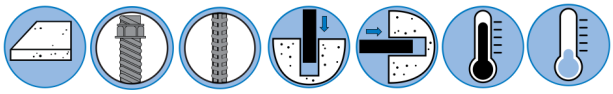
ULTRABOND® HS-200



Product Description

ULTRABOND® HS-200 is a non-sag, high-strength DOT anchoring epoxy developed to resist both long and short term tensile loading conditions and can be used in temperatures between 35 °F (2 °C) and 110 °F (43 °C). HS-200 has been tested in accordance with ASTM E488 and ASTM E1512 for its capability to resist static, dynamic, seismic and wind loads in uncracked concrete for both threaded rod and rebar.

General Uses & Applications

- Anchoring threaded rods, bolts and rebar dowels into uncracked concrete
- Short and long term tensile anchoring, including wind, seismic and shear forces 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

- Extensive coast-to-coast state DOT approvals, including Caltrans
- Moisture insensitive allowing installation and curing in damp environments
- Withstands freeze-thaw conditions
- In-service temperature range between 35 °F (2 °C) and 180 °F (82 °C)

STANDARDS & APPROVALS

ASTM C881-14
Type I, II, IV & V Grade 3 Class A, B & C

AASHTO M235

Multiple DOT Listings

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

Availability: Adhesives Technology Corp. (ATC) ULTRABOND products are available through select distributors who can provide you with all your construction needs. Please contact ATC for a distributor near you or visit our website to search by zip code.

Color & Ratio: Part A (Resin): White, Part B (Hardener): Black, Mixed: Concrete Gray, Mix Ratio: 2:1 by volume

Storage & Shelf Life: 28 months in unopened containers stored in dry conditions between 40 °F (4 °C) and 90 °F (32 °C). High relative humidity will reduce shelf life.

Installation & Coverage: Manufacturer's Printed Installation Instructions (MPII) are available within this Technical Data Sheet (TDS). Due to occasional updates and revisions, always verify that you are using the most current version of the MPII. In order to achieve maximum results, proper installation is imperative.

Clean Up: Always wear appropriate protective equipment such as safety glasses and gloves during cleanup. Clean uncured materials from tools and equipment with mild solvent. Cured material can only be removed mechanically.

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
- Performance characteristics, such as seismic and long term load resistance, were tested in accordance with ASTM E488-96 (2003) & E1512-01 (2015) provisions and not that of ACI 355.4, and are therefore not applicable in the concrete tension zone - always consult with a design professional prior to use to ensure product applicability

Safety: Please refer to the Safety Data Sheet (SDS) for ULTRABOND HS-200 published on our website or call ATC for more information at 1-800-892-1880.

Specification: The material shall be a two component, 2:1 ratio, epoxy system. The material must meet the requirements of ASTM C881 for Type I, II, IV & V, Grade 3 Class A, B & C. When cured 7 days and at a temperature of 50 °F (10 °C), the epoxy shall have a compressive strength of 14,690 psi (101.3 MPa) and a compressive modulus of 714,800 psi (4,928.4 MPa) per ASTM D695. The epoxy adhesive shall be ULTRABOND HS-200 from Adhesives Technology Corp., Pompano Beach, Florida.

Revision 7.1

ORDERING INFORMATION

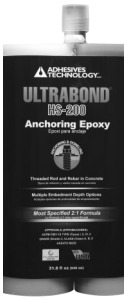
TABLE 1: ULTRABOND HS-200 Adhesive, Dispensing Tools and Mixing Nozzles

Package Size	16 oz. (473 ml) Cartridge	31.8 oz. (940 ml) Cartridge
Part #	A16-HS200	A33-HS200
Manual Dispensing Tool	TM16HD	TM33HD
Pneumatic Dispensing Tool	TA16HD-N	TA33HD-A
Case Qty	20	10
Pallet Qty	720	360
Pallet Weight	1,444	1,318
Recommended Mixing Nozzle	T34HF	T34HF


TM16HD


TA16HD-N

A16-HS200



A33-HS200


TM33HD


TA33HD-A

TABLE 2: Wire Brushes, Handles and Adapters[1]

Part #	Threaded Rod Diameter	Rebar Diameter	Brush Diameter	Qty.
HB038	3/8"	#3	5/8"	1
HB012	1/2"	#4	3/4"	1
HB058	5/8"	#5	1"	1
HB034	3/4"	#6	1-1/4"	1
HB078	7/8"	#7	1-1/2"	1
HB100	1"	#8	1-5/8"	1
HB125	1-1/4"	----	1-3/4"	1
HBHT	Steel brush 12" usable extension with T-Handle (manual)			1
HBEXT	Steel brush 12" usable extension with SDS + drill adaptor			1

1. Contact ATC for brush availability and ordering information for drill holes for 1-3/8" & 1-1/2" threaded rod.


T34HF

HBEXT


HBHT


HB100

MATERIAL SPECIFICATION

ASD Allowable Stress Design

TABLE 3: ULTRABOND HS-200 performance to **ASTM C881-14**[1,2]

Property	Cure Time	ASTM Standard	Units	Sample Conditioning Temperature		
				Class A	Class B	Class C
				35°F (2)°C	50°F (10)°C	110°F (43)°C
Gel Time - 60 Gram Mass[3]	----	C881	mins	45	26	5
Compressive Yield Strength	7 day	D695	psi (MPa)	15,580 (107.4)	14,690 (101.3)	12,560 (86.6)
Compressive Modulus	7 day	D695	psi (MPa)	681,200 (4,696.7)	714,800 (4,928.4)	655,200 (4,517.4)
Bond Strength Hardened to Hardened Concrete	2 day	C882	psi (MPa)	3,350 (23.1)	3,310 (22.8)	3,130 (21.6)
Bond Strength Hardened to Hardened Concrete	14 day	C882	psi (MPa)	3,480 (24.0)	3,270 (22.5)	3,020 (20.8)
Bond Strength Fresh Concrete to Hardened Concrete	14 day	C882	psi (MPa)	2,690 (18.5)		
Consistency or Viscosity	----	C881	----	Non-sag		
Heat Deflection Temperature	7 day	D648	°F (°C)	136 (57.8)		
Water Absorption	14 day	D570	%	0.04		
Linear Coefficient of Shrinkage	----	D2566	%	0.0006		

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. Results may vary due to environmental factors such as temperature, moisture and type of substrate.
3. Gel time may be lower than the minimum required for ASTM C881.

TABLE 4: ULTRABOND HS-200 **CURE SCHEDULE**[1,2,3]

Base Material Temperature °F (°C)	Working Time	Full Cure Time
40 (4)	50 mins	72 hrs
75 (24)	24 mins	24 hrs
110 (43)	8 mins	18 hrs

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.

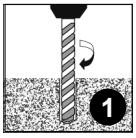
TABLE 5: ULTRABOND HS-200 **In-Service TEMPERATURE CHART**[1]

Base Material Temperature °F (°C)	Allowable Load Capacity Reduction Factor
35 (2)	1.00
70 (21)	1.00
110 (43)	1.00
135 (57)	1.00
150 (66)	0.94
180 (82)	0.71

1. Reduction factors may be linearly interpolated between listed temperatures.

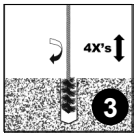
INSTALLATION INSTRUCTIONS (MPII)

Drilling and Cleaning



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 & skin and avoid inhalation of dust during the drilling and cleaning process. Refer to the Safety Data Sheet (SDS) for details prior to proceeding.

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/cycles (4X).

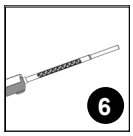


Select the correct wire brush size for the drilled hole diameter (see Table 2), making sure that the brush is long enough to reach the bottom of the drilled hole. Reaching the bottom of the hole, brush in an up/down and twisting motion for 4 cycles (4X). **CAUTION:** The brush should contact the walls 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.

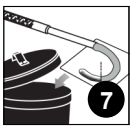
Blow the hole out once more to remove brush debris using oil free compressed air with a minimum pressure of 80 psi (5.5 bar). Insert the air wand to the bottom of the drilled hole and blow out the debris with an up/down motion for a minimum of 4 seconds/cycles (4X). Visually inspect the hole to confirm 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, balance the cartridge by dispensing a small amount of material until both components are flowing evenly. For a cleaner environment, hand mix the two components and let cure prior to disposal in accordance with local regulations.

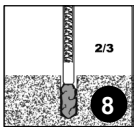


Only after the cartridge has been balanced, screw on the proper Adhesives Technology mixing nozzle to the cartridge (see Table 1). Do not modify mixing nozzle. Confirm that internal mixing element is in place prior to dispensing adhesive. Take note of the air and base material temperatures and review the working/full cure time chart (see Table 4) prior to starting the injection process.

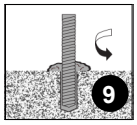


Dispense the initial amount of material from the mixing nozzle onto a disposable surface until the product is a uniform gray color with no streaks, as adhesive must be properly mixed in order to perform as published. Dispose of the initial amount of adhesive according to local regulations prior to injection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

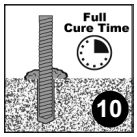
Installation and Curing (Vertical Down and Horizontal)



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. **NOTE:** When using a pneumatic dispensing tool, ensure that pressure is set at 90 psi (6.2 bar) maximum.



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. **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. For horizontal installations, wedges should be used to center and support the anchor while the adhesive is curing.



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 dependent - refer to Table 4 for appropriate full cure time.

TECHNICAL DATA

ASD Allowable Stress Design

TABLE 6: ULTRABOND HS-200 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	1 11/16 (43)	3,036 (13.5)	759 (3.4)	3,036 (13.5)	759 (3.4)	2,114 (9.4)	4,556 (20.3)	3,645 (16.2)
		3 3/8 (86)	8,214 (36.5)	2,054 (9.1)	8,214 (36.5)	2,054 (9.1)			
		4 1/2 (114)	9,277 (41.3)	2,319 (10.3)	9,277 (41.3)	2,319 (10.3)			
1/2	9/16	2 1/4 (57)	5,696 (25.3)	1,424 (6.3)	5,696 (25.3)	1,424 (6.3)	3,758 (16.7)	8,099 (36.0)	6,480 (28.8)
		4 1/2 (114)	17,076 (76.0)	4,269 (19.0)	18,376 (81.7)	4,594 (20.4)			
		6 (152)	22,227 (98.9)	5,557 (24.7)	22,224 (98.9)	5,556 (24.7)			
5/8	3/4	2 13/16 (71)	8,438 (37.5)	2,109 (9.4)	9,680 (43.1)	2,420 (10.8)	5,872 (26.1)	12,655 (56.3)	10,124 (45.0)
		5 5/8 (143)	23,865 (106.2)	5,966 (26.5)	26,580 (118.2)	6,645 (29.6)			
		7 1/2 (191)	34,819 (154.9)	8,705 (38.7)	34,819 (154.9)	8,705 (38.7)			
3/4	7/8	3 3/8 (86)	11,091 (49.3)	2,773 (12.3)	12,388 (55.1)	3,097 (13.8)	8,456 (37.6)	18,224 (81.1)	12,392 (55.1)
		6 3/4 (171)	31,371 (139.5)	7,843 (34.9)	38,414 (170.9)	9,604 (42.7)			
		9 (229)	44,725 (198.9)	11,181 (49.7)	44,725 (198.9)	11,181 (49.7)			
7/8	1	3 15/16 (100)	13,977 (62.2)	3,494 (15.5)	16,108 (71.7)	4,027 (17.9)	11,509 (51.2)	24,804 (110.3)	16,867 (75.0)
		7 7/8 (200)	39,532 (175.8)	9,883 (44.0)	52,393 (233.1)	13,098 (58.3)			
		10 1/2 (267)	60,864 (270.7)	15,216 (67.7)	66,130 (294.2)	16,533 (73.5)			
1	1 1/8	4 1/2 (114)	17,076 (76.0)	4,269 (19.0)	21,608 (96.1)	5,402 (24.0)	15,033 (66.9)	32,398 (144.1)	22,030 (98.0)
		9 (229)	48,299 (214.8)	12,075 (53.7)	60,837 (270.6)	15,209 (67.7)			
		11 1/4 (286)	72,540 (322.7)	18,135 (80.7)	72,540 (322.7)	18,135 (80.7)			
1 1/4	1 3/8	5 5/8 (143)	23,865 (106.2)	5,966 (26.5)	31,144 (138.5)	7,786 (34.6)	23,488 (104.5)	50,621 (225.2)	34,423 (153.1)
		11 1/4 (286)	67,500 (300.3)	16,875 (75.1)	82,181 (365.6)	20,545 (91.4)			
		15 (143)	103,923 (462.3)	25,981 (115.6)	106,186 (472.3)	26,547 (118.1)			
1 3/8	1 1/2	12 3/8 (314)	77,874 (346.4)	19,469 (86.6)	88,325 (392.9)	22,081 (98.2)	28,421 (126.4)	61,252 (272.5)	41,651 (185.3)
1 1/2	1 5/8	13 1/2 (343)	88,731 (394.7)	22,183 (98.7)	101,901 (453.3)	25,475 (113.3)	33,823 (150.5)	72,895 (324.3)	49,568 (220.5)

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 and embedment depths.

Revision 7.1

TABLE 7: ULTRABOND HS-200 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)	7,072 (31.5)	1,768 (7.9)	1,089 (4.8)	2,347 (10.4)	1,878 (8.4)
1/2	9/16	4 1/2 (114)	12,230 (54.4)	3,058 (13.6)	1,936 (8.6)	4,172 (18.6)	3,338 (14.8)
5/8	3/4	5 5/8 (143)	23,190 (103.2)	5,798 (25.8)	3,025 (13.5)	6,519 (29.0)	5,216 (23.2)
3/4	7/8	6 3/4 (171)	31,853 (141.7)	7,963 (35.4)	4,356 (19.4)	9,388 (41.8)	6,384 (28.4)
7/8	1	7 7/8 (200)	34,953 (155.5)	8,738 (38.9)	5,929 (26.4)	12,778 (56.8)	8,689 (38.7)
1	1 1/8	9 (229)	54,924 (244.3)	13,731 (61.1)	7,744 (34.4)	16,690 (74.2)	11,349 (50.5)
1 1/4	1 3/8	11 1/4 (286)	73,427 (326.6)	18,357 (81.7)	12,100 (53.8)	26,078 (116.0)	17,733 (78.9)
1 3/8	1 1/2	12 3/8 (314)	87,312 (388.4)	21,828 (97.1)	14,641 (65.1)	31,554 (140.4)	21,457 (95.4)
1 1/2	1 5/8	13 1/2 (343)	115,202 (512.4)	28,801 (128.1)	17,424 (77.5)	37,552 (167.0)	25,535 (113.6)

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 = $0.17*F_u*A_{nom}$.

TABLE 8: ULTRABOND HS-200 ultimate and allowable **TENSION** 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				Allowable Tension Loads 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 A615 Grade 60 lbs. (kN)	ASTM A615 Grade 75 lbs. (kN)
			Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)		
#4	5/8	4 1/2 (114)	17,076 (76.0)	4,269 (19.0)	18,975 (84.4)	4,744 (21.1)	4,800 (21.4)	6,000 (26.7)
#5	3/4	5 5/8 (143)	23,865 (106.2)	5,966 (26.5)	31,555 (140.4)	7,889 (35.1)	7,440 (33.1)	9,300 (41.4)
#6	7/8	6 3/4 (171)	31,371 (139.5)	7,843 (34.9)	39,109 (174.0)	9,777 (43.5)	10,560 (47.0)	13,200 (58.7)
#7[5]	1	7 7/8 (200)	39,532 (175.8)	9,883 (44.0)	47,523 (211.4)	11,881 (52.8)	14,400 (64.1)	18,000 (80.1)
#8	1 1/8	9 (229)	48,299 (214.8)	12,075 (53.7)	55,937 (248.8)	13,984 (62.2)	18,960 (84.3)	23,700 (105.4)

1. Allowable bond strength/concrete capacity was calculated using a safety factor of 4.0.
2. Load adjustment factors for 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 9: ULTRABOND HS-200 ultimate and allowable **SHEAR** loads for **REBAR** in normal-weight concrete[1,2,3]

Rebar Size	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 A615 Grade 60 lbs. (kN)	ASTM A615 Grade 75 lbs. (kN)
			Ultimate lbs. (kN)	Allowable lbs. (kN)		
#4	5/8	4 1/2 (114)	12,121 (53.9)	3,030 (13.5)	3,060 (13.6)	3,400 (15.1)
#5	3/4	5 5/8 (143)	20,597 (91.6)	5,149 (22.9)	4,743 (21.1)	5,270 (23.4)
#6	7/8	6 3/4 (171)	30,114 (134.0)	7,529 (33.5)	6,732 (29.9)	7,480 (33.3)
#7[5]	1	7 7/8 (200)	34,302 (152.6)	8,576 (38.1)	9,180 (40.8)	10,200 (45.4)
#8	1 1/8	9 (229)	38,489 (171.2)	9,622 (42.8)	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 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: Shear = $0.17*F_u*A_{nom.}$
5. Values for bond strength of #7 rebar were linearly interpolated from #6 & #8 data.

TABLE 10: ULTRABOND HS-200 Reduction factors for **EDGE DISTANCE** in **TENSION** at **4.5D**[1,2]

Diameter	in.	3/8	1/2	5/8	3/4	7/8	1	1 1/4
Embedment Depth	in. (mm)	1 11/16 (43)	2 1/4 (57)	2 13/16 (71)	3 3/8 (86)	3 15/16 (100)	4 1/2 (114)	5 5/8 (143)
Critical Edge Distance	in. (mm)	2 1/2 (64)	3 3/8 (86)	4 1/4 (108)	5 1/8 (130)	6 (152)	6 3/4 (171)	8 1/2 (216)
Min. Edge Distance	in. (mm)	7/8 (22)	1 1/8 (29)	1 1/2 (38)	1 3/4 (44)	2 (51)	2 1/4 (57)	2 3/4 (70)
Edge Distance		Allowable Load Capacity Reduction Factor						
in.	(mm)							
7/8	(22.2)	0.57						
1 1/8	(28.6)	0.64	0.57					
1 1/2	(38.1)	0.74	0.64	0.57				
1 3/4	(44.5)	0.80	0.69	0.61	0.57			
2	(50.8)	0.87	0.74	0.65	0.60	0.57		
2 1/4	(57.2)	0.93	0.79	0.69	0.63	0.60	0.57	
2 1/2	(63.5)	1.00	0.83	0.73	0.67	0.62	0.59	
2 3/4	(69.9)		0.88	0.77	0.70	0.65	0.62	0.57
3 3/8	(85.7)		1.00	0.86	0.78	0.72	0.68	0.62
3 3/4	(95.3)			0.92	0.82	0.76	0.71	0.64
4 1/4	(108.0)			1.00	0.89	0.81	0.76	0.68
4 3/4	(120.7)				0.95	0.87	0.81	0.72
5 1/8	(130.2)				1.00	0.91	0.84	0.75
5 3/4	(146.1)					0.97	0.90	0.79
6	(152.4)					1.00	0.93	0.81
6 3/4	(171.5)						1.00	0.87
7 1/4	(184.2)							0.91
8	(203.2)							0.96
8 1/2	(215.9)							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 HS-200 Reduction factors for **EDGE DISTANCE** in **TENSION** at **9D**[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 1/8 (130)	6 3/4 (171)	8 1/2 (216)	10 1/8 (257)	11 3/4 (298)	13 1/2 (343)	16 7/8 (429)
Min. Edge Distance	in. (mm)	1 3/4 (44)	2 1/4 (57)	2 3/4 (70)	3 3/8 (86)	4 (102)	4 1/2 (114)	5 5/8 (143)
Edge Distance		Allowable Load Capacity Reduction Factor						
in.	(mm)							
1 3/4	(44.5)	0.71						
2 1/4	(57.2)	0.75	0.71					
2 3/4	(69.9)	0.80	0.74	0.71				
3	(76.2)	0.82	0.76	0.72				
3 3/8	(85.7)	0.85	0.78	0.74	0.71			
4	(101.6)	0.90	0.82	0.77	0.74	0.71		
4 1/2	(114.3)	0.95	0.86	0.80	0.76	0.73	0.71	
4 3/4	(120.7)	0.97	0.87	0.81	0.77	0.74	0.72	
5 1/8	(130.2)	1.00	0.90	0.83	0.79	0.75	0.73	
5 5/8	(142.9)		0.93	0.86	0.81	0.77	0.75	0.71
6 1/4	(158.8)		0.97	0.89	0.83	0.79	0.77	0.73
6 3/4	(171.5)		1.00	0.91	0.86	0.81	0.78	0.74
7 1/2	(190.5)			0.95	0.89	0.84	0.81	0.76
8 1/2	(215.9)			1.00	0.93	0.88	0.84	0.78
9 1/4	(235.0)				0.96	0.91	0.86	0.80
10 1/8	(257.2)				1.00	0.94	0.89	0.83
11	(279.4)					0.97	0.92	0.85
11 3/4	(298.5)					1.00	0.94	0.87
12 1/2	(317.5)						0.97	0.89
13 1/2	(342.9)						1.00	0.91
14 1/2	(368.3)							0.94
15 3/4	(400.1)							0.97
16 7/8	(428.6)							1.00

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

TABLE 12: ULTRABOND HS-200 Reduction factors for **EDGE DISTANCE** in **TENSION** at **12D**[1,2]

Diameter	in.	3/8	1/2	5/8	3/4	7/8	1	1 1/4
Embedment Depth	in. (mm)	4 1/2 (114)	6 (152)	7 1/2 (191)	9 (229)	10 1/2 (267)	12 (305)	15 (381)
Critical Edge Distance	in. (mm)	6 3/4 (171)	9 (229)	11 1/4 (286)	13 1/2 (343)	15 3/4 (400)	18 (457)	22 1/2 (572)
Min. Edge Distance	in. (mm)	2 1/4 (57)	3 (76)	3 3/4 (95)	4 1/2 (114)	5 1/4 (133)	6 (152)	7 1/2 (191)
Edge Distance		Allowable Load Capacity Reduction Factor						
in.	(mm)							
2 1/4	(57.2)	0.71						
3	(76.2)	0.76	0.71					
3 3/4	(95.3)	0.81	0.75	0.71				
4	(101.6)	0.82	0.76	0.72				
4 1/2	(114.3)	0.86	0.78	0.74	0.71			
5 1/4	(133.4)	0.90	0.82	0.77	0.73	0.71		
6	(152.4)	0.95	0.86	0.80	0.76	0.73	0.71	
6 1/2	(165.1)	0.98	0.88	0.82	0.77	0.74	0.72	
6 3/4	(171.5)	1.00	0.89	0.83	0.78	0.75	0.73	
7 1/2	(190.5)		0.93	0.86	0.81	0.77	0.75	0.71
8 1/4	(209.6)		0.96	0.88	0.83	0.79	0.76	0.72
9	(228.6)		1.00	0.91	0.86	0.81	0.78	0.74
10	(254.0)			0.95	0.89	0.84	0.81	0.76
11 1/4	(285.8)			1.00	0.93	0.88	0.84	0.78
12	(304.8)				0.95	0.90	0.86	0.80
13 1/2	(342.9)				1.00	0.94	0.89	0.83
14 1/2	(368.3)					0.97	0.92	0.85
15 3/4	(400.1)					1.00	0.95	0.87
17	(431.8)						0.98	0.89
18	(457.2)						1.00	0.91
19 1/4	(489.0)							0.94
20 3/4	(527.1)							0.97
22 1/2	(571.5)							1.00

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

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TABLE 13: ULTRABOND HS-200 Reduction factors for **EDGE DISTANCE** in **SHEAR** at **9D**[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 1/8 (130)	6 3/4 (171)	8 1/2 (216)	10 1/8 (257)	11 3/4 (298)	13 1/2 (343)	16 7/8 (429)
Min. Edge Distance	in. (mm)	1 3/4 (44)	2 1/4 (57)	2 3/4 (70)	3 3/8 (86)	4 (102)	4 1/2 (114)	5 5/8 (143)
Edge Distance		Allowable Load Capacity Reduction Factor						
in.	(mm)							
1 3/4	(44.5)	0.29						
2 1/4	(57.2)	0.40	0.29					
2 3/4	(69.9)	0.50	0.37	0.29				
3	(76.2)	0.55	0.41	0.32				
3 3/8	(85.7)	0.63	0.47	0.37	0.29			
4	(101.6)	0.76	0.57	0.44	0.36	0.29		
4 1/2	(114.3)	0.87	0.65	0.51	0.41	0.34	0.29	
5	(127.0)	0.97	0.72	0.57	0.46	0.38	0.33	
5 1/8	(130.2)	1.00	0.74	0.58	0.47	0.39	0.34	
5 5/8	(142.9)		0.82	0.65	0.53	0.44	0.38	0.29
6 1/4	(158.8)		0.92	0.72	0.59	0.50	0.43	0.33
7	(177.8)		1.00	0.81	0.67	0.56	0.49	0.38
7 3/4	(196.9)			0.91	0.75	0.63	0.55	0.42
8 1/2	(215.9)			1.00	0.83	0.70	0.61	0.47
9 3/4	(247.7)				0.96	0.82	0.70	0.55
10 1/8	(257.2)				1.00	0.85	0.73	0.57
10 3/4	(273.1)					0.91	0.78	0.61
11 3/4	(298.5)					1.00	0.86	0.68
12 3/8	(314.3)						0.91	0.72
13 1/2	(342.9)						1.00	0.79
14 1/4	(362.0)							0.83
15 1/2	(393.7)							0.91
16 7/8	(428.6)							1.00

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

TABLE 14: ULTRABOND HS-200 Reduction factors for **SPACING** in **TENSION** at **9D**[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 Spacing Distance	in. (mm)	6 (152)	7 7/8 (200)	9 7/8 (251)	11 7/8 (302)	13 7/8 (352)	15 3/4 (400)	19 3/4 (502)
Min. Spacing Distance	in. (mm)	1 3/4 (44)	2 1/4 (57)	2 3/4 (70)	3 3/8 (86)	4 (102)	4 1/2 (114)	5 5/8 (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 1/2	(139.7)	0.96	0.87	0.81	0.77	0.74	0.72	
6	(152.4)	1.00	0.90	0.83	0.79	0.75	0.73	
5 5/8	(142.9)		0.88	0.82	0.77	0.74	0.72	0.69
6 1/2	(165.1)		0.92	0.85	0.80	0.77	0.75	0.71
7 7/8	(200.0)		1.00	0.91	0.85	0.81	0.78	0.74
9	(228.6)			0.96	0.90	0.85	0.81	0.76
9 7/8	(250.8)			1.00	0.93	0.87	0.84	0.78
11	(279.4)				0.97	0.91	0.87	0.81
11 7/8	(301.6)				1.00	0.94	0.89	0.83
13	(330.2)					0.97	0.92	0.85
13 7/8	(352.4)					1.00	0.95	0.87
15	(381.0)						0.98	0.90
15 3/4	(400.1)						1.00	0.91
17	(431.8)							0.94
18	(457.2)							0.96
19 3/4	(501.7)							1.00

1. Minimum slab thickness equals 1.5 x embedment depth.