0)	12,900 (88.9)	12,850 (88.6)
Compressive Modulus			psi (MPa)	246,500 (1,700)	276,900 (1,909)	506,300 (3,491)
Bond Strength Hardened to Hardened	2 day	C882	psi (MPa)	3,720 (25.6)	3,550 (24.5)	3,470 (23.9)
	14 day		psi (MPa)	3,170 (21.9)	3,750 (25.9)	3,670 (25.3)
Bond Strength Fresh to Hardened			psi (MPa)	2,000 (13.8)		
Tensile Strength	7 day	D638	psi (MPa)	4,590 (31.6)		
Elongation			%	0.9		
Heat Deflection Temperature		D648	°F (°C)	132 (55.6)		
Water Absorption	14 day	D570	%	0.20		
Linear Coefficient of Shrinkage	----	D2566		0.0001		

1. Results based on testing conducted on a representative lot(s) of product. Average results will vary according to the tolerances of the given property.
2. Full cure is listed above to obtain the given properties for each product characteristic.
3. Results may vary due to environmental factors such as temperature, moisture and type of substrate.
4. Gel time may be lower than the minimum required for ASTM C881.
5. Property not referenced in ASTM C881.
6. Pot life is measured as the workable and applicable time of 1.0 gallon (3.8 L) when mixed at 75 °F (24 °C).

TABLE 5: ULTRABOND 1 **CURE SCHEDULE**[1,2,3]

Base Material Temperature °F (°C)	Working Time	Full Cure Time
40 (4)	36 min	72 hr
75 (24)	20 min	24 hr
110 (43)	12 min	18 hr

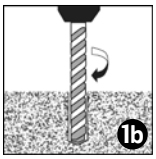
1. Working and full cure times are approximate, may be linearly interpolated between listed temperatures and are based on cartridge/nozzle system performance.
2. Application Temperature: Substrate and ambient air temperature should be from 40 - 110 °F (4 - 43 °C).
3. When ambient or base material temperature falls below 70 °F (21 °C), condition the adhesive to 70 - 75 °F (21 - 24 °C) prior to use.

High-Strength Anchoring Epoxy

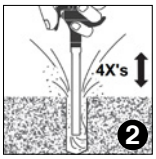
Installation Instructions

Drilling and Cleaning

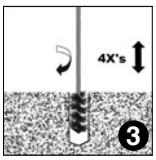
Recommended Dust Extractor System for drilling into dry concrete - Attach appropriate size drill bit to the Dust Extractor Vacuum System - see Table 2. The drill bit should conform to ANSI B212.15 and be the appropriate size for the anchor diameter to be installed. Drill the hole to the specified embedment depth. Skip to Step 5 if using Dust Extractor System.



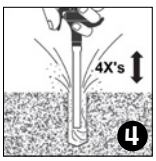
Traditional Drilling Method for dry and damp concrete - Using a rotary hammer drill, and a bit which conforms to ANSI B212.15 and is the appropriate size for the anchor diameter to be installed, drill the hole to the specified embedment depth. **CAUTION**: Always wear appropriate personal protection equipment (PPE) for eyes, ears and skin and avoid inhalation of dust during the drilling and cleaning process.



NOTE: Remove any standing water from hole prior to beginning the cleaning process. If removal of standing water is not possible, please contact ATC for application specific installation instructions. Using oil free compressed air with a minimum pressure of 80 psi (5.5 bar), insert the air wand to the bottom of the drilled hole and blow out the debris with an up/down motion for a minimum of 4 seconds each cycle (4X).



Select the correct wire brush size for the drilled hole diameter (see Table 3), making sure that the brush is long enough to reach the bottom of the drilled hole. Reaching the bottom of the hole, brush in an up/down and twisting motion for 4 cycles (4X). **CAUTION**: The brush should contact the walls of the hole. If it does not, the brush is either too worn or small and should be replaced with a new brush of the correct diameter.

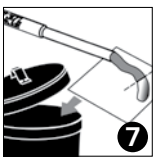


Blow the hole out once more to remove brush debris using oil free compressed air with a minimum pressure of 80 psi (5.5 bar). Insert the air wand to the bottom of the drilled hole and blow out the debris with an up/down motion for a minimum of 4 seconds/cycles (4X). Visually inspect the hole to confirm it is clean. **NOTE**: If installation will be delayed for any reason, cover cleaned holes to prevent contamination.

Cartridge Preparation

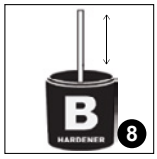
CAUTION: Check the expiration date on the cartridge to ensure it is not expired. **Do not use expired product!** Remove the protective cap from the adhesive cartridge and insert the cartridge into the recommended dispensing tool. Before attaching mixing nozzle to the cartridge, it is necessary to balance the cartridge by dispensing a small amount of material until both components are flowing evenly. For a cleaner environment, hand mix the two waste components and let cure prior to disposal in accordance with local regulations.

After the cartridge has been prepared, screw on the proper ATC mixing nozzle to the cartridge (see Table 1). Do not modify mixing nozzle. Confirm that internal mixing element is in place prior to dispensing the adhesive. Take note of the air and base material temperatures and review the working/full cure time chart prior to starting the injection process (see Table 5).



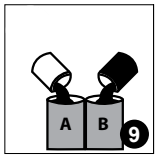
Dispense the initial amount of material from the mixing nozzle onto a disposable surface until the product is a uniform gray color with no streaks, as adhesive must be properly mixed in order to perform as published. Dispose of the initial amount of adhesive according to local regulations prior to injection into the drill hole. **CAUTION:** When changing cartridges, never re-use nozzles. A new nozzle should be used with each new cartridge and steps 5-7 should be repeated accordingly.

Installation Instructions

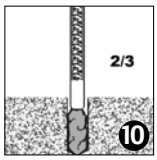


Bulk Preparation

Due to the high viscosity/non-sag consistency of this product, a bulk dispensing pump should be used to ensure mixed epoxy is placed to the deepest end of anchor hole and that threaded rod/rebar is fully encapsulated. **CAUTION:** Check the expiration dates on the bulk containers to ensure they are not expired. Do not use expired product! Epoxy materials may separate, this is normal and may be expected when stored over a period of time. **IMPORTANT!** It is common for components of Part B to separate in transit and it is important that Part B of all bulk containers be thoroughly mixed prior to pumping/dispensing the product. **NOTE:** Review Bulk Pump Operations Manual thoroughly before proceeding and follow all steps necessary for set-up and operation of the pump. Fill each reservoir (hopper) to at least one-half full. Incoming air supply pressure should be maintained at approximately 100 psi (6.9 bar).

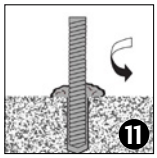


Ten Gallon Kit: Pour Part A and Part B into the appropriate tank attached to a bulk dispensing system and dispense through the hose's nozzle/static mixer connection. **One Hundred Gallon Kit:** Attach separate pump hoses through Part A and Part B drum lid opening and dispense through the pump system. Contact ATC for pump system recommendations.



Installation and Curing (Vertical Down and Horizontal)

NOTE: **The engineering drawings must be followed. For any applications not covered by this document, or if there are any installation questions, please contact Adhesives Technology Corp.** Insert the mixing nozzle to the bottom of the hole and fill from the bottom to the top approximately two-thirds full, being careful not to withdraw the nozzle too quickly as this may trap air in the adhesive. Use extension tubing - see Table 1, as necessary to ensure that adhesive is injected at the bottom of the hole first. **NOTE**: When using a pneumatic dispensing tool, ensure that pressure is set at 90 psi (6.2 bar) maximum.



Do not disturb, torque or apply any load to the installed anchor until the specified full cure time has passed. The amount of time needed to reach full cure is base material temperature and moisture dependent - refer to Table 5 for appropriate full cure time.

Prior to inserting the threaded rod or rebar into the hole, make sure it is clean and free of oil and dirt and that the necessary embedment depth is marked on the anchor element. Insert the anchor element into the hole while turning 1 - 2 rotations prior to the anchor reaching the bottom of the hole. Excess adhesive should be visible on all sides of the fully installed anchor. For horizontal installations, wedges should be used to center and support the anchor while the adhesive is curing. **CAUTION**: Use extra care with deep embedment or high temperature installations to ensure that the working time has not elapsed prior to the anchor being fully installed.

Technical Data

ASD Allowable Stress Design

TABLE 6: ULTRABOND 1 ultimate and allowable **TENSION** loads for **THREADED ROD** in normal-weight concrete[1,2,3]

Threaded Rod Diameter in.	Nominal Drill Bit Diameter in.	Embedment Depth in. (mm)	Tension Load Based on Bond Strength/Concrete Capacity				Allowable Tension Load Based on Steel Strength[4]		
			$f'_c \geq 2{,}000$ psi (13.8 MPa)[5]		$f'_c \geq 4{,}000$ psi (27.6 MPa)[5]		ASTM F1554 Grade 36 lbs. (kN)	ASTM A193 Grade B7 lbs. (kN)	ASTM F593 304/316 SS lbs. (kN)
			Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)			
3/8	7/16	3 3/8 (86)	9,248 (41.1)	2,312 (10.3)	9,248 (41.1)	2,312 (10.3)	2,114 (9.4)	4,556 (20.3)	3,645 (16.2)
1/2	9/16	4 1/2 (114)	17,076 (76.0)	4,269 (19.0)	22,328 (99.3)	5,582 (24.8)	3,758 (16.7)	8,099 (36.0)	6,480 (28.8)
5/8	3/4	5 5/8 (143)	23,865 (106.2)	5,966 (26.5)	29,950 (133.2)	7,488 (33.3)	5,872 (26.1)	12,655 (56.3)	10,124 (45.0)
3/4	7/8	6 3/4 (171)	31,371 (139.5)	7,843 (34.9)	39,278 (174.7)	9,820 (43.7)	8,456 (37.6)	18,224 (81.1)	12,392 (55.1)
7/8	1	7 7/8 (200)	39,532 (175.8)	9,883 (44.0)	53,862 (239.6)	13,466 (59.9)	11,509 (51.2)	24,804 (110.3)	16,867 (75.0)
1	1 1/8	9 (229)	48,299 (214.8)	12,075 (53.7)	62,697 (278.9)	15,674 (69.7)	15,033 (66.9)	32,398 (144.1)	22,030 (98.0)
1 1/4	1 3/8	11 1/4 (286)	67,500 (300.3)	16,875 (75.1)	88,594 (394.1)	22,149 (98.5)	23,488 (104.5)	50,621 (225.2)	34,423 (153.1)

1. Allowable bond strength/concrete capacity was calculated using a safety factor of 4.0.
2. Load adjustment factors for edge distance, spacing distance and in-service temperature should be applied if applicable.
3. The lower value of either the adjusted allowable bond strength/concrete capacity or steel strength should be used as the allowable tension value for design.
4. Allowable steel strengths calculated in accordance with AISC Manual of Steel Construction: Tensile = $0.33*F_u*A_{nom}$.
5. Linear interpolation may be used for intermediate concrete compressive strengths.

TABLE 7: ULTRABOND 1 ultimate and allowable **SHEAR** loads for **THREADED ROD** in normal-weight concrete[1,2,3]

Threaded Rod Diameter in.	Nominal Drill Bit Diameter in.	Embedment Depth in. (mm)	Shear Load Based on Bond Strength/Concrete Capacity		Allowable Shear Load Based on Steel Strength[4]		
			$f'_c \geq 2{,}000$ psi (13.8 MPa)		ASTM F1554 Grade 36 lbs. (kN)	ASTM A193 Grade B7 lbs. (kN)	ASTM F593 304/316 SS lbs. (kN)
			Ultimate lbs. (kN)	Allowable lbs. (kN)			
3/8	7/16	3 3/8 (86)	7,189 (32.0)	1,797 (8.0)	1,089 (4.8)	2,347 (10.4)	1,878 (8.4)
1/2	9/16	4 1/2 (114)	12,863 (57.2)	3,216 (14.3)	1,936 (8.6)	4,172 (18.6)	3,338 (14.8)
5/8	3/4	5 5/8 (143)	22,855 (101.7)	5,714 (25.4)	3,025 (13.5)	6,519 (29.0)	5,216 (23.2)
3/4	7/8	6 3/4 (171)	32,304 (143.7)	8,076 (35.9)	4,356 (19.4)	9,388 (41.8)	6,384 (28.4)
7/8	1	7 7/8 (200)	36,214 (161.1)	9,054 (40.3)	5,929 (26.4)	12,778 (56.8)	8,689 (38.7)
1	1 1/8	9 (229)	52,151 (232.0)	13,038 (58.0)	7,744 (34.4)	16,690 (74.2)	11,349 (50.5)
1 1/4	1 3/8	11 1/4 (286)	69,011 (307.0)	17,253 (76.7)	12,100 (53.8)	26,078 (116.0)	17,733 (78.9)

1. Allowable bond strength/concrete capacity was calculated using a safety factor of 4.0.
2. Load adjustment factors for edge distance, spacing distance and in-service temperature should be applied if applicable.
3. The lower value of either the adjusted allowable bond strength/concrete capacity or steel strength should be used as the allowable shear value for design.
4. Allowable steel strengths calculated in accordance with AISC Manual of Steel Construction: Shear = $0.17*F_u*A_{nom}$.

Revision 17.1

TABLE 8: ULTRABOND 1 ultimate and allowable **TENSION & SHEAR** loads for **REBAR** in normal-weight concrete[1,2,3]

Rebar Size	Nominal Drill Bit Diameter in.	Embedment Depth in. (mm)	Tension Load Based on Bond Strength/Concrete Capacity		Shear Load Based on Bond Strength/Concrete Capacity		Allowable Load Based on Steel Strength[4]			
			$f'_c \geq 2{,}000$ psi (13.8 MPa)		$f'_c \geq 2{,}000$ psi (13.8 MPa)		Tension		Shear	
			Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	ASTM A615 Grade 60 lbs. (kN)	ASTM A615 Grade 75 lbs. (kN)	ASTM A615 Grade 60 lbs. (kN)	ASTM A615 Grade 75 lbs. (kN)
#4	5/8	4 1/2 (114)	17,076 (76.0)	4,269 (19.0)	11,240 (50.0)	2,810 (12.5)	4,800 (21.4)	6,000 (26.7)	3,060 (13.6)	3,400 (15.1)
#5	3/4	5 5/8 (143)	23,865 (106.2)	5,966 (26.5)	21,024 (93.5)	5,256 (23.4)	7,440 (33.1)	9,300 (41.4)	4,743 (21.1)	5,270 (23.4)
#6	7/8	6 3/4 (171)	31,371 (139.5)	7,843 (34.9)	32,288 (143.6)	8,072 (35.9)	10,560 (47.0)	13,200 (58.7)	6,732 (29.9)	7,480 (33.3)
#7[5]	1	7 7/8 (200)	39,835 (177.2)	9,959 (44.3)	35,434 (157.6)	8,859 (39.4)	14,400 (64.1)	18,000 (80.1)	9,180 (40.8)	10,200 (45.4)
#8	1 1/8	9 (229)	48,299 (214.8)	12,075 (53.7)	38,580 (171.6)	9,645 (42.9)	18,960 (84.3)	23,700 (105.4)	12,087 (53.8)	13,430 (59.7)

1. Allowable bond strength/concrete capacity was calculated using a safety factor of 4.0.
2. Load adjustment factors for edge distance, spacing distance and in-service temperature should be applied if applicable.
3. The lower value of either the adjusted allowable bond strength/concrete capacity or steel strength should be used as the allowable tension or shear value for design.
4. Allowable steel strengths calculated in accordance with AISC Manual of Steel Construction: Tensile = $(F_y * A_{nom})/2.5$, Shear = $0.17 * F_u * A_{nom.}$
5. Values for bond strength of #7 rebar were linearly interpolated from #6 & #8 data.

TABLE 9: ULTRABOND 1 reduction factors for **EDGE DISTANCE** in **TENSION**[1,2]

Diameter	in.	3/8	1/2	5/8	3/4	7/8	1	1 1/4
Embedment Depth	in.	3 3/8	4 1/2	5 5/8	6 3/4	7 7/8	9	11 1/4
	(mm)	(86)	(114)	(143)	(171)	(200)	(229)	(286)
Critical Edge Distance	in.	5 1/4	6 3/4	8 1/2	10 1/4	11 3/4	13 1/2	17
	(mm)	(133)	(171)	(216)	(260)	(298)	(343)	(432)
Min. Edge Distance	in.	1 3/4	2 1/4	2 3/4	3 1/2	4	4 1/2	5 3/4
	(mm)	(44)	(57)	(70)	(89)	(102)	(114)	(146)
Edge Distance		Allowable Load Capacity Reduction Factor						
in.	(mm)							
1 3/4	(44.5)	0.63						
2 1/4	(57.2)	0.68	0.64					
2 3/4	(69.9)	0.73	0.68	0.66				
3	(76.2)	0.76	0.70	0.67				
3 1/2	(88.9)	0.81	0.74	0.70	0.67			
4	(101.6)	0.87	0.78	0.73	0.70	0.71		
4 1/2	(114.3)	0.92	0.82	0.76	0.72	0.73	0.74	
5	(127.0)	0.97	0.86	0.79	0.75	0.75	0.75	
5 1/4	(133.4)	1.00	0.88	0.81	0.76	0.75	0.76	
5 3/4	(146.1)		0.92	0.84	0.78	0.77	0.78	0.77
6 1/4	(158.8)		0.96	0.87	0.81	0.79	0.79	0.78
6 3/4	(171.5)		1.00	0.90	0.83	0.81	0.81	0.79
7 1/2	(190.5)			0.94	0.87	0.84	0.83	0.81
8 1/2	(215.9)			1.00	0.92	0.88	0.86	0.83
9 1/2	(241.3)				0.96	0.92	0.88	0.85
10 1/4	(260.4)				1.00	0.94	0.91	0.86
11	(279.4)					0.97	0.93	0.88
11 3/4	(298.5)					1.00	0.95	0.89
12 1/2	(317.5)						0.97	0.91
13 1/2	(342.9)						1.00	0.93
15	(381.0)							0.96
16	(406.4)							0.98
17	(431.8)							1.00

1. Minimum slab thickness equals 1.5 x embedment depth.
2. Linear interpolation may be used for intermediate edge distances.

TABLE 10: ULTRABOND 1 reduction factors for **EDGE DISTANCE** in **SHEAR**[1,2]

Diameter	in.	3/8	1/2	5/8	3/4	7/8	1	1 1/4
Embedment Depth	in. (mm)	3 3/8 (86)	4 1/2 (114)	5 5/8 (143)	6 3/4 (171)	7 7/8 (200)	9 (229)	11 1/4 (286)
Critical Edge Distance	in. (mm)	5 1/4 (133)	6 3/4 (171)	8 1/2 (216)	10 1/4 (260)	11 3/4 (298)	13 1/2 (343)	17 (432)
Min. Edge Distance	in. (mm)	1 3/4 (44)	2 1/4 (57)	2 3/4 (70)	3 1/2 (89)	4 (102)	4 1/2 (114)	5 3/4 (146)
Edge Distance		Allowable Load Capacity Reduction Factor						
in.	(mm)							
1 3/4	(44.5)	0.31						
2 1/4	(57.2)	0.41	0.29					
2 3/4	(69.9)	0.51	0.37	0.28				
3	(76.2)	0.56	0.41	0.31				
3 1/2	(88.9)	0.66	0.49	0.37	0.26			
4	(101.6)	0.75	0.57	0.44	0.32	0.26		
4 1/2	(114.3)	0.85	0.65	0.50	0.37	0.31	0.26	
5	(127.0)	0.95	0.73	0.56	0.43	0.35	0.30	
5 1/4	(133.4)	1.00	0.76	0.59	0.45	0.38	0.32	
5 3/4	(146.1)		0.84	0.65	0.51	0.43	0.36	0.25
6 1/4	(158.8)		0.92	0.72	0.56	0.47	0.40	0.29
6 3/4	(171.5)		1.00	0.78	0.62	0.52	0.44	0.32
7 1/2	(190.5)			0.87	0.70	0.59	0.50	0.37
8 1/2	(215.9)			1.00	0.81	0.69	0.59	0.44
9 1/2	(241.3)				0.92	0.78	0.67	0.50
10 1/4	(260.4)				1.00	0.86	0.73	0.55
11	(279.4)					0.93	0.79	0.60
11 3/4	(298.5)					1.00	0.86	0.65
12 1/2	(317.5)						0.92	0.70
13 1/2	(342.9)						1.00	0.77
15	(381.0)							0.87
16	(406.4)							0.93
17	(431.8)							1.00

1. Minimum slab thickness equals 1.5 x embedment depth.
2. Linear interpolation may be used for intermediate edge distances.

TABLE 11: ULTRABOND 1 reduction factors for **SPACING DISTANCE** in **TENSION**[1,2]

Diameter	in.	3/8	1/2	5/8	3/4	7/8	1	1 1/4
Embedment Depth	in.	3 3/8	4 1/2	5 5/8	6 3/4	7 7/8	9	11 1/4
	(mm)	(86)	(114)	(143)	(171)	(200)	(229)	(286)
Critical Spacing Distance	in.	6	7 7/8	9 7/8	11 7/8	13 7/8	15 3/4	19 3/4
	(mm)	(152)	(200)	(251)	(302)	(352)	(400)	(502)
Min. Spacing Distance	in.	1 3/4	2 1/4	2 3/4	3 3/8	4	4 1/2	5 5/8
	(mm)	(44)	(57)	(70)	(86)	(102)	(114)	(143)
Spacing Distance		Allowable Load Capacity Reduction Factor						
in.	(mm)							
1 3/4	(44.5)	0.69						
2 1/4	(57.2)	0.73	0.69					
2 3/4	(69.9)	0.76	0.72	0.69				
3	(76.2)	0.78	0.73	0.70				
3 3/8	(85.7)	0.81	0.75	0.72	0.69			
4	(101.6)	0.85	0.79	0.74	0.71	0.69		
4 1/2	(114.3)	0.89	0.81	0.77	0.73	0.71	0.69	
5 5/8	(142.9)	0.97	0.88	0.82	0.77	0.74	0.72	0.69
6	(152.4)	1.00	0.90	0.83	0.79	0.75	0.73	0.70
6 1/2	(165.1)		0.92	0.85	0.80	0.77	0.75	0.71
7 1/4	(184.2)		0.97	0.89	0.83	0.79	0.77	0.73
7 7/8	(200.0)		1.00	0.91	0.85	0.81	0.78	0.74
8 1/2	(215.9)			0.94	0.88	0.83	0.80	0.75
9 7/8	(250.8)			1.00	0.93	0.87	0.84	0.78
10 1/2	(266.7)				0.95	0.89	0.86	0.80
11 7/8	(301.6)				1.00	0.94	0.89	0.83
12 1/2	(317.5)					0.96	0.91	0.84
13 7/8	(352.4)					1.00	0.95	0.87
14 1/2	(368.3)						0.97	0.88
15 3/4	(400.1)						1.00	0.91
17	(431.8)							0.94
18 1/2	(469.9)							0.97
19 3/4	(501.7)							1.00

1. Minimum slab thickness equals 1.5 x embedment depth.
2. Linear interpolation may be used for intermediate spacing distances.