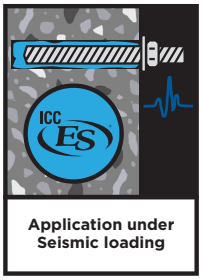
TECHNICAL DATA SHEET

LIQUIDROC® 700+

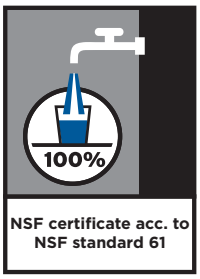
Styrene free vinyl ester resin based adhesive

Application in non-cracked concrete

Application in cracked concrete



Application under Seismic loading



NSF certificate acc. to NSF standard 61

Fire test report

CONTENT PAGE

CONTACT

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PRODUCT DESCRIPTION

Liquid Roc 700+ is a two component vinyl ester resin adhesive designed for a wide range of anchoring applications including cracked concrete and seismic loading.
This adhesive is packaged into a dual component cartridge that connects to a mixing nozzle allowing the installer to inject the adhesive directly into the drilled hole.

Liquid Roc 700+ can be used with threaded rod, rebar or internally threaded inserts to complete the fastening.
It is suitable for use in high temperature applications up to 248°F in service and can be installed as low as 14°F.

Condition the adhesive to room temperature for best dispensing results.

PROPERTIES AND BENEFITS

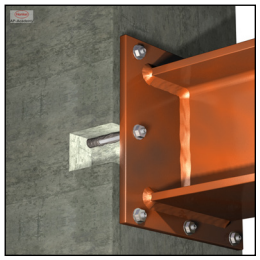
- US-approval acc. to AC 308 in concrete (ICC-ES): ESR-4004
- Certified for drinking water applications acc. to NSF Standard 61
- For heavy duty anchoring - dowelling and post-installed rebar connections
- Fire resistance test report: 3290/0966
- Can be installed overhead and in water-filled holes
- Suitable for attachment points with small edge distances and anchor spacings due to an anchoring free of expansion forces
- High chemical resistance
- Low odor
- Cartridge can be reused up to the end of the shelf life by replacing the static mixer or resealing cartridge with the sealing cap

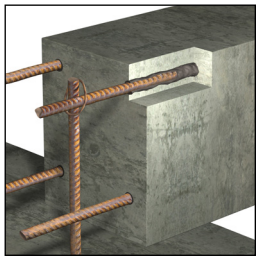
APPLICATION SAMPLES

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 cool 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, light-concrete, porous-concrete, solid masonry, hollow brick, natural stone (Attention! natural stone, can discolor; should be checked in advance); hammer drilled holes, (hollow material should be drilled without hammer drill mode)
- **Anchor elements:**
  Threaded rods (zinc plated or hot dip, stainless steel and high corrosion resistance steel), reinforcing bars, internally threaded inserts, profiled rod, steel section with undercuts (e.g. perforated section)
- **Temperature range:**
  14°F up to 104°F installation temperature
  cartridge temperature min. 41°F; optimal 70°F
  -40°F to 248°F base material temperature after full curing. Refer to load table for any effects.

ADHESIVE PROPERTIES

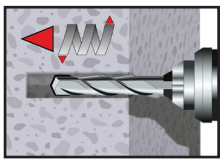
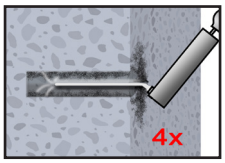
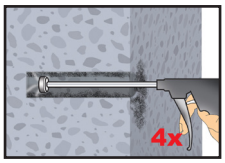
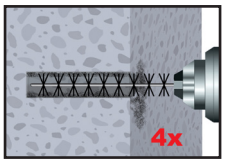
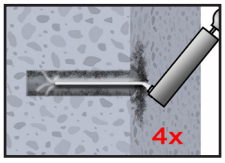
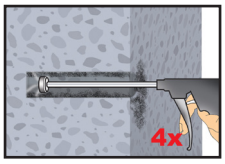
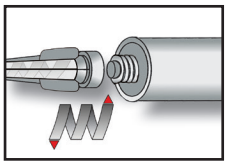
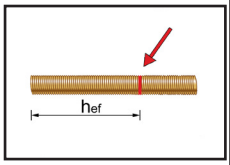
Properties	Test Method	Result
UV resistance		Pass
Water tightness	DIN EN 12390-8	0 inch
Temperature stability		248 °F
pH-value		7.2
Density		17.7 lb/gal
Compressive strength	EN 196 Section 1	14,500 psi
Flexural strength	EN 196 Section 1	2,170 psi
E modulus	EN 196 Section 1	2,031,930 psi
Shrinkage		< 0,3 %
Hardness Shore D		90
Electrical resistance	IEC 93	3.6 x 10^9 Ω m
Thermal conductivity	IEC 60093	0.65 W/m·K

REACTIVITY

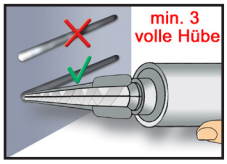
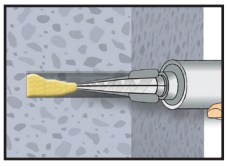
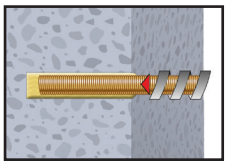
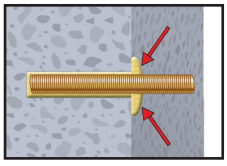
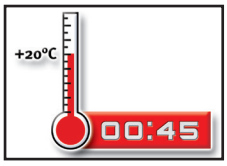
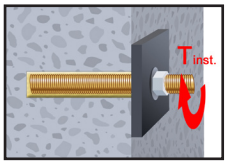
Temperature of base material	Gelling and working time	Full curing time in dry base material	Full curing time in wet base material
14°F[1)]	90 Min.	24 Hrs.	48 Hrs.
23 °F	90 Min.	14 Hrs.	28 Hrs.
32 °F	45 Min.	7 Hrs.	14 Hrs.
41 °F	25 Min.	2 Hrs.	4 Hrs.
50 °F	15 Min.	90 Min.	180 Min.
68 °F	6 Min.	45 Min.	90 Min.
86 °F	4 Min.	25 Min.	50 Min.
95 °F	2 Min.	20 Min.	40 Min.
104 °F	1.5 Min.	15 Min.	30 Min.

1) For installations in base material temperature between 14°F and 23°F the cartridge temperature must be conditioned to between 68°F and 95°F.

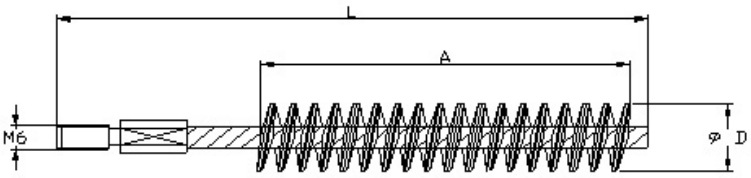
USAGE INSTRUCTIONS - CONCRETE

	1. Hammer drill a hole into the base material to the diameter and embedment depth required by the desired anchor size.
 or 	2a. Standing water must be removed before cleaning. Starting from the bottom or back of the hole, blow the hole clean with compressed air or a hand pump a minimum of four times. If the bottom of the hole is not reached an extension shall be used. The hand-pump can be used for anchor sizes up to hole diameter 3/4". For holes larger then 3/4" or deeper than 10 inches, compressed air (min. 90 psi) must be used.
	2b. Check brush diameter and attach the brush to a drill or battery screwdriver. Brush the hole with an appropriate sized wire brush four times. If the bottom of the hole is not reached with the brush, a brush extension should be used.
 or 	2c. Finally blow the hole clean again with compressed air or a hand pump a minimum of four times. If the bottom of the hole is not reached an extension should be used. The hand-pump can be used for anchor sizes up to 3/4" hole diameter. For holes larger than 3/4" or deeper than 10 inches, compressed air (min. 90 psi) must be used.
	3. Attach the static-mixing nozzle provided to the cartridge and load the cartridge into the correct dispensing tool. After every work interruption longer than the recommended working time as well as for new cartridges, a new static-mixer should be used.
	4. Prior to inserting the anchor rod into the filled hole, the embedment depth should be marked on the anchor rods.

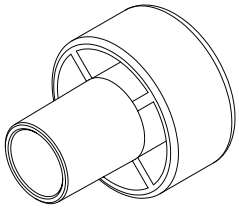
USAGE INSTRUCTIONS - CONCRETE

	5. Prior to dispensing into the anchor hole, dispense out a minimum of three full strokes and discard non-uniformly mixed adhesive 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 7.5“ an extension nozzle should be used. For overhead and horizontal installation in holes bigger than 3/4“ or deeper than 10“, a piston plug should be used. Be careful not to exceed the gel/working times given before inserting the rod.
	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 rod 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 met, the application has to be repeated.
	9. Allow the adhesive to cure for 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 DRILLED HOLE - CONCRETE



Brush:
M6 thread for drill connection



Piston plug

Blower

Threaded rod	Rebar	Drill hole-Ø	Brush-Ø	Min. brush-Ø	Piston plug size
(Inch)	(Inch)	(Inch)	d_b (Inch)	$d_{b,min}$ (Inch)	(Inch)
3/8	#3	7/16	0.528	0.475	-
1/2		9/16	0.654	0.600	9/16
	#4	5/8	0.720	0.708	5/8
5/8	#5	3/4	0.846	0.790	3/4
3/4	#6	7/8	0.976	0.920	7/8
7/8	#7	1	1.122	1.045	1
1	#8	1-1/8	1.252	1.175	1-1/8
1-1/4	#9	1-3/8	1.504	1.425	1-3/8
	#10	1-1/2	1.630	1.550	1-1/2

SETTING PARAMETER - HOLLOW BASE MATERIAL WITH SCREEN TUBE

			Nominal Size Metal Screen			Nominal Size Plastic Screen		
Threaded Rod	**-**	**-**	**3/8**	**1/2**	**5/8**	**3/8**	**1/2**	**5/8**
Nominal threaded rod diameter	d	[inch] (mm)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)
Nominal screen tube diameter	-	[inch] (mm)	0.500 (12.7)	0.625 (15.9)	0.750 (19.0)	0.625 (15.9)	0.625 (15.9)	0.787 (20)
Nominal diameter of drilled hole	d_{bit}	[inch] (mm)	1/2 (12.7) ANSI	5/8 (15.9) ANSI	3/4 (19.0) ANSI	5/8 (15.9) ANSI	13/16 (20.6) ANSI	13/16 (20.6) ANSI
Maximum Torque	T_{max}	[ft-lb] (Nm)	10 (14)	10 (14)	10 (14)	10 (14)	10 (14)	10 (14)

SETTING PARAMETER - CONCRETE

Anchor size			3/8	1/2	5/8	3/4	7/8	1	1-1/4
Effectiveness factor (cracked concrete)	$k_{c,cr}$	[-]	n.a.	17					
Effectiveness factor (uncracked concrete)	$k_{c,uncr}$	[-]	24						
Min. edge distance	c_{min}	[inch]	1-7/8	2-1/2	3-1/8	3-3/4	4-3/8	5	6-1/4
Min. anchor spacing	s_{min}	[inch]	1-7/8	2-1/2	3-1/8	3-3/4	4-3/8	5	6-1/4
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]	4-1/2	6	7-1/2	9	10-1/2	12	15
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	3/4	7/8	1	1 -1/8	1 -3/8
Installation torque [1)]	$T_{inst.}$	[ft-lb]	16	33	60	105	125	165	280

1) for A 193-B7 or stainless steel

Anchor size			#3	#4	#5	#6	#7	#8	#9	#10
Effectiveness factor (cracked concrete)	$k_{c,cr}$	[-]	n.a.	17						
Effectiveness factor (uncracked concrete)	$k_{c,uncr}$	[-]	24							
Min. edge distance	c_{min}	[inch]	1-7/8	2-1/2	3-1/8	3-3/4	4-3/8	5	5-5/8	6-1/4
Min. anchor spacing	s_{min}	[inch]	1-7/8	2-1/2	3-1/8	3-3/4	4-3/8	5	5-2/3	6-1/4
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]	4-1/2	6	7-1/2	9	10-1/2	12	13-1/2	15
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]	7/16	5/8	3/4	7/8	1	1 -1/8	1 -3/8	1-1/2
Installation torque	$T_{inst.}$	[ft-lb]	16	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		ϕ		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		ϕ		0,65						
Pullout and concrete cone failure										
Characteristic bond strength[3)] in concrete 2500psi										
Temperature Range 75°F/104°F [1)]	uncracked concrete	$\tau_{k,uncr}$	[psi]	1,450	1,450	1,450	1,450	1,450	1,305	1,030
	cracked concrete	$\tau_{k,cr}$		n.a.	871	907	907	907	918	918
Temperature Range 122°F/176°F [1)]	uncracked concrete	$\tau_{k,uncr}$		823	823	823	823	823	743 [4)]	588 [4)]
	cracked concrete	$\tau_{k,cr}$		n.a.	498	519	519	519	519	525
Temperature Range 161°F/248°F [1)]	uncracked concrete	$\tau_{k,uncr}$		405	405	405	405	405 [4)]	366 [4)]	n.a.
	cracked concrete	$\tau_{k,cr}$		n.a.	245	255	255	255	255	255
Strength reduction factor for permissible installation condition	dry	ϕ_d		0.65						
	wet	ϕ_{ws}		0.55						
	water-filled	ϕ_{wf}		0.45						
		κ_{wf}		0.78	0.78	0.78	0.78	0.70	0.69	0.67
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]	4-1/2	6	7-1/2	9	10-1/2	12	15
Increasing factor				$(f'_c/2500)^{0,13}$						
Concrete breakout										
Effectness factor (cracked concrete)		$k_{c,cr}$	[-]	n.a.	17					
Effectness 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						

The data in this table are evaluated according AC318-11 and ACI 355.4.
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. Room temperature range is not recognized by ACI 318-14 or ACI 318-11 and does not meet the minimum temperature requirement of ACI 355.4, Table 8.1 and consequently is not applicable to design under ACI 318-14, ACI 318-11 or current and past editions of the International Building Code (IBC). 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. For load combinations consisting of short-term loads only such as wind or seismic, bond strengths may be increased by 43 percent for Temperature Range 122°F/176°F and 122 percent for Temperature Range 161°F/248°F.
4) Not applicable in water-filled holes.

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	16,075	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		n.a.	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	17,060	23,545	30,890	49,425
Reduction factor	ϕ		0.60						
Reduction factor for seismic shear	ϕ		n.a.	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		0.65						

The data in this table are evaluated according AC318-11 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 2500psi											
Temperature Range 75°F/104°F [1]	uncracked concrete	$\tau_{k,uncr}$	[psi]	1,450	1,450	1,450	1,450	1,450	1,305	1160	1030
	cracked concrete	$\tau_{k,cr}$		n.a.	871	907	907	907	918	918	918
Temperature Range: 122°F/176°F [1]	uncracked concrete	$\tau_{k,uncr}$		823	823	823	823	823	743 [4]	668 [4]	588 [4]
	cracked concrete	$\tau_{k,cr}$		n.a.	331	345	345	345	345	349	349
Temperature Range: 161°F/248°F [1]	uncracked concrete	$\tau_{k,uncr}$		405	405	405	405	405 [4]	366 [4]	329 [4]	n.a.
	cracked concrete	$\tau_{k,cr}$		n.a.	163	170	170	170	170	172	172
Strength reduction factor for permissible installation condition	dry	ϕ_d		0.65							
	wet	ϕ_{ws}		0.55							
	water-filled	ϕ_{wf}		0.45							
		κ_{wf}		0.78	0.78	0.78	0.78	0.70	0.69	0.68	0.67
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]	4-1/2	6	7-1/2	9	10-1/2	12	13-1/2	15
Increasing factor				$(f'_c/2500)^{0,13}$							
Concrete breakout											
Effectness factor (cracked concrete)		$k_{c,uncr}$	[-]	17							
Effectness factor (uncracked concrete)		$k_{c,uncr}$	[-]	24							
Reduction factor Condition B[2]		ϕ		0.65							
Concrete breakout											
Reduction factor for seismic tension		$\alpha_{N,seis}$	[-]	1.0							

The data in this table are evaluated according AC318-11 and ACI 355.4.
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. Room temperature range is not recognized by ACI 318-14 or ACI 318-11 and does not meet the minimum temperature requirement of ACI 355.4, Table 8.1 and consequently is not applicable to design under ACI 318-14, ACI 318-11 or current and past editions of the International Building Code (IBC). 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. For load combinations consisting of short-term loads only such as wind or seismic, bond strengths may be increased by 42 percent for Temperature Range 122°F/176°F and 122 percent for Temperature Range 161°F/248°F.
4) Not applicable in water-filled holes.

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		n.a.	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		0.60							
Reduction factor for seismic shear	ϕ		n.a.	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		0.65							

The data in this table are evaluated according AC318-11 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.

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 $s \geq 2c_{Na}$
min thickness concrete $h \geq 2 \times h_{ef}$ concrete compressive strength $f'c \geq 2500$ psi
Static loads only. Allowable stress design conversion α=1.2D+1.6L=1.4
If these 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: 75°F/104°F [1]	$N_{allowable,ucr}$	[lb]	2,151	3,688	5,122	7,991	11,474	14,752	16,009
	$N_{allowable,cr}$	[lb]	n.a.	2,215	3,204	4,998	7,177	10,377	14,269
Temperature Range: 122°F/176°F [1]	$N_{allowable,ucr}$	[lb]	1,221	2,093	2,907	4,535	6,512	8,399	9,139
	$N_{allowable,cr}$	[lb]	n.a.	1,267	1,833	2,860	4,107	5,867	8,160
Temperature Range: 161°F/248°F [1]	$N_{allowable,ucr}$	[lb]	601	1,030	1,431	2,232	3,205	4.137	n.a.
	$N_{allowable,cr}$	[lb]	n.a.	623	901	1,405	2,018	2,883	3,964
Allowable shear load for steel strength, ASTM A36									
Temperature Range: 75°F/104°F [1]	$V_{allowable,ucr}$	[lb]	1,251	2,294	3,649	5,404	7,459	9,787	15,658
	$V_{allowable,cr}$	[lb]	n.a.	2,294	3,649	5,404	7,459	9,787	15,658
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]	n.a.	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	n.a.
	$V_{allowable,cr}$	[lb]	n.a.	1,732	2,503	3,905	5,608	8,011	11,015
Allowable shear load for steel strength, ASTM A193 Grade B7									
Temperature Range: 75°F/104°F [1]	$V_{allowable,ucr}$	[lb]	2,249	4,940	7,045	11,204	15,298	20,497	21,511
	$V_{allowable,cr}$	[lb]	n.a.	3,843	5,032	8,003	10,927	14,641	15,365
Temperature Range: 122°F/176°F [1]	$V_{allowable,ucr}$	[lb]	2,249	4,940	7,045	11,204	15,298	20,497	21,511
	$V_{allowable,cr}$	[lb]	n.a.	3,520	5,032	7,949	10,927	14,641	15,365
Temperature Range: 161°F/248°F [1]	$V_{allowable,ucr}$	[lb]	1,670	2,863	3,976	6,203	8,906	11,498	n.a.
	$V_{allowable,cr}$	[lb]	n.a.	1,732	2,503	3,905	5,608	8,011	11,015
Allowable shear load for steel strength, ASTM F593 CW Stainless									
Temperature Range: 75°F/104°F [1]	$V_{allowable,ucr}$	[lb]	1,993	3,649	5,811	7,309	10,091	13,239	21,180
	$V_{allowable,cr}$	[lb]	n.a.	3,649	5,032	7,309	10,091	13,239	15,365
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]	n.a.	3,520	5,032	7,309	10,091	13,239	15,365
Temperature Range: 161°F/248°F [1]	$V_{allowable,ucr}$	[lb]	1,670	2,863	3,976	6,203	8,906	11,498	n.a.
	$V_{allowable,cr}$	[lb]	n.a.	1,732	2,503	3,905	5,608	8,011	11,015
Embedment depth	h_{ef}	[inch]	3-1/2	4-1/2	5	6-1/2	8	10	11
Edge distance	c_{ca}	[inch]	6-1/2	8-3/8	9-3/8	12-1/8	14-7/8	17-7/8	17-7/8
Axial distance	s_a	[inch]	10-1/2	13-1/2	15	19-1/2	24	30	33

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. Room temperature range is not recognized by ACI 318-14 or ACI 318-11 and does not meet the minimum temperature requirement of ACI 355.4, Table 8.1 and consequently is not applicable to design under ACI 318-14, ACI 318-11 or current and past editions of the International Building Code (IBC). 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 $s \geq 2c_{Na}$
min thickness concrete $h \geq 2 \times h_{ef}$ concrete compressive strength $f'c \geq 2500$ psi
Static loads only. Allowable stress design conversion α=1.2D+1.6L=1.4
If these 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	#4	#5	#6	#7	#8	#9	#10
Allowable tension load for all steel strength										
Temperature Range: 75°F/104°F [1]	$N_{allowable,ucr}$	[lb]	2,151	3,688	5,122	7,991	11,474	14,752	16,227	16,009
	$N_{allowable,cr}$	[lb]	n.a.	2,215	3,204	4,998	7,177	10,377	12,842	14,269
Temperature Range: 122°F/176°F [1]	$N_{allowable,ucr}$	[lb]	1,221	2,093	2,907	4,535	6,512	8,399	9,345	9,139
	$N_{allowable,cr}$	[lb]	n.a.	842	1,219	1,901	2,730	3,900	4,826	5,425
Temperature Range: 161°F/248°F [1]	$N_{allowable,ucr}$	[lb]	601	1,030	1,431	2,232	3,205	4,137	4,602	n.a.
	$N_{allowable,cr}$	[lb]	n.a.	415	601	937	1,345	1,922	2,406	2,673
Allowable shear load for all steel strength										
Temperature Range: 75°F/104°F [1]	$V_{allowable,ucr}$	[lb]	2,263	4,114	6,377	9,051	12,343	16,251	20,571	21,511
	$V_{allowable,cr}$	[lb]	n.a.	3,843	5,032	8,003	10,927	14,641	16,113	15,365
Temperature Range: 122°F/176°F [1]	$V_{allowable,ucr}$	[lb]	2,263	4,114	6,377	9,051	12,343	16,251	20,571	21,511
	$V_{allowable,cr}$	[lb]	n.a.	2,340	3,387	5,284	7,587	10,838	13,413	15,076
Temperature Range: 161°F/248°F [1]	$V_{allowable,ucr}$	[lb]	1,670	2,863	3,976	6,203	8,906	11,498	12,791	n.a.
	$V_{allowable,cr}$	[lb]	n.a.	1,152	1,669	2,604	3,738	5,341	6,687	7,430
Embedment depth	h_{ef}	[inch]	3-1/2	4-1/2	5	6-1/2	8	10	11	11
Edge distance	c_{ca}	[inch]	6-1/2	8-3/8	9-3/8	12-3/8	14-7/8	17-7/8	17-7/8	17-7/8
Axial distance	s_a	[inch]	10-1/2	13-1/2	15	19-1/2	24	30	33	33

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. Room temperature range is not recognized by ACI 318-14 or ACI 318-11 and does not meet the minimum temperature requirement of ACI 355.4, Table 8.1 and consequently is not applicable to design under ACI 318-14, ACI 318-11 or current and past editions of the International Building Code (IBC). 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.

	Fire resistance time in minutes			
Anchor size	30 max F [lbf]	60 max F [lbf]	90 max F [lbf]	120 max F [lbf]
3/8“	≤ 504	≤ 342	≤ 180	≤ 101
1/2“	≤ 753	≤ 582	≤ 409	≤ 324
5/8“	≤ 1,304	≤ 1,007	≤ 710	≤ 562
3/4“	≤ 1,931	≤ 1,491	≤ 1,050	≤ 830
7/8“	≤ 2,664	≤ 2,057	≤ 1,450	≤ 1,147
1“	≤ 3,496	≤ 2,698	≤ 1,902	≤ 1,504
1-1/4“	≤ 5,018	≤ 3,874	≤ 2,729	≤ 2,158

CHEMICAL RESISTANCE

Chemical Agent	Concentration	Resistant	Not Resistant
Accumulator acid	100 %	•	
Acetic acid	40 %		•
Acetic acid	10 %	•	
Acetone	10 %		•
Ammonia, aqueous solution	5 %	•	
Aniline	100 %		•
Beer	100 %	•	
Benzene (kp 100-140°F)	100 %	•	
Benzol	100 %		•
Boric Acid, aqueous solution	any	•	
Calcium carbonate, suspended in water	any	•	
Calcium chloride, suspended in water	any	•	
Calcium hydroxide, suspended in water	any	•	
Carbon tetrachloride	100 %	•	
Caustic soda solution	10 %	•	
Citric acid	any	•	
Chlorine water, swimming pool	any	•	
Diesel oil	100 %	•	
Ethyl alcohol, aqueous solution	50 %		•
Formic acid	100 %		•
Formaldehyde, aqueous solution	30 %	•	
Freon	any	•	
Fuel Oil	any	•	
Gasoline (premium grade)	100 %	•	
Glycol (Ethylene glycol)	any	•	
Hydraulic fluid	conc.	•	
Hydrochloric acid (Muriatic Acid)	conc.		•
Hydrogen peroxide	30 %		•
Isopropyl alcohol	100 %		•
Lactic acid	any	•	
Linseed oil	100 %	•	
Lubricating oil	100 %	•	
Magnesium chloride, aqueous solution	any	•	
Methanol	100 %		•
Motor oil (SAE 20 W-50)	100 %	•	
Nitric acid	10 %		•
Oleic acid	100 %	•	
Perchloroethylene	100 %	•	
Petroleum	100 %	•	
Phenol, aqueous solution	8 %		•
Phosphoric acid	85 %	•	
Potash lye (Potassium hydroxide)	10 %	•	
Potassium carbonate, aqueous solution	any	•	
Potassium chlorite, aqueous solution	any	•	
Potassium nitrate, aqueous solution	any	•	
Sea water, salty	any	•	
Sodium carbonate	any	•	
Sodium Chloride, aqueous solution	any	•	
Sodium phosphate, aqueous solution	any	•	
Sodium silicate	any	•	
Standard Benzine	100 %	•	
Sulfuric acid	10 %	•	
Sulfuric acid	70 %		•
Tartaric acid	any	•	
Tetrachloroethylene	100 %	•	
Toluene	any		•
Trichloroethylene	100 %		•
Turpentine	100 %	•	

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).