TECHNICAL DATA SHEET

LIQUIDROC® 200

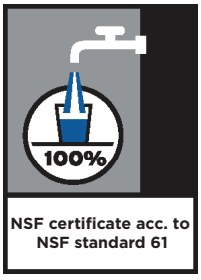
Styrene free Urethane hybrid adhesive

Application in non-cracked concrete

Post-installed rebar

Application in cracked concrete

Application under Seismic loading



NSF certificate acc. to NSF standard 61

Fire test report

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CONTACT

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PRODUCT DESCRIPTION

Liquid Roc 200 is a urethane hybrid adhesive that is styrene free and is available in a two component injection system for easy dispensing. This high performance adhesive may be dispensed using either manual, pneumatic or battery powered dispensers. It is specially designed for bonding threaded rod, rebar or internally threaded inserts into hardened concrete. Liquid Roc 200 can be installed into walls or even overhead, at temperatures as low as 23° F and in applications of up to 320° F in service. It is suitable for use in applications where chemical exposure is possible due to its high chemical resistance.

PROPERTIES AND BENEFITS

- ICC-ES approval according to AC308 in concrete, ESR-4252
- Certified for drinking water applications acc. to NSF Standard 61
- For heavy anchoring - doweling and post-installed rebar connection
- Fire resistance test report: up to 120 min.
- Overhead application
- Suitable for attachment points with short edge distance and anchor spacing due to an anchoring free of expansion forces
- High chemical resistance
- Low odor
- High bending and compressive 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
- Meets ASTM C881, Type IV, Grade 3, Class A, B and C

APPLICATIONS EXAMPLES

Suitable for fastening facades, roofs, wood construction, metal construction, metal profiles, columns, beams, consoles, railings, sanitary devices, cable trays, piping, post-installed rebar connection (reconstruction or reinforcement), etc.

HANDLING AND STORAGE

- Storage:
  store in a cold and dark place, storage temperature: from 41°F up to 77 °F
- Shelf life:
  18 months

APPLICATIONS AND INTENDED USE

Base material:
cracked and non-cracked concrete, lightweight-concrete, porous-concrete, natural stone (Caution! natural stone, can discolor; shall be checked in advance)

Anchor elements:
Threaded rods (zinc plated or hot dipped and stainless steel), reinforcing bars, internal threaded inserts, profiled rod, steel section with undercuts (e.g. perforated section)

Temperature range:
23°F up to 104°F installation temperature
cartridge temperature min. 41°F; optimal 70°F
-40°F to 320°F base material temperature after full curing

ADHESIVE PROPERTIES

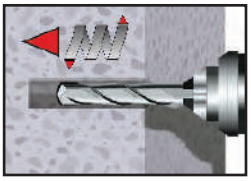
Properties	Test Method	Result
UV resistance		Pass
Water tightness	DIN EN 12390-8	0 in
Temperature stability		≤ 320°F
Density		14.85 lb/gal
Compressive strength	DIN EN 196-1	17,690 psi
Tensile strength	DIN EN ISO 527-2	2160 psi
Flexural strength	DIN EN 196-1	3219 psi
E modulus	DIN EN ISO 527-2	1,203,500 psi
Shrinkage	DIN 52450	< 0.2 %
Hardness Shore D	DIN EN ISO 868	97.6
Electrical resistance	DIN IEC 93	7.2×10^{13} Ω m
Thermal conductivity	DIN EN 993-15	1.06 W/m·K
Thermal heat capacity	DIN EN 993-15	1,090J/kg·K

REACTIVITY

Temperature of base material	Gelling- and working time	Full curing time in dry base material	Full curing time in wet base material
23 °F	50 Min.	5 hr	10 hr
32 °F	25 Min.	3-1/2 hr	7 hr
41 °F	15 Min.	2 hr	4 hr
50 °F	10 Min.	1 hr	2 hr
70 °F	6 Min.	40 Min.	80 Min.
86 °F	3 Min.	30 Min.	60 Min.
95 °F	2 Min.	30 Min.	60 Min.
104 °F	2 Min.	30 Min.	60 Min.

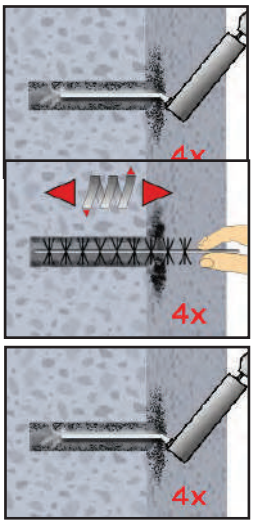
1) For installations in base material temperature between 23°F and 41°F the cartridge temperature must be conditioned to between 60°F and 77°F.

USAGE INSTRUCTIONS - CONCRETE



1. Hammer drill a hole into the base material to the diameter and embedment depth required by the selected anchor.

MAC: Cleaning for hole diameter $d_0 \leq 3/4$“ and hole depth $h_0 \leq 10d_s$ (uncracked concrete only!)

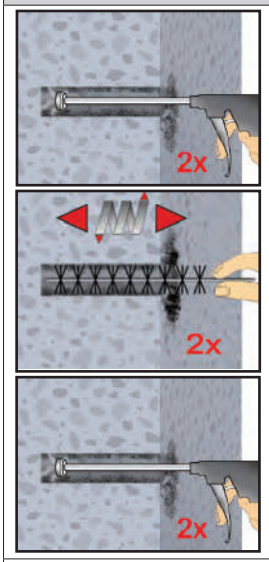


2a. Starting from the bottom or the back of the drilled hole, blow the hole clean by a hand pump (see page 7) a minimum of four times

2b. Check the brush diameter (page 7). Brush the hole with an appropriate sized wire brush > $d_{b,\,min}$ (see page 7) a minimum of four times in a twisting motion. If the bottom of the drilled hole is not reached with the brush, a brush extension must be used.

2c. Finally blow the hole clean again with a hand pump a minimum of four times.

CAC: Cleaning for all hole diameter in uncracked and cracked concrete

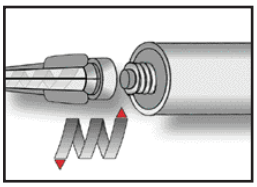
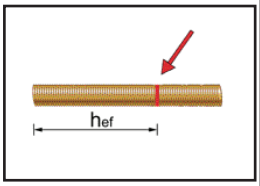
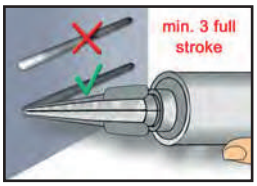
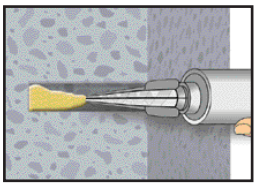
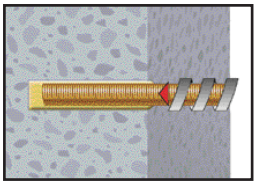
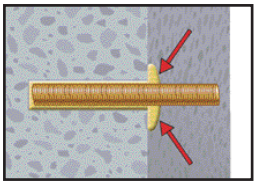
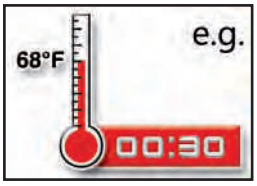
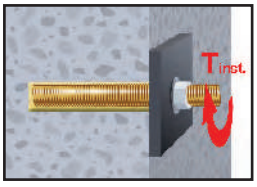


2a. Starting from the bottom or back of the hole, blow the hole clean with compressed air (min. 90 psi) a minimum of two times until return air stream is free of noticable dust. If the bottom of the drilled hole is not reached an extension must be used.

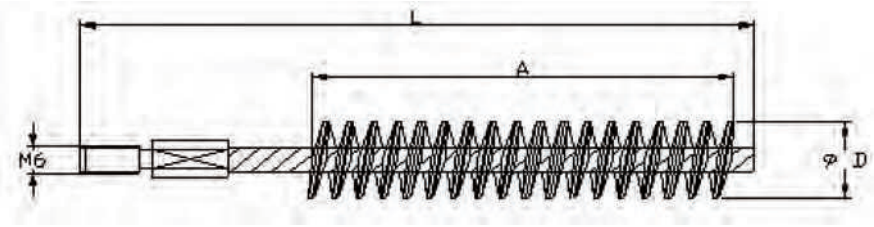
2b. Check the brush diameter (page 7). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (see page 7) a minimum of two times in a twisting motion. If the bottom of the drilled hole is not reached with the brush, a brush extension must be used.

2c. Finally blow the hole clean again with compressed air (min. 90 psi) a minimum of two times until return air stream is free of noticable dust. If the bottom of the drilled hole is not reached an extension must be used.

After cleaning, the hole has to be protected against re-contamination in an appropriate way, until dispensing the adhesive in the hole. If necessary, the cleaning has to be repeated directly before dispensing the adhesive.
In water-filled hole applications, the water must not be allowed to re-enter the hole.

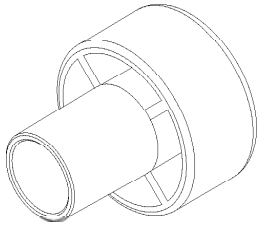
	3. Attach a static mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. After every working interruption longer than the recommended working time as well as for new cartridges, a new static-mixer shall be used.
	4. Prior to inserting the anchor rod into the filled hole, the embedment depth shall be marked on the anchor rods.
	5. Prior to dispensing into the anchor hole, squeeze out a minimum of three full strokes and discard non-uniformly mixed adhesive components until the adhesive shows a consistent grey color.
	6. Starting from the bottom of the cleaned anchor hole fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole is filled, avoid creating air pockets. For embedments deeper than 7-1/2“ an extension nozzle shall be used. For overhead and horizontal installation in holes bigger than 11/16“ or deeper than 10“ a piston plug shall be used. Observe the gel/ working times given.
	7. Push the 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. The anchor should be free of dirt, grease, oil or other foreign material.
	8. Be sure that the anchor is fully seated at the bottom of the hole and that excess adhesive is visible at the top of the hole. If these requirements are not maintained, the application has to be repeated.
	9. Allow the adhesive to cure the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured.
	10. After full curing, the fastening can be completed with the max. torque by using a calibrated torque wrench.

CLEANING OF THE DRILL HOLE - CONCRETE



Brush:
Brush length: 3.15 in
M6 thread for wood handle connection

Blower



Piston plug

Threaded rod	Rebar	hole-⌀	Brush-⌀	Min. Brush-⌀	Piston plug
(Inch)	(Inch)	(Inch)	d_b (Inch)	$d_{b,min}$(Inch)	(Nr.)
3/8		7/16	0.528	0.458	-
	#3	1/2	0.591	0.520	-
1/2		9/16	0.654	0.582	-
	#4	5/8	0.720	0.650	-
5/8		11/16	0.787	0.709	11/16
	#5	3/4	0.846	0.775	3/4
3/4	#6	7/8	0.976	0.905	7/8
7/8	#7	1	1.122	1.030	1
1	#8	1-1/8	1.252	1.160	1-1/8
1-1/4	#9	1-3/8	1.504	1.410	1-3/8
	#10	1-1/2	1.630	1.535	1-1/2

SETTING PARAMETER - CONCRETE

Anchor size			3/8	1/2	5/8	3/4	7/8	1	1- 1/4
Effectiveness factor (cracked concrete)	$k_{c,cr}$	[-]	17						
Effectiveness factor (uncracked concrete)	$k_{c,uncr}$	[-]	24						
Min. edge distance	c_{min}	[inch]	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3-1/4
Min. anchor spacing	s_{min}	[inch]	1-7/8	2-1/2	3	3-3/4	4-1/4	4-3/4	5-7/8
Embedment depth (hammer drilled)	$h_{ef,min}$	[inch]	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	5
	$h_{ef,max}$	[inch]	7-1/2	10	12-1/2	15	17-1/2	20	25
Min. member thickness	h_{min}	[inch]	h_{ef} + 1-1/4“		h_{ef} + $2d_0$				
Anchor diameter	d_a	[inch]	3/8	1/2	5/8	3/4	7/8	1	1-1/4
Drill diameter	d_0	[inch]	7/16	9/16	11/16	7/8	1	1 -1/8	1 -3/8
Installation torque	$T_{inst.}$	[ft-lb]	15	33	60	105	125	165	280

Anchor size			#3	#4	#5	#6	#7	#8	#9	#10
Effectiveness factor (cracked concrete)	$k_{c,cr}$	[-]	17							
Effectiveness factor (uncracked concrete)	$k_{c,uncr}$	[-]	24							
Min. edge distance	c_{min}	[inch]	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3	3-1/4
Min. anchor spacing	s_{min}	[inch]	1-7/8	2-1/2	3	3-3/4	4-1/4	4-3/4	5-1/4	5-7/8
Embedment depth	$h_{ef,min}$	[inch]	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	4-1/2	5
	$h_{ef,max}$	[inch]	7-1/2	10	12-1/2	15	17-1/2	20	22-1/2	25
Min. member thickness	h_{min}	[inch]	h_{ef} + 1-1/4“		h_{ef} + $2d_0$					
Anchor diameter	d_a	[inch]	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4
Drill diameter	d_0	[inch]	1/2	5/8	3/4	7/8	1	1 -1/8	1 -3/8	1-1/2
Installation torque	$T_{inst.}$	[ft-lb]	15	33	60	105	125	165	220	280

PERFORMANCE DATA - CONCRETE (THREADED ROD)[1)]

TENSION LOADS - Design acc. to ACI 318-11 Appendix D

Anchor size				3/8	1/2	5/8	3/4	7/8	1	1-1/4
Steel failure										
Nominal strength tension as governed by steel strength, ASTM A36		N_{sa}	[lb]	4,495	8,230	13,110	19,400	26,780	35,130	56,210
Nominal strength tension as governed by steel strength, ASTM A193 Grade B7		N_{sa}	[lb]	9,685	17,735	28,250	41,810	57,710	75,710	121,135
Reduction factor		f		0.75						
Nominal strength tension as governed by steel strength, ASTM F593 CW Stainless		N_{sa}	[lb]	7,750	14,190	22,600	28,430	39,245	51,485	82,370
Reduction factor		f		0.65						
Pullout and concrete cone failure										
Characteristic bond strength [3)] in concrete 2500 psi										
Temperature Range: 122°F/176°F [1)]	uncracked concrete	$\tau_{k,uncr}$	[psi]	2,600	2,415	2,260	2,140	2,055	2,000	1,990
	cracked concrete	$\tau_{k,cr}$		1,040	1,040	1,110	1,220	1,210	1,205	1,145
Temperature Range: 161°F/248°F [1)]	uncracked concrete	$\tau_{k,uncr}$		2,265	2,100	1,970	1,865	1,785	1,740	1,730
	cracked concrete	$\tau_{k,cr}$		905	905	965	1,060	1,055	1,050	995
Temperature Range: 212°F/320°F [1)]	uncracked concrete	$\tau_{k,uncr}$		1,630	1,515	1,420	1,345	1,290	1,255	1,250
	cracked concrete	$\tau_{k,cr}$		650	655	695	760	760	755	720
Strength reduction factor for permissible installation condition	dry	ϕ_d		0.65						
	wet	ϕ_{ws}		0.55						
Embedment depth		$h_{ef,min}$	[inch]	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	5
		$h_{ef,max}$	[inch]	7-1/2	10	12-1/2	15	17-1/2	20	25
Increasing factor				$(f'_c/2500)^{0.10}$						
Concrete breakout										
Effectiveness factor (cracked concrete)		$k_{c,cr}$	[-]	17						
Effectiveness factor (uncracked concrete)		$k_{c,uncr}$	[-]	24						
Reduction factor Condition B [2)]		ϕ		0.65						
Seismic										
Reduction factor for seismic tension		$\alpha_{N,seis}$	[-]	0.95		1.00				

The data in this table is evaluated according AC308-11 and ACI 355.4-11.
1) Long term temperature/ Short term temperature. 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. The tabulated values are provided for analysis and evaluation of existing conditions only.
2) Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in ACI 318-11 D.4.3.
The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, or ACI 318-11 9.2 are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
3) Characteristic bond strengths are for sustained loads including dead and live loads.

PERFORMANCE DATA - CONCRETE (THREADED ROD)

SHEAR LOADS - Design acc. to ACI 318-11 Appendix D

Anchor size			3/8	1/2	5/8	3/4	7/8	1	1-1/4
Steel failure									
Nominal shear strength as governed by steel strength, ASTM A36	V_{sa}	[lb]	2,695	4,940	7,860	11,640	16,065	21,080	33,725
Nominal shear strength as governed by steel strength, ASTM A193 Grade B7	V_{sa}	[lb]	4,845	10,640	16,950	25,085	34,625	45,425	72,680
Reduction factor	ϕ		0.65						
Reduction factor for seismic shear	ϕ		0.85	0.85	0.85	0.85	0.85	0.80	0.80
Nominal shear strength as governed by steel strength, ASTM F593 CW Stainless	V_{sa}	[lb]	4,650	8,515	13,560	17,055	23,545	30,890	49,420
Reduction factor	ϕ		0.60						
Reduction factor for seismic shear	ϕ		0.85	0.85	0.85	0.85	0.85	0.80	0.80
Concrete edge failure									
Effective length of anchor in shear loading	l_e	[Inch]	$\min(h_{ef}; 8d_a)$						
Outside diameter of anchor	d_a	[Inch]	3/8	1/2	5/8	3/4	7/8	1	1-1/4
Reduction factor Condition B [1)]	ϕ		0.70						

The data in this table is evaluated according AC308-11 and ACI 355.4.

1) Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in ACI 318-11, D.4.3. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, or ACI 318-11, 9.2 are used. If the load combinations of ACI 318-11, Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11, D.4.4.

PERFORMANCE DATA - CONCRETE (REBAR)

TENSION LOADS - Design acc. to ACI 318-11, Appendix D

Anchor size				#3	#4	#5	#6	#7	#8	#9	#10
Steel failure											
Nominal tension strength as governed by steel strength, ASTM A615, Grade 60		N_{sa}	[lb]	9,900	18,000	27,900	39,600	54,000	71,100	90,000	114,300
Reduction factor		ϕ		0.65							
Nominal tension strength as governed by steel strength, ASTM A706, Grade 60		N_{sa}	[lb]	8,800	16,000	24,800	35,200	48,000	63,200	80,000	101,600
Reduction factor		ϕ		0.75							
Pullout and concrete cone failure											
Characteristic bond strength [3] in concrete 2500 psi											
Temperature Range: 122°F/176°F [1]	uncracked conc.	$\tau_{k,uncr}$		2,200	2,100	2,030	1,970	1,920	1,880	1,845	1,815
	cracked conc.	$\tau_{k,cr}$		1,090	1,055	1,130	1,170	1,175	1,155	1,140	1,165
Temperature Range: 161°F/248°F [1]	uncracked conc.	$\tau_{k,uncr}$	[psi]	1,915	1,830	1,765	1,715	1,670	1,635	1,615	1,580
	cracked conc.	$\tau_{k,cr}$		945	915	980	1,015	1,020	1,005	995	1,010
Temperature Range: 212°F/320°F [1]	uncracked conc.	$\tau_{k,uncr}$		1,380	1,315	1,270	1,235	1,205	1,180	1,155	1,140
	cracked conc.	$\tau_{k,cr}$		680	660	705	735	735	725	715	730
Strength reduction factor for permissible installation condition	dry	ϕ_d		0.65							
	wet	ϕ_{ws}		0.55							
Embedment depth		$h_{ef,min}$	[inch]	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	4-1/2	5
		$h_{ef,max}$	[inch]	7-1/2	10	12-1/2	15	17-1/2	20	22-1/2	25
Increasing factor				$(f'_c/2500)^{0,10}$							
Concrete breakout											
Effectiveness factor (cracked concrete)		$k_{c,cr}$	[-]	17							
Effectiveness factor (uncracked concrete)		$k_{c,uncr}$	[-]	24							
Reduction factor Condition B [2]		ϕ		0.65							
Concrete breakout											
Reduction factor for seismic tension		$\alpha_{N,seis}$	[-]	0.95		1.00					

The data in this table is evaluated according AC308-11 and ACI 355.4-11.

1) Long term temperature/ Short term temperature. 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. The tabulated values are provided for analysis and evaluation of existing conditions only.
2) Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in ACI 318-11, D.4.3. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, or ACI 318-11, 9.2 are used. If the load combinations of ACI 318-11, Appendix C are used, the appropriate value ϕ must be determined in accordance with ACI 318-11, D.4.4.
3) Characteristic bond strengths are for sustained loads including dead and live loads.

PERFORMANCE DATA - CONCRETE (REBAR)

SHEAR LOADS - Design acc. to ACI 318-11, Appendix D, hammer and diamond drilled holes

Anchor size			#3	#4	#5	#6	#7	#8	#9	#10
Steel failure										
Nominal shear strength as governed by steel strength, ASTM A615, Grade 60	V_{sa}	[lb]	5,940	10,800	16,740	23,760	32,400	42,660	54,000	68,580
Reduction factor	ϕ		0.60							
Reduction factor for seismic shear	ϕ		0.70							
Nominal shear strength as governed by steel strength, ASTM A706, Grade 60	V_{sa}	[lb]	5,280	9,600	14,880	21,120	28,800	37,920	48,000	60,960
Reduction factor	ϕ		0.65							
Reduction factor for seismic shear	ϕ		0.70							
Concrete edge failure										
Effective length of anchor in shear loading	l_e	[Inch]	min (h_{ef}; $8d_a$)							
Outside diameter of anchor	d_a	[Inch]	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4
Reduction factor Condition B [1)]	ϕ		0.70							

The data in this table is evaluated according AC308-11 and ACI 355.4-11.

1) Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforce ment is not provided or where pullout or pryout governs, as set forth in ACI 318-11, D.4.3. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, or ACI 318-11, 9.2 are used. If the load combinations of ACI 318-11, Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11, D.4.4.

ALLOWABLE LOADS - CONCRETE (THREADED ROD)

The allowable loads are only valid for single anchor for an initial calculation, if the following conditions are valid:

min edge distance $c_a \geq c_{ac}$ min spacing $s \geq 2 \times c_{Na}$

min thickness concrete $h \geq 2 \times h_{ef}$ concrete compressive strength f'c ≥ 2500 psi

Static loads only. Allowable stress design conversion α=1.2D+1.6L=1.4

If the conditions are not fulfilled the loads must be calculated acc. to ACI 318-11, Appendix D.

The safety factors are already included in the allowable loads.

Anchor size			3/8	1/2	5/8	3/4	7/8	1	1-1/4
Allowable tension load for all Steel strength									
Temperature Range: 122°F/176°F 1)	$N_{allowable,ucr}$	[lb]	2,087	3,821	6,087	9,007	12,434	16,310	20,326
	$N_{allowable,cr}$	[lb]	1,991	3,413	4,412	6,540	8,930	12,840	14,398
Temperature Range: 161°F/248°F 1)	$N_{allowable,ucr}$	[lb]	2,087	3,821	6,087	9,007	12,434	16,310	20,326
	$N_{allowable,cr}$	[lb]	1,733	2,970	4,399	6,540	8,930	12,840	14,398
Temperature Range: 212°F/320°F 1)	$N_{allowable,ucr}$	[lb]	2,087	3,821	6,087	9,007	12,434	16,310	20,326
	$N_{allowable,cr}$	[lb]	1,244	2,150	3,168	5,440	7,760	11,012	14,398
Allowable shear load for steel strength, ASTM A36									
Temperature Range: 122°F/176°F 1)	$V_{allowable,ucr}$	[lb]	1,251	2,294	3,649	5,404	7,459	9,787	15,658
	$V_{allowable,cr}$	[lb]	1,251	2,294	3,649	5,404	7,459	9,787	15,658
Temperature Range: 161°F/248°F 1)	$V_{allowable,ucr}$	[lb]	1,251	2,294	3,649	5,404	7,459	9,787	15,658
	$V_{allowable,cr}$	[lb]	1,251	2,294	3,649	5,404	7,459	9,787	15,658
Temperature Range: 212°F/320°F 1)	$V_{allowable,ucr}$	[lb]	1,251	2,294	3,649	5,404	7,459	9,787	15,658
	$V_{allowable,cr}$	[lb]	1,251	2,294	3,649	5,404	7,459	9,787	15,658
Allowable shear load for steel strength, ASTM A193 Grade B7									
Temperature Range: 122°F/176°F 1)	$V_{allowable,ucr}$	[lb]	2,249	4,940	7,870	11,647	16,076	21,090	27,995
	$V_{allowable,cr}$	[lb]	2,249	4,713	6,009	9,351	12,563	17,367	19,996
Temperature Range: 161°F/248°F 1)	$V_{allowable,ucr}$	[lb]	2,249	4,940	7,870	11,647	16,076	21,090	26,470
	$V_{allowable,cr}$	[lb]	2,249	4,456	5,688	8,850	11,874	16,426	18,907
Temperature Range: 212°F/320°F 1)	$V_{allowable,ucr}$	[lb]	2,249	4,940	6,986	10,872	14,599	20,179	23,243
	$V_{allowable,cr}$	[lb]	2,249	3,911	4,990	7,766	10,428	14,414	16,602
Allowable shear load for steel strength, ASTM F593 CW Stainless									
Temperature Range: 122°F/176°F 1)	$V_{allowable,ucr}$	[lb]	1,993	3,649	5,811	7,309	10,091	13,239	21,180
	$V_{allowable,cr}$	[lb]	1,993	3,649	5,811	7,309	10,091	13,239	19,996
Temperature Range: 161°F/248°F 1)	$V_{allowable,ucr}$	[lb]	1,993	3,649	5,811	7,309	10,091	13,239	21,180
	$V_{allowable,cr}$	[lb]	1,993	3,649	5,811	7,309	10,091	13,239	18,907
Temperature Range: 212°F/320°F 1)	$V_{allowable,ucr}$	[lb]	1,993	3,649	5,811	7,309	10,091	13,239	21,180
	$V_{allowable,cr}$	[lb]	1,993	3,649	5,811	7,309	10,091	13,239	16,602
Embedment depth	h_{ef}	[Inch]	3-1/2	4-1/2	5	6-1/2	8	10	11
Edge distance	c_{ca}	[Inch]	8-1/4	10-1/4	11-1/8	14-1/8	17-1/8	21-1/8	23-1/4
Anchor spacing	s_{Na}	[Inch]	5-3/4	7-3/8	9	10-1/2	12	13-1/2	16-7/8

1) Long term temperature/ Short term temperature. 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. The tabulated values are provided for analysis and evaluation of existing conditions only.

ALLOWABLE LOADS - CONCRETE (REBAR)

The allowable loads are only valid for single anchor for an initial calculation, if the following conditions are valid:

min edge distance $c_a \geq c_{ac}$ min spacing $s \geq 2 \times c_{Na}$

min thickness concrete $h \geq 2 \times h_{ef}$ concrete compressive strength f'c ≧ 2500 psi

Static loads only. Allowable stress design conversion α=1.2D+1.6L=1.4

If the conditions are not fullfilled the loads must be calculated acc. to ACI 318-11, Appendix D.

The safety factors are already included in the allowable loads.

Anchor size			**#3**	**#4**	**#5**	**#6**	**#7**	**#8**	**#9**	**#10**
Allowable tension load for all steel strength										
Temperature Range: 122°F/176°F[1)]	$N_{allowable,ucr}$	[lb]	3,648	5,318	6,229	9,233	12,607	17,618	18,956	20,326
	$N_{allowable,cr}$	[lb]	2,087	3,462	4,412	6,540	8,930	12,480	13,427	14,398
Temperature Range: 161°F/248°F[1)]	$N_{allowable,ucr}$	[lb]	3,648	5,318	6,229	9,233	12,607	17,618	18,956	20,326
	$N_{allowable,cr}$	[lb]	1,809	3,003	4,412	6,540	8,930	12,480	13,427	14,398
Temperature Range: 212°F/320°F[1)]	$N_{allowable,ucr}$	[lb]	2,642	4,316	5,789	8,782	12,303	17,211	18,956	20,326
	$N_{allowable,cr}$	[lb]	1,302	2,166	3,213	5,226	7,504	10,575	12,319	14,398
Allowable shear load for all steel strength										
Temperature Range: 122°F/176°F[1)]	$V_{allowable,ucr}$	[lb]	2,451	4,457	6,909	9,806	13,371	17,606	22,286	26,983
	$V_{allowable,cr}$	[lb]	2,451	4,456	5,757	9,046	12,226	16,943	18,093	19,273
Temperature Range: 161°F/248°F[1)]	$V_{allowable,ucr}$	[lb]	2,451	4,457	6,909	9,806	13,371	17,606	22,286	25,527
	$V_{allowable,cr}$	[lb]	2,451	4,218	5,444	8,558	11,562	16,022	17,154	18,233
Temperature Range: 212°F/320°F[1)]	$V_{allowable,ucr}$	[lb]	2,451	4,457	6,681	9,806	13,371	17,606	21,002	22,403
	$V_{allowable,cr}$	[lb]	2,238	3,695	4,772	7,505	10,147	14,063	15,001	16,002
Embedment depth	h_{ef}	[Inch]	3-1/2	4-1/2	5	6-1/2	8	10	11	11
Edge distance	c_{ca}	[Inch]	7-3/4	9-3/4	10-5/8	13-5/8	16-5/8	20-5/8	21-1/2	22-3/8
Anchor spacing	s_{Na}	[Inch]	5-1/4	6-7/8	8-1/2	10	11-1/2	13	14-1/2	16

1) Long term temperature/ Short term temperature. 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. The tabulated values are provided for analysis and evaluation of existing conditions only.

FIRE RESISTANCE

Fire resistance times in combination with threaded rods (3/8“ to 1-1/4“) made of zinc plated steel, ASTM A36 or higher. The times below are valid for cracked and uncracked concrete.

		Fire resistance time in minutes			
Anchor size	**EMB.**	30 max F [lbf]	60 max F [lbf]	90 max F [lbf]	120 max F [lbf]
3/8“	3-1/2“	196	153	109	85
1/2“	4-1/2“	818	618	436	325
5/8“	5“	1439	1083	762	564
3/4“	6-1/2“	2061	1548	1089	804
7/8“	8“	2682	2013	1416	1044
1“	10“	3304	2478	1743	1283
1-1/4“	11“	4547	3408	2397	1762

The test anchors were exposed to the standard temperature-time curve (ETK). The fire resistances shown are valid for single anchors with an edge distance of more than $c_{cr} = 2\ h_{ef}$ and a spacing $s = 2\ c_{cr} = 4\ h_{ef}$.

CHEMICAL RESISTANCE

Chemical Agent	Concentration	Resistant	Not Resistant
Acetic acid	10	•	
Acetone	100		•
Ammonia, aqueous solution	5	•	
Benzyl Alcohol	100		•
Chlorinated lime	10	•	
Citric acid	10	•	
Chlorine water, swimming pool	all	•	
Demineralized Water	100	•	
Diesel oil	100	•	
Ethanol	100		•
Ethyl Acetate	100		•
Formic acid	100		•
Fuel Oil	100	•	
Gasoline (premium grade)	100	•	
Glycol (Ethylene glycol)	100		•
Hydraulic fluid	100	•	
Hydrogen peroxide	10		•
Isopropyl alcohol	100		•
Lactic acid	10	•	
Linseed oil	100	•	
Lubricating oil	100	•	
Nitric acid	10		•
Methanol	100		•
Phosphoric acid	10	•	
Potassium Hydroxide ph 13.2	100	•	
Salt (Calcium Chloride)	100	•	
Sea water, salty	100	•	
Sodium carbonate	10	•	
Sulfuric acid	10	•	

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).