FLO-ROK® FR5MAX INJECTION ADHESIVE ANCHOR

► DESCRIPTION

UCAN FLO-ROK® FR5 MAX is a styrene free epoxy acrylate adhesive suitable for year-round use without preconditioning in temperature ranging from -10°C to over 30°C. This versatile two component, high strength anchoring adhesive, provides stress free fastening and is an excellent choice for anchoring & dowelling. A matching static mixing nozzle, as well as FLO-ROK's low mix ratio sensitivity, ensures thorough, 10:1 mixing of the resin and the hardener. FR5-MAX is available in 2 sizes 10 oz. for small jobs, and 28 oz. that is perfect for high volume applications such as rebar dowelling.

UCAN FLO-ROK® FR5 MAX anchoring adhesive is specifically formulated for continuously threaded steel rod and deformed steel reinforcing bar anchoring to resist static, wind or earthquake (Seismic Design Categories A through F) tension and shear loads in cracked and un-cracked, normal-weight concrete having a specified compressive strength, f'_c of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

The FLO-ROK® FR5 MAX adhesive anchors for horizontal, upward inclined and overhead anchoring application must conform to ACI318-14 or CSA A23.3-14 Annex D requirements.

► FEATURES

- IAPMO ER 490
- ACI 318 Category 1 anchor (continous spec. inspection) for cracked & uncracked concrete
- Tested in accordance to AC 308 for long term sustained load at standard and elevated temperature.
- Seismic resistance
- Use friendly, low odour, styrene free & MMA free
- Meets LEED guidelines; low VOC
- Moisture insensitive, non sag formula
- Suitable for damp and water filled holes
- Shelf life 18 months, store cartridge at +5°C to +25°C before use
- Meets CSA A23.3-14, Annex D requirements

► TYPICAL APPLICATIONS

- Rebar dowelling
- Highway and bridge construction
- Machine, crane and hoist installation
- Hollow wall anchoring applications
- Renovations

► LISTING AND APPROVALS

- IAPMO ER 490

- MTO Approved
- MTQ Approved

NSF/ANSI Std 61
(cerficate for use in potable water)

► COMPLIANCE WITH THE FOLLOWING CODES

- 2015, 2012, 2011, 2009, 2003 International Building Code® (IBC)
- 2015, 2012, 2011, 2009, 2003 International Residential Code® (IRC)

► LEED® COMPLIANCE

- Credit 4.1 - Low Emitting Materials

► MATERIAL PROPERTIES

TABLE 1 - ANCHOR RODS

Properties	Symbol	Unit	Value	Test Standard
Standard Threaded Rod / Carbon Steel[1]	f_u	psi	72,500	ISO 898 Grade 5.8
		MPa	500	
	f_y	psi	58,000	
		MPa	400	
High Strengh Threaded Rod / Carbon Steel[1]	f_u	psi	125,000	ASTM A 193, Grade B7
		MPa	860	
	f_y	psi	105,000	
		MPa	724	
Stainless steel Threaded Rod[2]	f_u	psi	100,00 / 85,000	ASTM F593 CW1/CW2 (AISI 304/316)
		MPa	690 / 585	
	f_y	psi	65,000 / 45,000	
		MPa	450 / 310	
Carboon Steel Nuts	-	-	-	ASTM A 563
Stainless Steel Nuts	-	-	-	ASTM F 594

[1]Rods are considered ductile steel elements in accordance with Sections 4.3.4.1,4.3.4.2 and 4.3.5 of the IAPMO ER490 report
[2]Rods are considered brittle steel elements in accordance with Sections 4.3.4.1,4.3.4.2 and 4.3.5 of the IAPMO ER490 report.

TABLE 2 - CURED EPOXY

Properties	Symbol	Cure Time	Value	Test Standard
Compressive Strength	24 hrs.	psi	10,400	ASTM D 695 @ 20°C/72°
		MPa	72	
	7 days	psi	11,100	
		MPa	77	
Tensile Strength	24 hrs.	psi	1,885	ASTM D 638 @ 20°C/72°
		MPa	13	
	7 days	psi	2,175	
		MPa	15	
Elongation at Break	24 hrs.	%	6.0	ASTM D 638 @ 20°C/72°
	7 days		7.0	
Tensile Modulus	24 hrs.	psi	536,000	ASTM D 638 @ 20°C/72°
		GNm-2	3.7	
	7 days	psi	551,000	
		GNm-2	3.7	
Flexural Strength	24 hrs	psi	4,200	ASTM D 790 @ 20°C/72°
		MPa	29	

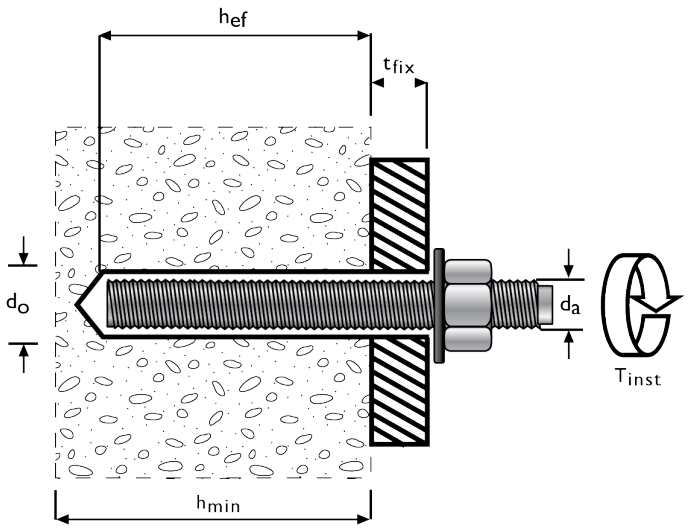
► IN SERVICE TEMPERATURE RANGE

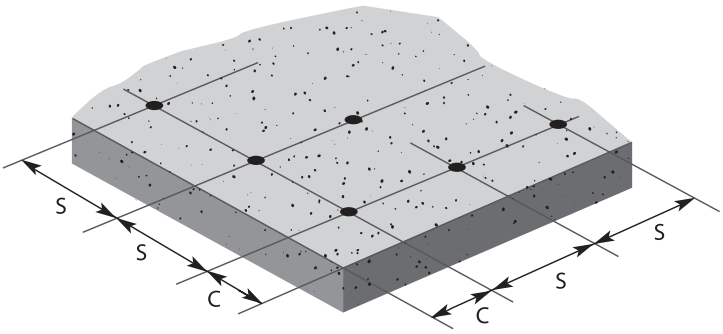
Short Term : -40°C (-40°F) to +80°C (+176° F)
Long Term : -40°C (-40°F) to +50°C (+122° F)

TABLE 3 - CURING TIMES

		CONCRETE TEMPERATURE TEMPÉRATURE D'APPLICATION	GEL TIME[1]	CURE TIME[2]
IMPORTANT! • Install stud immediately after injecting adhesive. Do not disturb stud during curing time.	*Suggested not verifed	-20°C to -10°C (14°F to 41°F)	16 mins	48 hours
		-10°C to +5°C (14°F to 41°F)	15 mins	12 hours
		+5°C to +10°C (41°F to 50°)	10 mins	145 mins
		+10°C to +15°C (50°F to 59°)	8 mins	85 mins
		+15°C to +20°C (59°F to 68°)	6 mins	75 mins
		+20°C to +25°C (68°F to 77°)	5 mins	50 mins
		+25°C to +30°C (77°F to 86°)	4 mins	40 mins
		+30°C to +35°C (86°F to 95°)	2 mins	30 mins
		Cartridge shall be conditioned to a minimum 41°F (+5°C) prior to use *Contact UCAN for site specific installation instructions		

[1]Gel time refers to the highest temperature in the range
[2]Cure time refers to the lowest temperature in the range





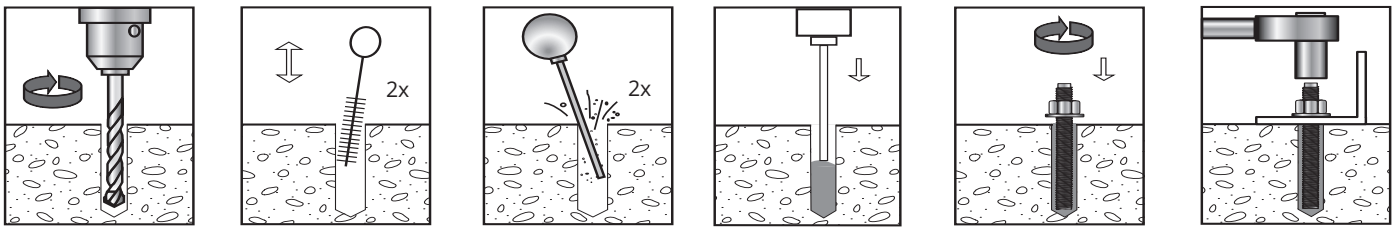
► INSTALLATION

TABLE 4 - ANCHOR RODS

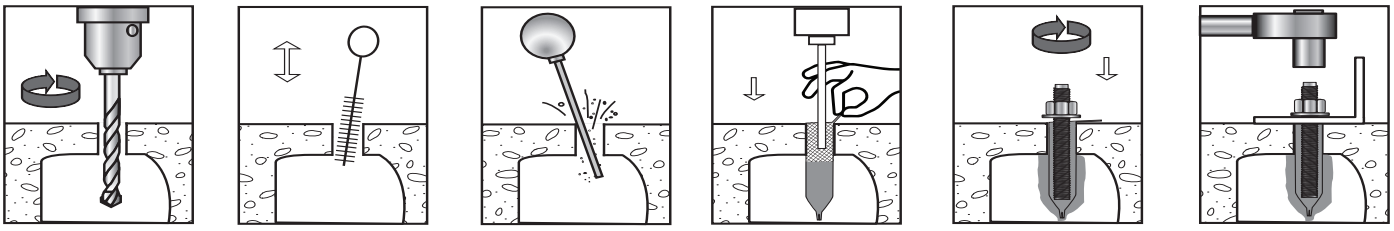
Characteristics		Symbol	Unit	Nominal Anchor Element Diameter						
UNC Threaded Bar	Size	d_a	inch	3/8	1/2	5/8	3/4	7/8	1	1-1/4
	drill size	d_o	inch	1/2	9/16	3/4	7/8	1	1-1/8	1-3/8
US Re-bar	Size	d_a	inch	#3	#4	#5	#6	#7	#8	#10
	drill size	d_o	inch	9/16	5/8	3/4	1	1-1/8	1-1/4	1-5/8
Metric Threaded Rod	Size	d_a	mm	10	12	16	20	-	24	30
	drill size	d_o	mm	12	14	18	22	-	26	35
Metric Re-bar (CAN)	Size	M	-	10M	-	15M	20M	-	25M	30M
plain	drill size	d_o	inch	9/16	-	3/4	7/8	-	1-1/4	1-1/2
Metric Re-bar (CAN)		M	-	10M	-	15M	20M	-	25M	30M
hot-dip galvanized		d_o	inch	5/8	-	7/8	1	-	1-1/4	1-1/2
Maximum Tightening Torque		T_{inst}	ft-lb	15	30	60	100	125	150	200
Embedment Depth Range		$hef,_{min}$		2-3/8	2-3/4	3-1/8	3-3/4	4	4	5
		$hef,_{max}$	inch	7-1/2	10	12-1/2	15	17-1/2	20	25
Minimum Concrete Thickness		h_{min}	inch	2.0 h_{ef}						
Critical Edge Distance		C_{ac}	inch	See Section 3.1.10. (IAPMO ER 490)						
Minimum Edge Distance		C_{min}	inch	0.5 h_{ef}						
Minimum Anchor Spacing		S_{min}	inch	0.5 h_{ef}						

For SI: 1 inch = 25.4 mm, 1ft.lb = 1.356 N.m

SOLID CONCRETE / MASONRY APPLICATIONS



HOLLOW CONCRETE BLOCK / MASONRY APPLICATIONS



NOTE:

- Clean hole thoroughly by using nylon brush and blow-out bulb or compressed air (65 - 80 psi)
- Always dispense about 1 oz. FLO - ROK to the side, prior to injecting it into the clean hole, to assure uniform mixing indicated by a consistent dark grey colour.
- At a minimum, half fill the hole starting from the bottom up by slowly withdrawing the nozzle. (solid installation)
  Fill the screen fully starting from the bottom by slowly withdrawing the nozzle. (hollow installation)
- Mark embedment depth on the threaded rod (rebar) prior to installation, and insert the rod (rebar) turning it slowly until it reaches the bottom of the hole (depth mark is flush with the surface). Remove all overflow at the surface around he rod (rebar) prior to placing the fixture over the anchor.
- Observe curing time. The installed anchor must not be disturbed or loaded before the specified curing time has elapsed.

► STRENGTH DESIGN

Strength design shall be in accordance with AIPMO ER 490 section 3.2.1 and 3.2.2.

Interaction of Tensile and Shear Forces: For designs that include combined tension and shear forces, the interaction of the tension and shear loads must be calculated in accordance with IAPMO ER 490 Section 3.3.2

► LIMIT STATE DESIGN (CSA A23.3-14, ANNEX D)

The design strength of anchors in Limit State Design (Canada) shall comply with CSA A23.3-14, Annex D.

Design parameters are provided in Tables 6 through 12. Strength Reduction Factors (R) and Material Resistance Factors (Φ) are provided in Table 5. The requirements for member thickness edge distance and spacing shown in Table must apply. For designs that include tension and shear forces, the interaction of the loads must be calculated in accordance with CSA A23.3-14, Annex D.8

TABLE 5 - RESISTANCE FACTORS FOR LIMIT STATE DESIGN IN ACCORDANCE WITH CSA A23.3-14, ANNEX D

Characteristics	Symbol	Unit	Nominal Anchor Element Diameter (in.)						
			3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/4"
			10M		15M	20M		25M	30M
Concrete material resistance factor (dry concrete)	Φ_c	-	0.65						
Steel material resistance factor	Φ_s	-	0.85						
Strength reduction factor for tension, steel failure modes (carbon and stainless steel threaded rod)	*R*	-	0.80						
Strength reduction factor for tension, steel failure modes (reinforcing bar)	*R*	-	0.70						
Strength reduction factor for shear, steel failure modes (carbon and stainless steel threaded rod)	*R*	-	0.75						
Strength reduction factor for shear, steel failure modes (reinforcing bar)	*R*	-	0.65						
Strength modification factor for tension, concrete failure modes	*R*	Cond. A*	1.15						
		Cond. B*	1.00 (Cat.1) - 0.85 (Cat.2) - 0.75 (Cat.3)						
Strength modification factor for Shear, concrete failure modes	*R*	Cond. A*	1.15						
		Cond. B*	1.00						

* Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member except where pullout or pryout resistance governs. *Condition B applies where such supplementary reinforcement is not provided or where pullout or pryout strength governs.

TABLE 6 - STEEL DESIGN INFORMATION FOR FRACTIONAL CARBON STEEL AND STAINLESS STEEL THREADED ROD[1,2,3,4]

	Characteristic	Symbol	Units	Nominal Rod Diameter						
	Nominal Size	d_a	inch	3/8	1/2	5/8	3/4	7/8	1	1-1/4
	Stress Area[1]	A_{se}	in.2	0.0775	0.1419	0.226	0.334	0.462	0.606	0.969
Carbon Steel Threaded Rod	**Reduction Factor for Tension Steel Failure**[3,4]	Ø	-	0.75						
	Strength Reduction Factor for Shear Steel Failure[3,4]	Ø	-	0.65						
	Reduction for Seismic Shear	$\alpha_{V,seis}$	-	0.73	0.73	0.67	0.67	--	0.61	0.46
	Tension Resistance of Carbon Steel ISO 898-1 Class 5.8	N_{sa}	lb (kN)	5,620 (25.0)	10,290 (45.8)	16,385 (72.9)	24,250 (107.9)	33.475 (148.9)	43,910 (195.3)	70,260 (312.5)
	Tension Resistance of Carbon Steel ASTM A193 B7	N_{sa}	lb (kN)	9,690 (43.1)	17,740 (78.9)	28,250 (125.7)	41,750 (185.7)	57,750 (256.9)	75,750 (337.0)	121,125 (538.8)
	Shear Resistance of Carbon Steel ISO 898-1 Class 5.8	V_{sa}	lb (kN)	2,810 (12.5)	6,175 (27.5)	9,830 (43.7)	14,550 (64.7)	20,085 (89.3)	26,345 (117.2)	42,155 (187.5)
	Shear Resistance of Carbon Steel ASTM A193 B7	V_{sa}	lb (kN)	4,845 (21.6)	10,645 (47.4)	16,950 (75.4)	25,050 (111.4)	34,650 (154.1)	45,450 (202.2)	72,675 (323.3)
Stainless Steel Threaded Rod	**Strength Reduction Factor for Tension Steel Failure**[3,4]	Ø	-							
	Strength Reduction Factor for Shear Steel Failure[3,4]	Ø	-							
	Tension Resistance of Stainless Steel ASTM F593 CW1	*Nsa*	lb (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	--	--	--	--
	Tension Resistance of Stainless Steel ASTM F593 CW2	N_{sa}	lb (kN)	--	--	--	28,390 (126.3)	39,270 (174.7)	51,510 (229.1)	82,365 (366.4)
	Tension Resistance of Stainless Steel ASTM F593 SH1	N_{sa}	lb (kN)	8,915 (39.7)	16,320 (72.6)	25,990 (115.6)	--	--	--	--
	Tension Resistance of Stainless Steel ASTM F593 SH2	N_{sa}	lb (kN)	--	--	--	35,070 (156.0)	48,510 (215.8)	63,630 (283.0	--
	Tension Resistance of Stainless Steel ASTM F593 SH3	N_{sa}	lb (kN)	--	--	--	--	--	--	92,055 (409.5)
	Shear Resistance of Stainless Steel ASTM F593 CW1	V_{sa}	lb (kN)	3,875 (17.2)	7,095 (31.6)	11,300 (50.3)	--	--	--	--
	Shear Resistance of Stainless Steel ASTM F593 CW2	V_{sa}	lb (kN)	--	--	--	14,195 (63.1)	19,635 (87.3)	25,755 (114.6)	41,185 (183.2)
	Shear Resistance of Stainless Steel ASTM F593 SH1	V_{sa}	lb (kN)	4,455 (19.8)	9,790 (43.5)	15,595 (69.4)	--	--	--	--
	Shear Resistance of Stainless Steel ASTM F593 SH2	V_{sa}	lb (kN)	--	--	--	17,535 (78.0)	24,255 (107.9)	31,815 (141.5)	
	Shear Resistance of Stainless Steel ASTM F593 SH3	V_{sa}	lb (kN)	--	--	--	--	--	--	46,030 (204.8)

For SI: 1 inch = 25.4 mm, 1 in.2 = 645.16 mm2, 1 lb = 0.004448 kN

[1] Values provided for common rod material types are based on specified strength and calculated in accordance with ACI 318-14 Eq. (17.4.1.2) and Eq. (17.5.1.2b) or ACI 318-11 Eq. (D-2) and Eq. (D-29). Nuts and washers shall be appropriate for the rod as set forth in Table 1 of this report.
[2] Stress area is minimum stress area applicable for either tension or shear.
[3] Tabulate value of φ complies with ACI 318-14 Section 17.3.3 (ACI 318-11 Section D.4.3) and applies when the load combinations of Section 1605.1 of the IBC or ACI318-14 Section 5.3 (ACI 318-11 Section 9.2) are used. When the load combinations in ACI 318 Appendix C are used, the appropriate value of φ shall be determined in accordance with ACI 318-11 D.4.4.
[4] For limit state design as per CSA A23.3-14, Annex D, Material resistance factors (Φ) and resistance modification factors (R) in table shall be used.

TABLE 7a - STEEL DESIGN INFORMATION FOR FRACTIONAL STEEL US REINFORCING BAR[1,2,3]

	Characteristic	Symbol	Units	Nominal Reinforcing Bar size						
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 10
Reinforcing bar	Nominal bar diameter	d_a	inch	0.375	0.500	0.625	0.750	0.875	1.000	1.250
	Stress Area	A_{se}	in.2	0.11	0.20	0.31	0.44	0.60	0.79	1.27
	Strength Reduction Factor for Tension Steel Failure	Ø		0.75						
	Strength Reduction Shear for Tension Steel Failure	Ø		0.65						
	Tension Resistance of Carbon Steel ASTM A615 Grade 40	N_{sa}	lb	6,600	12,000	18,600	26,400	36,000	47,400	76,200
			(kN)	(29.4)	(53.4)	(82.7)	(117.4)	(160.1)	(210.8)	(339.0)
	Tension Resistance of Carbon Steel ASTM A615 Grade 60	N_{sa}	lb	9,900	18,000	27,900	39,600	54,000	71,100	114,300
			(kN)	(44.0)	(80.1)	(124.1)	(176.1)	(240.2)	(316.3)	(508.4)
	Shear Resistance of Carbon Steel ASTM A615 Grade 40	V_{sa}	lb	3,960	7,200	11,160	15,840	21,600	28,440	45,720
			(kN)	(17.6)	(32.0)	(49.6)	(70.5)	(96.1)	(126.5)	(203.4)
	Shear Resistance of Carbon Steel ASTM A615 Grade 60	V_{sa}	lb	5,940	10,800	16,740	23,760	32,400	42,660	68,580
			(kN)	(26.4)	(48.0)	(74.5)	(105.7)	(144.1)	(189.8)	(305.1)

For SI: 1 inch = 25.4 mm, 1 in.^{2} = 645.16 mm^2, 1 lb = 0.004448 kN

[1]Values provided for common rod material types are based on specified strength and calculated in accordance with ACI 318-14 Eq. (17.4.1.2) and Eq. (17.5.1.2b) or ACI 318-11 Eq. (D-2) and Eq. (D-29).
[2]Stress area is minimum stress area applicable for either tension or shear.
[3]Tabulate value of φ complies with ACI 318-14 Section 17.3.3 (ACI 318-11 Section D.4.3) and applies when the load combinations of Section 1605.1 of the IBC or ACI318-14 Section 5.3 (ACI 318-11 Section 9.2) are used. When the load combinations in ACI 318 Appendix C are used, the appropriate value of φ shall be determined in accordance with ACI 318-11 D.4.4.

TABLE 7b - STEEL DESIGN STRENGTH FOR CAN GRADE 400 REINFORCING BAR[1,2]

Rebar size	Area(mm2)	f_{uta} (MPa)	f_{ya} (MPa)	Tension N_{sar}	Shear V_{sar}	Seismic Shear V_{sar}
10M	100	540	400	36.72 kN 8,255 lb	17.44 kN 3,921 lb	12.73 kN 2,863 lb
15M	200	540	400	73.44 kN 16,511 lb	34.88 kN 7,843 lb	23.37 kN 5,255 lb
20M	300	540	400	110.16 kN 24,766 lb	52.33 kN 11,764 lb	35.06 kN 7,882 lb
25M	500	540	400	183.60 kN 41,277 lb	87.21 kN 19,607 lb	53.20 kN 11,960 lb
30M	700	540	400	257.04 kN 57,788 lb	122.09 kN 27,449 lb	56.16 kN 12,627 lb

[1] Tabulated value are calculated in accordance with CSA A23.3-14 Annex D (Factored Resistance Loads)
[2] CSA G30.18 Grade 400 reinforcing bar are considered ductile steel elements.

TABLE 8 - FRACTIONAL THREADED ROD AND US REINFORCING BAR CONCRETE BREAKOUT STRENGTH DESIGN INFORMATION[1,2,3]

Characteristic		Symbol	Units	Nominal Anchor Element Diameter						
US Threaded Rod	Size	d_a	inch	3/8	1/2	5/8	3/4	7/8	1	1-1/4
	Drill Size	d_{hole}	inch	1/2	9/16	3/4	7/8	1	1-1/8	1-3/8
US Re-bar	Size	d_a	inch	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 10
	Drill Size	d_{hole}	inch	9/16	5/8	3/4	1	1-1/8	1-1/4	1-5/8
Embedment Depth Range		$h_{ef,min}$	inch	2-3/8	2-3/4	3-1/8	3-1/2	4	4	5
		$h_{ef,max}$	inch	7-1/2	10	12-1/2	15	17-1/2	20	25
Minimum Anchor Spacing		s_{min}	inch	0.5 · hef						
Minimum Edge Distance		c_{min}	inch	0.5 · hef						
Minimum Concrete Thickness		h_{min}	inch	2.0 · hef						
Critical Edge Distance		c_{ac}	-	See section 3.2.6 of IAPMO ER 490 report						
Effectiveness Factor for Uncracked Concrete, Breakout		$k_{c,uncr}$	-- (SI)	24 (10)						
Effectiveness Factor for Cracked Concrete, Breakout		$k_{c,cr}$	-- (SI)	17 (7.1)						
Strength Reduction Factor for Tension, Concrete Failure Modes, Condition B2		Ø	--	0.65						
Strength Reduction Factor for Shear, Concrete Failure Modes, Condition B2		Ø	--	0.70						

TABLE 9 - CANADIAN METRIC REINFORCING BAR CONCRETE STRENGTH DESIGN INFORMATION[1,2,3]

Characteristic	Symbol	Units	Bar size				
			10M	15 M	20M	25M	30M
Embedment Depth Range	$h_{ef,min}$	inch	2-3/8	3-1/8	3-1/2	4	5
	$h_{ef,max}$	inch	7-1/2	12-1/2	15	20	25
Minimum Anchor Spacing	s_{min}	inch	0.5 · h_{ef}				
Minimum Edge Distance	c_{min}	inch	0.5 · h_{ef}				
Minimum Concrete Thickness	h_{min}	inch	2.0 · h_{ef}				
Critical Edge Distance	c_{ac-}		See section 3.2.6 of IAPMO ER 490 report				
Effectiveness Factor for Uncracked Concrete, Breakout	$k_{c,uncr}$	-- (SI)	24 (10)				
Effectiveness Factor for Cracked Concrete, Breakout	kc,cr	-- (SI)	17 (7.1)				

For SI: 1 inch = 25.4 mm, 1 in.2 = 645.16 mm2, 1 lb = 0.004448 kN

[1] The tabulated value of Φ applies when the load combinations of Section 1605.2 of the IBC, or ACI 318-14 Section 5.3(ACI 318 Section 9.2), are used in accordance with ACI 318-14 Section 17.3.3 (ACI 318-11 Section D.4.3). If the load combinations of ACI 318 Appendix C are used, the appropriate value of shall be determined in accordance with ACI 318 D.4.4.

[2] The values of correspond to Condition B as described in Section 17.3.3 of ACI 318-14 (Section D.4.3 of ACI 318-11) for post-installation anchors designed using the load combination of IBC Section 1605.2. If the load combinations of ACI 318-11 Appendix C are used, the corresponding value of Φ shall be determined.

[3] For limit state design as per CSA A23.3-14, Annex D, material resistance factors (Φ) and resistance modification factors (R) in table shall be used. Condition B applies where supplemental reinforcement is not provided as per CAS A23.3-14, Clause D.5.3.c.

TABLE 10 - BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL STEEL THREADED RODS IN HAMMER DRILLED HOLES[1,2,3,4,5,6]

Design Information		Symbol	Units	Nominal Anchor Element Diameter					
				3/8"	1/2"	5/8"	3/4"	1"	1-1/4"
Minimum Embedment Depth		$h_{ef,min}$	Inch	2-3/8	2-3/4	3-1/8	3-1/2	4	5
Maximum Embedment Depth		$h_{ef,max}$	Inch	7-1/2	10	12-1/2	15	20	25
Characteristic Bond Strength in Uncracked Concrete for Sustained Tension Loading[2, 3, 6]		$t_{k,sust,uncr}$	Psi (N/mm^2)	1320 (9.1)	1237 (8.5)	1154 (7.9)	1070 (7.3)	890 (6.1)	735 (5.0)
Characteristic Bond Strength in Cracked Concrete for Sustained Tension Loading[2, 3, 6]		$t_{k,sust,cr}$	Psi (N/mm^2)	1000 (6.9)	1000 (6.9)	1000 (6.9)	1000 (6.9)	700 (4.8)	620 (4.2)
Permissible Installation Conditions, Periodic Special Inspection	Dry Concrete	*Anchor Category*		1	1	2	2	2	3
		ϕ_d	-	0.65	0.65	0.55	0.55	0.55	0.45
	Water-saturated Concrete	*Anchor Category*	-	1	2	2	2	2	2
		ϕ_{ws}	-	0.65	0.55	0.55	0.55	0.55	0.55
	Water-filled Holes	*Anchor Category*	-	3	3	3	3	3	3
		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45
Permissible Installation Conditions, Continuous Special Inspection	Dry Concrete	*Anchor Category*	-	1	1	1	1	1	1
		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65
	Water-saturated Concrete	*Anchor Category*	-	1	1	1	1	1	1
		ϕ_{ws}	-	0.65	0.65	0.65	0.65	0.65	0.65
	Water-filled Holes	*Anchor Category*	-	1	1	1	1	1	1
		ϕ_{wf}	-	0.65	0.65	0.65	0.65	0.65	0.65
Reduction for Seismic Tension		$\alpha_{N,seis}$	-	1.00	1.00	1.00	1.00	1.00	1.00

[1] Bond strength values correspond to concrete compressive strength, f c = 2,500 psi (17.2 MPa). Bond strength values shall not be increased for concrete compressive strength.
[2] Maximum long term temperature: 122°F (+50°C); maximum short-term temperature: 176°F (+80°C).
[3] Short-term elevated concrete temperatures are those that occur over brief intervals, e.g. transient or part of a regular cycle of heating and cooling, such as day-night temperature rise and fall. Long-term elevated concrete temperatures are roughly constant over significant periods of time.
[4] The tabulated value of applies when load combinations of Section 1605.2 of the IBC or ACI 318-19, ACI 318-14 5.3, or ACI 318-11 9.2, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of shall be determined in accordance with ACI 318-11 D.4.4.
[5] The values of correspond to Condition B as described in ACI 318-19 17.5.3, ACI 318-14 17.3.3, or ACI 318-11 D.4.3 for post-installed anchors designed using the load combinations of IBC Section 1605.2. If the load combinations in ACI 318-11 Appendix C are used, the corresponding value of shall be determined.
[6] For load combinations consisting of short-term loads only such as wind, the bond strength values remain the same.

TABLE 11 – BOND STRENGTH DESIGN INFORMATION FOR US AND CAN REINFORCING BARS IN HAMMER-DRILLED HOLES USED AS ANCHOR ELEMENTS [1,2,3,4,5,6,7,8]

Design Information		Symbol	Units	Nominal Rebar Size[1]					
				#3 10M	#4	#5 15M	#6 20M	#8 25M	#10 30M
Minimum Embedment Depth		$h_{ef,min}$	inch	2-3/8	3	3-1/4	4-1/2	6	7 ½
Maximum Embedment Depth		$h_{ef,max}$	inch	7-1/2	10	12-1/2	15	20	25
Characteristic Bond Strength in Uncracked Concrete for Sustained Tension Loading[3,4,7]		$t_{k,sust,uncr}$	psi (N/mm²)	1262 (8.7)	1174 (8.1)	1087 (7.5)	1,000 (6.9)	700 (4.8)	575 (3.9)
Characteristic Bond Strength in Cracked Concrete for Sustained Tension Loading[3,4,7]		$t_{k,sust,cr}$	psi (N/mm²)	800 (5.5)	800 (5.5)	800 (5.5)	800 (5.5)	600 (4.1)	500 (3.4)
Permissible Installation Conditions, Periodic Special Inspection	Dry Concrete	*Anchor Category*	-	1	1	2	2	3	3
		ϕ_d	-	0.65	0.65	0.55	0.55	0.45	0.45
	Water-saturated Concrete	*Anchor Category*	-	1	2	2	2	2	2
		ϕ_{ws}	-	0.65	0.55	0.55	0.55	0.55	0.55
	Water-filled Holes	*Anchor Category*	-	3	3	3	3	3	3
		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45
Permissible Installation Conditions, Continuous Special Inspection	Dry Concrete	*Anchor Category*	-	1	1	1	1	1	1
		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65
	Water-saturated Concrete	*Anchor Category*	-	1	1	1	1	1	1
		ϕ_{ws}	-	0.65	0.65	0.65	0.65	0.65	0.65
	Water-filled Holes	*Anchor Category*	-	1	1	1	1	1	1
		ϕ_{wf}	-	0.65	0.65	0.65	0.65	0.65	0.65
Reduction for Seismic Tension		$\alpha_{N,seis}$	-	0.90	0.90	0.90	0.90	0.90	0.90

[1] Tabulated data for Canadian metric rebars are based on engineering assumptions of comparable US rebar data and not verified by actual testing.
[2] Bond strength values correspond to concrete compressive strengths, f'_c = 2,500 psi (17.2 MPa). Bond strength values shall not be increased for concrete compressive strength.
[3] Maximum long term temperature: 122°F (+50°C); maximum short-term temperature: 176°F (+80°C).
[4] Short-term elevated concrete temperatures are those that occur over brief intervals, e.g. transient or part of a regular cycle of heating and cooling, such as day-night temperature rise and fall. Long-term elevated concrete temperatures are roughly constant over significant periods of time.
[5] The tabulated value of Φ applies when load combinations of Section 1605.2 of the IBC or ACI 318-19, ACI 318-14 5.3, or ACI 318-11 9.2, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of shall be determined in accordance with ACI 318-11 D.4.4.
[6] The values of Φ correspond to Condition B as described in ACI 318-19 17.5.3, ACI 318-14 17.3.3, or ACI 318-11 D.4.3 for post-installed anchors designed using the load combinations of IBC Section 1605.2. If the load combinations in ACI 318-11 Appendix C are used, the corresponding value of shall be determined.
[7] For load combinations consisting of short-term loads only such as wind, the bond strength values remain the same.
[8] For limit state design as per CSA A23.3-14, Annex D, material resistance factors (Φ) and resistance modification factors (R) in table 5 shall be used. Condition B applies where supplemental reinforcement is not provided as per CAS A23.3-14, Clause D.5.3

► STRENGTH DESIGN DATA TABLES AT SELECTED EMBEDMENT AND CONCRETE STRENGTH

TABLE 12 - DESIGN STRENGTH FOR FRACTIONAL THREADED RODS IN UNCRACKED CONCRETE [1,2,3,4,5,6,7]

Anchor Dia. (inch)	h_{ef} (inch)	f'_c = 2,500 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		ϕN_n (lbf)	ϕV_n (lbf)	ϕN_n (lbf)	ϕV_n (lbf)	ϕN_n (lbf)	ϕV_n (lbf)	ϕN_n (lbf)	ϕV_n (lbf)
3/8	2-3/8	2,401	2,401	2,401	2,401	2,401	2,401	2,401	2,401
	5	5,054	7,833	5,054	9,908	5,054	10,108	5,054	10,108
	7-1/2	7,581	14,390	7,581	15,162	7,581	15,162	7,581	15,162
1/2	2-3/4	3,473	3,073	3,473	3,887	3,473	4,760	3,473	5,497
	6-1/2	8,209	11,166	8,209	14,125	8,209	16,419	8,209	16,419
	10	12,630	21,308	12,630	25,260	12,630	25,260	12,630	25,260
5/8	3-1/8	3,894	3,432	3,894	4,516	3,894	5,531	3,894	6,387
	8	9,970	14,625	9,970	18,499	9,970	22,656	9,970	23,565
	12-1/2	15,578	28,564	15,578	36,130	15,578	36,820	15,578	36,820
3/4	3-1/2	4,853	3,772	4,853	5,116	4,853	6,266	4,853	7,235
	9	12,480	16,677	12,480	21,095	12,480	25,836	12,480	29,497
	15	20,799	35,883	20,799	45,389	20,799	49,162	20,799	49,162
1	4	6,151	4,037	6,151	5,596	6,151	6,854	6,151	7,914
	12	18,454	22,990	18,454	29,080	18,454	35,615	18,454	41,125
	20	30,756	49,466	30,756	62,570	30,756	72,696	30,756	72,696
1-1/4	5	6,494	5,276	6,494	6,973	6,494	8,540	6,494	9,861
	15	19,483	28,644	19,483	36,232	19,483	44,375	19,483	51,240
	25	32,471	61,632	32,471	77,959	32,471	93,806	32,471	93,806

[1] Tabulated values are calculated according to ACI318 for concrete cone and bond failures. Values must be compared to the relevant steel strength information with the lowest value controlling.
[2] Values are calculated assuming Condition B - without supplementary reinforcement.
[3] Values are only valid for the temperature range of max. long-term temp.: 122°F; max. short-term temp.: 176°F for anchors installed in dry concrete of compressive strength shown with periodic special inspection.
[4] Tabulated values are valid for single anchors without consideration for close edges or anchor spacing.
[5] Strength reduction factors have been developed in accordance with ACI355.4 and ICC-ES AC308.
[6] Calculated values assume sustained tension load acting on the anchor.
[7] Calculated values are for illustrative purposes only. An engineer must conduct anchor design with experience in the design of fasteners and independently verified.

TABLE 13 - DESIGN STRENGTH FOR FRACTIONAL THREADED RODS IN CRACKED CONCRETE [1,2,3,4,5,6,7]

Anchor Dia. (inch)	h_{ef} (inch)	f'_c = 2,500 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		ϕN_n (lbf)	ϕV_n (lbf)	ϕN_n (lbf)	ϕV_n (lbf)	ϕN_n (lbf)	ϕV_n (lbf)	ϕN_n (lbf)	ϕV_n (lbf)
3/8	2-3/8	1,819	1,819	1,819	1,819	1,819	1,819	1,819	1,819
	5	3,829	6,631	3,829	7,658	3,829	7,658	3,829	7,658
	7-1/2	5,743	11,486	5,743	11,486	5,743	11,486	5,743	11,486
1/2	2-3/4	2,520	2,535	2,808	3,421	2,808	4,190	2,808	4,838
	6-1/2	6,637	9,829	6,637	12,432	6,637	13,273	6,637	13,273
	10	10,210	18,755	10,210	20,420	10,210	20,420	10,210	20,420
5/8	3-1/8	3,052	2,791	3,375	4,064	3,375	5,076	3,375	5,861
	8	8,639	13,420	8,639	16,975	8,639	20,420	8,639	20,420
	12-1/2	13,499	26,211	13,499	31,907	13,499	31,907	13,499	31,907
3/4	3-1/2	3,618	3,067	4,536	4,468	4,536	6,016	4,536	6,947
	9	11,663	16,014	11,663	20,256	11,663	24,808	11,663	27,567
	15	19,439	34,456	19,439	43,583	19,439	45,946	19,439	45,946
1	4	4,420	3,282	4,838	4,781	4,838	5,934	4,838	6,852
	12	14,514	19,905	14,514	25,178	14,514	30,836	14,514	34,306
	20	24,190	42,828	24,190	54,174	24,190	57,177	24,190	57,177
1-1/4	5	5,478	4,290	5,478	6,249	5,478	7,711	5,478	8,904
	15	16,434	25,864	16,434	32,716	16,434	40,068	16,434	46,267
	25	27,391	55,651	27,391	70,393	27,391	79,129	27,391	79,129

[1] Tabulated values are calculated according to ACI318 for concrete cone and bond failures. Values must be compared to the relevant steel strength information with the lowest value controlling.
[2] Values are calculated assuming Condition B - without supplementary reinforcement.
[3] Values are only valid for the temperature range of max. long-term temp.: 122°F; max. short-term temp.: 176°F for anchors installed in dry concrete of compressive strength shown with periodic special inspection.
[4] Tabulated values are valid for single anchors without consideration for close edges or anchor spacing.
[5] Strength reduction factors have been developed in accordance with ACI355.4 and ICC-ES AC308.
[6] Calculated values assume sustained tension load acting on the anchor.
[7] Calculated values are for illustrative purposes only. An engineer must conduct anchor design with experience in the design of fasteners and independently verified.

TABLE 14 - BOND STRENGTH DESIGN INFORMATION FOR US AND CANADIAN METRIC REINFORCING BARS IN UNCRACKED CONCRETE USED AS ANCHOR ELEMENTS [1,2,3,4,5,6,7,8]

Rebar Size	h_{ef} (inch)	f'_c = 2,500 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		ϕN_n (lbf)	ϕV_n (lbf)	ϕN_n (lbf)	ϕV_n (lbf)	ϕN_n (lbf)	ϕV_n (lbf)	ϕN_n (lbf)	ϕV_n (lbf)
#3 10M	2-3/8	2,295	2,295	2,295	2,295	2,295	2,295	2,295	2,295
	5	4,832	7,625	4,832	9,644	4,832	9,664	4,832	9,664
	7-1/2	7,248	14,007	7,248	14,496	7,248	14,496	7,248	14,496
#4	3	3,596	3,393	3,596	4,292	3,596	5,257	3,596	6,070
	6 -1/2	7,791	10,822	7,791	13,688	7,791	15,583	7,791	15,583
	10	11,987	20,650	11,987	23,973	11,987	23,973	11,987	23,973
#5 15M	3-1/4	3,815	3,653	3,815	4,621	3,815	5,660	3,815	6,535
	8	9,391	14,109	9,391	17,847	9,391	21,858	9,391	22,197
	12-1/2	14,673	27,557	14,673	34,683	14,673	34,683	14,673	34,683
#6 20M	4 -1/2	5,855	5,662	5,855	7,161	5,855	8,771	5,855	10,128
	9	11,710	16,014	11,710	20,256	11,710	24,808	11,710	27,678
	15	19,516	34,456	19,516	43,583	19,516	46,130	19,516	46,130
#8 25M	4	7,257	7,037	7,257	8,902	7,257	10,902	7,257	12,589
	12	14,514	19,905	14,514	25,178	14,514	30,836	14,514	34,306
	20	24,190	42,828	24,190	54,174	24,190	57,177	24,190	57,177
#10 30M	5	8,504	8,276	8,504	10,468	8,504	12,821	8,504	14,804
	15	17,009	23,408	17,009	29,609	17,009	36,263	17,009	40,203
	25	28,348	50,365	28,348	63,707	28,348	67,004	28,348	67,004

[1] Tabulated data for Canadian metric rebars are based on engineering assumptions of comparable US rebar data and not verified by actual testing.
[2] Tabulated values are calculated according to ACI318 for concrete cone and bond failures. Values must be compared to the relevant rebar steel strength information with the lowest value controlling.
[3] Values are calculated assuming Condition B - without supplementary reinforcement.
[4] Values are only valid for the temperature range of max. long-term temp.: 122°F; max. short-term temp.: 176°F for anchors installed in dry concrete of compressive strength shown with periodic special inspection.
[5] Tabulated values are valid for single anchors without consideration for close edges or anchor spacing.
[6] Strength reduction factors have been developed in accordance with ACI355.4 and ICC-ES AC308.
[7] Calculated values assume sustained tension load acting on the anchor.
[8] Calculated values are for illustrative purposes only. An engineer must conduct anchor design with experience in the design of fasteners and independently verified.

TABLE 15 - BOND STRENGTH DESIGN INFORMATION FOR US AND CANADIAN METRIC REINFORCING BARS IN CRACKED CONCRETE USED AS ANCHOR ELEMENTS [1,2,3,4,5,6,7,8]

Rebar Size	h_{ef} (inch)	f'_c = 2,500 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		ϕN_n (lbf)	ϕV_n (lbf)	ϕN_n (lbf)	ϕV_n (lbf)	ϕN_n (lbf)	ϕV_n (lbf)	ϕN_n (lbf)	ϕV_n (lbf)
#3 10M	2-3/8	1,455	1,455	1,455	1,455	1,455	1,455	1,455	1,455
	5	3,063	5,800	3,063	6,126	3,063	6,126	3,063	6,126
	7-1/2	4,595	9,189	4,595	9,189	4,595	9,189	4,595	9,189
#4	3	2,450	2,696	2,450	3,410	2,450	4,176	2,450	4,822
	6-1/2	5,309	8,597	5,309	10,619	5,309	10,619	5,309	10,619
	10	8,168	16,336	8,168	16,336	8,168	16,336	8,168	16,336
#5 15M	3-1/4	2,808	2,995	2,808	3,845	2,808	4,709	2,808	5,437
	8	6,912	11,739	6,912	14,848	6,912	16,336	6,912	16,336
	12-1/2	10,799	22,927	10,799	25,525	10,799	25,525	10,799	25,525
#6 20M	4-1/2	4,684	4,811	4,684	6,264	4,684	7,672	4,684	8,859
	9	9,368	14,007	9,368	17,717	9,368	21,699	9,368	22,142
	15	15,613	30,138	15,613	36,904	15,613	36,904	15,613	36,904
#8 25M	4	6,220	6,416	6,220	8,115	6,220	9,939	6,220	11,477
	12	12,441	18,146	12,441	22,953	12,441	28,112	12,441	29,405
	20	20,735	39,045	20,735	49,009	20,735	49,009	20,735	49,009
#10 30M	5	8,099	8,037	8,099	10,166	8,099	12,451	8,099	14,377
	15	16,199	22,732	16,199	28,754	16,199	35,217	16,199	38,288
	25	26,998	48,912	26,998	61,869	26,998	63,814	26,998	63,814

[1] Tabulated data for Canadian metric rebars are based on engineering assumptions of comparable US rebar data and not verified by actual testing.
[2] Tabulated values are calculated according to ACI318 for concrete cone and bond failures. Values must be compared to the relevant rebar steel strength information with the lowest value controlling.
[3] Values are calculated assuming Condition B - without supplementary reinforcement.
[4] Values are only valid for the temperature range of max. long-term temp.: 122°F; max. short-term temp.: 176°F for anchors installed in dry concrete of compressive strength shown with periodic special inspection.
[5] Tabulated values are valid for single anchors without consideration for close edges or anchor spacing.
[6] Strength reduction factors have been developed in accordance with ACI355.4 and ICC-ES AC308.
[7] Calculated values assume sustained tension load acting on the anchor.
[8] Calculated values are for illustrative purposes only. An engineer must conduct anchor design with experience in the design of fasteners and independently verified.

► INTERACTION OF TENSILE AND SHEAR FORCES

Interaction of Tensile and Shear forces as per IAPMO ER 490 Section 3.3.2

► ALLOWABLE STRESS DESIGN (ASD)

For anchors designed using load combinations calculated in accordance with IBC Section 1605.3 (Allowable Stress Design), allowable loads must be established as per IAPMO ER 490 Section 3.3.1

The requirements for member thickness, edge distance and spacing, as described in Table 1, must apply.

TABLE 17 - ALLOWABLE AND ULTIMATE LOAD DATA IN HOLLOW CONCRETE BLOCK FOR ILUSTRATIVE POURPOSES

Rod Dia.	Hole Dia.	Screen Length	Installation Torque	Allowable Loads				Ultimate Loads			
				Tension		Shear		Tension		Shear	
inch	inch	inch	ft. lbs	lbf	kN	lbf	kN	lbf	kN	lbf	kN
3/8	1/2	3	10	360	1.60	803	3.56	1,800	8.00	3,200	14.23
		6									
1/2	5/8	3	15	490	2.18	1,005	4.47	2,450	10.90	4,020	17.88
		6									
5/8	3/4	6	20	490	2.18	1,238	5.50	2,450	10.90	4,950	22.04
		10									

Notes:
1./All load values are for anchors installed in min. 1500 psi CMU units (using local material)
2./ Allowable loads are calculated using 5:1 safety factor
3./ Maximum two anchors shall be installed into the face of a hollow (non-grouted) CMU.
Installation into mortar joints, flange and the web of the CMU is not allowed.
4./ Anchor installation must follow Ucan's installation instructions.

► CHEMICAL RESISTANCE

The chemical mortar has undergone extensive chemical resistance testing.
The results are summarised in the table below.

Chemical Environment	Concentration	Result
Aqueous Solution Acetic Acid	10%	c
Acetone	100%	✗
Aqueous Solution Aluminium Chloride	Saturated	✓
Aqueous Solution Aluminium Nitrate	10%	✓
Ammonia Solution	5%	✗
Jet Fuel	100%	✓
Benzene	100%	✗
Benzoic Acid	Saturated	✓
Benzyl Alcohol	100%	✗
Sodium Hypochlorite Solution	5 - 15%	✗
Butyl Alcohol	100%	c
Calcium Sulphate Aqueous Solution	Saturated	✓
Carbon Monoxide	Gas	✓
Carbon Tetrachloride	100%	c
Chlorine Water	Saturated	✗
Chloro Benzene	100%	c
Citric Acid Aqueous Solution	Saturated	✓
Cyclohexanol	100%	✓
Diesel Fuel	100%	c
Diethylene Glycol	100%	✓
Ethanol	95%	✗
Heptane	100%	c

Chemical Environment	Concentration	Result
Hexane	100%	c
Hydrochloric Acid	10%	✓
	15%	✓
	20%	c
Hydrogen Sulphide Gas	100%	✓
Linseed Oil	100%	✓
Lubricating Oil	100%	✓
Mineral Oil	100%	✓
Paraffin / Kerosene (Domestic)	100%	c
Phenol Aqueous Solution	1%	✗
Phosphoric Acid	50%	✓
Potassium Hydroxide	10% / pH13	c
Sea Water	100%	c
Sulphur Dioxide Solution Sulphur Dioxide (40°C)	10%	✓
	5%	✓
Sulphuric Acid	10%	✓
	30%	✓
Turpentine	100%	c
White Spirit	100%	✓
Xylene	100%	✗

✓ = Resistant to 75°C with at least 80% of physical properties retained.
c = Contact only to a maximun of 25°C.
✗ = Not Resistant.