EP 800

PURE EPOXY

REVISION R01.00 05.08.2024

NOTE: THIS TECHNICAL DATA SHEET REPLACES ALL PREVIOUS VERSIONS. THE INSTRUCTIONS IN THIS DOCUMENTATION ARE BASED ON OUR TESTS AND EXPERIENCE AND HAVE BEEN PREPARED TO THE BEST OF OUR KNOWLEDGE AND CONSCIENCE. DUE TO THE VARIETY OF DIFFERENT MATERIALS AND SUBSTRATES AND THE MANY DIFFERENT POSSIBLE APPLICATIONS BEYOND OUR CONTROL, WE ASSUME NO REPONSIBILITY FOR THE RESULTS ACHIEVED. SINCE THE CONSTRUCTION AND NATURE OF THE SUBSTRATE AND THE PROCESSING CONDITIONS ARE BEYOND OUR CONTROL, WE DO NOT ACCEPT ANY LIABILITY FOR THIS PUBLICATION. IN ANY CASE, IT IS RECOMMENDED TO CARRY OUT APPROPRIATE TESTS BEFORE USE.

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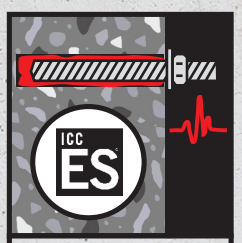
Application in non-cracked concrete

Application in cracked concrete



Seismic application

Post-installed rebar (incl. Seismic & Fire)

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NSF/ANSI/CAN 61
by WQA

1. General

1.1 Product description

The EP 800 mortar is a 2-component reaction resin mortar based on a pure epoxy and will be delivered in a exclusive 2-C cartridge system with 9.5 fl.oz. (280 ml), 13.5 fl.oz. (400 ml), 20.5 fl. oz. (610 ml) or 50.5 fl. oz. (1500 ml). This high performance product may be used in combination with a hand-, battery-, or pneumatic tool and a static mixer. It was designed especially for the anchoring of threaded rods and reinforcing bars into concrete.

1.2 Properties and benefits

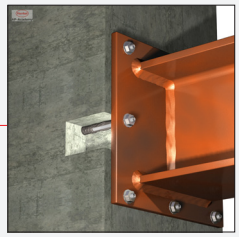
- US-approval acc. to AC 308 in concrete (ICC-ES): ESR-4901
- Physical properties acc. to ASTM C881 and AASHTO M 235
- For drinking water system components: Tested and certified by WQA to NSF/ANSI/CAN 61 (see WQA.org for product use restrictions)
- For heavy anchoring and post-installed rebar connection
- Seismic (anchoring and post-installed rebar)
- Fire (post-installed rebar)
- Application in dry, wet, submerged concrete or water filled bore holes
- Overhead application
- Suitable for attachment points with small edge- and axial distances due to an anchoring free of expansion forces
- High chemical resistance
- Low odour
- High bending and pressure strength
- Cartridge can be reused up to the end of the shelf life by replacing the static mixer or resealing cartridge with the sealing cap

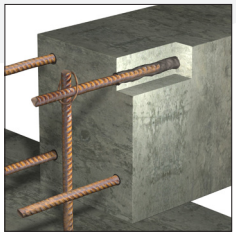
1.3 Applications samples

Suitable for the fixation of facades, roofs, wood constructions, metal constructions; metal profils, columns, beams, consoles, railings, sanitary devices, cable trays, piping, post-installed rebar connection (reconstruction or reinforcement), etc.

1.4 Handling and storage

- Storage: store in a cold and dark place
  Storage temperature: from +40°F (+5°C) up to 104°F (+40 °C)
- Shelf life: 24 months





1.5 Applications and intended use

- Base material:
  cracked and uncracked concrete.
- Anchor elements:
  Threaded rods, fractional and metric diameters (zinc electroplated, mechanically deposited zinc coating, stainless steel); reinforcing bars fractional and metric diameters.
- Temperature range:
  installation temperature; +40°F (+5°C) up to 104°F (+40 °C),
  cartridge temperature; min. +40°F (+5°C); optimal 95°F (+35 °C),
  base material temperature after full curing:
  -40°F (-40°C) to +110°F (+43°C) long term, 176°F (+80°C) short term

1.6 Mortar properties

Properties	Test Method	Result at 50±2 °F Class B	Result at 73±2 °F Class C
Tensile Strength (*) 7 days, min	ASTM D 638	2.359 psi	4.120 psi
Compressive Yield Strength 7 days, min	ASTM D 635	11.757 psi	13.392 psi
Compressive Modulus	-	1.790.431 psi	2.283.314 psi (60°F)
Water Absorption	ASTM D 570	0,11 %	0,11 %
Bond strength	ASTM C 882	2.461 N / mm²	2.558 N / mm²
Linear Coefficient of Shrinkage on cure, max	ASTM D 2566	0,001 in/in	0,001 in/in
Heat Deflection Temperature 7 days, min	-	138 °F	138 °F
Thermal conductivity	-	Passes	Passes
Gel Time, min	-	162 min	30 min
Viscosity (*)	-	Not required	Not required
Elongation at Break, min	-	0,1 %	0,1 %

(*) Tensile strength and viscosity are nor required for Grade 3.

The test results listed above met or exceeded the corresponding requirements as set forth in ASTM C881-20a for a Type I, II, IV and V, Grade 3, Class B and C material.

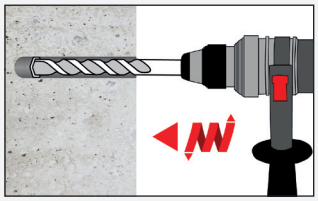
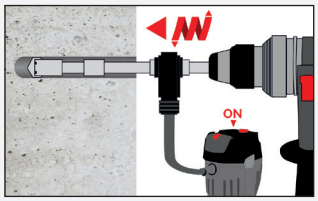
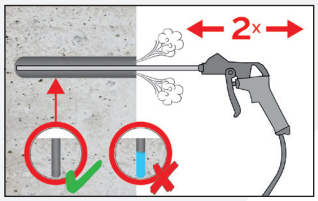
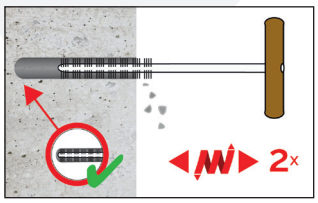
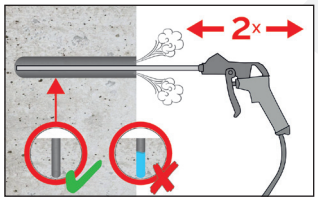
1.6 Reactivity

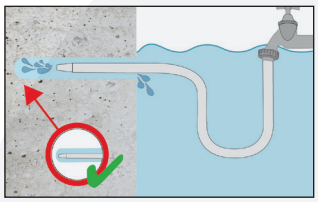
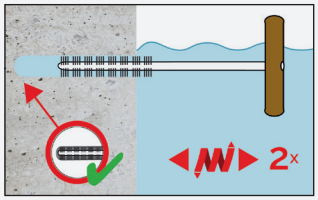
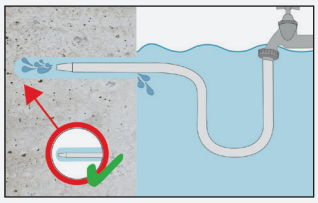
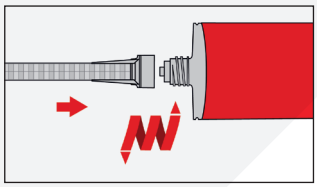
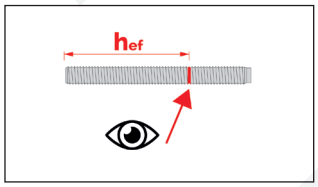
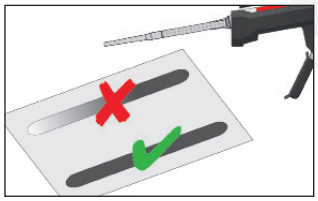
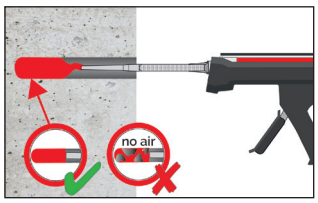
Temperature of base material					Maximum working time	Initial curing time 1)	Full curing time
41 °F	(+5 °C)	to	49 °F	(+9 °C)	80 min	24 h	48 h
50 °C	(+10 °C)	to	58 °F	(+14 °C)	60 min	15 h	30 h
59 °F	(+15 °C)	to	67 °F	(+19 °C)	40 min	10 h	20 h
68 °F	(+20 °C)	to	76 °F	(+24 °C)	30 min	5 h	11 h
77 °F	(+25 °C)	to	85 °F	(+29 °C)	12 min	4 h	9 h
86 °F	(+30 °C)	to	103 °F	(+39 °C)	8 min	3 h	6 h
104 °F (+40 °C)					7 min	2 h	4 h
Cartridge temperature					41 °F (+5 °C) to 104 °F (+40 °C)		

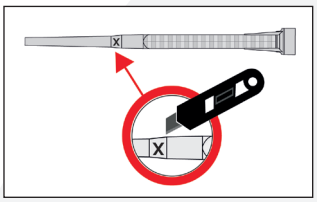
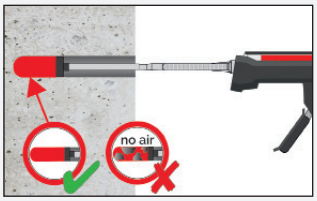
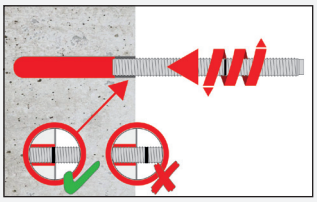
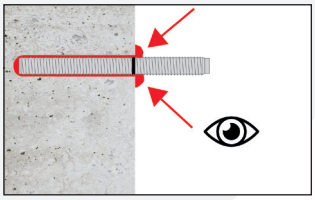
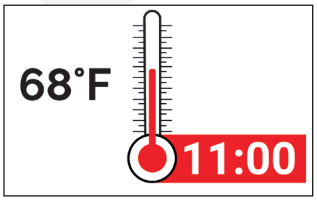
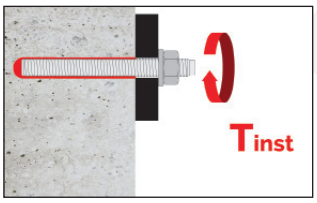
1) Initial curing times are for post-installed rebar applications only. After the initial curing time, the installation of connecting reinforcements and formwork attachments is permitted.

2. Installation

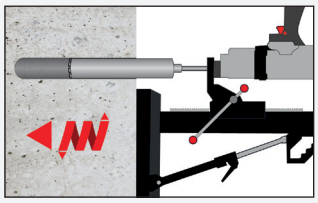
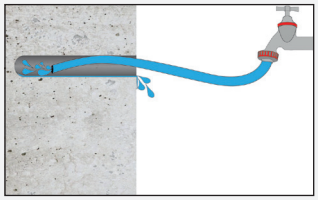
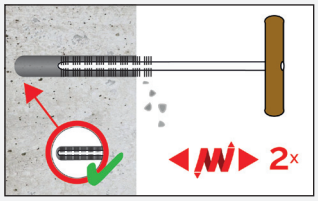
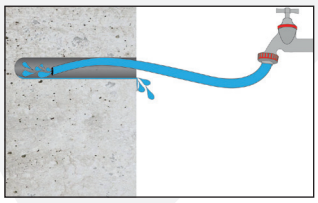
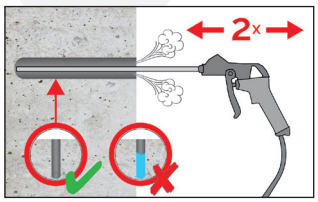
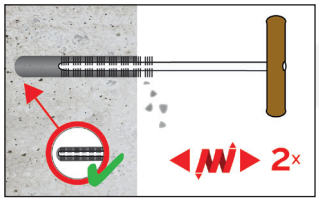
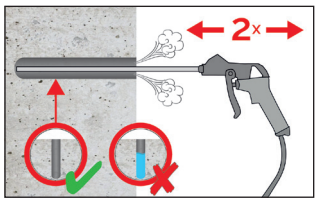
2.1 Installation instructions (HD, CD, HDB)

Drilling of the bore hole (HD, CD; HDB) - ESR-4901	
Precaution: Wear suitable eye and skin protection. Avoid inhalation of dusts during drilling and/or removal. (see dust extraction equipment by Chemofast to minimize dust emissions)	
 	**1.** Drill a hole into the base material with a hammer drill tool to the size and embedment required by the selected steel hardware element (see Table on page 12). The tolerances of the carbide drill bit must meet the requirements of ANSI Standard B212.15. For bore holes drilled with the Chemofast hollow drill bit system (consisting of Heller Duster Expert drill bits and a Class M vacuum with air flow 150 m³/h resp. 42 l/s resp. 90 cfm; the vacuum must be on!) no further cleaning is required go to Step 3, otherwise to Step 2a for MAC or CAC hole cleaning instructions.
Attention! Standing water must be removed (e.g. vacuum, compressed air, etc.) prior to cleaning.	
CAC: Cleaning (dry, water saturated and water-filled) for all drill hole diameter in uncracked and cracked concrete	
	**2a.** Starting from the bottom or back of the anchor hole, blow the hole clean with compressed air (min. 6 bar / 90 psi) a minimum of two times, until return air stream is free of noticeable dust. If the back of the drilled hole is not reached an extension shall be used.
	**2b.** Determine brush diameter (see Table on page 12) for the drilled hole. Brush the hole with the selected wire brush a minimum of two times (2×). A brush extension (supplied by Chemofast Anchoring GmbH) must be used for drill hole depth > 6” (150 mm). The wire brush diameter must be checked periodically during use ($ø_{brush} > d_{b,min}$ see Table on page 12). 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. If the back of the drilled hole is not reached a brush extension shall be used.
	**2c.** Finally blow the hole clean again with compressed air (min. 6 bar / 90 psi) a minimum of two times, until return air stream is free of noticeable dust. If the back of the drilled hole is not reached an extension shall be used. When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

UWC: Cleaning (submerged) for all bore hole diameter in uncracked and cracked concrete	
	**2a.** Starting from the bottom or back of the bore hole, rinse/flush the hole clean until clean water comes out. If the back of the drilled hole is not reached an extension shall be used.
	**2b.** Determine brush diameter (see Table on page 12) for the drilled hole. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied by Chemofast Anchoring GmbH) must be used for drill hole depth > 6" (150 mm). The wire brush diameter must be checked periodically during use ($d_{brush} > d_{b,min}$ see Table on page 12). 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. If the back of the drilled hole is not reached a brush extension shall be used.
	**2c.** Finally, starting from the bottom or back of the bore hole, rinse/flush the hole clean until clean water comes out. If the back of the drilled hole is not reached an extension shall be used.
After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning has to be repeated directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.	
	**3.** Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. For the permitted range of the base material and cartridge temperature see Table on page 4. Attach a supplied mixing nozzle to the cartridge. Do not modify the mixer in any way and make sure the mixing element is inside the nozzle. Load the cartridge into the correct dispensing tool. **Note: Always use a new mixing nozzle with new cartridges of adhesive and also for all work interruptions exceding the published gel (working) time of the adhesive.**
	**4.** Prior to inserting the anchor rod or rebar into the filled drilled hole, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.
	**5.** Adhesive must be properly mixed to achieve published properties. Prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent gray or red color. Review and note the published working and cure times (see Table on page 4) prior to injection of the mixed adhesive into the cleaned anchor hole.
	**6.** Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. If the bottom or back of the anchor hole is not reached with the mixing nozzle only an extension tube supplied by Chemofast Anchoring GmbH (Cat# 16009 or Cat# 16004) must be used with the mixing nozzle.

	In case of using the extension tube VL16/1,8 (Cat# 16004), cut the tip of the mixer nozzle at position “X”. Piston plugs (see Table on page 12) must be used with and attached to mixing nozzle and extension tube for: • overhead installations and installations between horizontal and overhead • all installations with drill hole depth d_0 > 10” (250 mm) • all installations in submerged bore holes with anchor rod 5/8" to 1-1/4" (M16 to M30) diameter and rebar sizes #5 to #11 (Ø14 to Ø36)
	Insert piston plug to the back of the drilled hole and inject as described in the method above. During installation the piston plug will be naturally extruded from the drilled hole by the adhesive pressure. **Attention! Do not install anchors overhead or upwardly inclined without installation hardware supplied by Chemofast and also receiving proper training and/or certification. Contact Chemofast for details prior to use.**
	7. The anchor should be free of dirt, grease, oil or other foreign material. Push clean threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.
	8. Be sure that the anchor is fully seated at the bottom of the hole and that some adhesive has flowed from the hole and all around the top of the anchor. If there is not enough adhesive in the hole, the installation must be repeated. For overhead applications and applications between horizontal and overhead the anchor must be secured from moving/falling during the cure time (e.g. wedges). Minor adjustments to the anchor may be performed during the gel time but the anchor shall not be moved after placement and during cure.
	9. Allow the adhesive anchor to cure to the specified full curing time prior to applying any load (see Table on page 4). Do not disturb, torque or load the anchor until it is fully cured.
	10. After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (shown in Tables on page 13) by using a calibrated torque wrench. Take care not to exceed the maximum torque for the selected anchor.

2.2 Installation instructions (DD)

Drilling of the bore hole with Diamond drilling - ESR-4901	
Precaution: Wear suitable eye and skin protection. Avoid inhalation of dusts during drilling and/or removal. (see dust extraction equipment by Chemofast to minimize dust emissions)	
	**1.** Drill with diamond drill a hole into the base material to the size and embedment depth required by the selected anchor (see Table on page 13). Proceed with Step 2. In case of aborted bore hole, the bore hole shall be filled with mortar.
Attention! Standing water must be removed (e.g. vacuum, compressed air, etc.) prior to cleaning.	
SPCAC: Cleaning for all bore hole diameter in uncracked concrete	
	**2a.** Starting from the bottom or back of the bore hole, rinse/flush the hole clean until clean water comes out.
	**2b.** Check brush diameter (see Table on page 13). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (see Table on page 13) a minimum of two times. If the bore hole ground is not reached with the brush, a brush extension must be used.
	**2c.** Finally, starting from the bottom or back of the bore hole, rinse/flush the hole clean until clean water comes out. If the back of the drilled hole is not reached an extension shall be used.
	**2d.** Starting from the bottom or back of the anchor hole, blow the hole clean with compressed air (min. 6 bar / 90 psi) a minimum of two times, until return air stream is free of noticeable dust. If the back of the drilled hole is not reached an extension shall be used.
	**2e.** Determine brush diameter (see Table on page 12) for the drilled hole. Brush the hole with the selected wire brush a minimum of two times (2×). A brush extension (supplied by Chemofast Anchoring GmbH) must be used for drill hole depth > 6" (150 mm). The wire brush diameter must be checked periodically during use ($ø_{brush}$ > $d_{b,min}$ see Table on page 12). 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. If the back of the drilled hole is not reached a brush extension shall be used.
	**2f.** Finally blow the hole clean again with compressed air (min. 6 bar / 90 psi) a minimum of two times, until return air stream is free of noticeable dust. If the back of the drilled hole is not reached an extension shall be used. When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

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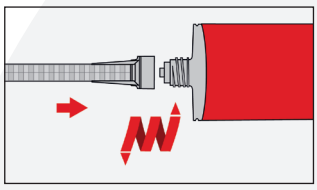
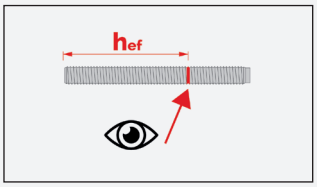
After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning has to be repeated directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.

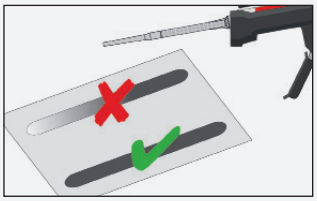


3. Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. For the permitted range of the base material and cartridge temperature see Table on page 4. Attach a supplied mixing nozzle to the cartridge. Do not modify the mixer in any way and make sure the mixing element is inside the nozzle. Load the cartridge into the correct dispensing tool.

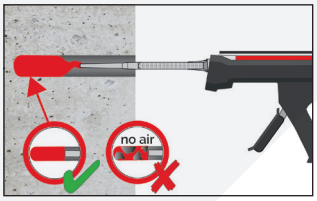
Note: Always use a new mixing nozzle with new cartridges of adhesive and also for all work interruptions exceding the published gel (working) time of the adhesive.

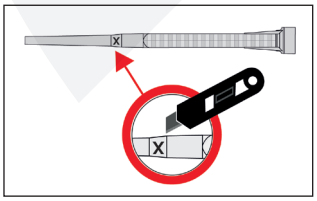


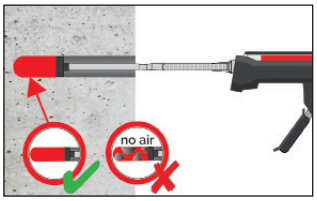
4. Prior to inserting the anchor rod or rebar into the filled drilled hole, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.



5. Adhesive must be properly mixed to achieve published properties. Prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent gray or red color. Review and note the published working and cure times (see Table on page 4) prior to injection of the mixed adhesive into the cleaned anchor hole.





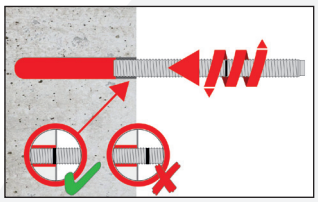
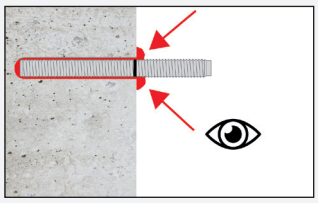
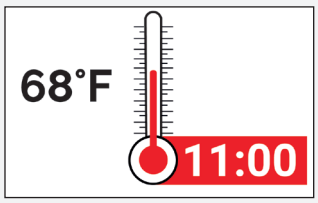


6. Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. If the bottom or back of the anchor hole is not reached with the mixing nozzle only an extension tube supplied by Chemofast Anchoring GmbH (Cat# 16009 or Cat# 16004) must be used with the mixing nozzle.
In case of using the extension tube VL16/1,8 (Cat# 16004), cut the tip of the mixer nozzle at position “X”. Piston plugs (see Table on page 12) must be used with and attached to mixing nozzle and extension tube for:

- overhead installations and installations between horizontal and overhead
- all installations with drill hole depth d_0 > 10” (250 mm)
- all installations in submerged bore holes with anchor rod 5/8" to 1-1/4" (M16 to M30) diameter and rebar sizes #5 to #11 (Ø14 to Ø36)

Insert piston plug to the back of the drilled hole and inject as described in the method above. During installation the piston plug will be naturally extruded from the drilled hole by the adhesive pressure.

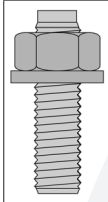
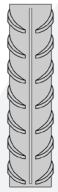
Attention! Do not install anchors overhead or upwardly inclined without installation hardware supplied by Chemofast and also receiving proper training and/or certification. Contact Chemofast for details prior to use.

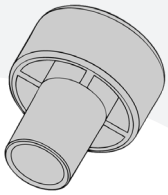
	**7.** The anchor should be free of dirt, grease, oil or other foreign material. Push clean threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.
	**8.** Be sure that the anchor is fully seated at the bottom of the hole and that some adhesive has flowed from the hole and all around the top of the anchor. If there is not enough adhesive in the hole, the installation must be repeated. For overhead applications and applications between horizontal and overhead the anchor must be secured from moving/falling during the cure time (e.g. wedges). Minor adjustments to the anchor may be performed during the gel time but the anchor shall not be moved after placement and during cure.
	**9.** Allow the adhesive anchor to cure to the specified full curing time prior to applying any load (see Table on page 4). Do not disturb, torque or load the anchor until it is fully cured.
	10. After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (shown in Tables on page 13) by using a calibrated torque wrench. Take care not to exceed the maximum torque for the selected anchor.

2.3 Installation accessories

Drilling and cleaning	Tool	Accessories and Shrouds	Vacuum
Dust extraction system for standard drilling and cleaning equipment		SDS-Plus and SDS-Max Drill Bit Capture Device CAT#01128	
Chemofast hollow drill bit system		Heller Duster Expert SDS-Plus and SDS-Max Hollow Drill bit	Class M vaccuum with a minimum air flow rating of 90 cfm (150m³/h resp. 42 l/s).
CAC - Rec. compressed air tool (min 6 bar).			
Brush RBT and brush extension			

Parameter cleaning and setting tools



Threaded rod	Rebar	d_0 Drill bit - Ø HD	d_b Brush-Ø		$d_{b,min}$ min. Brush-Ø		Cat. #	Piston plug	Cat. #	Installation direction and use of piston plug		
[mm]	[mm]	[mm]	[mm]	[inch]	[mm]	[inch]	[-]	[No.]	[-]	↓	→	↑
Fractional sizes												
3/8"	-	7/16	13,5	0,53	11,6	0,46	16111	-	-	Not required		
-	#3	1/2	14,3	0,56	13,2	0,52	16112	-	-			
1/2"	-	9/16	16,3	0,65	14,8	0,58	16114	-	-			
-	#4	5/8	18,3	0,72	16,5	0,65	16116	-	-			
5/8"	-	11/16	20,0	0,79	18,0	0,71	16117	11/16	40355	h_{ef} > 10" h_{ef} > 250 mm		all
-	#5	3/4	21,5	0,85	19,5	0,78	16118	3/4	40341			
3/4"	#6	7/8	24,8	0,98	23,0	0,91	16121	7/8	40343			
7/8"	#7	1	28,5	1,12	26,2	1,03	16123	1	40345			
1"	#8	1 1/8	31,8	1,25	29,5	1,16	16125	1 1/8	40346			
1 1/4"	#9	1 3/8	38,2	1,50	35,8	1,41	16128	1 3/8	40349			
-	#10	1 1/2	41,4	1,63	39,0	1,54	16129	1 1/2	40350			
-	#11	1 3/4	47,0	1,85	45,0	1,77	16080	1 3/4	40352			
Metric sizes												
M10	-	12	13,5	0,53	12,5	0,41	16111	-	-	Not required		
M12	10	14	15,5	0,61	14,5	0,49	16113	-	-			
-	12	16	17,5	0,69	16,5	0,57	16115	-	-			
M16	14	18	20	0,79	18,5	0,65	16117	VS 18	40340	h_{ef} > 250 mm		all
-	16	20	22	0,87	20,5	0,73	16119	VS 20	40342			
M20	-	22	24	0,94	22,5	0,81	16120	VS 22	40343			
-	20	25	27	1,06	24,5	0,89	16122	VS 25	40345			
M24	-	28	30	1,18	28,5	0,96	16124	VS 28	40346			
M27	-	30	31,8	1,25	30,5	1,12	16125	VS 30	40347			
-	25	32	34	1,34	32,5	1,20	16126	VS 32	40348			
M30	28	35	37	1,46	35,5	1,28	16127	VS 35	40349			
-	32	40	43,5	1,71	40,5	1,40	16130	VS 40	40351			
-	36	45	47,0	1,85	45,0	1,77	16080	VS 45	40352			

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2.4 Setting parameter

Nominal threaded rod			Fractional							Metric						
			[inch.], [ft.-lb.]							[mm], [Nm]						
Anchor size			3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/4"	M10	M12	M16	M20	M24	M27	M30
Outer diameter of anchor	$d = d_{nom}$	[inch] [mm]	0,375	0,500	0,625	0,750	0,875	1,000	1,250	10	12	16	20	24	27	30
Nominal drill hole diameter	d_0	[inch] [mm]	7/16	9/16	11/16	7/8	1	1-1/8	1-3/8	12	14	18	22	28	30	35
Effective embedment depth	$h_{ef,min}$	[inch] [mm]	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	5	60	70	80	90	96	108	120
	$h_{ef,max}$	[inch] [mm]	7-1/2	10	12-1/2	15	17-1/2	20	25	200	240	320	400	480	540	600
Maximum torque moment	$T_{inst} \leq$	[inch] [mm]	20[1)]	30	44	66	96	147	221	20	40	80	120	170	250	300
Minimum thickness of member	h_{min}	[inch] [mm]	h_{ef} + 1-1/4		$h_{ef} + 2d_0$					h_{ef} + 30		$h_{ef} + 2d_0$				
Minimum spacing	S_{min}	[inch] [mm]	1-7/8	2-1/2	3	3-3/4	4-1/4	4-3/4	5-7/8	50	60	80	95	115	130	145
Minimum edge distance	C_{min}	[inch] [mm]	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3-1/4	40	45	55	60	70	75	80

[1)] for ASTM 36 and F1554 Grade 36, T_{max} = 15 ft.-lb.

Reinforcing bar			Fractional									Metric								
			[inch.], [ft.-lb.]									[mm], [Nm]								
Anchor size			#3	#4	#5	#6	#7	#8	#9	#10	#11	ø10	ø12	ø14	ø16	ø20	ø25	ø28	ø32	ø36
Outer diameter of anchor	$d=d_{nom}$	[inch] [mm]	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	10	12	14	16	20	25	28	32	36
Nominal drill hole diameter	d_0	[inch] [mm]	1/2	5/8	3/4	7/8	1	1-1/8	1-3/8	1-1/2	1-3/4	14	16	18	20	25	32	35	40	45
Effective embed-ment depth	$h_{ef,min}$	[inch] [mm]	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	4-1/2	5	-	60	70	75	80	90	100	112	128	-
	$h_{ef,max}$	[inch] [mm]	7-1/2	10	12-1/2	15	17-1/2	20	22-1/2	25	-	200	240	280	320	400	500	560	640	-
Maximum torque moment	$T_{inst} \leq$	[inch] [mm]	20[1)]	30	44	66	96	147	185	221	-	20	40	45	80	120	175	250	300	-
Minimum thickness of member	h_{min}	[inch] [mm]	h_{ef} + 1-1/4		$h_{ef} + 2d_0$							h_{ef} + 30			$h_{ef} + 2d_0$					
Minimum spacing	S_{min}	[inch] [mm]	1-7/8	2-1/2	3	3-3/4	4-1/4	4-3/4	5-1/4	5-7/8	-	50	60	70	80	95	120	135	150	-
Minimum edge distance	C_{min}	[inch] [mm]	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3	3-1/4	-	40	45	50	55	60	70	75	85	-
Parameter valid for post-installed rebar																				
Effective embed-ment depth	$h_{ef,min}$	[inch] [mm]	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	4-1/2	5	5-1/2	60	70	75	80	90	100	112	128	128
	$h_{ef,max}$	[inch] [mm]	22-1/2	30	37-1/2	45	52-1/2	60	67-1/2	75	82-1/2-	600	720	840	960	1200	1500	1680	1920	2160

3. Anchorage in concrete

3.1 Allowable Stress Design (ASD)

[1] Allowable load capacities listed are calculated using the applied global safety factors of 4,0 wich includes an assessment of freezing/thawing conditions and sensitivity to sustained loads (i.e. creep resistance).

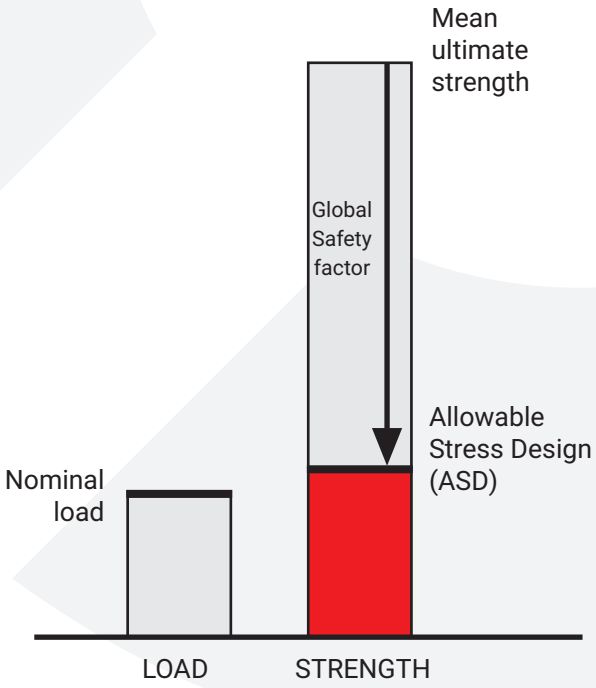
[2] Tabular values are provided for illustration and are applicable for single anchors installed at critical edge and spacing distances in cracked normal-weight concrete where the minimum slab thickness $h_a = h_{min}$ is the greater of [h_{nom} + 1-1/4] and [h_{nom} + $2d_{bit}$] and the following edge distances are meet:
- c_{a1} is greater than or equal to the critical edge distance, cac
- c_{a2} is greater than or equal to 1.5 times c_{a1}.

[3] Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.

[4] The tabulated load values are applicable for dry concrete. Holes must be drilled with a hammer drill and an ANSI carbide drill bit. Installations into saturated (wet) and underwater (submerged) concrete and water-filled holes are required a reduction in capacity for tabulated values.

[5] Temperature range A: 110°F (43°C) / 140°F (60°C). Adhesives experience reductions in capacity at elevated temperatures.

[6] Allowable bond strength/concrete capacity must be checked against allowable steel strength to determine the controlling allowable load.



Ultimate and Allowable Loads Threaded Rod and Reinforcing Bar (fractional) - cracked concrete

Load Capacities for EP 800 installed into Normal Weight Concrete (based on bond strength/concrete capacity) [1) 2) 3) 4) 5) 6)]

Nominal Rod Diameter Size d	Minimum Embedment Depth h_{nom}	Minimum Concrete Compressive Strength							
		f'c = 3.000 psi		f'c = 4.000 psi		f'c = 5.000 psi		f'c = 6.000 psi	
		Ultimate Tension Load Capacity	Allowable Tension Load Capacity	Ultimate Tension Load Capacity	Allowable Tension Load Capacity	Ultimate Tension Load Capacity	Allowable Tension Load Capacity	Ultimate Tension Load Capacity	Allowable Tension Load Capacity
[in.]	[in.]	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])
#3 or 3/8	2 3/8	4.545	1.136	5.245	1.311	5.515	1.379	5.535	1.384
		(20,2)	(5,1)	(23,3)	(5,8)	(24,5)	(6,1)	(24,6)	(6,2)
	3 1/2	8.050	2.013	8.095	2.024	8.130	2.033	8.155	2.039
		(35,8)	(9,0)	(36,0)	(9,0)	(36,2)	(9,0)	(36,3)	(9,1)
	4 1/2	10.350	2.588	10.405	2.601	10.450	2.613	10.485	2.621
		(46,0)	(11,5)	(46,3)	(11,6)	(46,5)	(11,6)	(46,6)	(11,7)
#4 or 1/2	2 3/4	5.660	1.415	6.540	1.635	7.310	1.828	8.005	2.001
		(25,2)	(6,3)	(29,1)	(7,3)	(32,5)	(8,1)	(35,6)	(8,9)
	4 3/8	11.360	2.840	13.120	3.280	13.545	3.386	13.595	3.399
		(50,5)	(12,6)	(58,4)	(14,6)	(60,3)	(15,1)	(60,5)	(15,1)
	6	18.245	4.561	18.500	4.625	18.580	4.645	18.645	4.661
		(81,2)	(20,3)	(82,3)	(20,6)	(82,6)	(20,7)	(82,9)	(20,7)
#5 or 5/8	3 1/8	6.860	1.715	7.920	1.980	8.855	2.214	9.700	2.425
		(30,5)	(7,6)	(35,2)	(8,8)	(39,4)	(9,8)	(43,1)	(10,8)
	5 1/4	14.935	3.734	17.245	4.311	18.340	4.585	18.405	4.601
		(66,4)	(16,6)	(76,7)	(19,2)	(81,6)	(20,4)	(81,9)	(20,5)
	7 1/2	25.500	6.375	26.090	6.523	26.200	6.550	26.290	6.573
		(113,4)	(28,4)	(116,1)	(29,0)	(116,5)	(29,1)	(116,9)	(29,2)
#6 or 3/4	3 1/2	8.130	2.033	9.385	2.346	10.495	2.624	11.495	2.874
		(36,2)	(9,0)	(41,7)	(10,4)	(46,7)	(11,7)	(51,1)	(12,8)
	6 1/4	19.400	4.850	22.400	5.600	25.045	6.261	27.435	6.859
		(86,3)	(21,6)	(99,6)	(24,9)	(111,4)	(27,9)	(122,0)	(30,5)
	9	33.520	8.380	38.705	9.676	41.800	10.450	41.945	10.486
		(149,1)	(37,3)	(172,2)	(43,0)	(185,9)	(46,5)	(186,6)	(46,6)
#7 or 7/8	3 1/2	8.130	2.033	9.385	2.346	10.495	2.624	11.495	2.874
		(36,2)	(9,0)	(41,7)	(10,4)	(46,7)	(11,7)	(51,1)	(12,8)
	7	22.995	5.749	26.550	6.638	29.685	7.421	32.515	8.129
		(102,3)	(25,6)	(118,1)	(29,5)	(132,0)	(33,0)	(144,6)	(36,2)
	10 1/2	42.240	10.560	48.775	12.194	54.535	13.634	57.095	14.274
		(187,9)	(47,0)	(217,0)	(54,2)	(242,6)	(60,6)	(254,0)	(63,5)
#8 or 1	4	9.930	2.483	11.470	2.868	12.820	3.205	14.045	3.511
		(44,2)	(11,0)	(51,0)	(12,8)	(57,0)	(14,3)	(62,5)	(15,6)
	8	28.090	7.023	32.440	8.110	36.265	9.066	39.730	9.933
		(125,0)	(31,2)	(144,3)	(36,1)	(161,3)	(40,3)	(176,7)	(44,2)
	12	51.610	12.903	59.590	14.898	66.625	16.656	72.985	18.246
		(229,6)	(57,4)	(265,1)	(66,3)	(296,4)	(74,1)	(324,7)	(81,2)
#9	5	13.880	3.470	16.030	4.008	17.920	4.480	19.630	4.908
		(61,7)	(15,4)	(71,3)	(17,8)	(79,7)	(19,9)	(87,3)	(21,8)
	10	39.260	9.815	45.335	11.334	50.685	12.671	55.520	13.880
		(174,6)	(43,7)	(201,7)	(50,4)	(225,5)	(56,4)	(247,0)	(61,7)
	15	72.125	18.031	83.285	20.821	93.115	23.279	102.000	25.500
		(320,8)	(80,2)	(370,5)	(92,6)	(414,2)	(103,5)	(453,7)	(113,4)
1 1/4	5	13.880	3.470	16.030	4.008	17.920	4.480	19.630	4.908
		(61,7)	(15,4)	(71,3)	(17,8)	(79,7)	(19,9)	(87,3)	(21,8)
	10	39.260	9.815	45.335	11.334	50.685	12.671	55.520	13.880
		(174,6)	(43,7)	(201,7)	(50,4)	(225,5)	(56,4)	(247,0)	(61,7)
	15	72.125	18.031	83.285	20.821	93.115	23.279	102.000	25.500
		(320,8)	(80,2)	(370,5)	(92,6)	(414,2)	(103,5)	(453,7)	(113,4)
#10	5	13.880	3.470	16.030	4.008	17.920	4.480	19.630	4.908
		(61,7)	(15,4)	(71,3)	(17,8)	(79,7)	(19,9)	(87,3)	(21,8)
	10	39.260	9.815	45.335	11.334	50.685	12.671	55.520	13.880
		(174,6)	(43,7)	(201,7)	(50,4)	(225,5)	(56,4)	(247,0)	(61,7)
	15	72.125	18.031	83.285	20.821	93.115	23.279	102.000	25.500
		(320,8)	(80,2)	(370,5)	(92,6)	(414,2)	(103,5)	(453,7)	(113,4)

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Ultimate and Allowable Loads Threaded Rod and Reinforcing Bar (metric) - cracked concrete

Load Capacities for EP 800 installed into Normal Weight Concrete (based on bond strength/concrete capacity) [1) 2) 3) 4) 5) 6)]

Nominal Rod Diameter Size d	Minimum Embedment Depth h_{nom}	Minimum Concrete Compressive Strength							
		f'c = 3.000 psi		f'c = 4.000 psi		f'c = 5.000 psi		f'c = 6.000 psi	
		Ultimate Tension Load Capacity	Allowable Tension Load Capacity	Ultimate Tension Load Capacity	Allowable Tension Load Capacity	Ultimate Tension Load Capacity	Allowable Tension Load Capacity	Ultimate Tension Load Capacity	Allowable Tension Load Capacity
[in.]	[in.]	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])
Ø10 or M10	2 3/4	5.660	1.415	6.540	1.635	6.705	1.676	6.730	1.683
		(25,2)	(6,3)	(29,1)	(7,3)	(29,8)	(7,5)	(29,9)	(7,5)
	4	9.660	2.415	9.710	2.428	9.750	2.438	9.785	2.446
		(43,0)	(10,7)	(43,2)	(10,8)	(43,4)	(10,8)	(43,5)	(10,9)
	6	14.485	3.621	14.565	3.641	14.630	3.658	14.680	3.670
		(64,4)	(16,1)	(64,8)	(16,2)	(65,1)	(16,3)	(65,3)	(16,3)
Ø12 or M12	3 1/8	6.860	1.715	7.920	1.980	8.855	2.214	9.175	2.294
		(30,5)	(7,6)	(35,2)	(8,8)	(39,4)	(9,8)	(40,8)	(10,2)
	5	13.880	3.470	14.565	3.641	14.630	3.658	14.680	3.670
		(61,7)	(15,4)	(64,8)	(16,2)	(65,1)	(16,3)	(65,3)	(16,3)
	7 1/2	21.730	5.433	21.850	5.463	21.945	5.486	22.020	5.505
		(96,7)	(24,2)	(97,2)	(24,3)	(97,6)	(24,4)	(97,9)	(24,5)
Ø14	3 1/8	6.860	1.715	7.920	1.980	8.855	2.214	9.700	2.425
		(30,5)	(7,6)	(35,2)	(8,8)	(39,4)	(9,8)	(43,1)	(10,8)
	5	13.880	3.470	16.030	4.008	17.065	4.266	17.125	4.281
		(61,7)	(15,4)	(71,3)	(17,8)	(75,9)	(19,0)	(76,2)	(19,0)
	7 1/2	25.355	6.339	25.490	6.373	25.600	6.400	25.690	6.423
		(112,8)	(28,2)	(113,4)	(28,3)	(113,9)	(28,5)	(114,3)	(28,6)
Ø16 or M16	3 1/2	8.130	2.033	9.385	2.346	10.495	2.624	11.495	2.874
		(36,2)	(9,0)	(41,7)	(10,4)	(46,7)	(11,7)	(51,1)	(12,8)
	6	18.245	4.561	21.035	5.259	21.125	5.281	21.200	5.300
		(81,2)	(20,3)	(93,6)	(23,4)	(94,0)	(23,5)	(94,3)	(23,6)
	9	31.385	7.846	31.555	7.889	31.690	7.923	31.800	7.950
		(139,6)	(34,9)	(140,4)	(35,1)	(141,0)	(35,2)	(141,5)	(35,4)
Ø20 or M20	3 1/2	8.130	2.033	9.385	2.346	10.495	2.624	11.495	2.874
		(36,2)	(9,0)	(41,7)	(10,4)	(46,7)	(11,7)	(51,1)	(12,8)
	7	22.995	5.749	26.550	6.638	29.685	7.421	32.515	8.129
		(102,3)	(25,6)	(118,1)	(29,5)	(132,0)	(33,0)	(144,6)	(36,2)
	10 1/2	42.240	10.560	48.775	12.194	51.200	12.800	51.380	12.845
		(187,9)	(47,0)	(217,0)	(54,2)	(227,7)	(56,9)	(228,5)	(57,1)
Ø25 or M24	4	9.930	2.483	11.470	2.868	12.820	3.205	14.045	3.511
		(44,2)	(11,0)	(51,0)	(12,8)	(57,0)	(14,3)	(62,5)	(15,6)
	8	28.090	7.023	32.440	8.110	36.265	9.066	39.730	9.933
		(125,0)	(31,2)	(144,3)	(36,1)	(161,3)	(40,3)	(176,7)	(44,2)
	12	51.610	12.903	59.590	14.898	66.625	16.656	72.985	18.246
		(229,6)	(57,4)	(265,1)	(66,3)	(296,4)	(74,1)	(324,7)	(81,2)
Ø28 or M27	5	13.880	3.470	16.030	4.008	17.920	4.480	19.630	4.908
		(61,7)	(15,4)	(71,3)	(17,8)	(79,7)	(19,9)	(87,3)	(21,8)
	10	39.260	9.815	45.335	11.334	50.685	12.671	55.520	13.880
		(174,6)	(43,7)	(201,7)	(50,4)	(225,5)	(56,4)	(247,0)	(61,7)
	15	72.125	18.031	83.285	20.821	93.115	23.279	100.610	25.153
		(320,8)	(80,2)	(370,5)	(92,6)	(414,2)	(103,5)	(447,5)	(111,9)
Ø32 or M30	5	13.880	3.470	16.030	4.008	17.920	4.480	19.630	4.908
		(61,7)	(15,4)	(71,3)	(17,8)	(79,7)	(19,9)	(87,3)	(21,8)
	10	39.260	9.815	45.335	11.334	50.685	12.671	55.520	13.880
		(174,6)	(43,7)	(201,7)	(50,4)	(225,5)	(56,4)	(247,0)	(61,7)
	15	72.125	18.031	83.285	20.821	93.115	23.279	102.000	25.500
		(320,8)	(80,2)	(370,5)	(92,6)	(414,2)	(103,5)	(453,7)	(113,4)

Steel Allowable Loads Threaded Rods (fractional and metric)

Size	Unit	ASTM A36, F1554; Grade 36		ASTM F1554; Grade 55		ASTM A193; Grade B7, ASTM F1554; Grade 105		ASTM A449		ASTM F568M; Class 5.8		ASTM F593; CW Stainless		ASTM A193/ A193M; Grade B8/B8M2, Class 2B	
[in.]		Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear
3/8	[lbs.]	2.114	1.089	2.733	1.408	4.546	2.342	4.388	2.260	2.643	1.362	3.648	1.879	3.462	1.784
	([kN])	(9,4)	(4,8)	(12,2)	(6,3)	(20,2)	(10,4)	(19,5)	(10,1)	(11,8)	(6,1)	(16,2)	(8,4)	(15,4)	(7,9)
1/2	[lbs.]	3.759	1.937	4.859	2.503	8.082	4.163	7.800	4.018	4.699	2.421	6.484	3.340	6.156	3.171
	([kN])	(16,7)	(8,6)	(21,6)	(11,1)	(36,0)	(18,5)	(34,7)	(17,9)	(20,9)	(10,8)	(28,8)	(14,9)	(27,4)	(14,1)
5/8	[lbs.]	5.874	3.026	7.592	3.911	12.628	6.505	12.188	6.279	7.342	3.782	10.132	5.220	9.618	4.955
	([kN])	(26,1)	(13,5)	(33,8)	(17,4)	(56,2)	(28,9)	(54,2)	(27,9)	(32,7)	(16,8)	(45,1)	(23,2)	(42,8)	(22,0)
3/4	[lbs.]	8.458	4.357	10.932	5.632	18.185	9.368	17.550	9.041	10.572	5.446	12.476	6.427	13.850	7.135
	([kN])	(37,6)	(19,4)	(48,6)	(25,1)	(80,9)	(41,7)	(78,1)	(40,2)	(47,0)	(24,2)	(55,5)	(28,6)	(61,6)	(31,7)
7/8	[lbs.]	11.512	5.931	14.880	7.665	24.751	12.751	23.888	12.306	14.390	7.413	16.981	8.748	18.851	9.711
	([kN])	(51,2)	(26,4)	(66,2)	(34,1)	(110,1)	(56,7)	(106,3)	(54,7)	(64,0)	(33,0)	(75,5)	(38,9)	(83,9)	(43,2)
1	[lbs.]	15.036	7.746	19.435	10.012	32.328	16.654	31.201	16.073	18.796	9.683	22.179	11.425	24.622	12.684
	([kN])	(66,9)	(34,5)	(86,4)	(44,5)	(143,8)	(74,1)	(138,8)	(71,5)	(83,6)	(43,1)	(98,7)	(50,8)	(109,5)	(56,4)
1 1/4	[lbs.]	23.494	12.103	30.367	15.643	50.513	(224,7)	42.290	21.786	29.368	15.129	34.654	17.852	38.472	19.819
	([kN])	(104,5)	(53,8)	(135,1)	(69,6)	26.022	(115,8)	(188,1)	(96,9)	(130,6)	(67,3)	(154,1)	(79,4)	(171,1)	(88,2)

Size	Unit	ISO 898-1; Class 5.8		ISO 898-1; Class 8.8		ISO 3506-1; A4 stainless steel [4]	
[mm]		Tension	Shear	Tension	Shear	Tension	Shear
M8	[lbs.]	2.610	1.345	2.983	1.537	2.610	1.345
	([kN])	(11,6)	(6,0)	(13,3)	(6,8)	(11,6)	(6,0)
M10	[lbs.]	4.079	2.101	4.661	2.401	4.079	2.101
	([kN])	(18,1)	(9,3)	(20,7)	(10,7)	(18,1)	(9,3)
M12	[lbs.]	5.873	3.026	6.712	3.458	5.873	3.026
	([kN])	(26,1)	(13,5)	(29,9)	(15,4)	(26,1)	(13,5)
M16	[lbs.]	10.441	5.379	11.933	6.147	10.441	5.379
	([kN])	(46,4)	(23,9)	(53,1)	(27,3)	(46,4)	(23,9)
M20	[lbs.]	16.315	8.404	18.645	9.605	16.315	8.404
	([kN])	(72,6)	(37,4)	(82,9)	(42,7)	(72,6)	(37,4)
M24	[lbs.]	23.493	12.102	26.849	13.831	23.493	12.102
	([kN])	(104,5)	(53,8)	(119,4)	(61,5)	(104,5)	(53,8)
M27	[lbs.]	21.238	10.941	33.981	17.505	21.238	10.941
	([kN])	(94,5)	(48,7)	(151,2)	(77,9)	(94,5)	(48,7)
M30	[lbs.]	26.220	13.507	41.952	21.611	26.220	13.507
	([kN])	(116,6)	(60,1)	(186,6)	(96,1)	(116,6)	(60,1)

[1] AISC defined steel strength (ASD) for threaded rod and reinforcing bars: Tensile = $0.33 \cdot f_u \cdot A_{nom,\ shear} = 0.17 \cdot f_u \cdot A_{nom}$

[2] Allowable load capacities are calculated for the steel element type. Consideration of applying additional safety factors may be necessary depending on the application, such as life safety or overhead.

[3] Allowable steel strength in tension must be checked against allowable bond strength/concrete capacity in tension to determine the controlling allowable load.

[4] A4-70 Stainless steel (M8-M24), A4-50 Stainless steel (M27-M30).

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Steel Allowable Loads Reinforcing bar (fractional and metric)

Size	Unit	ASTM A615, A767, A996; Grade 60		ASTM A706; Grade 60		ASTM A615; Grade 40	
[in.]		Tension	Shear	Tension	Shear	Tension	Shear
#3	[lbs.]	3.277	1.688	2.907	1.498	2.194	1.130
	([kN])	(14,6)	(7,5)	(12,9)	(6,7)	(9,8)	(5,0)
#4	[lbs.]	5.827	3.002	5.169	2.663	3.900	2.009
	([kN])	(25,9)	(13,4)	(23,0)	(11,8)	(17,3)	(8,9)
#5	[lbs.]	9.104	4.690	8.076	4.160	6.094	3.139
	([kN])	(40,5)	(20,9)	(35,9)	(18,5)	(27,1)	(14,0)
#6	[lbs.]	13.110	6.754	11.630	5.991	8.775	4.521
	([kN])	(58,3)	(30,0)	(51,7)	(26,6)	(39,0)	(20,1)
#7	[lbs.]	17.844	9.192	15.829	8.155	-	-
	([kN])	(79,4)	(40,9)	(70,4)	(36,3)	-	-
#8	[lbs.]	23.306	12.006	20.675	10.651	-	-
	([kN])	(103,7)	(53,4)	(92,0)	(47,4)	-	-
#9	[lbs.]	29.497	15.196	26.167	13.480	-	-
	([kN])	(131,2)	(67,6)	(116,4)	(60,0)	-	-
#10	[lbs.]	36.416	18.760	32.305	16.642	-	-
	([kN])	(162,0)	(83,4)	(143,7)	(74,0)	-	-

Size	Unit	DIN 488 BSt 500	
[mm]		Tension	Shear
Ø8	[lbs.]	2.051	1.057
	([kN])	(9,1)	(4,7)
Ø10	[lbs.]	3.205	1.651
	([kN])	(14,3)	(7,3)
Ø12	[lbs.]	4.615	2.377
	([kN])	(20,5)	(10,6)
Ø14	[lbs.]	6.281	3.236
	([kN])	(27,9)	(14,4)
Ø16	[lbs.]	8.204	4.226
	([kN])	(36,5)	(18,8)
Ø20	[lbs.]	12.819	6.604
	([kN])	(57,0)	(29,4)
Ø25	[lbs.]	20.029	10.318
	([kN])	(89,1)	(45,9)
Ø28	[lbs.]	25.124	12.943
	([kN])	(111,8)	(57,6)
Ø32	[lbs.]	32.816	16.905
	([kN])	(146,0)	(75,2)

[1] AISC defined steel strength (ASD) for threaded rod and reinforcing bars: Tensile = $0.33 \cdot f_u \cdot A_{nom, shear} = 0.17 \cdot f_u \cdot A_{nom}$
[2] Allowable load capacities are calculated for the steel element type. Consideration of applying additional safety factors may be necessary depending on the application, such as life safety or overhead.
[3] Allowable steel strength in tension must be checked against allowable bond strength/concrete capacity in tension to determine the controlling allowable load.

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3.2 Strength Design (Limit state design)

1) Tabular values are provided for illustration and are applicable for single anchors installed at critical edge and spacing distances in normal-weight concrete where the minimum slab thickness $h_a = h_{min}$ is the greater of [h_{nom} + 1-1/4] and [h_{nom} + $2d_{bit}$] and the following edge distances are meet:
- c_{a1} is greater than or equal to the critical edge distance, cac
- c_{a2} is greater than or equal to 1.5 times c_{a1}

2) Calculations were performed according to ACI 318-19, Ch.17 and ICC-ES AC308. The load level corresponding to the failure mode listed (Concrete breakout strength, bond strength/ pryout strength) must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.

3) Strength reduction factors (φ) for concrete breakout strength are based on ACI 318-19 section 5.3 for load combinations. Condition B was assumed.

4) Strength reduction factors (φ) for bond strength are determined from reliability testing and qualification in accordance with ICC-Es AC308 and are tabulated in this product information and in ESR-4901.

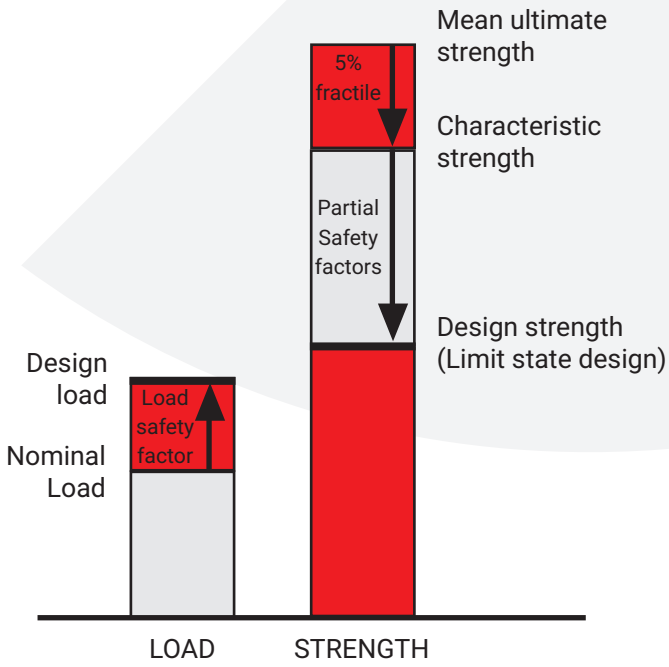
5) Tabular values are permitted for static and sustained loads, including dead and live loads, only. Seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-4901 for applicable information.

6) The tabulated load values are applicable for dry uncracked concrete installed into holes drilled with a hammer drill and an ANsI carbide drill bit. Installations into saturated (wet) concrete or water-filled holes require a reduction in capacity for tabulated values.

7) For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-19, Ch.17.

8) Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318-19, Ch.17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318-19, Ch.17 and ICC-ES AC308 and ESR-4901.

9) Temperature range A: 110°F (43°C) / 176°F (80°C). Adhesives experience reductions in capacity at elevated temperatures. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.



Design Loads Threaded Rod and Reinforcing Bar (fractional) - uncracked concrete

for EP 800 installed in Normal Weight Concrete (based on bond strength/concrete capacity) [1) 2) 3) 4) 5) 6) 7) 8) 9)]

Nominal Rod Diameter Size d	Minimum Embedment Depth h_{nom}	Minimum Concrete Compressive Strength									
		f'c = 2.500 psi		f'c = 3.000 psi		f'c = 4.000 psi		f'c = 6.000 psi		f'c = 8.000 psi	
		ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear
[in.]	[in.]	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])
#3 or 3/8	2 3/8	2.574	2.542	2.820	2.785	3.021	3.216	3.254	3.504	3.430	3.694
		(11,4)	(11,3)	(12,5)	(12,4)	(13,4)	(14,3)	(14,5)	(15,6)	(15,3)	(16,4)
	3 1/2	4.086	3.012	4.224	3.300	4.452	3.810	4.795	4.667	5.055	5.389
		(18,2)	(13,4)	(18,8)	(14,7)	(19,8)	(16,9)	(21,3)	(20,8)	(22,5)	(24,0)
	4 1/2	5.253	7.484	5.431	8.198	5.725	9.466	6.166	11.594	6.499	13.387
		(23,4)	(33,3)	(24,2)	(36,5)	(25,5)	(42,1)	(27,4)	(51,6)	(28,9)	(59,5)
#4 or 1/2	2 3/4	3.122	3.531	3.420	3.868	3.949	4.466	4.836	5.470	5.200	6.316
		(13,9)	(15,7)	(15,2)	(17,2)	(17,6)	(19,9)	(21,5)	(24,3)	(23,1)	(28,1)
	4 3/8	6.686	7.725	6.913	8.462	7.287	9.771	7.848	11.967	8.272	13.818
		(29,7)	(34,4)	(30,8)	(37,6)	(32,4)	(43,5)	(34,9)	(53,2)	(36,8)	(61,5)
	6	9.170	13.127	9.481	14.380	9.993	16.604	10.763	20.336	11.345	23.482
		(40,8)	(58,4)	(42,2)	(64,0)	(44,5)	(73,9)	(47,9)	(90,5)	(50,5)	(104,5)
#5 or 5/8	3 1/8	3.722	4.655	4.078	5.099	4.708	5.888	5.767	7.211	6.659	8.326
		(16,6)	(20,7)	(18,1)	(22,7)	(20,9)	(26,2)	(25,7)	(32,1)	(29,6)	(37,0)
	5 1/4	9.151	11.139	10.024	12.202	10.739	14.090	11.566	17.256	12.192	19.926
		(40,7)	(49,5)	(44,6)	(54,3)	(47,8)	(62,7)	(51,5)	(76,8)	(54,2)	(88,6)
	7 1/2	14.077	20.056	14.555	21.971	15.342	25.370	16.524	31.071	17.417	35.878
		(62,6)	(89,2)	(64,7)	(97,7)	(68,2)	(112,8)	(73,5)	(138,2)	(77,5)	(159,6)
#6 or 3/4	3 1/2	4.368	6.182	4.785	6.773	5.525	7.820	6.767	9.578	7.814	11.060
		(19,4)	(27,5)	(21,3)	(30,1)	(24,6)	(34,8)	(30,1)	(42,6)	(34,8)	(49,2)
	6 1/4	11.911	15.206	13.048	16.658	15.066	19.235	16.230	23.558	17.108	27.202
		(53,0)	(67,6)	(58,0)	(74,1)	(67,0)	(85,6)	(72,2)	(104,8)	(76,1)	(121,0)
	9	19.912	26.083	20.587	28.573	21.700	32.993	23.372	40.408	24.635	46.659
		(88,6)	(116,0)	(91,6)	(127,1)	(96,5)	(146,8)	(104,0)	(179,7)	(109,6)	(207,6)
#7 or 7/8	3 1/2	4.266	7.486	4.673	8.200	5.396	9.469	6.608	11.597	7.631	13.391
		(19,0)	(33,3)	(20,8)	(36,5)	(24,0)	(42,1)	(29,4)	(51,6)	(33,9)	(59,6)
	7	14.019	17.850	15.357	19.554	17.732	22.579	20.824	27.653	21.950	31.932
		(62,4)	(79,4)	(68,3)	(87,0)	(78,9)	(100,4)	(92,6)	(123,0)	(97,6)	(142,0)
	10 1/2	26.539	32.539	27.515	35.645	29.002	41.159	31.236	50.410	32.925	58.208
		(118,0)	(144,7)	(122,4)	(158,6)	(129,0)	(183,1)	(138,9)	(224,2)	(146,5)	(258,9)
#8 or 1	4	5.226	9.282	5.724	10.168	6.610	11.741	8.095	14.380	9.348	16.605
		(23,2)	(41,3)	(25,5)	(45,2)	(29,4)	(52,2)	(36,0)	(64,0)	(41,6)	(73,9)
	8	17.206	21.589	18.848	23.649	21.764	27.308	26.655	33.445	28.142	38.619
		(76,5)	(96,0)	(83,8)	(105,2)	(96,8)	(121,5)	(118,6)	(148,8)	(125,2)	(171,8)
	12	32.424	39.374	35.277	43.132	37.184	49.805	40.048	60.998	42.212	70.435
		(144,2)	(175,1)	(156,9)	(191,9)	(165,4)	(221,5)	(178,1)	(271,3)	(187,8)	(313,3)
#9	5	7.688	11.154	8.422	12.218	9.725	14.109	11.910	17.279	13.753	19.953
		(34,2)	(49,6)	(37,5)	(54,4)	(43,3)	(62,8)	(53,0)	(76,9)	(61,2)	(88,8)
	10	24.666	29.538	27.020	32.357	31.200	37.362	35.980	45.759	37.925	52.839
		(109,7)	(131,4)	(120,2)	(143,9)	(138,8)	(166,2)	(160,0)	(203,5)	(168,7)	(235,0)
	15	45.314	53.921	47.541	59.068	50.111	68.206	53.970	83.535	56.888	96.457
		(201,6)	(239,9)	(211,5)	(262,7)	(222,9)	(303,4)	(240,1)	(371,6)	(253,0)	(429,1)
1 1/4	5	7.345	14.242	8.046	15.601	9.290	18.015	11.378	22.064	13.139	25.477
		(32,7)	(63,4)	(35,8)	(69,4)	(41,3)	(80,1)	(50,6)	(98,1)	(58,4)	(113,3)
	10	24.282	33.013	26.599	36.164	30.714	41.759	37.617	51.144	43.436	59.056
		(108,0)	(146,9)	(118,3)	(160,9)	(136,6)	(185,8)	(167,3)	(227,5)	(193,2)	(262,7)
	15	45.314	60.267	49.639	66.019	57.318	76.232	70.200	93.364	81.060	107.808
		(201,6)	(268,1)	(220,8)	(293,7)	(255,0)	(339,1)	(312,3)	(415,3)	(360,6)	(479,6)
#10	5	5.426	8.109	5.944	8.883	6.863	10.257	8.406	12.562	9.706	14.506
		(24,1)	(36,1)	(26,4)	(39,5)	(30,5)	(45,6)	(37,4)	(55,9)	(43,2)	(64,5)
	10	17.472	19.669	19.139	21.546	22.100	24.879	27.067	30.471	29.219	35.185
		(77,7)	(87,5)	(85,1)	(95,8)	(98,3)	(110,7)	(120,4)	(135,5)	(130,0)	(156,5)
	15	32.097	35.906	35.161	39.333	40.600	45.418	43.590	55.625	43.829	64.230
		(142,8)	(159,7)	(156,4)	(175,0)	(180,6)	(202,0)	(193,9)	(247,4)	(195,0)	(285,7)

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Design Loads Threaded Rod (fractional) - cracked concrete

for EP 800 installed in Normal Weight Concrete (based on bond strength/concrete capacity) 1) 2) 3) 4) 5) 6) 7) 8) 9)

Nominal Rod Diameter Size d	Minimum Embedment Depth h_{nom}	Minimum Concrete Compressive Strength									
		f'c = 2.500 psi		f'c = 3.000 psi		f'c = 4.000 psi		f'c = 6.000 psi		f'c = 8.000 psi	
		ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear
[in.]	[in.]	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])
3/8	2 3/8	1.905	1.816	2.087	1.990	2.410	2.298	2.951	2.814	3.266	3.249
		(8,5)	(8,1)	(9,3)	(8,9)	(10,7)	(10,2)	(13,1)	(12,5)	(14,5)	(14,5)
	3 1/2	3.618	2.152	3.963	2.357	4.368	2.722	4.623	3.334	4.813	3.850
		(16,1)	(9,6)	(17,6)	(10,5)	(19,4)	(12,1)	(20,6)	(14,8)	(21,4)	(17,1)
	4 1/2	5.258	5.348	5.394	5.858	5.615	6.764	5.943	8.284	6.188	9.566
		(23,4)	(23,8)	(24,0)	(26,1)	(25,0)	(30,1)	(26,4)	(36,9)	(27,5)	(42,6)
1/2	2 3/4	2.291	2.550	2.510	2.794	2.898	3.226	3.549	3.951	4.098	4.562
		(10,2)	(11,3)	(11,2)	(12,4)	(12,9)	(14,3)	(15,8)	(17,6)	(18,2)	(20,3)
	4 3/8	5.056	5.579	5.538	6.112	6.395	7.057	7.770	8.643	8.090	9.980
		(22,5)	(24,8)	(24,6)	(27,2)	(28,4)	(31,4)	(34,6)	(38,4)	(36,0)	(44,4)
	6	8.120	9.481	8.895	10.386	10.068	11.992	10.656	14.688	11.094	16.960
		(36,1)	(42,2)	(39,6)	(46,2)	(44,8)	(53,3)	(47,4)	(65,3)	(49,4)	(75,4)
5/8	3 1/8	2.750	3.238	3.013	3.547	3.479	4.095	4.261	5.016	4.920	5.792
		(12,2)	(14,4)	(13,4)	(15,8)	(15,5)	(18,2)	(19,0)	(22,3)	(21,9)	(25,8)
	5 1/4	6.646	7.748	7.281	8.488	8.407	9.801	10.296	12.003	10.854	13.860
		(29,6)	(34,5)	(32,4)	(37,8)	(37,4)	(43,6)	(45,8)	(53,4)	(48,3)	(61,7)
	7 1/2	11.348	13.951	12.431	15.283	14.071	17.647	14.893	21.613	15.505	24.957
		(50,5)	(62,1)	(55,3)	(68,0)	(62,6)	(78,5)	(66,2)	(96,1)	(69,0)	(111,0)
3/4	3 1/2	3.172	4.579	3.474	5.016	4.012	5.792	4.914	7.094	5.674	8.192
		(14,1)	(20,4)	(15,5)	(22,3)	(17,8)	(25,8)	(21,9)	(31,6)	(25,2)	(36,4)
	6 1/4	8.633	11.182	9.457	12.249	10.920	14.144	13.374	17.323	15.443	20.003
		(38,4)	(49,7)	(42,1)	(54,5)	(48,6)	(62,9)	(59,5)	(77,1)	(68,7)	(89,0)
	9	14.918	19.180	16.341	21.011	18.869	24.261	23.110	29.713	25.198	34.310
		(66,4)	(85,3)	(72,7)	(93,5)	(83,9)	(107,9)	(102,8)	(132,2)	(112,1)	(152,6)
7/8	3 1/2	3.085	5.553	3.379	6.083	3.902	7.025	4.779	8.603	5.518	9.934
		(13,7)	(24,7)	(15,0)	(27,1)	(17,4)	31	(21,3)	(38,3)	(24,5)	(44,2)
	7	10.232	13.143	11.209	14.397	12.943	16.624	15.852	20.360	18.304	23.510
		(45,5)	(58,5)	(49,9)	(64,0)	(57,6)	(73,9)	(70,5)	(90,6)	(81,4)	(104,6)
	10 1/2	18.798	23.958	20.592	26.244	23.778	30.305	29.122	37.115	33.627	42.857
		(83,6)	(106,6)	(91,6)	(116,7)	(105,8)	(134,8)	(129,5)	(165,1)	(149,6)	(190,6)
1	4	3.776	6.874	4.136	7.530	4.776	8.695	5.850	10.650	6.755	12.297
		(16,8)	(30,6)	(18,4)	(33,5)	(21,2)	(38,7)	(26,0)	(47,4)	(30,0)	(54,7)
	8	12.502	15.873	13.695	17.388	15.813	20.078	19.367	24.590	22.364	28.395
		(55,6)	(70,6)	(60,9)	(77,3)	(70,3)	(89,3)	(86,2)	(109,4)	(99,5)	(126,3)
	12	22.967	28.950	25.159	31.713	29.051	36.619	35.580	44.849	41.085	51.787
		(102,2)	(128,8)	(111,9)	(141,1)	(129,2)	(162,9)	(158,3)	(199,5)	(182,8)	(230,4)
1 1/4	5	5.292	9.229	5.797	10.110	6.694	11.674	8.199	14.298	9.467	16.510
		(23,5)	(41,1)	(25,8)	(45,0)	(29,8)	(51,9)	(36,5)	(63,6)	(42,1)	(73,4)
	10	17.472	21.814	19.139	23.896	22.100	27.593	27.067	33.794	31.254	39.022
		(77,7)	(97,0)	(85,1)	(106,3)	(98,3)	(122,7)	(120,4)	(150,3)	(139,0)	(173,6)
	15	32.097	39.821	35.161	43.622	40.600	50.371	49.725	61.691	57.417	71.235
		(142,8)	(177,1)	(156,4)	(194,0)	(180,6)	(224,1)	(221,2)	(274,4)	(255,4)	(316,9)

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Design Loads Reinforcing Bar (fractional) - cracked concrete

for EP 800 installed in Normal Weight Concrete (based on bond strength/concrete capacity) 1) 2) 3) 4) 5) 6) 7) 8) 9)

Nominal Rod Diameter Size d	Minimum Embedment Depth h_{nom}	Minimum Concrete Compressive Strength									
		f'c = 2.500 psi		f'c = 3.000 psi		f'c = 4.000 psi		f'c = 6.000 psi		f'c = 8.000 psi	
		ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear
[in.]	[in.]	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])
#3	2 3/8	1.916	1.784	2.099	1.955	2.424	2.257	2.698	2.764	2.713	2.922
		(8,5)	(7,9)	(9,3)	(8,7)	(10,8)	(10,0)	(12,0)	(12,3)	(12,1)	(13,0)
	3 1/2	3.618	2.133	3.924	2.336	3.946	2.698	3.976	3.304	3.998	3.815
		(16,1)	(9,5)	(17,5)	(10,4)	(17,6)	(12,0)	(17,7)	(14,7)	(17,8)	(17,0)
	4 1/2	5.028	5.253	5.045	5.754	5.073	6.644	5.112	8.138	5.140	9.396
		(22,4)	(23,4)	(22,4)	(25,6)	(22,6)	(29,6)	(22,7)	(36,2)	(22,9)	(41,8)
#4	2 3/4	2.305	2.497	2.525	2.735	2.916	3.158	3.571	3.868	4.124	4.466
		(10,3)	(11,1)	(11,2)	(12,2)	(13,0)	(14,0)	(15,9)	(17,2)	(18,3)	(19,9)
	4 3/8	5.056	5.462	5.538	5.983	6.395	6.908	6.627	8.461	6.663	9.770
		(22,5)	(24,3)	(24,6)	(26,6)	(28,4)	(30,7)	(29,5)	(37,6)	(29,6)	(43,5)
	6	8.120	9.281	8.895	10.167	9.019	11.740	9.088	14.378	9.138	16.602
		(36,1)	(41,3)	(39,6)	(45,2)	(40,1)	(52,2)	(40,4)	(64,0)	(40,6)	(73,9)
#5	3 1/8	2.764	3.181	3.028	3.485	3.496	4.024	4.282	4.928	4.945	5.690
		(12,3)	(14,2)	(13,5)	(15,5)	(15,6)	(17,9)	(19,0)	(21,9)	(22,0)	(25,3)
	5 1/4	6.646	7.613	7.281	8.339	8.407	9.629	8.972	11.793	9.021	13.618
		(29,6)	(33,9)	(32,4)	(37,1)	(37,4)	(42,8)	(39,9)	(52,5)	(40,1)	(60,6)
	7 1/2	11.348	13.707	12.431	15.015	12.719	17.338	12.817	21.235	12.888	24.520
		(50,5)	(61,0)	(55,3)	(66,8)	(56,6)	(77,1)	(57,0)	(94,5)	(57,3)	(109,1)
#6	3 1/2	3.192	4.438	3.497	4.862	4.038	5.614	4.945	6.876	5.710	7.939
		(14,2)	(19,7)	(15,6)	(21,6)	(18,0)	(25,0)	(22,0)	(30,6)	(25,4)	(35,3)
	6 1/4	8.633	10.905	9.457	11.946	10.920	13.794	13.374	16.894	14.278	19.508
		(38,4)	(48,5)	(42,1)	(53,1)	(48,6)	(61,4)	(59,5)	(75,1)	(63,5)	(86,8)
	9	14.918	18.706	16.341	20.491	18.869	23.661	20.449	28.978	20.561	33.461
		(66,4)	(83,2)	(72,7)	(91,1)	(83,9)	(105,2)	(91,0)	(128,9)	(91,5)	(148,8)
#7	3 1/2	3.098	5.423	3.393	5.941	3.918	6.860	4.799	8.401	5.542	9.701
		(13,8)	(24,1)	(15,1)	(26,4)	(17,4)	(30,5)	(21,3)	(37,4)	(24,6)	(43,2)
	7	10.232	12.895	11.209	14.126	12.943	16.311	15.852	19.977	18.304	23.067
		(45,5)	(57,4)	(49,9)	(62,8)	(57,6)	(72,6)	(70,5)	(88,9)	(81,4)	(102,6)
	10 1/2	18.798	23.506	20.592	25.750	23.778	29.733	27.833	36.416	27.986	42.049
		(83,6)	(104,6)	(91,6)	(114,5)	(105,8)	(132,3)	(123,8)	(162,0)	(124,5)	(187,0)
#8	4	3.785	6.787	4.146	7.435	4.787	8.585	5.863	10.515	6.770	12.141
		(16,8)	(30,2)	(18,4)	(33,1)	(21,3)	(38,2)	(26,1)	(46,8)	(30,1)	(54,0)
	8	12.502	15.712	13.695	17.212	15.813	19.874	19.367	24.341	22.364	28.106
		(55,6)	(69,9)	(60,9)	(76,6)	(70,3)	(88,4)	(86,2)	(108,3)	(99,5)	(125,0)
	12	22.967	28.656	25.159	31.391	29.051	36.247	35.580	44.394	36.553	51.261
		(102,2)	(127,5)	(111,9)	(139,6)	(129,2)	(161,2)	(158,3)	(197,5)	(162,6)	(228,0)
#9	5	5.408	8.244	5.924	9.030	6.841	10.427	8.378	12.771	9.674	14.747
		(24,1)	(36,7)	(26,4)	(40,2)	(30,4)	(46,4)	(37,3)	(56,8)	(43,0)	(65,6)
	10	17.472	21.682	19.139	23.752	22.100	27.426	27.067	33.590	31.254	38.787
		(77,7)	(96,4)	(85,1)	(105,7)	(98,3)	(122,0)	(120,4)	(149,4)	(139,0)	(172,5)
	15	32.097	39.581	35.161	43.359	40.600	50.067	49.725	61.319	50.330	70.805
		(142,8)	(176,1)	(156,4)	(192,9)	(180,6)	(222,7)	(221,2)	(272,8)	(223,9)	(315,0)
#10	5	5.300	9.160	5.805	10.034	6.704	11.586	8.210	14.190	9.480	16.385
		(23,6)	(40,7)	(25,8)	(44,6)	(29,8)	(51,5)	(36,5)	(63,1)	(42,2)	(72,9)
	10	17.472	21.682	19.139	23.752	22.100	27.426	27.067	33.590	31.254	38.787
		(77,7)	(96,4)	(85,1)	(105,7)	(98,3)	(122,0)	(120,4)	(149,4)	(139,0)	(172,5)
	15	32.097	39.581	35.161	43.359	40.600	50.067	49.725	61.319	55.922	70.805
		(142,8)	(176,1)	(156,4)	(192,9)	(180,6)	(222,7)	(221,2)	(272,8)	(248,8)	(315,0)

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Design Loads Threaded Rod and Reinforcing Bar (metric) - uncracked concrete

for EP 800 installed in Normal Weight Concrete (based on bond strength/concrete capacity) [1) 2) 3) 4) 5) 6) 7) 8) 9)]

Nominal Rod Diameter Size d	Minimum Embedment Depth h_{nom}	Minimum Concrete Compressive Strength									
		f'c = 2.500 psi		f'c = 3.000 psi		f'c = 4.000 psi		f'c = 6.000 psi		f'c = 8.000 psi	
		ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear
[in.]	[in.]	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])
Ø10 or M10	2 3/4	2.521	3.646	2.762	3.994	3.189	4.612	3.906	5.649	4.510	6.523
		(11,2)	(16,2)	(12,3)	(17,8)	(14,2)	(20,5)	(17,4)	(25,1)	(20,1)	(29,0)
	4	4.448	6.862	4.872	7.517	5.626	8.680	6.890	10.630	7.721	12.275
		(19,8)	(30,5)	(21,7)	(33,4)	(25,0)	(38,6)	(30,6)	(47,3)	(34,3)	(54,6)
	6	8.244	13.556	9.031	14.850	10.202	17.147	10.987	21.001	11.581	24.249
		(36,7)	(60,3)	(40,2)	(66,1)	(45,4)	(76,3)	(48,9)	(93,4)	(51,5)	(107,9)
Ø12 or M12	3 1/8	3.052	4.760	3.344	5.215	3.861	6.021	4.729	7.375	5.460	8.515
		(13,6)	(21,2)	(14,9)	(23,2)	(17,2)	(26,8)	(21,0)	(32,8)	(24,3)	(37,9)
	5	6.221	10.496	6.815	11.498	7.870	13.276	9.638	16.260	11.129	18.776
		(27,7)	(46,7)	(30,3)	(51,1)	(35,0)	(59,1)	(42,9)	(72,3)	(49,5)	(83,5)
	7 1/2	11.537	20.732	12.638	22.710	14.593	26.224	16.296	32.117	17.177	36.997
		(51,3)	(92,2)	(56,2)	(101,0)	(64,9)	(116,6)	(72,5)	(142,9)	(76,4)	(164,6)
Ø14	3 1/8	3.854	4.960	4.222	5.433	4.875	6.274	5.971	7.684	6.894	8.872
		(17,1)	(22,1)	(18,8)	(24,2)	(21,7)	(27,9)	(26,6)	(34,2)	(30,7)	(39,5)
	5	8.721	10.936	9.553	11.980	11.031	13.833	12.512	16.942	13.188	19.563
		(38,8)	(48,6)	(42,5)	(53,3)	(49,1)	(61,5)	(55,7)	(75,4)	(58,7)	(87,0)
	7 1/2	15.990	21.601	16.532	23.663	17.426	27.323	18.768	33.464	19.783	38.641
		(71,1)	(96,1)	(73,5)	(105,3)	(77,5)	(121,5)	(83,5)	(148,9)	(88,0)	(171,9)
Ø16 or M16	3 1/2	3.612	6.202	3.957	6.794	4.569	7.845	5.595	9.608	6.461	11.094
		(16,1)	(27,6)	(17,6)	(30,2)	(20,3)	(34,9)	(24,9)	(42,7)	(28,7)	(49,4)
	6	8.165	15.339	8.945	16.803	10.329	19.403	12.650	23.763	14.607	27.439
		(36,3)	(68,2)	(39,8)	(74,7)	(45,9)	(86,3)	(56,3)	(105,7)	(65,0)	(122,1)
	9	15.130	28.846	16.574	31.599	19.139	36.487	23.440	44.687	26.611	51.600
		(67,3)	(128,3)	(73,7)	(140,6)	(85,1)	(162,3)	(104,3)	(198,8)	(118,4)	(229,5)
Ø20 or M20	3 1/2	3.605	6.567	3.949	7.193	4.560	8.306	5.585	10.173	6.449	11.747
		(16,0)	(29,2)	(17,6)	(32,0)	(20,3)	(36,9)	(24,8)	(45,3)	(28,7)	(52,3)
	7	10.281	19.691	11.262	21.571	13.005	24.908	15.927	30.506	18.391	35.225
		(45,7)	(87,6)	(50,1)	(96,0)	(57,8)	(110,8)	(70,8)	(135,7)	(81,8)	(156,7)
	10 1/2	19.043	35.895	20.860	39.321	24.088	45.404	29.501	55.609	34.065	64.212
		(84,7)	(159,7)	(92,8)	(174,9)	(107,1)	(202,0)	(131,2)	(247,4)	(151,5)	(285,6)
Ø25 or M24	4	4.403	8.537	4.824	9.352	5.570	10.798	6.822	13.225	7.877	15.271
		(19,6)	(38,0)	(21,5)	(41,6)	(24,8)	(48,0)	(30,3)	(58,8)	(35,0)	(67,9)
	8	12.555	23.800	13.754	26.071	15.881	30.105	19.450	36.870	22.460	42.574
		(55,8)	(105,9)	(61,2)	(116,0)	(70,6)	(133,9)	(86,5)	(164,0)	(99,9)	(189,4)
	12	23.250	43.407	25.469	47.550	29.409	54.906	36.018	67.246	41.590	77.648
		(103,4)	(193,1)	(113,3)	(211,5)	(130,8)	(244,2)	(160,2)	(299,1)	(185,0)	(345,4)
Ø28 or M27	5	6.160	11.787	6.748	12.912	7.792	14.910	9.544	18.260	11.020	21.085
		(27,4)	(52,4)	(30,0)	(57,4)	(34,7)	(66,3)	(42,5)	(81,2)	(49,0)	(93,8)
	10	17.582	32.872	19.261	36.009	22.240	41.580	27.239	50.925	31.452	58.803
		(78,2)	(146,2)	(85,7)	(160,2)	(98,9)	(185,0)	(121,2)	(226,5)	(139,9)	(261,6)
	15	32.592	60.008	35.702	65.735	41.226	75.904	50.491	92.964	58.302	107.345
		(145,0)	(266,9)	(158,8)	(292,4)	(183,4)	(337,6)	(224,6)	(413,5)	(259,3)	(477,5)
Ø32 or M30	5	5.292	7.775	5.797	8.517	6.694	9.834	8.198	12.045	9.467	13.908
		(23,5)	(34,6)	(25,8)	(37,9)	(29,8)	(43,7)	(36,5)	(53,6)	(42,1)	(61,9)
	10	17.472	21.682	19.139	23.752	22.100	27.426	27.067	33.590	31.254	38.787
		(77,7)	(96,4)	(85,1)	(105,7)	(98,3)	(122,0)	(120,4)	(149,4)	(139,0)	(172,5)
	15	32.097	39.581	35.161	43.359	40.600	50.067	49.725	61.319	56.362	70.805
		(142,8)	(176,1)	(156,4)	(192,9)	(180,6)	(222,7)	(221,2)	(272,8)	(250,7)	(315,0)

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Design Loads Threaded Rod (metric) - cracked concrete

for EP 800 installed in Normal Weight Concrete (based on bond strength/concrete capacity) 1) 2) 3) 4) 5) 6) 7) 8) 9)

Nominal Rod Diameter Size d	Minimum Embedment Depth h_{nom}	Minimum Concrete Compressive Strength									
		f'c = 2.500 psi		f'c = 3.000 psi		f'c = 4.000 psi		f'c = 6.000 psi		f'c = 8.000 psi	
		ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear
[in.]	[in.]	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])
M10	2 3/4	1.790	3.286	1.961	3.600	2.264	4.157	2.773	5.091	3.202	5.878
		(8,0)	(14,6)	(8,7)	(16,0)	(10,1)	(18,5)	(12,3)	(22,6)	(14,2)	(26,1)
	4	3.162	5.738	3.463	6.285	3.999	7.257	4.898	8.889	5.656	10.264
		(14,1)	(25,5)	(15,4)	(28,0)	(17,8)	(32,3)	(21,8)	(39,5)	(25,2)	(45,7)
	6	5.870	10.452	6.430	11.449	7.425	13.220	9.094	16.192	10.501	18.697
		(26,1)	(46,5)	(28,6)	(50,9)	(33,0)	(58,8)	(40,5)	(72,0)	(46,7)	(83,2)
M12	3 1/8	2.167	3.991	2.374	4.371	2.741	5.048	3.357	6.182	3.876	7.139
		(9,6)	(17,8)	(10,6)	(19,4)	(12,2)	(22,5)	(14,9)	(27,5)	(17,2)	(31,8)
	5	4.422	8.009	4.844	8.774	5.593	10.131	6.850	12.408	7.910	14.328
		(19,7)	(35,6)	(21,5)	(39,0)	(24,9)	(45,1)	(30,5)	(55,2)	(35,2)	(63,7)
	7 1/2	8.214	14.588	8.997	15.980	10.389	18.452	12.724	22.600	14.693	26.096
		(36,5)	(64,9)	(40,0)	(71,1)	(46,2)	(82,1)	(56,6)	(100,5)	(65,4)	(116,1)
M16	3 1/2	2.564	4.517	2.809	4.948	3.244	5.713	3.972	6.997	4.587	8.080
		(11,4)	(20,1)	(12,5)	(22,0)	(14,4)	25	(17,7)	(31,1)	(20,4)	(35,9)
	6	5.807	10.030	6.361	10.987	7.345	12.687	8.995	15.538	10.387	17.942
		(25,8)	(44,6)	(28,3)	(48,9)	(32,7)	(56,4)	(40,0)	(69,1)	(46,2)	(79,8)
	9	10.780	18.274	11.809	20.018	13.636	23.115	16.700	28.310	19.284	32.690
		(48,0)	(81,3)	(52,5)	(89,0)	(60,7)	(102,8)	(74,3)	(125,9)	(85,8)	(145,4)
M20	3 1/2	2.556	4.741	2.800	5.193	3.234	5.997	3.960	7.344	4.573	8.480
		(11,4)	(21,1)	(12,5)	(23,1)	(14,4)	(26,7)	(17,6)	(32,7)	(20,3)	(37,7)
	7	7.298	13.222	7.995	14.484	9.232	16.725	11.307	20.483	13.056	23.652
		(32,5)	(58,8)	(35,6)	(64,4)	(41,1)	(74,4)	(50,3)	(91,1)	(58,1)	(105,2)
	10 1/2	13.532	24.102	14.824	26.403	17.117	30.488	20.964	37.339	24.208	43.116
		(60,2)	(107,2)	(65,9)	(117,4)	(76,1)	(135,6)	(93,3)	(166,1)	(107,7)	(191,8)
M24	4	3.122	5.751	3.420	6.299	3.949	7.274	4.837	8.909	5.585	10.287
		(13,9)	(25,6)	(15,2)	(28,0)	(17,6)	(32,4)	(21,5)	(39,6)	(24,8)	(45,8)
	8	8.910	16.032	9.760	17.562	11.270	20.279	13.803	24.836	15.939	28.679
		(39,6)	(71,3)	(43,4)	(78,1)	(50,1)	(90,2)	(61,4)	(110,5)	(70,9)	(127,6)
	12	16.514	29.239	18.091	32.030	20.889	36.985	25.584	45.298	29.542	52.305
		(73,5)	(130,1)	(80,5)	(142,5)	(92,9)	(164,5)	(113,8)	(201,5)	(131,4)	(232,7)
M27	5	4.368	7.921	4.785	8.677	5.525	10.020	6.767	12.271	7.814	14.170
		(19,4)	(35,2)	(21,3)	(38,6)	(24,6)	(44,6)	(30,1)	(54,6)	(34,8)	(63,0)
	10	12.480	22.090	13.671	24.199	15.786	27.942	19.334	34.222	22.324	39.517
		(55,5)	(98,3)	(60,8)	(107,6)	(70,2)	(124,3)	(86,0)	(152,2)	(99,3)	(175,8)
	15	23.156	40.326	25.366	44.175	29.290	51.009	35.873	62.473	41.423	72.138
		(103,0)	(179,4)	(112,8)	(196,5)	(130,3)	(226,9)	(159,6)	(277,9)	(184,3)	(320,9)
M30	5	4.364	7.822	4.781	8.569	5.521	9.894	6.761	12.118	7.807	13.992
		(19,4)	(34,8)	(21,3)	(38,1)	(24,6)	(44,0)	(30,1)	(53,9)	(34,7)	(62,2)
	10	12.458	21.814	13.647	23.896	15.759	27.593	19.300	33.794	22.286	39.022
		(55,4)	(97,0)	(60,7)	(106,3)	(70,1)	(122,7)	(85,9)	(150,3)	(99,1)	(173,6)
	15	23.097	39.821	25.302	43.622	29.216	50.371	35.782	61.691	41.317	71.235
		(102,7)	(177,1)	(112,5)	(194,0)	(130,0)	(224,1)	(159,2)	(274,4)	(183,8)	(316,9)

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Design Loads Reinforcing Bar (metric) - cracked concrete

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Nominal Rod Diameter Size d	Minimum Embedment Depth h_{nom}	Minimum Concrete Compressive Strength									
		f'c = 2.500 psi		f'c = 3.000 psi		f'c = 4.000 psi		f'c = 6.000 psi		f'c = 8.000 psi	
		ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear	ΦN_{cb} ; ΦN_a Tension	ΦV_{cb} ; ΦV_{cp} Shear
[in.]	[in.]	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])	[lbs] ([kN])
Ø10	2 3/4	2.451	2.324	2.685	2.546	3.101	2.939	3.280	3.600	3.298	4.157
		(10,9)	(10,3)	(11,9)	(11,3)	(13,8)	(13,1)	(14,6)	(16,0)	(14,7)	(18,5)
	4	4.420	4.373	4.708	4.790	4.734	5.531	4.771	6.775	4.797	7.823
		(19,7)	(19,5)	(20,9)	(21,3)	(21,1)	(24,6)	(21,2)	(30,1)	(21,3)	(34,8)
	6	7.038	8.639	7.063	9.463	7.101	10.927	7.156	13.383	7.195	15.454
		(31,3)	(38,4)	(31,4)	(42,1)	(31,6)	(48,6)	(31,8)	(59,5)	(32,0)	(68,7)
Ø12	3 1/8	2.925	3.047	3.205	3.338	3.700	3.855	4.473	4.721	4.497	5.451
		(13,0)	(13,6)	(14,3)	(14,8)	(16,5)	17	(19,9)	(21,0)	(20,0)	(24,2)
	5	6.177	6.719	6.767	7.360	7.101	8.499	7.156	10.409	7.195	12.019
		(27,5)	(29,9)	(30,1)	(32,7)	(31,6)	(37,8)	(31,8)	(46,3)	(32,0)	(53,5)
	7 1/2	10.557	13.272	10.594	14.538	10.652	16.787	10.734	20.560	10.793	23.247
		(47,0)	(59,0)	(47,1)	(64,7)	(47,4)	(74,7)	(47,7)	(91,5)	(48,0)	(103,4)
Ø14	3 1/8	2.813	3.192	3.081	3.496	3.558	4.037	4.357	4.944	5.031	5.709
		(12,5)	(14,2)	(13,7)	(15,6)	(15,8)	(18,0)	(19,4)	(22,0)	(22,4)	(25,4)
	5	6.177	7.037	6.767	7.709	7.814	8.901	8.349	10.902	8.395	12.588
		(27,5)	(31,3)	(30,1)	(34,3)	(34,8)	(39,6)	(37,1)	(48,5)	(37,3)	(56,0)
	7 1/2	11.348	13.900	12.360	15.226	12.427	17.582	12.523	21.533	12.592	24.864
		(50,5)	(61,8)	(55,0)	(67,7)	(55,3)	(78,2)	(55,7)	(95,8)	(56,0)	(110,6)
Ø16	3 1/2	3.359	3.860	3.680	4.229	4.249	4.883	5.204	5.980	6.009	6.905
		(14,9)	(17,2)	(16,4)	(18,8)	(18,9)	(21,7)	(23,1)	(26,6)	(26,7)	(30,7)
	6	8.120	9.547	8.895	10.459	10.255	12.077	10.335	14.791	10.391	17.079
		(36,1)	(42,5)	(39,6)	(46,5)	(45,6)	(53,7)	(46,0)	(65,8)	(46,2)	(76,0)
	9	14.918	17.954	15.299	19.668	15.383	22.710	15.502	27.814	15.587	32.117
		(66,4)	(79,9)	(68,1)	(87,5)	(68,4)	(101,0)	(69,0)	(123,7)	(69,3)	(142,9)
Ø20	3 1/2	3.161	4.300	3.462	4.711	3.998	5.439	4.897	6.662	5.654	7.693
		(14,1)	(19,1)	(15,4)	(21,0)	(17,8)	(24,2)	(21,8)	(29,6)	(25,2)	(34,2)
	7	10.232	12.895	11.209	14.126	12.943	16.311	15.852	19.977	16.789	23.067
		(45,5)	(57,4)	(49,9)	(62,8)	(57,6)	(72,6)	(70,5)	(88,9)	(74,7)	(102,6)
	10 1/2	18.798	23.506	20.592	25.750	23.778	29.733	25.047	36.416	25.184	42.049
		(83,6)	(104,6)	(91,6)	(114,5)	(105,8)	(132,3)	(111,4)	(162,0)	(112,0)	(187,0)
Ø25	4	3.796	5.636	4.158	6.174	4.801	7.129	5.881	8.731	6.790	10.082
		(16,9)	(25,1)	(18,5)	(27,5)	(21,4)	(31,7)	(26,2)	(38,8)	(30,2)	(44,8)
	8	12.502	15.712	13.695	17.212	15.813	19.874	19.367	24.341	22.364	28.106
		(55,6)	(69,9)	(60,9)	(76,6)	(70,3)	(88,4)	(86,2)	(108,3)	(99,5)	(125,0)
	12	22.967	28.656	25.159	31.391	29.051	36.247	35.580	44.394	35.977	51.261
		(102,2)	(127,5)	(111,9)	(139,6)	(129,2)	(161,2)	(158,3)	(197,5)	(160,0)	(228,0)
Ø28	5	5.430	7.775	5.949	8.517	6.869	9.834	8.413	12.045	9.714	13.908
		(24,2)	(34,6)	(26,5)	(37,9)	(30,6)	(43,7)	(37,4)	(53,6)	(43,2)	(61,9)
	10	17.472	21.682	19.139	23.752	22.100	27.426	27.067	33.590	31.254	38.787
		(77,7)	(96,4)	(85,1)	(105,7)	(98,3)	(122,0)	(120,4)	(149,4)	(139,0)	(172,5)
	15	32.097	39.581	35.161	43.359	40.600	50.067	49.048	61.319	49.317	70.805
		(142,8)	(176,1)	(156,4)	(192,9)	(180,6)	(222,7)	(218,2)	(272,8)	(219,4)	(315,0)
Ø32	5	5.292	7.775	5.797	8.517	6.694	9.834	8.198	12.045	9.467	13.908
		(23,5)	(34,6)	(25,8)	(37,9)	(29,8)	(43,7)	(36,5)	(53,6)	(42,1)	(61,9)
	10	17.472	21.682	19.139	23.752	22.100	27.426	27.067	33.590	31.254	38.787
		(77,7)	(96,4)	(85,1)	(105,7)	(98,3)	(122,0)	(120,4)	(149,4)	(139,0)	(172,5)
	15	32.097	39.581	35.161	43.359	40.600	50.067	49.725	61.319	56.362	70.805
		(142,8)	(176,1)	(156,4)	(192,9)	(180,6)	(222,7)	(221,2)	(272,8)	(250,7)	(315,0)

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Steel design Loads Threaded Rods (fractional and metric)

Size	Unit	ASTM A36, F1554; Grade 36		ASTM F1554; Grade 55		ASTM A193; Grade B7, ASTM F1554; Grade 105		ASTM A449		ASTM F568M; Class 5.8		ASTM F593; CW Stainless		ASTM A193/ A193M; Grade B8/B8M2, Class 2B	
		Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear
[in.]		$ØN_{sa}$	$ØV_{sa}$	$ØN_{sa}$	$ØV_{sa}$	$ØN_{sa}$	$ØV_{sa}$	$ØN_{sa}$	$ØV_{sa}$	$ØN_{sa}$	$ØV_{sa}$	$ØN_{sa}$	$ØV_{sa}$	$ØN_{sa}$	$ØV_{sa}$
3/8	[lbs.]	3370	1.750	4.360	2.270	4.360	6.295	6.975	3.625	3.655	2.020	5.040	2.790	5.525	2.875
	([kN])	(15,0)	(7,8)	(19,4)	(10,1)	(19,4)	(28,0)	(31,0)	(16,1)	(16,3)	(9,0)	(22,4)	(12,4)	(24,6)	(12,8)
1/2	[lbs.]	6.175	3.210	7.985	4.150	7.980	11.530	12.775	6.645	6.690	3.705	9.225	5.110	10.110	5.260
	([kN])	(27,5)	(14,3)	(35,5)	(18,5)	(35,5)	(51,3)	(56,8)	(29,6)	(29,8)	(16,5)	(41,0)	(22,7)	(45,0)	(23,4)
5/8	[lbs.]	9.835	5.110	12.715	6.610	12.715	18.365	20.340	10.575	10.650	5.900	14.690	8.135	16.105	8.370
	([kN])	(43,7)	(22,7)	(56,6)	(29,4)	(56,6)	(81,7)	(90,5)	(47,0)	(47,4)	(26,2)	(65,3)	(36,2)	(71,6)	(37,2)
3/4	[lbs.]	14.550	7.565	18.820	9.785	18.815	27.175	30.105	15.655	15.765	8.730	18.480	10.235	23.835	12.395
	([kN])	(64,7)	(33,7)	(83,7)	(43,5)	(83,7)	(120,9)	(133,9)	(69,6)	(70,1)	(38,8)	(82,2)	(45,5)	(106,0)	(55,1)
7/8	[lbs.]	20.085	10.440	25.975	13.505	25.970	37.510	41.555	21.605	21.755	12.050	25.510	14.125	32.895	17.110
	([kN])	(89,3)	(46,4)	(115,5)	(60,1)	(115,5)	(166,9)	(184,8)	(96,1)	(96,8)	(53,6)	(113,5)	(62,8)	(146,3)	(76,1)
1	[lbs.]	26.350	13.700	34.075	17.720	34.070	49.210	54.515	28.345	28.540	15.810	33.465	18.535	43.155	(192,0)
	([kN])	(117,2)	(60,9)	(151,6)	(78,8)	(151,6)	(218,9)	(242,5)	(126,1)	(127,0)	(70,3)	(148,9)	(82,4)	22.440	(99,8)
1 1/4	[lbs.]	42.160	21.920	54.515	28.345	54.510	78.740	76.315	39.685	45.670	25.295	53.540	29.650	69.050	35.905
	([kN])	(187,5)	(97,5)	(242,5)	(126,1)	(242,5)	(350,3)	(339,5)	(176,5)	(203,2)	(112,5)	(238,2)	(131,9)	(307,1)	(159,7)

Size	Unit	ISO 898-1; Class 5.8		ISO 898-1; Class 8.8		ISO 3506-1; A4 stainless steel [5]	
		Tension	Shear	Tension	Shear	Tension	Shear
[mm]		$ØN_{sa}$	$ØV_{sa}$	$ØN_{sa}$	$ØV_{sa}$	$ØN_{sa}$	$ØV_{sa}$
M8	[lbs.]	2675	1.480	4280	2.370	3745	2.075
	([kN])	(11,9)	(6,6)	(19,0)	(10,5)	(16,7)	(9,2)
M10	[lbs.]	4235	1.955	6780	3.130	5930	2.740
	([kN])	(18,8)	(8,7)	(30,2)	(13,9)	(26,4)	(12,2)
M12	[lbs.]	6.155	3.410	9.850	5.455	8.620	4.775
	([kN])	(27,4)	(15,2)	(43,8)	(24,3)	(38,3)	(21,2)
M16	[lbs.]	11.470	6.350	18.350	10.160	16.055	8.890
	([kN])	(51,0)	(28,2)	(81,6)	(45,2)	(71,4)	(39,5)
M20	[lbs.]	17.895	9.910	28.635	15.860	25.055	13.875
	([kN])	(79,6)	(44,1)	(127,4)	(70,5)	(111,5)	(61,7)
M24	[lbs.]	25.785	14.280	41.255	22.850	36.100	19.995
	([kN])	(114,7)	(63,5)	(183,5)	(101,6)	(160,6)	(88,9)
M27	[lbs.]	33.525	18.570	53.645	29.710	33.525	18.570
	([kN])	(149,1)	(82,6)	(238,6)	(132,2)	(149,1)	(82,6)
M30	[lbs.]	40.980	22.695	65.565	36.315	40.980	22.695
	([kN])	(182,3)	(101,0)	(291,6)	(161,5)	(182,3)	(101,0)

[1] Steel tensile design strength according to ACI 318-19 Ch.17 Appendix D, $\varphi N_{sa} = \varphi \cdot A_{se,N} \cdot f_{uta}$
[2] The tabulated steel design strength in tension must be checked against the bond strength/concrete capacity design strength to determine the controlling failure mode,
the lowest load level controls.
[3] Steel shear design strength according to ACI 318-19 Ch.17 Appendix D, $\varphi V_{sa} = \varphi \cdot 0.60 \cdot A_{se,V} \cdot f_{uta}$
[4] The tabulated steel design strength in shear must be checked against the bond strength/concrete capacity design strength to determine the controlling failure mode, the lowest load level controls.
[5] A4-70 Stainless steel (M8-M24), A4-50 Stainless steel (M27-M30).

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Steel design Loads Reinforcing Bar (fractional and metric)

Size	Unit	ASTM A615, A767, A996; Grade 60		ASTM A706; Grade 60		ASTM A615; Grade 40	
		Tension	Shear	Tension	Shear	Tension	Shear
[in.]		$ØN_{sa}$	$ØV_{sa}$	$ØN_{sa}$	$ØV_{sa}$	$ØN_{sa}$	$ØV_{sa}$
#3	[lbs.]	6.435	3.565	6.600	3.430	4.290	2.375
	([kN])	(28,6)	(15,9)	(29,4)	(15,3)	(19,1)	(10,6)
#4	[lbs.]	11.700	6.480	12.000	6.240	7.800	4.320
	([kN])	(52,0)	(28,8)	(53,4)	(27,8)	(34,7)	(19,2)
#5	[lbs.]	18.135	10.045	18.600	9.670	12.090	6.695
	([kN])	(80,7)	(44,7)	(82,7)	(43,0)	(53,8)	(29,8)
#6	[lbs.]	25.740	14.255	26.400	13.730	17.160	9.505
	([kN])	(114,5)	(63,4)	(117,4)	(61,1)	(76,3)	(42,3)
#7	[lbs.]	35.100	19.440	36.000	18.720	-	-
	([kN])	(156,1)	(86,5)	(160,1)	(83,3)	-	-
#8	[lbs.]	46.215	25.595	47.400	24.650	-	-
	([kN])	(205,6)	(113,9)	(210,8)	(109,6)	-	-
#9	[lbs.]	58.500	32.400	60.000	31.200	-	-
	([kN])	(260,2)	(144,1)	(266,9)	(138,8)	-	-
#10	[lbs.]	74.295	41.150	76.200	39.625	-	-
	([kN])	(330,5)	(183,0)	(339,0)	(176,3)	-	-

Size	Unit	DIN 488 BSt 500	
		Tension	Shear
[mm]		$ØN_{sa}$	$ØV_{sa}$
Ø8	[lbs.]	4.020	2.225
	([kN])	(17,9)	(9,9)
Ø10	[lbs.]	6.350	3.515
	([kN])	(28,2)	(15,6)
Ø12	[lbs.]	9.080	5.030
	([kN])	(40,4)	(22,4)
Ø14	[lbs.]	12.375	6.855
	([kN])	(55,0)	(30,5)
Ø16	[lbs.]	16.155	8.945
	([kN])	(71,9)	(39,8)
Ø20	[lbs.]	25.235	13.975
	([kN])	(112,3)	(62,2)
Ø25	[lbs.]	39.460	21.855
	([kN])	(175,5)	(97,2)
Ø28	[lbs.]	49.505	27.420
	([kN])	(220,2)	(122,0)
Ø32	[lbs.]	64.615	35.790
	([kN])	(287,4)	(159,2)

1) Steel tensile design strength according to ACI 318-19 Ch.17 Appendix D, $\varphi N_{sa} = \varphi \cdot A_{se,N} \cdot f_{uta}$

2) The tabulated steel design strength in tension must be checked against the bond strength/concrete capacity design strength to determine the controlling failure mode,

the lowest load level controls.

3) Steel shear design strength according to ACI 318-19 Ch.17 Appendix D, $\varphi V_{sa} = \varphi \cdot 0.60 \cdot A_{se,V} \cdot f_{uta}$

4) The tabulated steel design strength in shear must be checked against the bond strength/concrete capacity design strength to determine the controlling failure mode, the lowest load level controls.

4. Post-installed rebar

4.1 Development length

Holes drilled with a hammer drill and carbide bit or Chemofast hollow carbide drill bits

Design information	Symbol	Criteria Section of Reference Standard	Units	U.S. customary unit reinforcing bar size[1) 2) 3)]							
				#3	#4	#5	#6	#7	#8	#9	#10
Nominal reinforcing bar diameter	d_b	ASTM A615/ A706	in.	0.375	0.500	0.625	0.750	0.875	1.000	1.125	1.250
			(mm)	(9.5)	(12.7)	(15.9)	(19.1)	(22.2)	(25.4)	(28.6)	(31.8)
Nominal bar area	A_b	ASTM A615/ A706	in^2	0.11	0.20	0.31	0.44	0.60	0.79	1.00	1.27
			(mm^2)	(71.3)	(126.7)	(197.9)	(285.0)	(387.9)	(506.7)	(644.7)	(817.3)
Development length for f_y = 60 ksi and f'_c = 2,500 psi (normalweight concrete)[3)]	l_d	ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3	in.	12.0	14.4	18.0	21.6	31.5	36.0	40.5	45.0
			(mm)	(304.8)	(365.8)	(457.2)	(548.6)	(800.1)	(914.4)	(1028.7)	(1143.0)
Development length for f_y = 60 ksi and f'_c = 4,000 psi (normalweight concrete)[3)]	l_d	ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3	in.	12.0	12.0	14.2	17.1	24.9	28.5	32.0	35.6
			(mm)	(304.8)	(304.8)	(361.4)	(433.7)	(632.5)	(722.9)	(812.8)	(904.2)

Design information	Symbol	Criteria Section of Reference Standard	Units	EU metric reinforcing bar size[1) 2) 4)]						
				8	10	12	16	20	25	32
Nominal reinforcing bar diameter	d_b	BS 4449: 2005	mm	8	10	12	16	20	25	32
			(in.)	(0.315)	(0.394)	(0.472)	(0.630)	(0.787)	(0.984)	(1.260)
Nominal bar area	A_b	BS 4449: 2005	mm^2	50.3	78.5	113.1	201.1	314.2	490.9	804.2
			(in^2)	(0.08)	(0.12)	(0.18)	(0.31)	(0.49)	(0.76)	(1.25)
Development length for fy = 72.5 ksi and f'c = 2,500 psi (normalweight concrete)[3)]	l_d	ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3	mm	305	348	417	556	871	1087	1392
			(in.)	(12.0)	(13.7)	(16.4)	(21.9)	(34.3)	(42.8)	(54.8)
Development length for fy = 72.5 ksi and f'c = 4,000 psi (normalweight concrete)[3)]	l_d	ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3	mm	305	305	330	439	688	859	1100
			(in.)	(12.0)	(12.0)	(13.0)	(17.3)	(27.1)	(33.8)	(43.3)

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 Mpa

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 Mpa = 145.0 psi

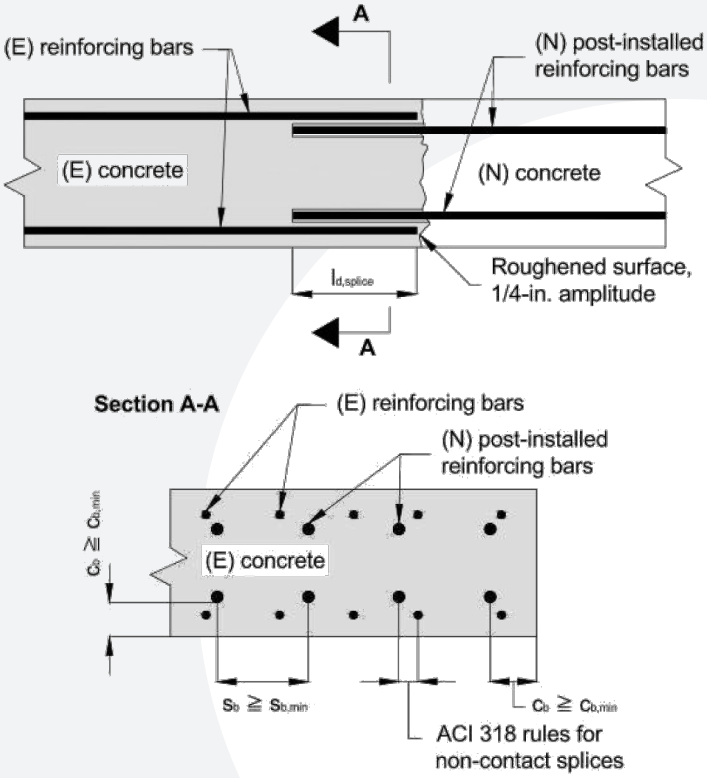
1) Development lengths valid for static, wind and earthquake loads (SDC A and B).

2) Development lengths in SDC C through F must comply with ACI 318-19 Chapter 18, ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21 and Section 4.2.4 of this report.

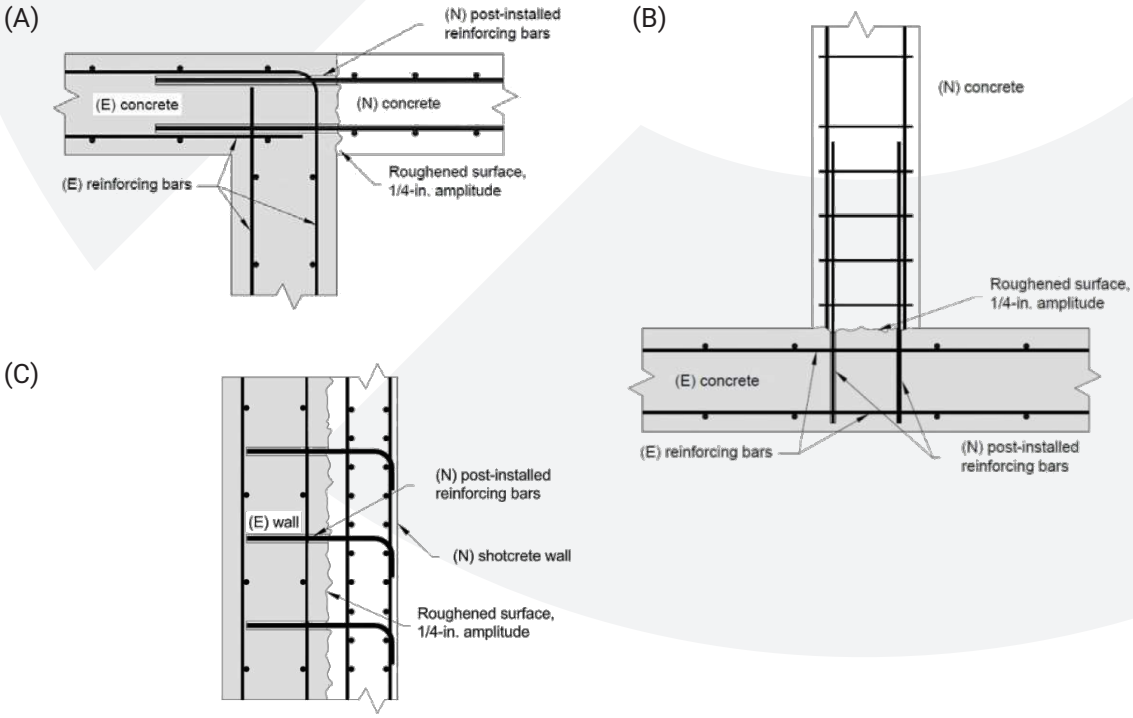
3) f_y and f'_c used in this table are for example purposes only. For sand-lightweight concrete, increase develpment length by 33%, unless the provisions of ACI 318-19 25.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (d) are met to permit $\lambda > 0.75$

4) $(c_b + K_{tr}) / d_b = 2.5$, $\psi_t = 1.0$, $\psi_e = 1.0$, $\psi_s = 0.8$ for U.S. customary unit: $d_b \leq$ #6, 1.0 $d_b >$ #6; for EU metric unit: $d_b \leq 20$ mm, 1.0 for $d_b > 20$ mm.

4.2 Installation parameters for Post-installed reinforcing bars



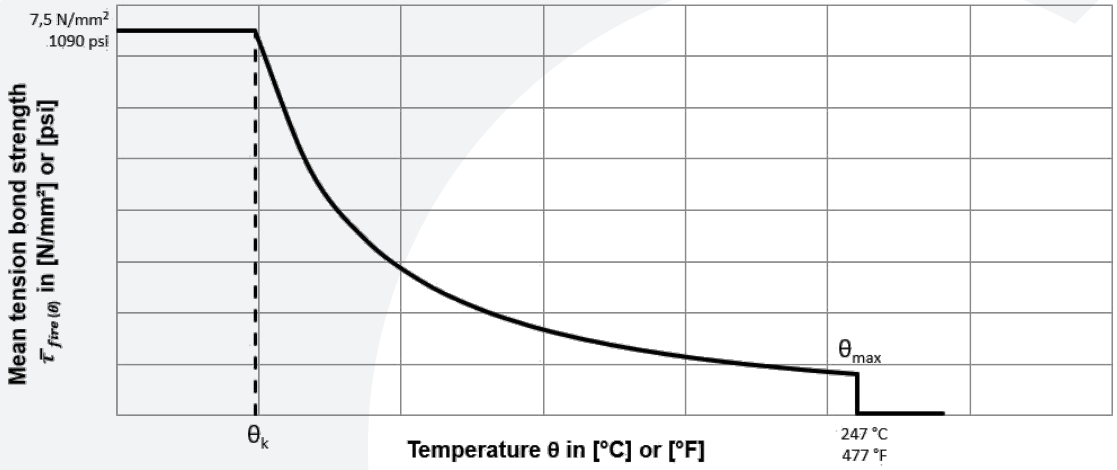
4.3 Application examples for post-installed reinforcing bars



(A) Tension lap splice with existing flexural reinforcement; (B) Tension development of column dowels; (C) Development of shear dowels for newly thickened shear wall

4.4 Bond strength vs temperature

Post installed reinforcing bar applications subject to elevated temperature / fire in holes drilled with hammer drill and carbide bit (or Chemofast hollow carbide drill bit) or diamand core bit [1) 2) 3)]



The mean tension bond strength $\bar{\tau}_{fire}(\Theta)$ under fire conditions shall be determined in accordance with the following equations:

For hammer drill and carbide bit (or Chemofast hollow carbide bit):

$\bar{\tau}_{fire}(\Theta) = 1955671 * \Theta^{-1.585} \leq 1090$ [psi] with θ in °F
$\bar{\tau}_{fire}(\Theta) = 1277 * \Theta^{-1.341} \leq 7.5$ [N/mm²] with θ in °C
$\Theta_k = 113$°F (46°C)

For diamond core bit:

$\bar{\tau}_{fire}(\Theta) = 1814842 * \Theta^{-1.585} \leq 1090$ [psi] with θ in °F
$\bar{\tau}_{fire}(\Theta) = 1185 * \Theta^{-1.341} \leq 7.5$ [N/mm²] with θ in °C
$\Theta_k = 108$°F (44°C)

1) With θ_{max} = 247°C (477°F). For temperatures larger than θ_{max} the bond sthrength.
2) For application with rebar #11 (36mm) or larger for overhead installation, bond strengths must be decreased by 11 percent.
3) Bond strengths under fire are for short-term loads such as wind, for sustained loads including dead and live, and for seismic loads.

5. Chemical resistance

Chemical Agent	Concentration	Resistant	Not resistant
Accumulator acid			x
Acetic acid	10%		x
Acetic acid	40%		x
Laitance		x	
Acetone	5%		x
Acetone	10%		x
Acetone	100%		x
Ammonia, aqueous solution	5%	x	
Ammonia, aqueous solution	32%		x
Aniline	100%		x
Beer	100%	x	
Chlorine	All	x	
Benzol	100%		x
Boric Acid, aqueous solution		x	
Calcium carbonate, suspended in water	All	x	
Calcium chloride, suspended in water		x	
Calcium hydroxide, suspended in water		x	
Chlorinated lime (Calcium hypochlorite)	10%		x
Carbon tetrachloride	100%	x	
Caustic soda solution	10%	x	
Caustic soda solution	40%	x	
Citric acid	10%		x
Citric acid	50%		x
Citric acid	All	x	
Chlorine water, swimming pool	All		x
Demineralized water	All		x
Diesel oil	100%	x	
Ethyl alcohol, aqueous solution	100%		x
Ethyl alcohol, aqueous solution	50%		x
Formic acid	10%	x	
Formic acid	30%		x
Formic acid	100%		x
Formaldehyde, aqueous solution	20%	x	
Formaldehyde, aqueous solution	30%	x	
Freon		x	
Fuel Oil		x	
Gasoline (premium grade)	100%	x	
Glycol (Ethylene glycol)		x	
Hydraulic fluid	Conc.		x
Hydrochloric acid (Muriatic Acid)	Conc.		x
Hydrogen peroxide	10%		x
Hydrogen peroxide	30%		x
Isopropyi alcohol	100%		x
Lactic acid	10%		x

Results shown in the table are applicable to brief periods of chemical contact with full cured adhesive (e.g. temporary contact with adhesive during a spill).

Chemical Agent	Concentration	Resistant	Not resistant
Lactic acid	All		x
Linseed oil	100%	x	
Lubricating oil	100%	x	
Magnesium chloride, aqueous solution	All	x	
Methanol	100%		x
Standard benzine			x
Motor oil (SAE 20 W-50)	100%	x	
Nitric acid	10%		x
Oleic acid	100%	x	
Perchloroethylene	100%	x	
Petroleum	100%	x	
Phenol, aqueous solution	8%		x
Benzyl alocohol	100%		x
Phosphoric acid	85%	x	
Phosphoric acid	10%	x	
Potash lye (Potassium hydroxide)	10%	x	
Potash lye (Potassium hydroxide)	40%	x	
Potassium carbonate, aqueous solution	All	x	
Potassium chlorite, aqueous solution	All	x	
Potassium nitrate, aqueous solution	All	x	
Sea water, salty	All	x	
Sodium carbonate	All	x	
Sodium chloride, aqueous solution	All	x	
Sodium phosphate, aqueous solution	All	x	
Sodium silicate	All	x	
Sulfuric acid	10%		x
Sulfuric acid	30%		x
Sulfuric acid	70%		x
Tartaric acid	All	x	
Tetrachloroethylene	100%	x	
Toluene			x
Trichloroethylene	100%		x
Turpentine	100%	x	

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