Ramset™

Excerpt 2026 ISSUE

SPECIFIERS ANCHORING RESOURCE BOOK

ChemSet™ REO502™ Xtrem™

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ChemSet™ Reo 502™ Xtrem™

SEISMIC ANCHOR STUDS - CHEMICAL INJECTION

AVAILABLE IN AUSTRALIA ONLY

(New Zealand refer to EPCON™ G5 Xtrem™ range)

GENERAL INFORMATION

Performance Related	Material Specification	Installation Related
	Zn, GAL, A4 316, HCR	

Product

ChemSet™ Reo 502™ Xtrem™ is a heavy duty pure Epoxy for anchoring threaded studs and reinforcing bar into cracked and uncracked concrete.

Compliance

European Technical Assessment (option 1) - ETA-25/0648

Design according to:

- AS 5216 (formerly TS101)
- AS 1170.4 - Earthquake Actions
- EN 1992-4 (formerly ETAG001 Annex C, E & TR045)
- Seismic Category C1 and C2
- Use enclosed data for simplified calculation method

Use Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.

SEISMIC C1 & C2 · 100 YEAR WORKING LIFE · ETA · CRACKED CONCRETE CERTIFIED · FLOODED HOLE APPROVED

Principal Applications

- Threaded Studs
- Starter Bars
- Threaded Inserts
- Over-head installation
- Steel Columns
- Hand Rails
- Road Stitching

Benefits, Advantages and Features

- 100 year working Life

Greater productivity:

- Anchors in dry, damp, wet or flooded holes

Greater security:

- Strong bond
- Rated for sustained loading

Versatile:

- Anchors in carbide drilled and diamond drilled holes
- Cold and temperate climates

Greater safety:

- Low odour
- VOC Compliant
- Suitable for contact with drinking water

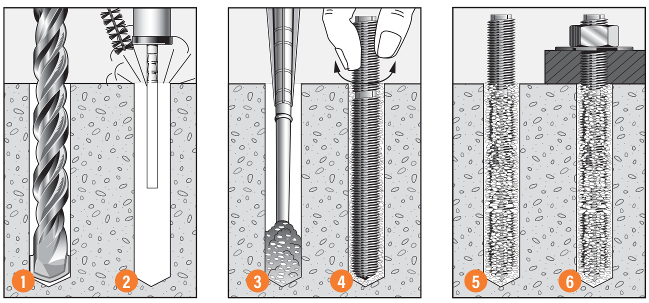
Installation & Substrate Temperature Range

Minimum	Maximum
5°C	40°C

Service Temperature Limits

T1: -40°C to +40°C
T2: -40°C to +60°C
T3: -40°C to +75°C

Installation



1. Drill recommended diameter and depth hole.
2. **Important:** For hammer drilling technique clean dust and debris from hole with stiff wire brush and blower in the following sequence: blow x 2, brush x 2, blow x 2, brush x 2, blow x 2. For diamond drilling technique refer to **ETA-25/0648.**
3. Screw mixing nozzle onto cartridge and dispense adhesive to waste until colour is orange. Insert mixing nozzle to bottom of hole.
   Fill hole to 2/3 the hole depth slowly, ensuring no air pockets form.
4. Insert **Ramset**™ ChemSet™ Anchor Stud/rebar to bottom of hole while turning.
5. Allow ChemSet™ Reo 502™ Xtrem™ to cure as per setting times.
6. Attach fixture.

Setting Times

Temperature of base material	Gel Time	Curing time in dry concrete	Curing time in wet and flooded concrete
5°C	75 min	30h	60 h
10°C	45 min	22h	44 h
15°C	35 min	14h	28 h
20°C	22 min	7h	14 h
25°C	14 min	5h	10 h
30°C	8 min	4h	8 h
35°C	6 min	3h	6h
40°C	4 min	2h 45min	5h 30min

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Installation and performance details: ChemSet™ Reo 502™ XTREM™ and ChemSet™ Anchor Studs

Anchor size, d_b (mm)	Drilled hole diameter, d_h (mm)	Fixture hole diameter, d_f (mm)	Anchor effective depth, h_n (mm)	Tightening torque, T_r (Nm)	Optimum dimensions*		Concrete substrate thickness, b_m (mm)	Seismic C1 & C2 Cracked Concrete reduced characteristic tensile capacity, $N_{Rd,seis}$ (kN) **					
								Concrete Compressive Strength, f'_c					
					Anchor* spacing, a_c (mm)	Edge* distance, e_c (mm)		20 MPa		30 MPa		40 MPa	
								C1	C2	C1	C2	C1	C2
M10	12	12	90	20	270	135	120	9.9	6.4	9.9	6.4	9.9	6.4
M12	14	14	110	30	330	165	140	19.9	12.2	20.2	12.2	20.2	12.2
M16	18	18	125	60	375	188	161	24.1	14.6	29.5	14.6	33.1	14.6
M20	25	22	170	120	510	255	214	38.2	23.0	46.7	23.0	54.0	23.0
M24	28	26	210	150	630	315	262	52.4	26.0	64.2	26.0	74.1	26.0
M30	35	33	280	180	840	420	350	80.7	71.8	98.8	71.8	114.1	71.8

All data relevant for Dry and Wet Holes. For Flooded Holes MULTIPLY $N_{Rd,seis}$ x 0.62

* For anchor spacings or edge distances less than the minimum, please refer to the simplified strength limit state design process to verify capacity.

** Tension values are based on service temperature limits -40°C to +40°C only. If service temperature limits is beyond this range please contact Ramset Engineer.

** Note: Seismic Cracked concrete combined pull-out and concrete cone resistance, tension = $N^0_{Rd,p,seis} = \alpha_{Nseis} N^0_{Rk,p,seis} / \gamma_{Msp}$ where $\gamma_{Msp} = 1.5$

Anchor size, d_b (mm)	Reduced Characteristic Capacity											
	Grade 5.8 Steel Studs			Grade 8.8 Steel Studs			ANSI 316 Stainless Steel Studs			HCR 1.4529 Stainless Steel Studs		
	Shear, $V_{Rd,s,seis}$ (kN)#		Tension, $N_{Rd,s,seis}$ (kN)***	Shear, $V_{Rd,s,seis}$ (kN)#		Tension, $N_{Rd,s,seis}$ (kN)***	Shear, $V_{Rd,s,seis}$ (kN)#		Tension, $N_{Rd,s,seis}$ (kN)***	Shear, $V_{Rd,s,seis}$ (kN)#		Tension, $N_{Rd,s,seis}$ (kN)***
	C1	C2	C1 & C2	C1	C2	C1 & C2	C1	C2	C1 & C2	C1	C2	C1 & C2
M10	3.5	3.9	19.3	5.5	6.3	30.9	3.9	4.4	21.7	4.8	5.5	27.1
M12	6.0	6.1	28.1	9.6	9.8	44.9	6.8	6.8	31.6	8.4	8.5	39.3
M16	10.9	10.7	52.3	17.5	17.1	83.7	12.3	12.0	58.8	15.3	15.0	73.3
M20	17.1	16.7	81.7	27.3	26.7	130.7	19.2	18.7	91.7	23.9	23.4	114.3
M24	18.9	17.8	117.7	30.3	28.5	188.3	21.2	20.0	132.1	26.5	25.0	164.7
M30	30.1	30.1	187.0	48.1	45.8	299.2	33.7	32.1	210.0	42.1	40.1	261.8

***Note: Seismic Cracked Concrete steel resistance, tension = $N_{Rd,s,seis} = \alpha_{Nseis} N^0_{Rk,s,seis} / \gamma_{Ms}$ (kN) where $\gamma_{Ms} = 1.5$ (Grade 5.8 & 8.8 steel), $\gamma_{Ms} = 1.87$ (A4 316 SS) and $\gamma_{Ms} = 1.5$ (HCR 1.4529 stainless steel)

 # Note: Shear Data includes annular gap reduction factor of 0.5

For optimised performance data, including performance based on diamond drilling technique, please use Ramset iExpert Anchoring Software.

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
ChemSet Reo502 Xtrem	600ml	CREO502X

ENGINEERING PROPERTIES Reo 502™ Plus ChemSet™ Anchor Studs and Threaded Rod

Anchor Size, d_b	Grade 8.8 Threaded Rod				Stainless Steel High Corrosion Resistance HCR Grade 1.4529/1.4565 Threaded Rod				Section modulus Z (mm^3)
	Shank diameter, d_s (mm)	Stressed Area (mm^2)	Yield Strength f_y MPa	UTS f_u MPa	Shank diameter, d_s (mm)	Stressed Area (mm^2)	Yield Strength f_y MPa	UTS f_u MPa	
M10	8.6	58	640	800	8.2	52.8	450	650	62.3
M12	10.4	84.3	640	800	10	78.5	450	650	109.2
M16	14.1	157	640	800	14	153.9	450	650	277.5
M20	17.7	245	640	800	17.2	232.4	450	650	540.9
M24	21.2	353	640	800	20.7	336.5	450	650	935.5
M30	26.7	561	640	800	-	-	-	-	-

Refer to "Engineering Properties" for ChemSet™ Anchor Studs Grade 5.8 and AISI 316 Stainless Steel in the SARB ANZ.

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STRENGTH LIMIT STATE DESIGN

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STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

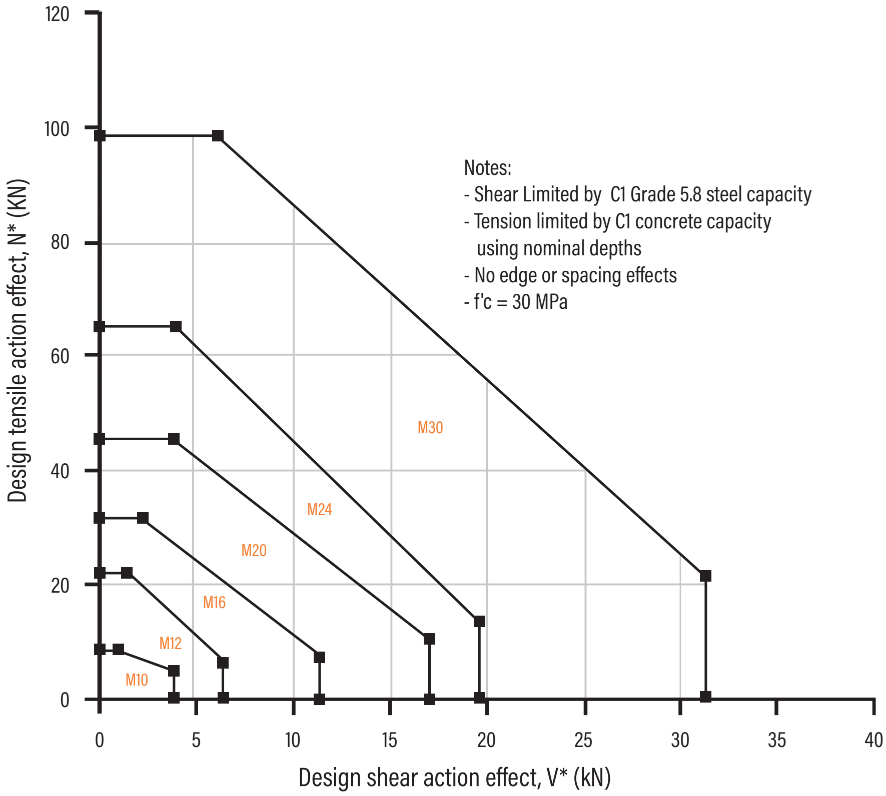

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Min. Anchor Spacing - a_m	40	50	70	85	90	140
Min. Edge Distance - e_m	40	40	45	55	60	90

Step 1c Calculate anchor effective depth, h (mm)

Refer to "Description and Part Numbers" table for ChemSet™ Anchor Studs page in the SARB ANZ.

Effective depth, h (mm)

Preferred h = h_n otherwise,

$$h = L_e - t$$

t = total thickness of material(s) being fastened.

Substrate thickness b_m (mm)		
Anchor Stud Size (mm)		
M10	M12	M16 to M30
h + 30mm ≥ 100mm		h + (2 x d_h)

Checkpoint 1 Anchor size determined, absolute minima compliance achieved, effective depth (h) calculated.

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STRENGTH LIMIT STATE DESIGN

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STEP 2 Verify Seismic C1 & C2 cracked concrete tensile capacity - per anchor

Table 2a - Seismic C1 & C2 Cracked concrete combinded Pull-out and concrete cone resistance, tension

$N^0_{Rd,p,seis} = \alpha_{seis} N^0_{Rk,p,seis} / \gamma_{Msp}$ (kN), $\alpha_{N,seis} = 0.85$, $\gamma_{Msp} = 1.5$, f'c = 30 MPa where $N^0_{Rk,p,seis} = \pi * d_b * h * \tau_{Rk,cr,seis}$

Anchor Size, d_b	C1 & C2 Seismic Data combined pull-out and concrete cone resistance $N^0_{Rd,p,seis}$												Concrete Cone Resistance - $N^0_{Rd,c,seis}$
	M10		M12		M16		M20		M24		M30		
Drilled Hole Dia, d_h (mm)	12		14		18		25		28		35		
Effective Depth, h (mm)	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	
70	7.7	5.0											12.4
80	8.8	5.7											15.1
90	**9.9**	**6.4**	16.5	10.0									18.0
100	11.0	7.1	18.4	11.1									21.1
110	12.1	7.8	**20.2**	**12.2**	29.1	12.8							24.3
120	13.2	8.5	22.0	13.3	31.8	14.0							27.7
125	13.8	8.9	23.0	13.9	**33.1**	**14.6**							29.5
140	15.5	10.0	25.7	15.6	37.1	16.3							34.9
150	16.6	10.7	27.6	16.7	39.7	17.5	49.1	20.3					38.7
160	17.7	11.4	29.4	17.8	42.4	18.7	52.4	21.6	64.9	19.8			42.7
170	18.8	12.1	31.2	18.9	45.0	19.9	**55.7**	**23.0**	69.0	21.1			46.7
180	19.9	12.8	33.1	20.0	47.7	21.0	59.0	24.4	73.1	22.3			50.9
190	21.0	13.5	34.9	21.1	50.3	22.2	62.2	25.7	77.1	23.5			55.2
200	22.1	14.2	36.7	22.2	53.0	23.4	65.5	27.1	81.2	24.8			59.6
210			38.6	23.3	55.6	24.5	68.8	28.4	**85.2**	**26.0**	93.1	53.8	64.2
240			44.1	26.7	63.6	28.0	78.6	32.5	97.4	29.7	106.4	61.5	78.4
280					74.2	32.7	91.7	37.9	113.7	34.7	**124.1**	**71.8**	98.8
320					84.8	37.4	104.8	43.3	129.9	39.6	141.8	82.0	120.7
350							114.6	47.4	142.1	43.4	155.1	89.7	138.1
400							131.0	54.1	162.4	49.6	177.3	102.5	168.7
450									182.7	55.8	199.5	115.4	201.3
480									194.8	59.5	212.8	123.0	221.8
550											243.8	141.0	272.0
600											266.0	153.8	309.9

Bold values are at ChemSet Anchors Stud nominal depths h_n

All data relevant for Dry and Wet Holes. For Flooded Holes MULTIPLY $N^0_{Rd,p,seis}$ x 0.62 & $N^0_{Rd,c,seis}$ x 0.62. For single anchor values: Multiply $N^0_{Rd,p,seis}$ *1.17 & $N^0_{Rd,c,seis}$ x 1.13.
For optimised performance data, including performance based on diamond drilling technique, please use Ramset iExpert Anchoring Software.

For C1 Seismic - Calculate $N_{Rd,p,seis}$, $N_{Rd,c,seis}$ then choose minimum - Refer to Checkpoint 2a and 2b
For C2 Seismic - Calculate $N_{Rd,p,seis}$ only then choose minimum - Refer to Checkpoint 2a only

Table 2b-1 Seismic Cracked concrete service temperature limits effect, tension, X_{ns}

Service temperature (˚C)	Seis. Cat.	M10	M12	M16	M20	M24	M30
-40˚C to +40˚C	C1	1.00	1.00	1.00	1.00	1.00	1.00
	C2	1.00	1.00	1.00	1.00	1.00	1.00
-40˚C to +60˚C	C1	0.85	0.85	0.84	0.85	0.84	0.85
	C2	0.85	0.85	0.85	0.84	0.85	0.83
-40˚C to +75˚C	C1	0.26	0.27	0.26	0.26	0.26	0.26
	C2	0.25	0.27	0.27	0.26	0.26	0.25

Table 2b-2 Seismic Cracked concrete compressive strength effect, tension, X_{nc}

f'c (MPa)	20	25	30	40	50
X_{nc} for $N^0_{Rd,p,seis}$ (Bond)	1.0	1.0	1.0	1.0	1.0
X_{nc} for $N^0_{Rd,c,seis}$ (Conc.)	0.81	0.91	1.0	1.15	1.29

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STRENGTH LIMIT STATE DESIGN

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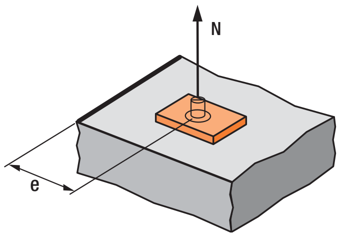


$X_{ne} = 0.25 + 0.5*(e/h)$

Where $e_m \le e \le e_c$

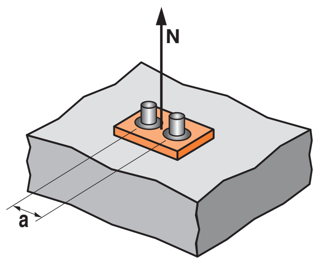
$e_c = 1.5*h$

Note: Tabled values are based on the nominal effective depth, h shown in the installation details.

For other values of X_{ne}, please use equation shown above.

Table 2c - Seismic cracked concrete Edge distance effect, tension, X_{ne}

Anchor size, db	M10	M12	M16	M20	M24	M30
Edge distance, e (mm)						
40	0.47	0.43				
45	0.50	0.45	0.43			
50	0.53	0.48	0.45			
55	0.56	0.50	0.47	0.41		
60	0.58	0.52	0.49	0.43	0.39	
65	0.61	0.55	0.51	0.44	0.40	
70	0.64	0.57	0.53	0.46	0.42	
90	0.75	0.66	0.61	0.51	0.46	0.41
100	0.81	0.70	0.65	0.54	0.49	0.43
115	0.89	0.77	0.71	0.59	0.52	0.46
135	1.00	0.86	0.79	0.65	0.57	0.49
165		1.00	0.91	0.74	0.64	0.54
187			1.00	0.80	0.70	0.58
255				1.00	0.86	0.71
315					1.00	0.81
420						1.00



$X_{na} = 0.5 + a/(6*h)$

Where $a_m \le a \le a_c$

$a_c = 3*h$

Note: Tabled values are based on the nominal effective depth, h shown in the installation details.

For other values X_{na}, please use equation shown above.

Table 2d - Seismic cracked concrete anchor spacing effect, tension, X_{na}

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Anchor spacing, a (mm)						
40	0.57					
45	0.58					
50	0.59	0.58				
55	0.60	0.58				
60	0.61	0.59				
70	0.63	0.61	0.59			
80	0.66	0.63	0.61	0.58		
90	0.67	0.64	0.62	0.59	0.57	
140	0.76	0.71	0.69	0.64	0.61	0.58
170	0.81	0.76	0.73	0.67	0.63	0.60
200	0.87	0.80	0.77	0.70	0.66	0.62
270	1.00	0.91	0.86	0.76	0.71	0.66
330		1.00	0.94	0.82	0.76	0.70
375			1.00	0.87	0.80	0.72
510				1.00	0.90	0.80
630					1.00	0.88
840						1.00

Checkpoint 2a

Design seismic cracked concrete combined pull-out and concrete cone resistance, $N_{Rd,p,seis}$

$N_{Rd,p,seis} = N^0_{Rd,p,seis} * X_{ns} * X_{nc} * X_{ne} * X_{na}$

Checkpoint 2b

Design seismic cracked concrete combined pull-out and concrete cone resistance, $N_{Rd,c,seis}$

$N_{Rd,c,seis} = N^0_{Rd,c,seis} * X_{ns} * X_{nc} * X_{ne} * X_{na}$

STEP 3

Verify seismic C1 & C2 cracked concrete tensile resistance - per anchor

Table 3a - Seismic (C1 & C2) Cracked Concrete steel resistance, tensile, $N_{Rd,s,seis} = \alpha_{seis} N_{Rk,s,seis} / \gamma_{Ms}$ (kN), $\alpha_{seis} = 1.0$

$\gamma_{Ms} = 1.5$ for Grade 5.8 and Grade 8.8 Carbon Steel

$\gamma_{Ms} = 1.87$ for A4 316 Stainless Steel

$\gamma_{Ms} = 1.5$ for HCR 1.4529 Stainless Steel

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Grade 5.8 Carbon Steel	19.3	28.1	52.3	81.7	117.7	187.0
Grade 8.8 Carbon Steel	30.9	44.9	83.7	130.7	188.3	299.2
A4 316 Stainless Steel	21.7	31.6	58.8	91.7	132.1	210.0
HCR 1.4529 Stainless Steel	27.1	39.3	73.3	114.3	164.7	261.8

Checkpoint 3

Design seismic C1 & C2 cracked concrete tensile resistance, $N_{Rd,seis}$

$N_{Rd,seis}$ = minimum of $N_{Rd,p,seis}$, $N_{Rd,c,seis}$, $N_{Rd,s,seis}$

Check $N^*/N_{Rd,seis} \le 1$,

if not satisfied return to step 1

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STEP 4

Step 4 - Verify seismic C1 & C2 cracked concrete edge shear resistance - per anchor

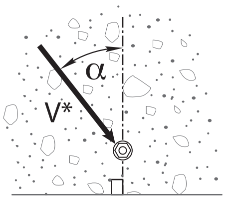
Table 4a - Seismic C1 & C2 cracked concrete edge resistance, $V^0_{Rd,c,seis} = \alpha_{seis} V^0_{Rk,c,seis} / \gamma_{Mc}$ (kN), $\gamma_{Mc} = 1.5$, $\alpha_{seis} = 0.85$, $f'_c = 30$ MPa

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Effective depth, h (mm)	90	110	125	170	210	280
Edge distance, e_m						
40	1.3	1.5				
45			1.9			
55				2.8		
60					3.5	
90						6.5

Note: Data includes annular gap reduction factor of 0.5. If annular gap is filled multiply $V_{Rd,c,seis}$ *2

For single anchor values: Multiply $V^0_{Rd,c,seis}$ * 1.17

For optimised performance data, please use Ramset iExpert Anchoring Software.



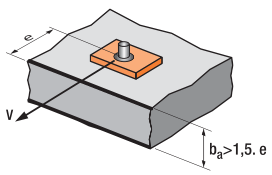
Load direction effect, conc. edge shear, X_{vd}

Table 4b - Seismic cracked concrete compressive strength effect, shear, X_{vc}

f'c (MPa)	20	25	30	40	50
X_{vc}	0.82	0.91	1.00	1.15	1.29

Table 4c - Seismic cracked concrete load direction effect, concrete edge shear, X_{vd}

Angle, α°	0-55	60	70	80	90-180
X_{vd}	1	1.1	1.2	1.5	2

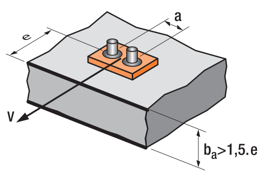


$X_{ve} = e/e_m * \sqrt{e/e_m}$

Table 4d - Seismic cracked concrete anchor spacing and edge distance effect, concrete edge shear, X_{ve}

For single anchor fastening X_{ve}

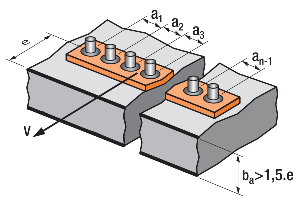
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



$$X_{ve} = \frac{3*e+a}{6*e_m} * \sqrt{e/e_m}$$

For 2 anchors fastening X_{ve}

e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
a/e_m												
1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16
1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
2.5	0.92	1.11	1.32	1.54	1.77	2.00	2.25	2.50	2.77	3.04	3.32	3.61
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35
5.5						2.71	2.99	3.28	3.71	4.02	4.33	4.65
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65



For 3 anchors fastening and more

$$X_{ve} = \frac{3*e + a_1 + a_2 + a_3 + ... + a_{n-1}}{3*n*e_m} * \sqrt{e/e_m}$$

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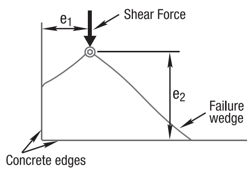
Table 4e - Seismic C1 & C2 Cracked concrete Pryout failure, $V^0_{Rd,cp,seis} = \alpha_{seis} V_{Rk,cp} / \gamma_{Mpr}$ (kN), $\gamma_{Mpr} = 1.5$, $\alpha_{seis} = 0.75$, $f'_c = 30$ MPa

Anchor size, d_b		M10	M12	M16	M20	M24	M30
Effective depth, h (mm)		90	110	125	170	210	280
-40˚C to +40˚C	C1 Seismic Data	8.8	17.8	29.2	46.7	64.2	98.8
	C2 Seismic Data	5.7	10.8	12.9	20.3	23.0	63.3
-40˚C to +60˚C	C1 Seismic Data	7.5	15.1	24.5	39.6	54.0	83.9
	C2 Seismic Data	4.8	9.1	11.0	17.1	19.6	52.8
-40˚C to +75˚C	C1 Seismic Data	2.3	4.8	7.5	12.2	16.6	25.7
	C2 Seismic Data	1.4	2.9	3.5	5.3	6.0	15.8

Note: Data includes annular gap reduction factor of 0.5 For single anchor values: Multiply $V^0_{Rd,cp,seis}$ *1.13
If annular gap is filled multiply $V_{Rd,cp,seis}$ *2

Table 4f Anchor at a corner effect, concrete edge shear, X_{VS}

Note: For $e_1/e_2 > 1.25$, $X_{VS} = 1.0$



ANCHOR AT A CORNER

Edge distance, e_2 (mm)	25	30	35	50	60	75	125	200	300	400	600	900
Edge distance, e_1 (mm)												
25	0.86	0.77	0.70	0.58	0.53	0.49	0.41	0.37	0.35	0.34	0.32	0.32
30	0.97	0.86	0.78	0.64	0.58	0.52	0.43	0.38	0.36	0.34	0.33	0.32
35	1.00	0.95	0.86	0.69	0.63	0.56	0.46	0.40	0.37	0.35	0.33	0.32
50	1.00	1.00	1.00	0.86	0.77	0.67	0.52	0.44	0.39	0.37	0.35	0.33
60	1.00	1.00	1.00	0.97	0.86	0.75	0.57	0.47	0.41	0.38	0.36	0.34
75	1.00	1.00	1.00	1.00	1.00	0.86	0.64	0.51	0.44	0.41	0.37	0.35
125	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.65	0.53	0.48	0.42	0.38
200	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.67	0.58	0.49	0.42
300	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.72	0.58	0.49
400	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.67	0.55
500	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.77	0.61
600	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.67
900	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86

Checkpoint 4a

Design seismic cracked concrete edge shear resistance, $V_{Rd,c,seis} = V^0_{Rd,c,seis} * X_{vc} * X_{vd} * X_{ve} * X_{vs}$

Checkpoint 4b

Design seismic cracked concrete Pryout failure,
$V_{Rd,cp,seis} = V^0_{Rd,cp,seis} * X_{nc} * X_{ne} * X_{na}$

STEP 5 Verify seismic C1 & C2 cracked concrete shear resistance - per anchor

Table 5a - Seismic C1 & C2 Cracked Concrete steel shear resistance, $V_{Rd,s,seis} = \alpha_{seis} V_{Rk,s,seis} / \gamma_{Ms}$ (kN), $\alpha_{seis} = 0.85$

$\gamma_{Ms} = 1.25$ for Grade 5.8 and Grade 8.8 Carbon Steel

$\gamma_{Ms} = 1.56$ for A4 316 Stainless Steel

Anchor size, db	M10		M12		M16		M20		M24		M30	
Seismic Category	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
Grade 5.8 Carbon Steel	3.5	3.9	6.0	6.1	10.9	10.7	17.1	16.7	18.9	17.8	30.1	30.1
Grade 8.8 Carbon Steel	5.5	6.3	9.6	9.8	17.5	17.1	27.3	26.7	30.3	28.5	48.1	45.8
A4 316 Stainless Steel	3.9	4.4	6.8	6.8	12.3	12.0	19.2	18.7	21.2	20.0	33.7	32.1
HCR 1.4529 Stainless Steel	4.8	5.5	8.4	8.5	15.3	15.0	23.9	23.4	26.5	25.0	42.1	40.1

Note: Data includes annular gap reduction factor of 0.5 If annular gap is filled multiply $V_{Rd,s,seis}$ *2
For single anchor values: Multiply $V_{Rd,s,seis}$ *1.17

Checkpoint 5

Design seismic C1 & C2 cracked concrete shear resistance, $V_{Rd,seis}$
$V_{Rd,seis}$ = minimum of $V_{Rd,c,seis}$, $V_{Rd,cp,seis}$, $V_{Rd,s,seis}$
Check $V^*/V_{Rd,seis} \leq 1$,
if not satisfied return to step 1

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STEP 6 Combined Loading

Checkpoint 6

Check
$N^*/N_{Rd,seis} + V^*/V_{Rd,seis} \leq 1.0$,
if not satisfied return to step 1

Specifiy - Threaded Stud Anchors
Ramset™ ChemSet™ Reo 502™ Xtrem™ with (Anchor Size) grade 5.8 ChemSet™ Anchor Stud (Anchor Stud Part Number) Drilled Hole Depth to be (h) mm.

Example
Ramset™ ChemSet™ Reo 502™ Xtrem™ Injection with M16 grade 5.8 ChemSet™ Anchor Stud (CS16190GH). Drilled hole depth to be 125mm. To be installed according to Ramset™ Installation Instructions.

Use Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.

ChemSet™ Reo 502™ Xtrem™

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

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(New Zealand refer to EPCON™ G5 Xtrem™ range)

GENERAL INFORMATION

Performance Related	Material Specification	Installation Related
	Zn, GAL, A4 316, HCR	

Product

ChemSet™ Reo 502™ Xtrem™ is a heavy duty pure Epoxy for anchoring threaded studs and reinforcing bar into cracked and uncracked concrete.

Principal Applications

- Threaded Studs
- Starter Bars
- Threaded Inserts
- Over-head installation
- Steel Columns
- Hand Rails
- Road Stitching

Compliance

European Technical Assessment (option 1) - ETA-25/0648

Design according to:

- AS 5216 (formerly TS101)
- EN 1992-4 (formerly ETAG001 Annex C, E & TR045)
- Use enclosed data for simplified calculation method

Use Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.

Benefits, Advantages and Features

- 100 year working Life

Greater productivity:

- Anchors in dry, damp, wet or flooded holes

Greater security:

- Strong bond
- Rated for sustained loading

Versatile:

- Anchors in carbide drilled and diamond drilled holes
- Cold and temperate climates

Greater safety:

- Low odour
- VOC Compliant
- Suitable for contact with drinking water

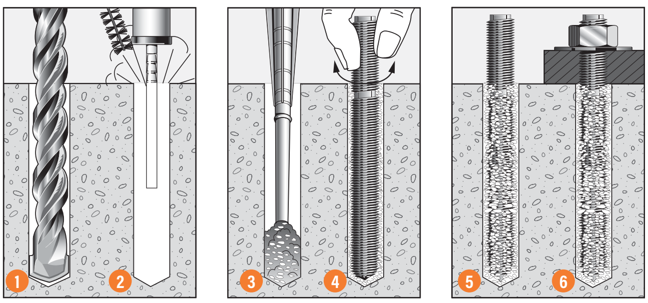
Installation & Substrate Temperature Range

Minimum	Maximum
5°C	40°C

Service Temperature Limits

T1: -40°C to +40°C
T2: -40°C to +60°C
T3: -40°C to +75°C

Installation



1. Drill recommended diameter and depth hole.
2. **Important:** For hammer drilling technique clean dust and debris from hole with stiff wire brush and blower in the following sequence: blow x 2, brush x 2, blow x 2, brush x 2, blow x 2. For diamond drilling technique refer to **ETA-25/0648.**
3. Screw mixing nozzle onto cartridge and dispense adhesive to waste until colour is uniform orange.
   Insert mixing nozzle to bottom of hole.
   Fill hole to 2/3 the hole depth slowly, ensuring no air pockets form.
4. Insert **Ramset**™ ChemSet™ Anchor Stud/rebar to bottom of hole while turning.
5. Allow ChemSet™ Reo 502™ XTREM™ to cure as per setting times.
6. Attach fixture.

Setting Times

Temperature of base material	Gel Time	Curing time in dry concrete	Curing time in wet and flooded concrete
5°C	75 min	30h	60 h
10°C	45 min	22h	44 h
15°C	35 min	14h	28 h
20°C	22 min	7h	14 h
25°C	14 min	5h	10 h
30°C	8 min	4h	8 h
35°C	6 min	3h	6h
40°C	4 min	2h 45min	5h 30min

Ramset™

ChemSet™ Reo 502™ Xtrem™

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

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Installation and performance details: ChemSet™ Reo 502™ Xtrem™ and ChemSet™ Anchor Studs

Anchor size, d_b (mm)	Installation Details				Optimum dimensions*		
	Drilled hole diameter, d_h (mm)	Fixture hole diameter, d_f (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Concrete substrate thickness, b_m (mm)
M10	12	12	90	20	135	270	120
M12	14	14	110	30	165	330	140
M16	18	18	125	60	187.5	375	160
M20	25	22	150	120	225	450	190
			170		255	510	220
M24	28	26	160	150	240	480	200
			210		315	630	270
M30	35	33	280	180	420	840	350

* Note: For shear loads acting towards an edge or where these optimum dimensions are not achievable, please use the simplified strength limit state design process to verify capacity.

Anchor size, d_b (mm)	Reduced Characteristic Capacity#								
	Grade 5.8 Steel Studs		Grade 8.8 Steel Studs		ANSI 316 Stainless Steel Studs		Non-Cracked Concrete		
							Tension, ϕN_{uc} (kN)**		
							Concrete Compressive Strength, f'$_c$		
	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	20 MPa	32 MPa	40 MPa
M10	11.8	18.9	17.5	28.2	14.2	19.8	28.0	35.4	37.0
M12	17.5	28.1	26.0	41.9	21.1	29.5	37.8	47.9	53.6
M16	33.1	53.9	50.9	82.1	41.4	57.7	45.8	58.0	64.9
M20	49.9	81.3	76.8	123.9	62.4	87.1	60.2	76.2	85.4
							72.6	91.9	103.0
M24	72.3	117.8	111.3	179.5	90.4	126.2	66.3	84.0	94.0
							99.7	126.2	141.4
M30	-	-	185.5	299.2	-	-	153.5	194.4	217.7

**Note: Reduced characteristic ultimate concrete tensile capacity = ϕN_{uc} and N_{uc} = Characteristic ultimate concrete tensile capacity. For value of ϕ refer to Table 2a

For conversion to Working Load Limit MULTIPLY ϕN_{uc} x 0.5

***Note: Reduced characteristic ultimate steel tensile capacity = ϕN_{us} where ϕ = 0.67 and N_{us} = Characteristic ultimate steel tensile capacity .

For conversion to Working Load Limit MULTIPLY ϕN_{us} x 0.67 for Gr 5.8 & Gr 8.8

#Note: Design Tensile Capacity ϕN_{ur} = minimum of ϕN_{uc} and ϕN_{us}

For Cracked Concrete performance, please use the simplified strength limit state design process to verify capacity.

Data is based on a Service temperature limit of -40°C to +40°C

All data relevant for Dry and Wet Holes. For Flooded Holes MULTIPLY ϕN_{uc} x 0.63

For optimised performance data, including performance based on diamond drilling technique, please use Ramset iExpert Anchoring Software.

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
ChemSet Reo 502 Xtrem	600ml	CRE0502X

ENGINEERING PROPERTIES

ChemSet™ Anchor Studs and Threaded Rod

Anchor Size, d_b	Grade 8.8 Threaded Rod				Stainless Steel High Corrosion Resistance HCR Grade 1.4529/1.4565 Threaded Rod				Section modulus Z (mm³)
	Shank diameter, d_s (mm)	Stressed Area (mm²)	Yield Strength f_y MPa	UTS f_u MPa	Shank diameter, d_s (mm)	Stressed Area (mm²)	Yield Strength f_y MPa	UTS f_u MPa	
M10	8.6	58	640	800	8.2	52.8	450	650	62.3
M12	10.4	84.3	640	800	10	78.5	450	650	109.2
M16	14.1	157	640	800	14	153.9	450	650	277.5
M20	17.7	245	640	800	17.2	232.4	450	650	540.9
M24	21.2	353	640	800	20.7	336.5	450	650	935.5
M30	26.7	561	640	800	-	-	-	-	-

Refer to "Engineering Properties" for ChemSet™ Anchor Studs Grade 5.8 and AISI 316 Stainless Steel in the SARB ANZ.

ChemSet™ Reo 502™ Xtrem™

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STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram

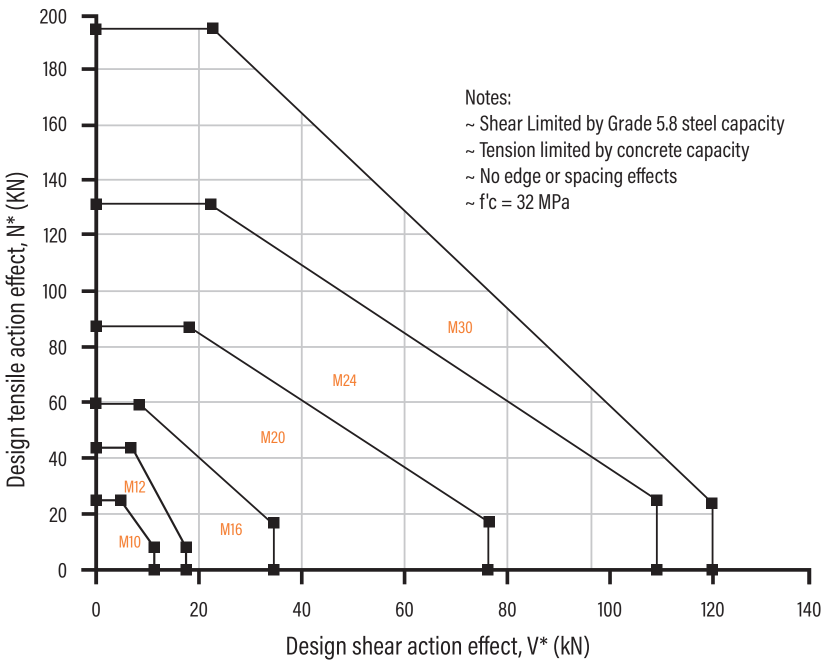

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Min. Anchor Spacing - a_m	40	50	70	85	90	140
Min. Edge Distance - e_m	40	40	45	55	60	90

Step 1c Calculate anchor effective depth, h (mm)

Refer to "Description and Part Numbers" table for ChemSet Anchor Studs page in the SARB ANZ.

Effective depth, h (mm)

Preferred $h = h_n$ otherwise,

$$h = L_e - t$$

t = total thickness of material(s) being fastened.

Substrate thickness, b_m (mm)		
Anchor Stud Size (mm)		
M10	M12	M16 to M30
$h + 30mm \geq 100mm$		$h + (2 \times d_h)$

Checkpoint 1 Anchor size determined, absolute minima compliance achieved, effective depth (h) calculated.

ChemSet™ Reo 502™ Xtrem™

STRENGTH LIMIT STATE DESIGN

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STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, ϕN_{uc} (kN), ϕ_c = 1/1.5 = 0.67, f'_c = 32 MPa

	Combined pull-out and concrete cone resistance - ϕN_{ucp}						Concrete Cone Resistance - ϕN_{ucc}
Anchor Size, d_b	M10	M12	M16	M20	M24	M30	
Drilled Hole Dia, d_h (mm)	12	14	18	25	28	35	
Effective Depth, h (mm)							
70	27.5						24.3
80	31.5						29.7
90	**35.5**	40.5					35.4
100	39.3	45.0					41.5
110	43.3	**49.5**	64.1				47.9
120	47.2	54.0	69.9				54.5
125	49.2	56.3	**72.8**				58.0
140	55.1	63.0	81.6				68.7
150	59.0	67.5	87.4	102.7			76.2
160	63.0	72.0	93.2	109.6	131.0		84.0
170	66.9	76.5	99.0	**116.4**	139.2		91.9
180	70.8	81.0	104.9	123.3	147.4		100.2
190	74.8	85.5	110.7	130.1	155.6		108.6
200	78.7	90.0	116.5	137.0	163.8		117.3
210		94.4	122.4	143.8	**172.0**	202.2	126.2
240		108.0	139.8	164.4	196.5	231.1	154.2
280			163.1	191.8	229.3	**269.6**	194.4
320			186.4	219.2	262.1	308.2	237.5
350				239.7	286.6	337.1	271.6
400				274.0	327.6	385.2	331.9
450					368.5	433.4	396.0
480					393.1	462.2	436.3
550						529.7	535.1
600						577.8	609.7

For optimised performance data, including performance based on diamond drilling technique, please use Ramset iExpert Anchoring Software.

Table 2a-2 Cracked Concrete effect, tension, X_{ncr}

	Cracked Concrete Effect - X_{ncr} where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)						X_{ncr} where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
Anchor Size, d_b	M10	M12	M16	M20	M24	M30	
f'c (MPa)							
20 to 50	0.36	0.53	0.57	0.65	0.63	0.68	0.70

Bold values are at Chemset Anchor Stud nominal Depths. For Sustained Loads MULTIPLY ϕN_{uc} x 0.72 (100 years). All data relevant for Dry and Wet Holes. For Flooded Holes MULTIPLY ϕN_{uc} x 0.63 For Non-cracked concrete X_{ncr} = 1.

Calculate ϕN_{urc} for both ϕN_{ucp} and ϕN_{ucc} then choose the minimum - Refer to Checkpoint 2

Table 2b-1 Concrete service temperature limits effect, tension, X_{ns}

	Service temperature limits effect, tension, X_{ns}						X_{ns} where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
Anchor Size, d_b	M10	M12	M16	M20	M24	M30	
Service temperature (°C)							
T1: -40°C to +40°C	1.00						1.00
T2: -40°C to +60°C	0.84						
T3: -40°C to +75°C	0.26						

Table 2b-2 Concrete compressive strength effect, tension, X_{nc}

NON-CRACKED	Non-Cracked Concrete - X_{nc} where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)						X_{nc} where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
Anchor Size, d_b	M10	M12	M16	M20	M24	M30	
f'c (MPa)							
20	0.91	0.91	0.87	0.87	0.83	0.83	0.79
25	0.95	0.95	0.93	0.93	0.91	0.91	0.88
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.05	1.05	1.07	1.07	1.09	1.09	1.12
50	1.09	1.09	1.14	1.14	1.20	1.20	1.25

CRACKED	Cracked Concrete - X_{nc} where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)						X_{nc} where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
Anchor Size, d_b	M10	M12	M16	M20	M24	M30	
f'c (MPa)							
20	0.95	0.95	0.95	0.91	0.91	0.87	0.79
25	0.98	0.98	0.98	0.95	0.95	0.93	0.88
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.02	1.02	1.02	1.05	1.05	1.07	1.12
50	1.05	1.05	1.05	1.09	1.09	1.14	1.25

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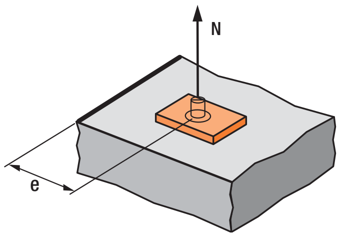
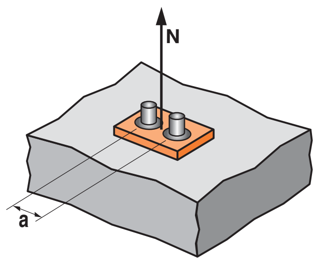


$X_{ne} = 0.25 + 0.5*(e/h)$
Where $e_m \le e \le e_c$
$e_c = 1.5*h$
Note: Tabled values are based on the nominal effective depth,
h shown in the installation details.
For other values of X_{ne}, please use equation shown above.

Table 2c - Concrete Edge distance effect, tension, X_{ne}

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Edge distance, e (mm)						
40	0.47	0.43				
45	0.50	0.45	0.43			
50	0.53	0.48	0.45			
55	0.56	0.50	0.47	0.41		
60	0.58	0.52	0.49	0.43	0.39	
65	0.61	0.55	0.51	0.44	0.40	
70	0.64	0.57	0.53	0.46	0.42	
90	0.75	0.66	0.61	0.51	0.46	0.41
100	0.81	0.70	0.65	0.54	0.49	0.43
115	0.89	0.77	0.71	0.59	0.52	0.46
135	1	0.86	0.79	0.65	0.57	0.49
165		1	0.91	0.74	0.64	0.54
187			1	0.80	0.70	0.58
255				1	0.86	0.71
315					1	0.81
420						1



$X_{na} = 0.5 + a/(6*h)$
Where $a_m \le a \le a_c$
$a_c = 3*h$
Note: Tabled values are based on the nominal effective depth,
h shown in the installation details.
For other values X_{na}, please use equation shown above.

Table 2d - Concrete anchor spacing effect, tension, X_{na}

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Anchor spacing, a (mm)						
40	0.57					
45	0.58					
50	0.59	0.58				
55	0.60	0.58				
60	0.61	0.59				
70	0.63	0.61	0.59			
85	0.66	0.63	0.61	0.58		
90	0.67	0.64	0.62	0.59	0.57	
140	0.76	0.71	0.69	0.64	0.61	0.58
170	0.81	0.76	0.73	0.67	0.63	0.60
200	0.87	0.80	0.77	0.70	0.66	0.62
270	1	0.91	0.86	0.76	0.71	0.66
330		1	0.94	0.82	0.76	0.70
375			1	0.87	0.80	0.72
510				1	0.90	0.80
630					1	0.88
840						1

Checkpoint 2

Design reduced ultimate concrete tensile capacity, ϕN_{urc}

ϕN_{urc} = minimum of $\phi N_{ucp} *X_{ncr} *X_{ns} *X_{nc} *X_{ne} *X_{na}$ and $\phi N_{ucc} *X_{ncr} *X_{ns} *X_{nc} *X_{ne} *X_{na}$

STEP 3

Verify anchor tensile capacity - per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, ϕN_{us} (kN) where ϕ_n = 0.67 for Gr 5.8 & Gr 8.8

Anchor size, d_b	M10	M12	M16	M20	M24	M30
ChemSet™ Anchor Stud Grade 5.8 Carbon Steel	18.9	28.1	53.9	81.3	117.8	-
ChemSet™ Anchor Stud A4/316 Stainless Steel	19.8	29.5	57.7	87.1	126.2	-
ChemSet™ Anchor Stud Grade 8.8 Carbon Steel	28.2	41.9	82.1	123.9	179.5	299.2

Note ϕ_n = 0.58 for ChemSet™ Anchor Stud A4/316 Stainless Steel

Checkpoint 3

Design reduced ultimate tensile capacity, ϕN_{ur}
ϕN_{ur} = minimum of ϕN_{urc}, ϕN_{us}
Check $N^*/\phi N_{ur} \le 1.0$,
if not satisfied return to step 1

ChemSet™ Reo 502™ Xtrem™

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STEP 4

Step 4 - Verify concrete shear capacity - per anchor

Table 4a - 1 Reduced characteristic ultimate concrete edge shear capacity, ϕV_{uc} (kN), ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

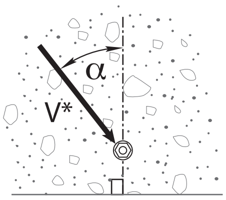
Anchor size, d_b	M10	M12	M16	M20	M24	M30
Effective depth, h (mm)	70 - 200	90 - 240	110 - 320	150 - 400	160 - 480	210 - 600
Edge distance, e_m						
40	4.3	4.7				
45			6.2			
55				9.1		
60					10.8	
90						20.0

For optimised performance data, please use Ramset iExpert Anchoring Software.

Table 4a-2 Cracked Concrete effect, shear, X_{vcr}

Anchor size, d_b	M10	M12	M16	M20	M24	M30
X_{vcr}	0.70					

For Non-cracked concrete X_{vcr} = 1.0



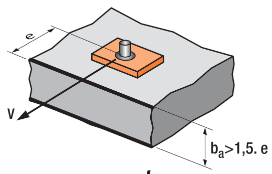
Load direction effect, conc. edge shear, X_{vd}

Table 4b - Concrete compressive strength effect, shear, X_{vc}

f'_c (MPa)	20	25	32	40	50
X_{vc}	0.79	0.86	1	1.11	1.22

Table 4c - Concrete load direction effect, concrete edge shear, X_{vd}

Angle, α°	0-55	60	70	80	90-180
X_{vd}	1	1.1	1.2	1.5	2

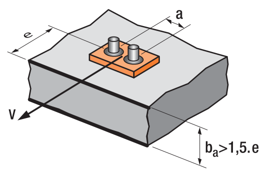


$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

Table 4d - Concrete anchor spacing and edge distance effect, concrete edge shear, X_{ve}

For single anchor fastening X_{ve}

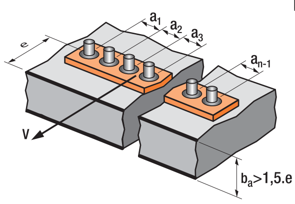
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



$$X_{ve} = \frac{3*e+a}{6*e_m} * \sqrt{e/e_m}$$

For 2 anchors fastening X_{ve}

e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
a/e_m												
1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16
1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
2.5	0.92	1.11	1.32	1.54	1.77	2.00	2.25	2.50	2.77	3.04	3.32	3.61
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35
5.5						2.71	2.99	3.28	3.71	4.02	4.33	4.65
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65



For 3 anchors fastening and more

$$X_{ve} = \frac{3*e + a_1 + a_2 + a_3 + ... + a_{n-1}}{3*n*e_m} * \sqrt{e/e_m}$$

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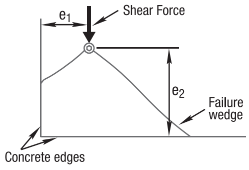
Table 4e Reduced characteristic ultimate concrete pryout capacity, ϕV_{ucp} (kN), ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Effective depth, h (mm)	90	110	125	170	210	280
-40°C to +40°C	70.8	95.7	116.0	183.9	252.5	388.7
-40°C to +60°C	59.5	83.2	116.0	183.9	252.5	388.7
-40°C to +75°C	18.4	25.7	37.9	60.5	89.4	140.2



ANCHOR AT A CORNER

Table 4f Anchor at a corner effect, concrete edge shear, X_{vs}

Note: For e_1/e_2 > 1.25, X_{VS} = 1.0

Edge distance, e_2 (mm)	25	30	35	50	60	75	125	200	300	400	600	900
Edge distance, e_1 (mm)												
25	0.86	0.77	0.70	0.58	0.53	0.49	0.41	0.37	0.35	0.34	0.32	0.32
30	0.97	0.86	0.78	0.64	0.58	0.52	0.43	0.38	0.36	0.34	0.33	0.32
35	1.00	0.95	0.86	0.69	0.63	0.56	0.46	0.40	0.37	0.35	0.33	0.32
50	1.00	1.00	1.00	0.86	0.77	0.67	0.52	0.44	0.39	0.37	0.35	0.33
60	1.00	1.00	1.00	0.97	0.86	0.75	0.57	0.47	0.41	0.38	0.36	0.34
75	1.00	1.00	1.00	1.00	1.00	0.86	0.64	0.51	0.44	0.41	0.37	0.35
125	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.65	0.53	0.48	0.42	0.38
200	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.67	0.58	0.49	0.42
300	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.72	0.58	0.49
400	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.67	0.55
500	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.77	0.61
600	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.67
900	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86

Checkpoint 4a

Design reduced ultimate concrete edge shear capacity, ϕV_{urc}

$\phi V_{urc} = \phi V_{uc} * X_{vcr} * X_{vc} * X_{vd} * X_{ve} * X_{vs}$

Checkpoint 4b

Design reduced ultimate concrete pryout capacity, ϕV_{urcp}

$\phi V_{urcp} = \phi V_{ucp} * X_{ncr} * X_{nc} * X_{ne} * X_{na}$

STEP 5

Verify anchor shear capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, ϕV_{us} (kN) where ϕ_v = 0.67

Anchor size, d_b	M10	M12	M16	M20	M24	M30
ChemSet™ Anchor Stud Grade 5.8 Carbon Steel	11.8	17.5	33.1	49.9	72.3	-
ChemSet™ Anchor StudA4/316 Stainless Steel	14.2	21.1	41.4	62.4	90.4	-
ChemSet™ Anchor Stud Grade 8.8 Carbon Steel	17.5	26.0	50.9	76.8	111.3	185.5

Checkpoint 5

Design reduced ultimate shear capacity, ϕV_{ur}

ϕV_{ur} = minimum of ϕV_{urc}, ϕV_{urcp}, ϕV_{us}

Check $V^*/\phi V_{ur} \leq 1.0$,

if not satisfied return to step 1

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STEP 6 Combined Loading

Checkpoint 6

Check
$N^*/\phi N_{ur} + V^*/\phi V_{ur} \leq 1.2$,
if not satisfied return to step 1

Specifiy - Threaded Stud Anchors
Ramset™ ChemSet™ Reo 502™ Xtrem™ with (Anchor Size) grade 5.8 ChemSet™ Anchor Stud (Anchor Stud Part Number) Drilled Hole Depth to be (h) mm.

Example
Ramset™ ChemSet™ Reo 502™ Xtrem™ Injection with M16 grade 5.8 ChemSet™ Anchor Stud (CS16190GH). Drilled hole depth to be 125mm. To be installed according to Ramset™ Installation Instructions.

Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.

ChemSet™ Reo 502™ Xtrem™

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

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(New Zealand refer to EPCON™ G5 Xtrem™ range)

GENERAL INFORMATION

Performance Related	Installation Related

Product

ChemSet™ Reo 502™ Xtrem™ is a heavy duty pure Epoxy for anchoring threaded studs and reinforcing bar into cracked and uncracked concrete.

SEISMIC C1 | 100 YEAR WORKING LIFE | ETA | CRACKED CONCRETE CERTIFIED | FLOODED HOLE APPROVED

Principal Applications

- Threaded Studs
- Starter Bars
- Threaded Inserts
- Over-head installation
- Steel Columns
- Hand Rails
- Road Stitching

Compliance

European Technical Assessment (option 1) - ETA-25/0648

Design according to:

- AS 5216 (formerly TS101)
- EN 1992-4 (formerly ETAG001 Annex C, E & TR045)
- Use enclosed data for simplified calculation method

Use Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.

Benefits, Advantages and Features

- European Technical Approval 001 Part 5-option 1
- 100 year working Life

Greater productivity:

- Anchors in dry, damp, wet or flooded holes

Greater security:

- Strong bond
- Rated for sustained loading

Versatile:

- Anchors in carbide drilled and diamond drilled holes
- Cold and temperate climates

Greater safety:

- Low odour
- VOC Compliant

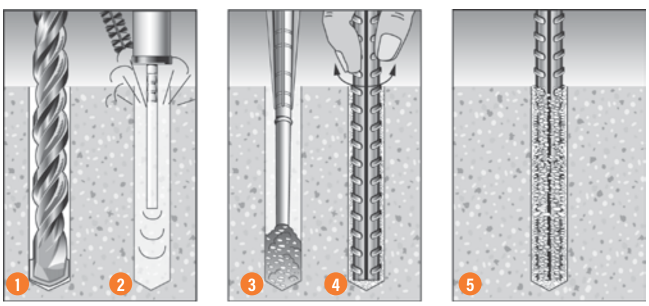
Installation & Substrate Temperature Range

Minimum	Maximum
5°C	40°C

Service Temperature Limits

T1: -40°C to +40°C
T2: -40°C to +60°C
T3: -40°C to +75°C

Installation



1. Drill recommended diameter and depth hole.
2. **Important:** For hammer drilling technique clean dust and debris from hole with stiff wire brush and blower in the following sequence: blow x 2, brush x 2, blow x 2, brush x 2, blow x 2. For diamond drilling technique refer to **ETA-25/0648.**
3. Screw mixing nozzle onto cartridge and dispense adhesive to waste until colour is orange. Insert mixing nozzle to bottom of hole.
   Fill hole to 2/3 the hole depth slowly, ensuring no air pockets form.
4. Insert **Ramset™** ChemSet™ Anchor Stud/rebar to bottom of hole while turning.
5. Allow ChemSet™ Reo 502™ XTREM™ to cure as per setting times.

Setting Times

Temperature of base material	Gel Time	Curing time in dry concrete	Curing time in wet and flooded concrete
5°C	75 min	30h	60 h
10°C	45 min	22h	44 h
15°C	35 min	14h	28 h
20°C	22 min	7h	14 h
25°C	14 min	5h	10 h
30°C	8 min	4h	8 h
35°C	6 min	3h	6h
40°C	4 min	2h 45min	5h 30min

ChemSet™ Reo 502™ Xtrem™

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

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Installation and performance details: ChemSet™ Reo502™ Xtrem™ and Reinforcing Bar

Anchor Size, d_b (mm)	Drilled Hole diam., d_h (mm)	Anchor Effective Depth, h (mm)	Optimum dimensions*			Reduced Characteristic Capacity #				
			Edge* distance, e_c (mm)	Anchor spacing, a_c (mm)	Concrete substrate thickness, b_m (mm)	Gr 500 Rebar - Steel		Non-Cracked Concrete		
						Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	Tension, ϕN_{uc} (kN)** Concrete compressive strength, f'_c		
								20 MPa	32 MPa	40 MPa
10	12	90	135	270	115	31.4	21.4	27.3	27.3	27.3
12	15	110	165	330	140	45.2	30.8	37.8	41.0	41.5
16	20	125	187	375	160	80.4	54.8	45.8	58.0	62.4
20	25	150	225	450	190	125.6	85.7	60.2	76.2	85.2
		170	255	510	215			72.7	91.9	102.8
24	30	180	270	540	215	180.8	123.3	79.2	100.2	112.0
		210	315	630	275			99.8	126.2	141.1
32	40	240	360	720	320	321.6	219.3	121.9	154.2	172.4
		300	450	900	380			170.4	215.6	241.0

* Note: For shear loads acting towards an edge or where these optimum dimensions are not achievable, please use the simplified strength limit state design process to verify capacity.
Note: Reduced characteristic ultimate concrete tensile capacity = ϕN_{uc} and N_{uc} = Characteristic ultimate concrete tensile capacity. **For value of ϕ refer to Table 2a
For conversion to Working Load Limit MULTIPLY ϕN_{uc} x 0.5
***Note: Reduced characteristic ultimate steel tensile capacity = ϕN_{us} where ϕ = 0.8 and N_{us} = Characteristic ultimate steel tensile capacity .
For conversion to Working Load Limit MULTIPLY ϕN_{us} x 0.56
#Note: Design Tensile Capacity ϕN_{ur} = minimum of ϕN_{uc} and ϕN_{us}
For Cracked Concrete performance, please use the simplified strength limit state design process to verify capacity.
Data is based on a **Service temperature limit of -40°C to +40°C**
All data relevant for Dry and Wet Holes. For Flooded Holes MULTIPLY ϕN_{uc} x 0.65
For optimised performance data, including performance based on diamond drilling technique, please use Ramset iExpert Anchoring Software.

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
ChemSet Reo 502 Xtrem	600ml	CRE0502X

Typical Engineering Properties of Grade 500 Reinforcing Bar

Rebar Size	10	12	16	20	24	32
Drilled Hole Dia, d_h (mm)	12	15	20	25	30	40
Stress Area, A_s (mm²)	78.5	113	201	314	491	804
Yield Stress, f_{sy} (MPa)	500	500	500	500	500	500
Tensile Steel Yield Capacity, N_{sy} (kN)	39.3	56.5	100.5	157.0	226.0	402.0

For further information refer to reinforcing bar manufacturer's published information and current revision of **AS/NZS 4671**

ChemSet™ Reo 502™ Xtrem™

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

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STEP 1

Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

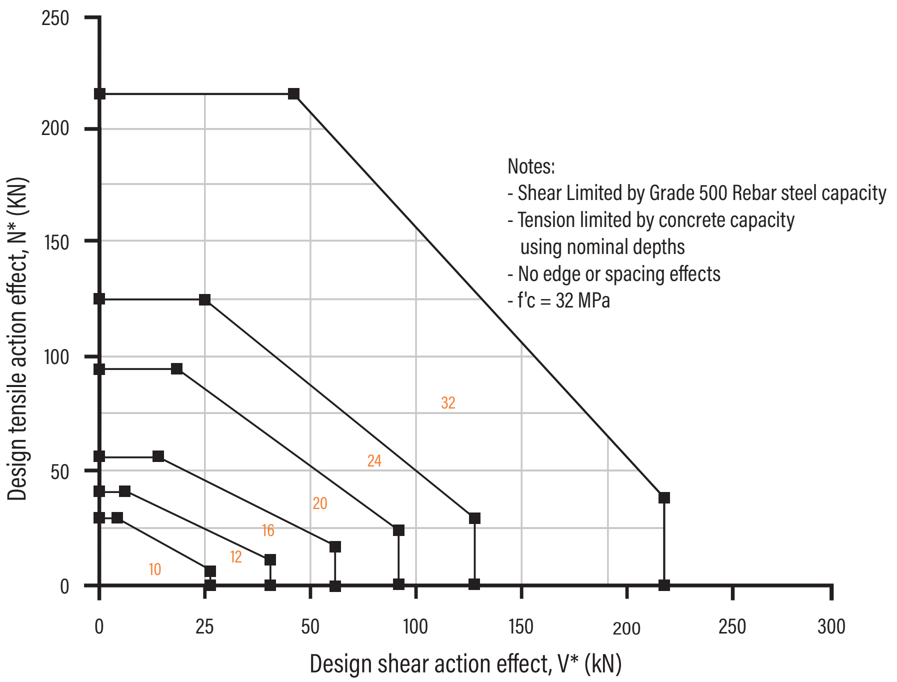

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b	10	12	16	20	24	32
Min. Anchor Spacing - a_m	40	50	70	85	90	140
Min. Edge Distance - e_m	40	40	45	55	60	90

Step 1c Calculate anchor effective depth, h (mm)

Refer to nominal recommended effective depths, h, listed in installation and performance details table on previous page.

Effective depth, h (mm)

Preferred $h = h_n$ otherwise,

$$h = L_e - t$$

t = total thickness of material(s) being fastened.

Substrate thickness b_m (mm)		
Anchor Stud Size (mm)		
10	12	16 to 32
h + 30mm ≥ 100mm		h + (2 x d_h)

Checkpoint 1

Anchor size determined, absolute minima compliance achieved, effective depth (h) calculated.

ChemSet™ Reo 502™ Xtrem™

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STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, ϕN_{uc} (kN), ϕ_c = 1/1.5 = 0.67, f'$_c$ = 32 MPa

	Combined pull-out and concrete cone resistance - ϕN_{ucp}						Concrete Cone Resistance - ϕN_{ucc}
Rebar Size, d_b	10	12	16	20	24	32	
Drilled Hole Dia, d_h (mm)	12	15	20	25	30	40	
Effective Depth, h (mm)							
70	21.3						24.3
80	24.3						29.7
90	**27.3**	33.6					35.4
100	30.4	37.3					41.5
110	33.4	**41.0**					47.9
120	36.4	44.8	59.3				54.5
125	38.0	46.6	**61.8**				58.0
140	42.5	52.2	69.2				68.7
150	45.6	56.0	74.1	92.6			76.2
160	48.6	59.7	79.0	98.8			84.0
170	51.6	63.4	84.0	**105.0**			91.9
180	54.7	67.2	88.9	111.2	135.6		100.2
190	57.7	70.9	93.9	117.3	143.1		108.6
200	60.7	74.6	98.8	123.5	150.7		117.3
210		78.3	103.7	129.7	**158.2**		126.2
240		89.5	118.6	148.2	180.8	241.1	154.2
270			133.4	166.7	203.4	271.2	184.0
280			138.3	172.9	210.9	281.3	194.4
300			148.2	185.3	226.0	**301.4**	215.6
320			158.1	197.6	241.1	321.4	237.5
350				216.1	263.7	351.6	271.6
400				247.0	301.4	401.8	331.9
450					339.0	452.0	396.0
480					361.6	482.2	436.3
560						562.5	549.7
640						642.9	671.7

For optimised performance data, including performance based on diamond drilling technique, please use Ramset iExpert Anchoring Software.

Table 2a-2 Cracked Concrete effect, tension, X_{ncr}

	Cracked Concrete Effect - X_{ncr}						X_{ncr}
	where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)						where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
Rebar Size, d_b	10	12	16	20	24	32	
f'c (MPa)							
20 to 50	0.74	0.73	0.71	0.70	0.70	0.67	0.70

Bold values are at Chemset Anchor Stud nominal Depths. For Sustained Loads MULTIPLY ϕN_{uc} x 0.72 (100 years) All data relevant for Dry and Wet Holes. For Flooded Holes MULTIPLY ϕN_{uc} x 0.65. For Non-cracked concrete X_{ncr} = 1.0.

Calculate ϕN_{urc} for both ϕN_{ucp} and ϕN_{ucc} then choose the minimum - Refer to Checkpoint 2

Table 2b-1 Concrete service temperature limits effect, tension, X_{ns}

	Service temperature limits effect, tension, X_{ns}						X_{ns}
	where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)						where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
Rebar Size, d_b	10	12	16	20	24	32	
Service temperature (°C)							
T1: -40°C to +40°C	1.00						1.00
T2: -40°C to +60°C	0.84						
T3: -40°C to +75°C	0.25						

Table 2b-2 Concrete compressive strength effect, tension, X_{nc}

NON-CRACKED	Non-Cracked Concrete - X_{nc}						X_{nc}
	where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)						where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
Anchor Size, d_b	10	12	16	20	24	32	
f'c (MPa)							
20	1.00	0.98	0.98	0.98	0.95	0.95	0.79
25	1.00	0.99	0.99	0.99	0.97	0.97	0.88
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.00	1.01	1.01	1.01	1.02	1.02	1.12
50	1.00	1.02	1.02	1.02	1.04	1.04	1.25

CRACKED	Cracked Concrete - X_{nc}						X_{nc}
	where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)						where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
Anchor Size, d_b	10	12	16	20	24	32	
f'c (MPa)							
20	0.95	0.95	0.95	0.91	0.88	0.87	0.79
25	0.97	0.97	0.97	0.95	0.94	0.93	0.88
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.02	1.02	1.02	1.04	1.04	1.07	1.12
50	1.04	1.04	1.04	1.09	1.09	1.14	1.25

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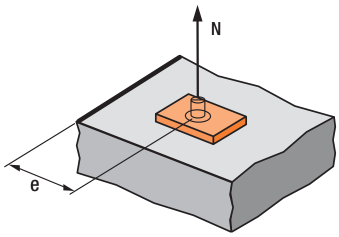
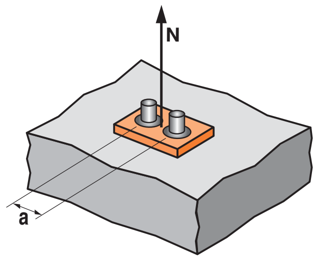


$X_{ne} = 0.25 + 0.5*(e/h)$
Where $e_m \le e \le e_c$
$e_c = 1.5*h$
Note: Tabled values are based on the nominal effective depth,
h shown in the installation details.
For other values of X_{ne}, please use equation shown above.

Table 2c - Concrete Edge distance effect, tension, X_{ne}

Anchor size, d_b	10	12	16	20	24	32
Edge distance, e (mm)						
40	0.47	0.43				
45	0.50	0.45	0.43			
50	0.53	0.48	0.45			
55	0.56	0.50	0.47	0.41		
60	0.58	0.52	0.49	0.43	0.39	
65	0.61	0.55	0.51	0.44	0.40	
70	0.64	0.57	0.53	0.46	0.42	
90	0.75	0.66	0.61	0.51	0.46	0.40
100	0.81	0.70	0.65	0.54	0.49	0.42
115	0.89	0.77	0.71	0.59	0.52	0.44
135	1	0.86	0.79	0.65	0.57	0.48
165		1	0.91	0.74	0.64	0.53
187			1	0.80	0.70	0.56
255				1	0.86	0.68
315					1	0.78
450						1



$X_{na} = 0.5 + a/(6*h)$
Where $a_m \le a \le a_c$
$a_c = 3*h$
Note: Tabled values are based on the nominal effective depth,
h shown in the installation details.
For other values X_{na}, please use equation shown above.

Table 2d - Concrete anchor spacing effect, tension, X_{na}

Anchor size, d_b	10	12	16	20	24	32
Anchor spacing, a (mm)						
40	0.57					
45	0.58					
50	0.59	0.58				
55	0.60	0.58				
60	0.61	0.59				
70	0.63	0.61	0.59			
85	0.66	0.63	0.61	0.58		
90	0.67	0.64	0.62	0.59	0.57	
140	0.76	0.71	0.69	0.64	0.61	0.58
170	0.81	0.76	0.73	0.67	0.63	0.59
200	0.87	0.80	0.77	0.70	0.66	0.61
270	1	0.91	0.86	0.76	0.71	0.65
330		1	0.94	0.82	0.76	0.68
375			1	0.87	0.80	0.71
510				1	0.90	0.78
630					1	0.85
900						1

Checkpoint 2

Design reduced ultimate concrete tensile capacity, ϕN_{urc}

ϕN_{urc} = minimum of $\phi N_{ucp} *X_{ncr} *X_{ns} *X_{nc} *X_{ne} *X_{na}$ and $\phi N_{ucc} *X_{ncr} *X_{ns} *X_{nc} *X_{ne} *X_{na}$

STEP 3

Verify anchor tensile capacity - per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity. ϕN_{us} (kN), where $\phi = 0.8$

Anchor size, d_b	10	12	16	20	24	32
Gr 500 Rebar	31.4	45.2	80.4	125.6	180.8	321.6

Checkpoint 3

Design reduced ultimate tensile capacity, ϕN_{ur}

ϕN_{ur} = minimum of ϕN_{urc}, ϕN_{us}
Check $N^*/\phi N_{ur} \le 1.0$,
if not satisfied return to step 1

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STEP 4

Step 4 - Verify Concrete shear capacity - per anchor

Table 4a-1 Reduced characteristic ultimate concrete edge shear capacity, ϕV_{uc} (kN),ϕ = 1/1.5,= 0.67, f'_c = 32 MPa

Rebar size, d_b	10	12	16	20	24	32
Effective depth, h (mm)	70 - 200	90 - 240	120 - 320	150 - 400	180 - 480	240 - 640
Edge distance, e_m						
40	4.3	4.7				
45			6.3			
55				9.1		
60					11.2	
90						21.3

For optimised performance data, please use Ramset iExpert Anchoring Software.

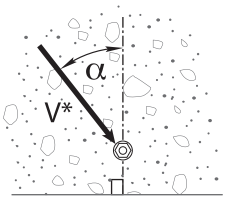
Table 4a-2 Cracked Concrete effect, shear, X_{vcr}

Anchor size, d_b	10	12	16	20	24	32
X_{vcr}	0.70					

For Non-cracked concrete X_{vcr} = 1.0

Table 4b - Concrete compressive strength effect, shear, X_{vc}

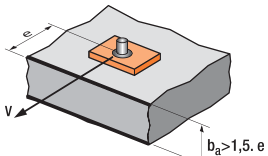
f'_c (MPa)	20	25	32	40	50
X_{vc}	0.79	0.86	1	1.11	1.22



Load direction effect, conc. edge shear, X_{vd}

Table 4c - Concrete load direction effect, concrete edge shear, X_{vd}

Angle, α°	0-55	60	70	80	90-180
X_{vd}	1	1.1	1.2	1.5	2

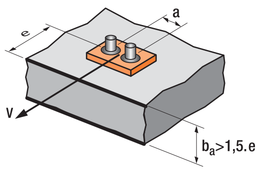


$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

Table 4d - Concrete anchor spacing and edge distance effect, concrete edge shear, X_{ve}

For single anchor fastening X_{ve}

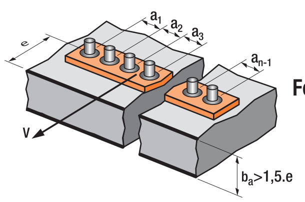
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



$$X_{ve} = \frac{3*e+a}{6*e_m} * \sqrt{e/e_m}$$

For 2 anchors fastening X_{ve}

e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
a/e_m												
1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16
1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
2.5	0.92	1.11	1.32	1.54	1.77	2.00	2.25	2.50	2.77	3.04	3.32	3.61
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35
5.5						2.71	2.99	3.28	3.71	4.02	4.33	4.65
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65



For 3 anchors fastening and more

$$X_{ve} = \frac{3*e + a_1 + a_2 + a_3 + ... + a_{n-1}}{3*n*e_m} * \sqrt{e/e_m}$$

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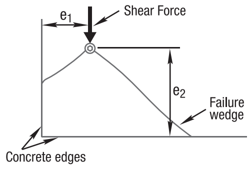
Table 4e Reduced characteristic ultimate concrete pryout capacity, ϕV_{ucp} (kN), ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

Rebar size, d_b	10	12	16	20	24	32
Effective depth, h (mm)	**90**	**110**	**125**	**170**	**210**	**300**
-40°C to +40°C	54.7	82.1	116.0	183.9	252.5	431.1
-40°C to +60°C	45.9	68.9	103.7	176.4	252.5	431.1
-40°C to +75°C	13.7	20.5	30.9	52.5	79.1	150.7



ANCHOR AT A CORNER

Table 4f Anchor at a corner effect, concrete edge shear, X_{vs}

Note: For e_1/e_2 > 1.25, X_{VS} = 1.0

Edge distance, e_2 (mm)	25	30	35	50	60	75	125	200	300	400	600	900
Edge distance, e_1 (mm)												
25	0.86	0.77	0.70	0.58	0.53	0.49	0.41	0.37	0.35	0.34	0.32	0.32
30	0.97	0.86	0.78	0.64	0.58	0.52	0.43	0.38	0.36	0.34	0.33	0.32
35	1.00	0.95	0.86	0.69	0.63	0.56	0.46	0.40	0.37	0.35	0.33	0.32
50	1.00	1.00	1.00	0.86	0.77	0.67	0.52	0.44	0.39	0.37	0.35	0.33
60	1.00	1.00	1.00	0.97	0.86	0.75	0.57	0.47	0.41	0.38	0.36	0.34
75	1.00	1.00	1.00	1.00	1.00	0.86	0.64	0.51	0.44	0.41	0.37	0.35
125	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.65	0.53	0.48	0.42	0.38
200	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.67	0.58	0.49	0.42
300	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.72	0.58	0.49
400	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.67	0.55
500	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.77	0.61
600	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.67
900	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86

Checkpoint 4a

Design reduced ultimate concrete edge shear capacity, ϕV_{urc}

$\phi V_{urc} = \phi V_{uc} * X_{vcr} * X_{vc} * X_{vd} * X_{ve} * X_{vs}$

Checkpoint 4b

Design reduced ultimate concrete pryout capacity, ϕV_{urcp}

$\phi V_{urcp} = \phi V_{ucp} * X_{ncr} * X_{nc} * X_{ne} * X_{na}$

STEP 5

Verify anchor shear capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, ϕV_{us}, (kN) where ϕ_v = 0.80

Anchor size, d_b	10	12	16	20	24	32
Gr 500 Rebar	21.4	30.8	54.8	85.7	123.3	219.3

Checkpoint 5

Design reduced ultimate shear capacity, ϕV_{ur}

ϕV_{ur} = minimum of ϕV_{urc}, ϕV_{urcp}, ϕV_{us}

Check $V^*/\phi V_{ur} \leq 1.0$, if not satisfied return to step 1

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STEP 6 Combined loading and specification

Checkpoint 6

Check
$N^*/\phi N_{ur} + V^*/\phi V_{ur} \leq 1.2$,
if not satisfied return to step 1

Specify - Reinforcing Bar Anchorage

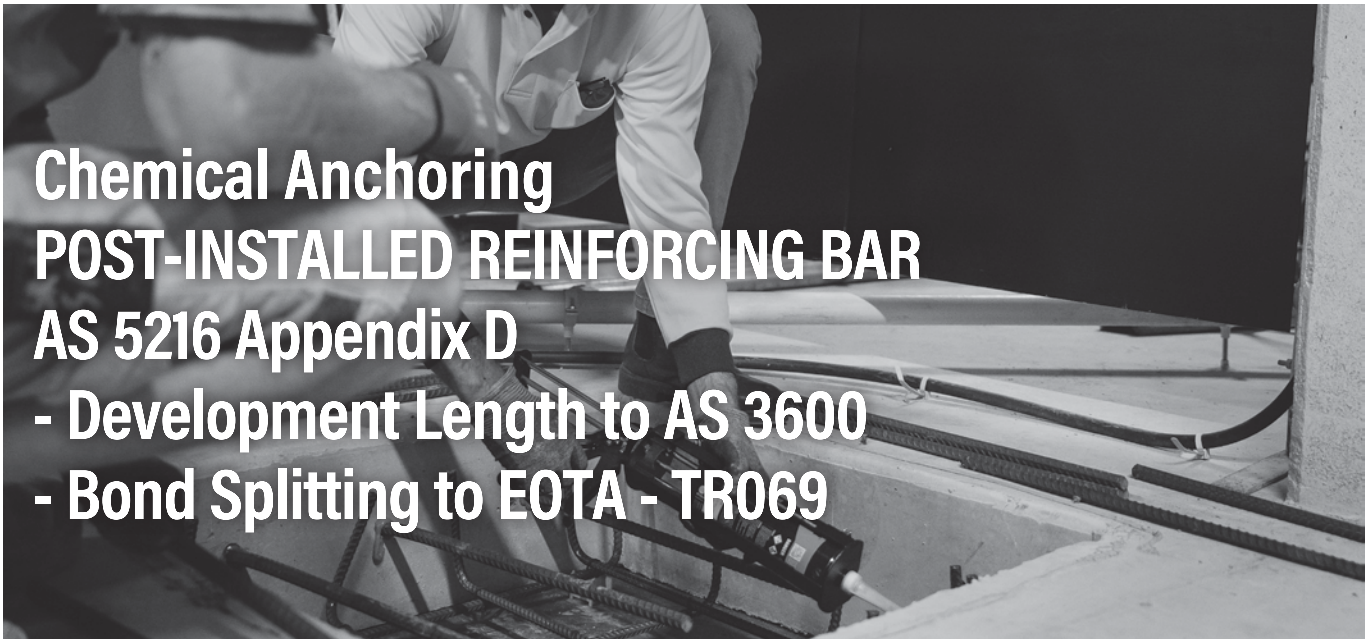
Ramset™ ChemSet™ Reo 502™ Xtrem™ with (Anchor Size) grade 500 Rebar.
Drilled hole depth to be (h) mm.

Example

Ramset™ ChemSet™ Reo 502™ Xtrem™ with 16mm grade 500 Rebar
Drilled hole depth to be 125 mm.
To be installed in accordance with Ramset™ Installation Instructions.

Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.

Introduction
POST-INSTALLED REINFORCING BAR TO AS 5216 Appendix D
Development Length to AS 3600 & Bond Splitting to EOTA - TR069



AS 3600 Section 13 covers development of stress in cast-in reinforcement.
In order to obtain full steel yield stress in a reinforcing bar it must be embedded in concrete to a length where the bond stress and steel stress are balanced and the bar does not displace within the concrete. The embedded length of bar is termed the Development Length ($L_{sy.t}$).
Furthermore, in accordance with AS 5216 Appendix D, the Chemical Adhesive when used with post-installed reinforcing bar requires a pre-qualification document demonstrating testing in accordance with EAD 330087

Stress Development in Post-installed Adhesive Bonded Reinforcement in Solid Concrete
Polymer adhesives like epoxy, generally bond significantly better to steel reinforcement than concrete to steel reinforcement. Consequently the development lengths of reinforcing bars bonded in concrete with adhesives are often significantly shorter than development lengths of cast-in bars.
As with cast-in bars, loads on adhesive bonded reinforcing bars are transmitted to and cause stress in the surrounding concrete.

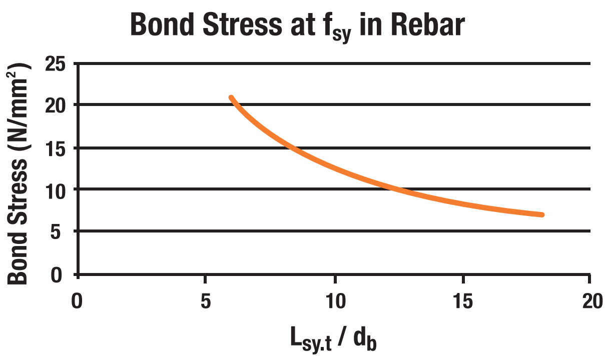
The stress around a single reinforcing bar in tension remote from a concrete edge is given by:

$$\sigma_b = \frac{A_b . f_{sy}}{L_{sy.t} . \pi . d_b} \quad \text{.....Equation 1}$$

σ_b	=	Bond Stress to the Concrete (MPa)
A_b	=	Cross-sectional Area of the Bar (mm^2)
f_{sy}	=	Steel Yield Stress (MPa)
$L_{sy.t}$	=	Minimum embedment length of rebar to develop steel yield stress (mm)
π	=	pi
d_b	=	nominal bar diameter (mm)

In the case where spacing and edge distances are remote, there is enough concrete cover to the bar and adhesive to dissipate the stresses in the concrete and avoid concrete splitting failures.
However, the situation changes when another bar or bars is/are introduced and or the concrete edge is no longer remote. Close bar spacing or insufficient concrete cover may result in concrete splitting failures such as those illustrated in figure 1.

From equation 1 above, stress (σ_b) in the concrete surrounding the bar decreases with increasing embedded length ($L_{sy.t}$). See graph below of bond stress developed in concrete when steel yield stress is applied to a reinforcing bar as a function of embedded length.



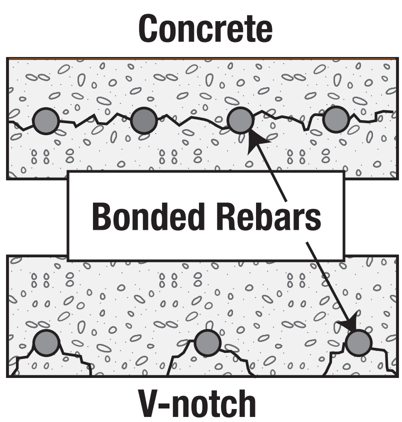


Figure 1.

Introduction
POST-INSTALLED REINFORCING BAR TO AS 5216 Appendix D
Development Length to AS 3600 & Bond Splitting to EOTA - TR069

Therefore where there is shallow cover or close bar spacing, it is necessary to apply the factor coefficients k_1,k_2 & k_3 listed in Section 13 of AS 3600. These factors influence the development length to ensure there is sufficient embedment to reduce stress in concrete and prevent concrete splitting failures.

Development lengths calculated from bond strength alone should NOT be used for bar anchorages designed to comply with AS 3600 as concrete splitting is not accounted for.

If the factor coefficients from AS 3600 are not applied to development lengths of post-installed reinforcing bars in structural concrete elements, there may be a significant reduction in safety resulting in concrete failure and collapse due to concrete splitting. Concrete splitting is a function of edge distance and spacing and is independent of adhesive bond strength.

Derivation of Development Length for Adhesive Bonded Bars

Development lengths are predicted from bond stress, determined from pull out tests, according to equation 2. The predicted lengths are verified according to the current revision of AS/NZS 4671, Appendix C4, where a load equal to N_{sy} is applied and a displacement of the bar less than 0.2 mm recorded.

$$L_{sy.t} = \frac{A_b . f_{sy}}{\sigma_b . \pi . d_b} \quad \text{.....Equation 2}$$

The development length is a function of adhesive bond stress so a limit state factor of 0.6 is applied:

$$\frac{L_{sy.t}}{Ø} = \frac{A_b . f_{sy}}{0.6 . \sigma_b . \pi . d_b} \quad \text{.....Equation 3}$$

Effectively the limit state factor increases development length by 67%.

For designs where there are multiple parallel reinforcing bars in structural elements such as walls, floors, beams and columns, the factor coefficients from section 13.1 of AS 3600 should be used. Concrete splitting is independent of adhesive bond strength and should be applied to all adhesive bonded bars where the design is intended to comply with AS 3600.

AS 5216 Appendix D covers development length of post-installed reinforcing bar

AS 5216 Appendix D states 'The embedment length of post-installed reinforcing bars to develop characteristic yield strength of a reinforcing bar shall not be less than the development length obtained in accordance with AS 3600.' Therefore, the basic development length of deformed bar according to AS 3600 Clause 13.1.2.2 can be calculated as follows,

$$L_{sy.t} = \frac{0.5 . k_1 . k_3 . f_{sy} . d_b}{k_2 \sqrt{(f'c)}} \geq 0.058 . f_{sy} . k_1 . d_b \quad \text{.....Equation 4}$$

Furthermore, where the full yield strength is not required, the development length can be calculated in accordance with AS 3600 Clause 13.1.2.4 which prohibits development lengths less than 12db as follows,

$$L_{st} = L_{sy.t} . \frac{\sigma_{st}}{f_{sy}} \geq 12 d_b \quad \text{.....Equation 5}$$

where σ_{st} = Required tensile stress

The development length tables in "Design Case 2, 3 and 4" in the following section are calculated using equation 4.
k_1 = 1.0 for adhesive bonded bars. In section 13.1 of AS 3600 k_1 = 1.3 for all horizontal bars with > 300 mm of concrete below them. According to Warner et al[3] (pg391), a zone of weak, air and water rich concrete forms on the lower surface of 'top' bars, which reduces the bond characteristics of bars in this position. Since the weakened zone of concrete is specific to cast-in bars it is not relevant to bonded bars and therefore k_1 = 1 in all cases.
k_2 is the direction function of the bar diameter (d_b).
The value of k_3 is influenced by the anchor spacing (a), edge distance/cover (e) and the bar diameter (d_b).

Edge Distance and Spacing

Edge distance and spacing of reinforcing bars are independent of adhesive bond strength. They are related to the stress transferred from the bars under tension, through the adhesive and into the concrete. As shown in equation 1 stress transferred to concrete by bars under tension is reduced by increasing embedded length. Hence AS 3600 applies the factor coefficients, k_1, k_2 and k_3 to influence the development length.
AS 3600 allows for various depths of concrete cover to bars depending on environmental and other circumstances. The designer must refer to AS 3600 to determine required cover.
In the following tables a minimum cover of 30 mm or 2 x d_b (2.5 x d_b edge distance) is adopted.

AS 5216 Appendix D also covers design considering bond-splitting behaviour of post-installed reinforcing bar (equivalent to EOTA TR069)

AS 5216 Appendix D considers that when designing post-installed reinforcing bars in groups which are subjected to a tensile load, verification of capacity is by adopting the mode of failure producing the lowest design strength between steel, concrete cone and bond-splitting failure. However, for a single post-installed reinforcing bar, the most unfavourable mode of failure is bond-splitting and therefore the most likely verified capacity. To use this method, the adhesive used needs to be pre qualified in accordance with EAD 332402. The table below provides the verification required for this design method.

Mode of Failure	Required Verification	
	Post-installed reinforcing group	Single post-installed reinforcing bar
Steel	$N^*_{group} = \phi_s{*}N_{us}$	
Concrete cone	$N^*_{group} = \phi_c{*}N_{urc}$	
Bond-splitting	$N^*_{group} = \phi{*}N_{ursp}$	$N^*_{single} = \phi{*}N_{usp}$ (most unfavourable)

References
1. AS 3600 Concrete Structures, Standards Australia
2. AS/NZS 4671 Steel Reinforcing Materials, Standards Australia
3. Warner, R.F. Rangan B.V. Hall A.S. Faulkes K.A. 1998, 'Concrete Structures', Addison Wesley Longman Australia
4. AS 5216 Design of post-installed and Cast-in fastenings in concrete.

Design Process
POST-INSTALLED REINFORCING BAR TO AS 5216 Appendix D
Development Length to AS 3600 & Bond Splitting to EOTA - TR069

This information is intended for use by qualified engineers or other suitably skilled persons. It is the designer's responsibility to ensure compliance with the relevant standards, codes of practice, building regulations, workplace regulations and statutes as applicable.

This section must be used in conjunction with AS 5216 Clause D.4 & AS 3600 and is intended to assist in design of reinforcing bar connections where they are post-installed using ChemSet™ Anchoring adhesives rather than being cast into the concrete.

For selection of the appropriate reinforcing bar diameter, reference should be made to the manufacturer's design tables and AS 3600.

The document provides the steel yield development length $L_{sy.t}$, required by AS 3600, clause 13.1.2.2 for Grade 500 reinforcing bars post-installed with ChemSet™ Anchoring adhesives into concrete.

The design process begins with the Designer choosing the relevant Design Case:

The Design Cases are:
1. Design considering Bond splitting behaviour to EOTA-TR069. (Single and multiple bars)
2. Development Length of multiple bars in concrete elements to AS 3600. (Large clear anchor spacing)
3. Development Length of multiple bars in concrete elements to AS 3600. (Medium clear anchor spacing)
4. Development Length of multiple bars in concrete elements to AS 3600. (Minimum clear anchor spacing)

For Design cases 1
Single and multiple bar assessments can be made using this method.
For multiple bar assessment, the governing tensile capacity will be the minimum of steel, concrete cone and bond splitting failure. For single bar assessment, the most unfavourable mode of failure will be bond splitting.

For Design cases 2, 3 and 4
Having obtained the nominal development length for the design case, adjustment is made for the influence of concrete compressive strength to yield the value $L_{sy.t}$.

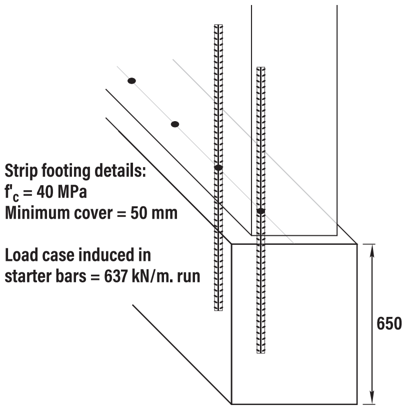
In the case where there is not sufficient depth of concrete for the reinforcing bar to be installed to $L_{sy.t}$, or the stress area of tensile steel exceeds design requirements, the stress (σ_{st}) less than the yield strength (f_{sy}) developed in the bar is provided for a variety of lengths (L_{st}), per clause 13.1.2.4 of AS 3600. Having obtained the stress developed in the bar for a nominated installed length, adjustment is made to the developed stress for the influence of concrete compressive strength.

Design Process
POST-INSTALLED REINFORCING BAR TO AS 5216 Appendix D
Development Length to AS 3600 & Bond Splitting to EOTA - TR069

DESIGN EXAMPLE 1

Using the AS1170 family of Australian Standards, the design action effect causing tension in reinforcing bars is calculated to be:

$N^* = 637$ kN/m. run



Consider design of Grade 500 reinforcement bar, fully developed.

To satisfy Strength Limit State Design criteria,

$$N^* \leq \phi f_{sy} * A_b$$

therefore, $637 * 10^3 \text{ N} \leq 0.8 * 500 * A_b$

transposing gives us, $A_b \geq 1593 \text{ mm}^2$

From reinforcement bar manufacturers tables,

Rebar Size 24 @ 275 mm. centres provides 1636 mm^2/m. run

Which satisfies our steel sectional requirement.

As the project requires a post-installed solution, consider the use of ChemSet™ Reo 502™ Xtrem™, ChemSet™ 801 Xtrem™ XC² or ChemSet™ EPCON™ G5 Xtrem™

Design is a wall with multiple longitudinal bars at 275 mm centres so Design Case 2 applies.

From Table 2, $L_{sy.t\,(nom)} = 700$ mm

From Table 2a, $X_{nc} = 0.89$ @ $f'_c = 40$ MPa

The tensile development length for Rebar Size 24 using ChemSet™ Reo 502™ Xtrem™, ChemSet™ 801 Xtrem™ XC² or ChemSet™ EPCON™ G5 Xtrem™ is:

$$L_{sy.t} = L_{sy.t\,(nom)} * X_{nc}$$
$$= 700 * 0.89$$
$$= 623 \text{ mm}$$

Specify

N24 @ 275 mm. centres post-installed using Ramset™ ChemSet™ Reo 502™ Xtrem™, Chemset™ 801 Xtrem™ XC² or EPCON™ G5 Xtrem™ @ 623 mm. deep

DESIGN EXAMPLE 2

Consider the previous case; however the footing depth is 590 mm. Given minimum cover is 50 mm, the maximum bar length is 540 mm.

Use stress developed in the bar to determine the centre spacings required to achieve the design load case at shorter bar lengths.

From Table 2, Using $L_{st} = 540$ mm

Rebar Size = 24

gives, $\sigma_{st\,(nom)} = 386$ MPa

From Table 2b, $X_{nc} = 1.12$ @ 40 MPa

The stress developed in the bar at this depth is,

$$\sigma_{st} = \sigma_{st\,(nom)} * X_{nc}$$
$$= 430 \text{ MPa}$$

hence, $N^* \leq \phi\sigma_{st} * A_b$

therefore, $637 * 10^3 \text{ N} \leq 0.8 * 430 * A_b$

transposing gives us, $A_b \geq 1852 \text{ mm}^2$

From reinforcement bar manufacturers tables,

Rebar Size 24 @ 250 mm. centres provides 1850 mm^2/m. run

Which satisfies our steel sectional requirement.

Specify

N24 @ 250 mm. centres post-installed using Ramset™ ChemSet™ Reo 502™ Xtrem™, Chemset™ 801 Xtrem™ XC² or ChemSet™ EPCON™ G5 Xtrem™ @ 540 mm. deep

Reinforcing Bar

ENGINEERING PROPERTIES

Grade 500 Reinforcing Bar

ENGINEERING PROPERTIES

Typical Engineering Properties of Grade 500 Reinforcing Bar

Rebar size	10	12	16	20	24	25	28	32	36	40
Drilled hole dia., d_h (mm)	12	15	20	25	30	30	35	40	45	50
Stress area, A_b (mm2)	78.5	113	201	314	452	491	616	804	1020	1260
Yield stress, f_{sy} (MPa)	500	500	500	500	500	500	500	500	500	500
Tensile steel yield capacity $N_{us} = N_{sy}$, (kN)	39.3	56.5	100.5	157.0	226.0	245.5	308.0	402.0	510.0	630.0
Design Tensile steel resistance ϕN_{us} (kN)	31.4	45.2	80.4	125.6	180.8	196.4	246.4	321.6	408.0	504.0

For further information refer to reinforcing bar manufacturer's published information and current revision of **AS/NZS 4671.**

Chemset™ Reo502™ Xtrem™

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

AVAILABLE IN AUSTRALIA ONLY

(New Zealand refer to G5 Xtrem™ range)

GENERAL INFORMATION

Performance Related	Installation Related

Product

ChemSet™ Reo 502™ PLUS is a heavy duty pure Epoxy for anchoring threaded studs and reinforcing bar into cracked and uncracked concrete.

Compliance

Design according to AS 5216 Appendix D and AS 3600 clause 13.1.2.2 steel yield development length

- D.4.1 - Design considering development Length (AS 3600 clause 13.1.2.2)
- D.4.2 - Design considering Bond splitting behaviour (EOTA TR069)
- European Technical Assessment - tested to EAD 330087 and EAD 332402

Use Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.

Principal Applications

- Threaded Studs
- Starter Bars
- Threaded Inserts
- Over-head installation
- Steel Columns
- Hand Rails
- Road Stitching

Benefits, Advantages and Features

- 100 year working life

Greater productivity:

- Anchors in dry, damp, wet or flooded holes

Greater security:

- Strong bond
- Rated for sustained loading

Versatile:

- Anchors in carbide drilled and diamond drilled holes
- Cold and temperate climates

Greater safety:

- Low odour
- VOC Compliant
- Suitable for contact with drinking water

Fire Rated: Refer Fire rated anchoring section.

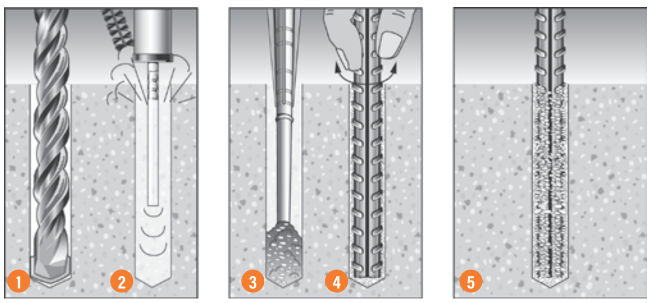
Installation & Substrate Temperature Range

Minimum	Maximum
5°C	40°C

Service Temperature Limits

-40°C to +75°C

Installation



1. Drill recommended diameter and depth hole.
2. **Important:** For hammer drilling technique clean dust and debris from hole with stiff wire brush and blower in the following sequence: blow x 2, brush x 2, blow x 2, brush x 2, blow x 2.
3. Screw mixing nozzle onto cartridge and dispense adhesive to waste until colour is orange. Insert mixing nozzle to bottom of hole.
   Fill hole to 2/3 the hole depth slowly, ensuring no air pockets form.
4. Insert **Ramset**™ ChemSet™ Anchor Stud/rebar to bottom of hole while turning.
5. Allow ChemSet™ Reo 502™ XTREM™ to cure as per setting times.

Setting Times

Temperature of base material	Gel Time	Curing time in dry concrete	Curing time in wet and flooded concrete
5°C	75 min	30h	60 h
10°C	45 min	22h	44 h
15°C	35 min	14h	28 h
20°C	22 min	7h	14 h
25°C	14 min	5h	10 h
30°C	8 min	4h	8 h
35°C	6 min	3h	6h
40°C	4 min	2h 45min	5h 30min

Description and Part Numbers

Description	Cartridge Size	Part No.	Working Time at 20°C	Cure Time at 20°C
ChemSet™ Reo 502™ Xtrem™	600 ml	CRE0502X	22 min	7 hours

ChemSet™ 801 Xtrem™ XC²

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

GENERAL INFORMATION

Performance Related	Installation Related

Product

Chemset™ 801 Xtrem™ XC² is a heavy duty Vinylester for anchoring threaded studs and reinforcing bar into cracked and uncracked concrete.

Compliance

Design according to AS 5216 Appendix D and AS 3600 clause 13.1.2.2 steel yield development length

- European Technical Assessment - tested to EAD 330087

Use Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.

Benefits, Advantages and Features

- 100 year working life
- Flooded Holes
- Fire rated

Greater productivity:

- Easy dispensing even in cold weather
- Apply torque in 2 hours @ 20°C

Greater security:

- Strong bond
- Rated for sustained loading

Versatile:

- Earthquake, Fire & Flooded Conditions
- Cold and temperate climates

Greater safety:

- Low odour
- VOC Compliant
- Suitable for contact with drinking water

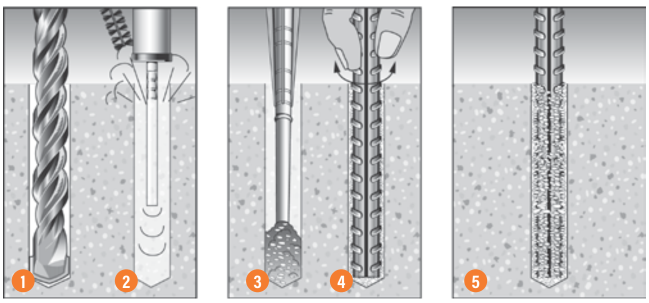
Made in Australia

SEISMIC C1 | 100 YEAR WORKING LIFE | ETA | CRACKED CONCRETE CERTIFIED | FLOODED HOLE APPROVED

Principal Applications

- Threaded Studs
- Starter Bars
- Threaded Inserts
- Over-head installation
- Steel Columns
- Hand Rails
- Road Stitching

Installation



1. Drill recommended diameter and depth hole.
2. **Important:** Use **Ramset™** Dustless Drilling System to ensure holes are clean. Alternatively, clean dust and debris from hole with stiff wire or nylon brush and blower in the following sequence: blow x 2, brush x 2, blow x 2.
3. Dispense adhesive to waste until colour is uniform light grey (2-3 trigger pulls). Insert mixing nozzle to bottom of hole. Fill hole to 3/4 the hole depth slowly, ensuring no air pockets form.
4. Insert **Ramset™** ChemSet™ Anchor Stud/rebar to bottom of hole while turning.
5. Allow ChemSet™ 801 Xtrem™ XC² to cure as per setting times.

Installation & Substrate Temperature Range

	Minimum	Maximum
Substrate	5°C	40°C
Adhesive	5°C	40°C

Service Temperature Limits

-40°C to 80°C

Setting Times 801 Xtrem™ XC²

Temperature of base material	Gel Time	Curing time in dry concrete	Curing time in wet concrete
+5°C	60 min	240 min	480 min
6°C - 10°C	40 min	180 min	360 min
11°C - 20°C	15 min	120 min	240 min
21°C - 30°C	8 min	90 min	180 min
31°C - 40°C	4 min	60 min	120 min
Note: Cartridge temperature minimum +5°C			

Note:
* Diamond Core drilling only applicable for 50 years working life.

Description and Part Numbers

Description	Cartridge Size	Part No.	Working Time at 20°C	Cure Time at 20°C
ChemSet™ 801 Xtrem™ XC2	600 ml	C801X600	15 min	2 hours

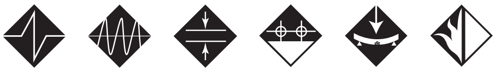
Chemset™ EPCON™ G5 Xtrem™

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

AVAILABLE IN NEW ZEALAND ONLY

(Australia refer to ChemSet™ Reo502™ Xtrem™ range)

GENERAL INFORMATION

Performance Related	Installation Related
	

Product

ChemSet™ EPCON™ G5 Xtrem™ is a heavy duty pure Epoxy for anchoring threaded studs and reinforcing bar into cracked and uncracked concrete.

Compliance

Design according to AS 5216 Appendix D and AS 3600 clause 13.1.2.2 steel yield development length

- D.4.1 - Design considering development Length (AS 3600 clause 13.1.2.2)
- D.4.2 - Design considering Bond splitting behaviour (EOTA TR069)
- European Technical Assessment - tested to EAD 330087 and EAD 332402

Use Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.

Principal Applications

- Threaded Studs
- Starter Bars
- Threaded Inserts
- Over-head installation
- Steel Columns
- Hand Rails
- Road Stitching

Benefits, Advantages and Features

- 100 year working life

Greater productivity:

- Anchors in dry, damp, wet or flooded holes

Greater security:

- Strong bond
- Rated for sustained loading

Versatile:

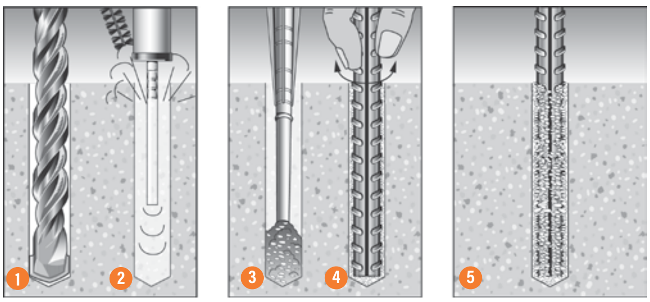
- Anchors in carbide drilled and diamond drilled holes
- Cold and temperate climates

Greater safety:

- Low odour
- VOC Compliant
- Suitable for contact with drinking water

Fire Rated: Refer Fire rated anchoring section.

Installation



1. Drill recommended diameter and depth hole.
2. **Important:** For hammer drilling technique clean dust and debris from hole with stiff wire brush and blower in the following sequence: blow x 2, brush x 2, blow x 2, brush x 2, blow x 2.
3. Screw mixing nozzle onto cartridge and dispense adhesive to waste until colour is orange. Insert mixing nozzle to bottom of hole.
   Fill hole to 2/3 the hole depth slowly, ensuring no air pockets form.
4. Insert **Ramset**™ ChemSet™ Anchor Stud/rebar to bottom of hole while turning.
5. Allow Chemset™ EPCON™ G5 Xtrem™ to cure as per setting times.

Installation & Substrate Temperature Range

Minimum	Maximum
5°C	40°C

Service Temperature Limits

-40°C to +75°C

Setting Times

Temperature of base material	Gel Time	Curing time in dry concrete	Curing time in wet and flooded concrete
5°C	75 min	30h	60 h
10°C	45 min	22h	44 h
15°C	35 min	14h	28 h
20°C	22 min	7h	14 h
25°C	14 min	5h	10 h
30°C	8 min	4h	8 h
35°C	6 min	3h	6h
40°C	4 min	2h 45min	5h 30min

Description and Part Numbers

Description	Cartridge Size	Part No.	Working Time at 20°C	Cure Time at 20°C
ChemSet™ EPCON™ G5 Xtrem™	600 ml	CEG5X600	22 min	7 hours

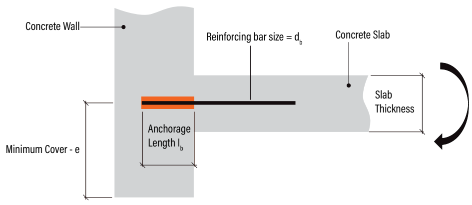
Chemset Reo 502™ Xtrem™ or ChemSet™ EPCON™ G5 Xtrem™
STRENGTH LIMIT STATE DESIGN

Strength Limit State Design

Design Case 1

For Single and Multiple Bars in concrete elements (bond splitting behaviour to EOTA-TR069)

For compliance with AS 5216 Appendix D.4.2 design considering bond splitting behaviour



Concrete Splitting Factors

A_k	4.48
sp1	0.19
sp2	0.44
sp3	0.60
sp4	0.33
lb1	0.55

Table 1a Bond-splitting tensile capacity utilising Grade 500 reinforcing bar post-installed in 32 MPa concrete with ChemSet™ Reo 502 Xtrem™ or ChemSet™ EPCON™ G5 Xtrem™

Rebar size	10	12	16	20	24	25	32	40
Minimum Cover, e (mm)	176	300	475	615	850	975	1665	2775
Min. Clear Spacing, a (mm)	90	90	130	180	220	220	270	320
Slab Thickness (mm)	100	100	150	200	250	250	300	320
Nominal embedment length of bar in tension, $L_{sy.t\ (nom)}$*	118	200	315	410	565	650	1110	1500
Effective length, $L_{st\ (m)}$	Bond-Splitting Design Tensile Resistance , ϕN_{usp} (kN)							
100	22							
118	26							
120		32						
140		38						
160		40	57					
200		45	65	88**				
240			70	95	118**			
250			71	97	120**	123**		
315			79	108	134	136		
320				109	134	137	176**	
410				121	150	154	197	244**
500					164	168	215	267
565					174	177	227	282
600						182	234	289
650						189	242	300
700							250	310
800							266	330
900							280	348
1110							308	382
1300								411
1500								437

Note: Bond Splitting design tensile resistance = ϕN_{usp} (kN), ϕ = 1/1.5 = 0.67 and data based on temperature range T1 : -40°C to +40°C
*Note: Moment loading assumed with central rebar placement **Note: Values only apply to compressive strengths of 32 MPa or higher
Note: Data assumes no transverse reinforcement is intercepted (K_m =0), no transverse pressure (P_{tr} = 0) and 100% of actions are considered to be sustained (α_{sus} = 1)

Checkpoint 1a

Table 1a-2 Concrete compressive strength effect on bond-splitting design resistance, tension, X_{nsp}

	Bond-Splitting Design Resistance - X_{nsp}							
Anchor size, d_b	10	12	16	20	24	25	32	40
f'_c (MPa)								
20	0.98	0.91	0.91	0.91	0.91	0.91	0.91	0.91
25	0.99	0.95	0.95	0.95	0.95	0.95	0.95	0.95
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.00	1.01	1.02	1.04	1.04	1.04	1.04	1.04
50	1.01	1.02	1.03	1.07	1.09	1.09	1.09	1.09

Table 1a-3 Cracked Concrete effect, X_{ncr}

	Cracked Concrete Effect - X_{ncr}							
Anchor size, d_b	10	12	16	20	24	25	32	40
f'_c (MPa)								
20 to 50	0.78	0.78	0.77	0.76	0.80	0.83	0.95	0.92

For Non-cracked concrete X_{ncr} = 1.0

Design reduced bond-splitting tensile resistance, ϕN_{ursp}

$\phi N_{ursp} = \phi N_{usp} * X_{nsp} * X_{ncr}$

Use Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.

Chemset Reo 502™ Xtrem™ or ChemSet™ EPCON™ G5 Xtrem™
STRENGTH LIMIT STATE DESIGN

Strength Limit State Design

Design Case 1

For Single and Multiple Bars in concrete elements (bond splitting behaviour to EOTA-TR069)

For compliance with AS 5216 Appendix D.4.2 design considering bond splitting behaviour

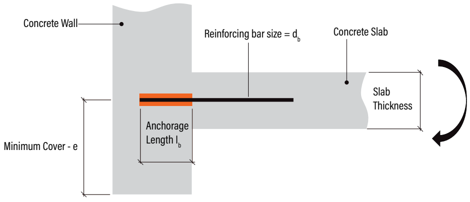


Table 1b Concrete cone break-out tensile capacity utilising Grade 500 reinforcing bar post-installed in 32 MPa concrete with ChemSet™ Reo 502 Xtrem™ or ChemSet™ EPCON™ G5 Xtrem™

Rebar size	10	12	16	20	24	25	32	40
Minimum Cover, e (mm)	176	300	475	615	850	975	1665	2775
Min. Clear Spacing, a (mm)	90	90	130	180	220	220	270	320
Slab Thickness (mm)	100	100	150	200	250	250	300	320
Nominal embedment length of bar in tension, $L_{syt\ (nom)}$ *	118	200	315	410	565	650	1110	1500
Effective length, $L_{st\ (m)}$	Concrete cone break-out Design Tensile Resistance , ϕN_{uc} (kN) *							
100	24							
118	27							
120		28						
140		30						
160		33	45					
200		37	52	68**				
240			57	76	90**			
250			59	78	92**	93**		
315			67	90	107	107		
320				91	108	108	131**	
410				105	125	126	153	182**
500					141	141	172	205
565					151	151	185	220
600						157	191	227
650						164	200	238
700							209	248
800							225	267
900							240	285
1110							268	320
1300								348
1500								375

Note: Concrete cone design tensile resistance = ϕN_{uc} (kN), ϕ = 1/1.5 = 0.67 and data based on temperature range T1 : -40°C to +40°C
*Note: Moment loading assumed with central rebar placement **Note: Values only apply to compressive strengths of 32 MPa or higher

Checkpoint 1b

Table 1b-2 Concrete compressive strength effect on Concrete cone break-out Resistance, tension, X_{nc}

f'_c (MPa)	20	25	32	40	50
X_{nc}	0.79	0.88	1.00	1.11	1.23

Table 1b-3 Cracked Concrete effect, X_{ncr}

	Cracked Concrete Effect - X_{ncr}							
Anchor size, d_b	10	12	16	20	24	25	32	40
f'_c (MPa)								
20 to 50	0.70							

For Non-cracked concrete X_{ncr} = 1.0

Design reduced concrete cone break-out tensile resistance, ϕN_{urc}

$\phi N_{urc} = \phi N_{uc} * X_{nc} * X_{ncr}$

Checkpoint 1c

Design tensile resistance, ϕN_{ur}

ϕN_{ur} = minimum of $\phi N_{ursp}, \phi N_{urc}, \phi N_{us}$

Check $N^*/\phi N_{ur} \leq 1$

Use Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.

Strength Limit State Design

Design Case 2 Multiple Bars in Concrete Elements (Large clear anchor spacing)

Steel yield development length, $L_{sy.t}$ (AS 5216 Appendix D.4.1 and AS 3600 clause 13.1.2.2)

Table 2 Nominal steel yield development length $L_{sy.t\,(nom)}$, of Grade 500 reinforcing bar in tension post-installed in 32 MPa concrete with ChemSet™ Reo 502™ Xtrem™, Chemset™ 801 Xtrem™ XC² or ChemSet™ EPCON™ G5 Xtrem™

Rebar size	10*	12	16	20	24	25	28	32	36#	40#
Concrete Splitting Factor, k_1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Concrete Splitting Factor, k_2	1.2	1.2	1.2	1.1	1.1	1.1	1.0	1.0	1.0	0.9
Concrete Splitting Factor, k_3	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Minimum Cover, e (mm)	40	40	45	60	75	75	95	110	130	150
Min. Clear Spacing, a (mm)	80	80	90	125	150	150	190	220	260	300
Adhesive reduced ultimate tensile bond capacity ϕN_{ub}, (kN), $\phi_c = 0.6$	39.3	56.5	100.5	157.0	226.0	245.5	308.0	402.0	510.0	630.0
Nominal development length of bar in tension, $L_{sy.t\,(nom)}$**	290	350	465	580	700	725	835	990	1160	1345
Effective length, L_{st} (mm)	Stress developed in steel, $\sigma_{st\,(nom)}$ (MPa)									
140	241									
160	276									
180	310	257								
240	414	343								
290	500	414	312							
310		443	333							
330		471	355							
350		500	376	302						
370			398	319						
410			441	353						
465			500	401	332	321				
490				422	350	338	293			
540				466	386	372	323	273		
580				500	414	400	347	293	250	
615					439	424	368	311	265	
650					464	448	389	328	280	242
700					500	483	419	354	302	260
725						500	434	366	312	270
780							467	394	336	290
835							500	422	360	310
875								442	360	310
915								462	394	340
990								500	427	368
1160									500	431
1345										500

$\sigma_{st} < f_{sy}$

$\sigma_{st} < f_{sy}$

500 Denotes adhesive tensile bond stress at Grade 500 steel yield development length, $L_{sy.t}$ Interpolation permitted. Do not extrapolate.

*Note: 10mm Reinforcing bar diameter data only applies to ChemSet™ Reo 502™ Xtrem™ and ChemSet™ EPCON™ G5 Xtrem™ for hammer drilling technique.

**Note: For Reinforcing bar diameters 12mm to 40mm, both hammer drilling technique and diamond core drilling technique can be used.

#Note: 36mm and 40mm Reinforcing bar diameter data only applies to ChemSet™ Reo502™ Xtrem™ and ChemSet™ EPCON G5™ Xtrem™.

Chemset Reo 502™ Xtrem™, Chemset 801 Xtrem™ XC² or ChemSet™ EPCON™ G5 Xtrem™
STRENGTH LIMIT STATE DESIGN

Checkpoint 2a

Table 2a Concrete compressive strength effect on development length, tension, X_{nc}

f'_c (MPa)	20	25	32	40	50
X_{nc} - for 10-40 bar diam.	1.26	1.13	1.00	0.89	0.80
X_{nc} - for 32 bar diam. C801X600 only	1.26	1.13	1.00	1.00	1.00

Design reinforcing bar steel development length, $L_{sy.t}$ (mm)

$$L_{sy.t} = L_{sy.t\,(nom)} * X_{nc}$$

If there is insufficient concrete depth to install bar to $L_{sy.t}$ go to Checkpoint 2b

Note: Effect of water in hole, multiply $L_{sy.t}$ by 1.4.

Checkpoint 2b

Table 2b Concrete compressive strength effect on steel stress, tension, X_{nc}

f'_c (MPa)	20	25	32	40	50
X_{nc} - for 10-40 bar diam.	0.79	0.88	1.00	1.12	1.25
X_{nc} - for 32 bar diam. C801X600 only	0.79	0.88	1.00	1.00	1.00

Design tensile steel stress, σ_{st} (MPa)

$$\sigma_{st} = \sigma_{st\,(nom)} * X_{nc}$$

Note: Effect of water in hole, multiply σ_{st} by 0.7.

Chemset Reo 502™ Xtrem™, Chemset 801 Xtrem™ XC² or ChemSet™ EPCON™ G5 Xtrem™ STRENGTH LIMIT STATE DESIGN

Strength Limit State Design

Design Case 3 Multiple Bars in Concrete Elements (Medium clear anchor spacing)

Steel yield development length, $L_{sy.t}$ (AS 5216 Appendix D.4.1 and AS 3600 clause 13.1.2.2)

Table 3 Nominal steel yield development length $L_{sy.t\,(nom)}$, of Grade 500 reinforcing bar in tension post-installed in 32 MPa concrete with ChemSet™ Reo 502™ Xtrem™, Chemset™ 801 Xtrem™ XC² or ChemSet™ EPCON™ G5 Xtrem™

Rebar size	10*	12	16	20	24	25	28	32	36#	40#
Concrete Splitting Factor, k_1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Concrete Splitting Factor, k_2	1.2	1.2	1.2	1.1	1.1	1.1	1.0	1.0	1.0	0.9
Concrete Splitting Factor, k_3	0.7	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Minimum Cover, e (mm)	30	30	32	40	48	50	56	64	72	80
Min. Clear Spacing, a (mm)	60	60	70	80	100	100	120	130	150	150
Adhesive reduced ultimate tensile bond capacity ϕN_{ub}, (kN), $\phi_c = 0.6$	39.3	56.5	100.5	157.0	226.0	245.5	308.0	402.0	510.0	630.0
Nominal development length of bar in tension, $L_{sy.t\,(nom)}$**	290	350	520	675	835	880	1015	1205	1410	1670
Effective length, L_{st} (mm)	Stress developed in steel, $\sigma_{st\,(nom)}$ (MPa)									
120	207									
180	310									
200	345	286								
250	431	357								
290	500	414	279							
300		429	288							
330		471	317							
350		500	337	259						
400			385	296						
445			428	330						
520			500	385	311	295				
550				407	329	313	271			
595				441	356	338	293	247		
675				500	404	384	332	280	239	
700					419	398	345	290	248	
775					464	440	382	322	275	232
835					500	474	411	346	296	250
880						500	433	365	312	263
945							465	392	335	283
1015							500	421	360	304
1050								436	372	314
1120								465	397	335
1205								500	427	361
1410									500	422
1670										500

$\sigma_{st} < f_{sy}$

$\sigma_{st} < f_{sy}$

500 Denotes adhesive tensile bond stress at Grade 500 steel yield development length, $L_{sy.t}$ Interpolation permitted. Do not extrapolate.

*Note: 10mm Reinforcing bar diameter data only applies to ChemSet™ Reo 502™ Xtrem™ and ChemSet™ EPCON™ G5 Xtrem™ for hammer drilling technique.

**Note: For Reinforcing bar diameters 12mm to 40mm, both hammer drilling technique and diamond core drilling technique can be used.

#Note: 36mm and 40mm Reinforcing bar diameter data only applies to ChemSet™ Reo502™ Xtrem™ and ChemSet™ EPCON G5™ Xtrem™.

Chemset Reo 502™ Xtrem™, Chemset 801 Xtrem™ XC² or ChemSet™ EPCON™ G5 Xtrem™
STRENGTH LIMIT STATE DESIGN

Checkpoint 3a

Table 3a Concrete compressive strength effect on development length, tension, X_{nc}

f'_c (MPa)	20	25	32	40	50
X_{nc} - for 10-40 bar diam.	1.26	1.13	1.00	0.89	0.80
X_{nc} - for 32 bar diam. C801X600 only	1.26	1.13	1.00	1.00	1.00

Design reinforcing bar steel development length, $L_{sy.t}$ (mm)

$$L_{sy.t} = L_{sy.t}\text{ (nom)} * X_{nc}$$

If there is insufficient concrete depth to install bar to $L_{sy.t}$ go to Checkpoint 3b

Note: Effect of water in hole, multiply $L_{sy.t}$ by 1.4.

Checkpoint 3b

Table 3b Concrete compressive strength effect on steel stress, tension, X_{nc}

f'_c (MPa)	20	25	32	40	50
X_{nc} - for 10-40 bar diam.	0.79	0.88	1.00	1.12	1.25
X_{nc} - for 32 bar diam. C801X600 only	0.79	0.88	1.00	1.00	1.00

Design tensile steel stress, σ_{st} (MPa)

$$\sigma_{st} = \sigma_{st}\text{ (nom)} * X_{nc}$$

Note: Effect of water in hole, multiply σ_{st} by 0.7.

Ramset™

Excerpt p369-372

Chemset™ Reo502™ Xtrem™

FIRE RATED CHEMICAL ANCHOR

AVAILABLE IN AUSTRALIA ONLY

(New Zealand refer to EPCON™ G5 Xtrem™ range)

GENERAL INFORMATION

Performance Related	Installation Related

Product

ChemSet™ Reo 502™ Xtrem™ is a heavy duty pure Epoxy for anchoring threaded studs and reinforcing bar into cracked and uncracked concrete.

Compliance

European Technical Assessment ETA-25/0647 and ETA-25/1142

Design according to:

- AS 5216 (formerly TS101)
- EN 1992-4 (formerly ETAG001 Annex C, E & TR045)
- Fire Design according to EN 1992-1-1 and EN 1992-1-2.
- Use enclosed data for simplified calculation method

Use Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed

Principal Applications

- Threaded Studs
- Starter Bars
- Threaded Inserts
- Over-head installation
- Steel Columns
- Hand Rails
- Road Stitching

Benefits, Advantages and Features

- 120 year working Life
- Fire tested to European Assessment Document

Greater productivity:

- Anchors in dry, damp, wet or flooded holes

Greater security:

- Strong bond
- Rated for sustained loading

Versatile:

- Anchors in carbide drilled and diamond drilled holes
- Cold and temperate climates

Greater safety:

- Low odour
- VOC Compliant
- Suitable for contact with drinking water

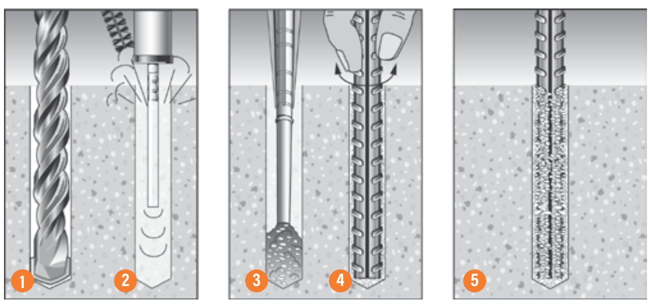
Installation & Substrate Temperature Range

Minimum	Maximum
5°C	40°C

Service Temperature Limits

-40°C to +75°C

Installation



1. Drill recommended diameter and depth hole.
2. **Important:** For hammer drilling technique clean dust and debris from hole with stiff wire brush and blower in the following sequence: blow x 2, brush x 2, blow x 2, brush x 2, blow x 2.
3. Screw mixing nozzle onto cartridge and dispense adhesive to waste until colour is orange. Insert mixing nozzle to bottom of hole.
   Fill hole to 2/3 the hole depth slowly, ensuring no air pockets form.
4. Insert **Ramset**™ ChemSet™ Anchor Stud/rebar to bottom of hole while turning.
5. Allow ChemSet™ Reo 502™ Xtrem™ to cure as per setting times.

Setting Times

Temperature of base material	Gel Time	Curing time in dry concrete	Curing time in wet and flooded concrete
5°C	75 min	30h	60 h
10°C	45 min	22h	44 h
15°C	35 min	14h	28 h
20°C	22 min	7h	14 h
25°C	14 min	5h	10 h
30°C	8 min	4h	8 h
35°C	6 min	3h	6h
40°C	4 min	2h 45min	5h 30min

Chemset™ Reo502™ Xtrem™

FIRE RATED CHEMICAL ANCHOR

AVAILABLE IN AUSTRALIA ONLY

Installation Details

ChemSet™ Reo 502™ Xtrem™ with Reinforcing Bar

Anchor size, d_b (mm)	Drilled hole diameter, d_h (mm)
10	12
12	15
16	20
20	25
24	30
25	30
28	35
32	40
36	45
40	50

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
ChemSet™ Reo 502™ Xtrem™	600 ml	CRE0502X

Typical Engineering Properties of Grade 500 Reinforcing Bar

Rebar size	10	12	16	20	24	25	28	32	36	40
Drilled hole dia, d_h (mm)	12	15	20	25	30	30	35	40	45	50
Stress area, A_s (mm^2)	78.5	113	201	314	452	491	616	804	1020	1260
Yield stress, f_{sy} (MPa)	500	500	500	500	500	500	500	500	500	500
Tensile steel yield capacity, $N_{us} = N_{sy}$, (kN)	39.3	56.5	100.5	157.0	226.0	245.5	308.0	402.0	509.0	628.0
Design tensile steel resistance ϕN_{us} (kN)	31.4	45.2	80.4	125.6	180.8	196.4	246.4	321.6	407.2	502.4

For further information refer to reinforcing bar manufacturer's published information and current revision of **AS/NZS 4671**

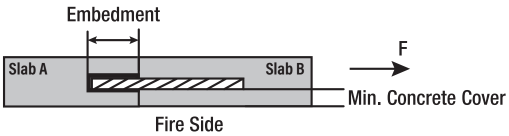
Chemset™ Reo502™ Xtrem™

FIRE RATED CHEMICAL ANCHOR

AVAILABLE IN AUSTRALIA ONLY

Fire Rated Anchoring Systems

Reinforcing Bar Anchored with ChemSet™ Reo502™ Xtrem™



Design Case 1

Fire resistance duration = 30 minutes

For Reinforcing Bar Steel Grade - 500 MPa and Concrete cylinder compressive strength f'_c = 20 MPa

Rebar Size	Hole Diameter (mm)	*Min. Concrete Cover(mm)	**Design reistance in accordance with Eurocode 2 for fire duration 30 minutes - $R_{d,fi}$ (kN)													
10	12	50	3.32	4.98	6.64	8.30	9.96	11.62	13.28	14.94	16.59	18.25	19.91	23.23	26.55	29.87
		70	7.63	11.45	15.26	19.08	22.89	26.71	30.52	**31.42**	**31.42**	**31.42**	**31.42**	**31.42**	**31.42**	**31.42**
12	15	50	3.98	5.97	7.97	9.96	11.95	13.94	15.93	17.92	19.91	21.91	23.90	27.88	31.86	35.84
		70	9.16	13.73	18.31	22.89	27.47	32.05	36.63	41.20	**45.24**	**45.24**	**45.24**	**45.24**	**45.24**	**45.24**
16	20	50		7.97	10.62	13.28	15.93	18.59	21.24	23.90	26.55	29.21	31.86	37.17	42.48	47.79
		70		18.31	24.42	30.52	36.63	42.73	48.83	54.94	61.04	67.15	73.25	**80.42**	**80.42**	**80.42**
20	25	50			13.28	16.59	19.91	23.23	26.55	29.87	33.19	36.51	39.83	46.47	53.10	59.74
		70			30.52	38.15	45.78	53.41	61.04	68.67	76.30	83.93	91.56	106.83	122.09	**125.66**
24	30	50				19.91	23.90	27.88	31.86	35.84	39.83	43.81	47.79	55.76	63.72	71.69
		70				45.78	54.94	64.10	73.25	82.41	91.56	100.72	109.88	128.19	146.50	164.82
25	30	50				20.74	24.89	29.04	33.19	37.34	41.49	45.64	49.78	58.08	66.38	74.68
		70				47.69	57.23	66.77	76.30	85.84	95.38	104.92	114.46	133.53	152.61	171.68
28	35	50					27.88	32.53	37.17	41.82	46.47	51.11	55.76	65.05	74.34	83.64
		70					64.10	74.78	85.46	96.14	106.83	117.51	128.19	149.56	170.92	192.29
32	40	50						37.17	42.48	47.79	53.10	58.41	63.72	74.34	84.97	95.59
		70						85.46	97.67	109.88	122.09	134.30	146.50	170.92	195.34	219.76
36	45	50						41.82	47.79	53.77	59.74	65.72	71.69	83.64	95.59	107.53
		70						96.14	109.88	123.61	137.35	151.08	164.82	192.29	219.76	247.23
40	50	50						46.47	53.10	59.74	66.38	73.02	79.66	92.93	106.21	119.48
		70						106.83	122.09	137.35	152.61	167.87	183.13	213.65	244.17	274.69
Embedment (mm)			100	150	200	250	300	350	400	450	500	550	600	700	800	900

*Note: Minimum concrete cover based on minimum slab thickness of 200mm according to Eurocode 2 Part 1.2 (EN 1992-1-2)
**Note: Performance data based on hammer drilling technique. For data using core drilling technique, please refer to Ramset Engineer.
Bold values depicts design tensile steel resistance governs

Design Case 2

Fire resistance duration = 60 minutes

For Reinforcing Bar Steel Grade - 500 MPa and Concrete cylinder compressive strength f'_c = 20 MPa

Rebar Size	Hole Diameter (mm)	*Min. Concrete Cover(mm)	**Design reistance in accordance with Eurocode 2 for fire duration 60 minutes - $R_{d,fi}$ (kN)													
10	12	80	3.64	5.47	7.29	9.11	10.93	12.76	14.58	16.40	18.22	20.04	21.87	25.51	29.15	**31.42**
		100	6.60	9.91	13.21	16.51	19.81	23.12	26.42	29.72	**31.42**	**31.42**	**31.42**	**31.42**	**31.42**	**31.42**
12	15	80	4.37	6.56	8.75	10.93	13.12	15.31	17.49	19.68	21.87	24.05	26.24	30.61	34.99	39.36
		100	7.93	11.89	15.85	19.81	23.78	27.74	31.70	35.67	39.63	**43.59**	**45.24**	**45.24**	**45.24**	**45.24**
16	20	80		8.75	11.66	14.58	17.49	20.41	23.32	26.24	29.15	32.07	34.99	40.82	46.65	52.48
		100		15.85	21.13	26.42	31.70	36.99	42.27	47.55	52.84	58.12	63.40	73.97	**80.42**	**80.42**
20	25	80			14.58	18.22	21.87	25.51	29.15	32.80	36.44	40.09	43.73	51.02	58.31	65.60
		100			26.42	33.02	39.63	46.23	52.84	59.44	66.05	72.65	79.26	92.46	105.67	118.88
24	30	80				21.87	26.24	30.61	34.99	39.36	43.73	48.10	52.48	61.22	69.97	78.72
		100				39.63	47.55	55.48	63.40	71.33	79.26	87.18	95.11	110.96	126.81	142.66
25	30	80				22.78	27.33	31.89	36.44	41.00	45.55	50.11	54.66	63.78	72.89	82.00
		100				41.28	49.53	57.79	66.05	74.30	82.56	90.81	99.07	115.58	132.09	148.60
28	35	80					30.61	35.71	40.82	45.92	51.02	56.12	61.22	71.43	81.63	91.84
		100					55.48	64.73	73.97	83.22	92.46	101.71	110.96	129.45	147.94	166.44
32	40	80						40.82	46.65	52.48	58.31	64.14	69.97	81.63	93.29	104.96
		100						73.97	84.54	95.11	105.67	116.24	126.81	147.94	169.08	190.21
36	45	80						45.92	52.48	59.04	65.60	72.16	78.72	91.84	104.96	118.08
		100						83.22	95.11	107.00	118.88	130.77	142.66	166.44	190.21	213.99
40	50	80						51.02	58.31	65.60	72.89	80.17	87.46	102.04	116.62	131.19
		100						92.46	105.67	118.88	132.09	145.30	158.51	184.93	211.35	237.77
Embedment (mm)			100	150	200	250	300	350	400	450	500	550	600	700	800	900

*Note: Minimum concrete cover based on minimum slab thickness of 200mm according to Eurocode 2 Part 1.2 (EN 1992-1-2)
**Note: Performance data based on hammer drilling technique. For data using core drilling technique, please refer to Ramset Engineer.
Bold values depicts design tensile steel resistance governs

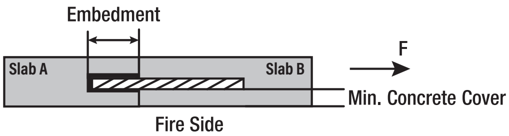
Note: Design resistance is based on 20 MPa concrete strength. For values in higher concrete strengths, and design optimisation, please refer to Ramset iExpert Anchor Software.

Chemset™ Reo502™ Xtrem™

FIRE RATED CHEMICAL ANCHOR

AVAILABLE IN AUSTRALIA ONLY

Reinforcing Bar Anchored with ChemSet™ Reo502™ Xtrem™



Design Case 3

Fire resistance duration = 90 minutes

For Reinforcing Bar Steel Grade - 500 MPa and Concrete cylinder compressive strength f'_c = 20 MPa

Rebar Size	Hole Diameter (mm)	*Min. Concrete Cover(mm)	**Design reistance in accordance with Eurocode 2 for fire duration 90 minutes - $R_{d,fi}$ (kN)													
10	12	90	4.05	5.39	6.74	8.09	9.44	10.79	12.14	13.49	14.84	16.18	18.88	21.58	24.28	26.97
		100	5.28	7.03	8.79	10.55	12.31	14.07	15.83	17.59	19.34	21.10	24.62	28.14	**31.42**	**31.42**
12	15	90	4.86	6.47	8.09	9.71	11.33	12.95	14.57	16.18	17.80	19.42	22.66	25.90	29.13	32.37
		100	6.33	8.44	10.55	12.66	14.77	16.88	18.99	21.10	23.21	25.32	29.54	33.76	37.98	42.20
16	20	90		8.63	10.79	12.95	15.11	17.26	19.42	21.58	23.74	25.90	30.21	34.53	38.84	43.16
		100		11.25	14.07	16.88	19.70	22.51	25.32	28.14	30.95	33.76	39.39	45.02	50.65	56.27
20	25	90			13.49	16.18	18.88	21.58	24.28	26.97	29.67	32.37	37.76	43.16	48.55	53.95
		100			17.59	21.10	24.62	28.14	31.65	35.17	38.69	42.20	49.24	56.27	63.31	70.34
24	30	90				19.42	22.66	25.90	29.13	32.37	35.61	38.84	45.32	51.79	58.27	64.74
		100				25.32	29.54	33.76	37.98	42.20	46.42	50.65	59.09	67.53	75.97	84.41
25	30	90				20.23	23.60	26.97	30.35	33.72	37.09	40.46	47.21	53.95	60.69	67.44
		100				26.38	30.77	35.17	39.57	43.96	48.36	52.76	61.55	70.34	79.13	87.93
28	35	90					26.44	30.21	33.99	37.76	41.54	45.32	52.87	60.42	67.98	75.53
		100					34.47	39.39	44.31	49.24	54.16	59.09	68.93	78.78	88.63	98.48
32	40	90						34.53	38.84	43.16	47.48	51.79	60.42	69.05	77.69	86.32
		100						45.02	50.65	56.27	61.90	67.53	78.78	90.04	101.29	112.55
36	45	90						38.84	43.70	48.55	53.41	58.27	67.98	77.69	87.40	97.11
		100						50.65	56.98	63.31	69.64	75.97	88.63	101.29	113.95	126.61
40	50	90						43.16	48.55	53.95	59.34	64.74	75.53	86.32	97.11	107.90
		100						56.27	63.31	70.34	77.37	84.41	98.48	112.55	126.61	140.68
Embedment (mm)			150	200	250	300	350	400	450	500	550	600	700	800	900	1000

*Note: Minimum concrete cover based on minimum slab thickness of 200mm according to Eurocode 2 Part 1.2 (EN 1992-1-2)
**Note: Performance data based on hammer drilling technique. For data using core drilling technique, please refer to Ramset Engineer.
Bold values depicts design tensile steel resistance governs

Design Case 4

Fire resistance duration = 120 minutes

For Reinforcing Bar Steel Grade - 500 MPa and Concrete cylinder compressive strength f'_c = 20 MPa

Rebar Size	Hole Diameter (mm)	*Min. Concrete Cover(mm)	**Design reistance in accordance with Eurocode 2 for fire duration 120 minutes - $R_{d,fi}$ (kN)													
10	12	90	3.64	4.55	5.47	6.38	7.29	8.20	9.11	10.02	10.93	12.75	14.57	16.40	18.22	20.04
		100	4.64	5.80	6.96	8.12	9.28	10.44	11.60	12.76	13.92	16.24	18.56	20.88	23.20	25.52
12	15	90	4.37	5.47	6.56	7.65	8.74	9.84	10.93	12.02	13.12	15.30	17.49	19.67	21.86	24.05
		100	5.57	6.96	8.35	9.74	11.13	12.53	13.92	15.31	16.70	19.48	22.27	25.05	27.84	30.62
16	20	90		7.29	8.74	10.20	11.66	13.12	14.57	16.03	17.49	20.40	23.32	26.23	29.15	32.06
		100		9.28	11.13	12.99	14.85	16.70	18.56	20.41	22.27	25.98	29.69	33.40	37.11	40.83
20	25	90			10.93	12.75	14.57	16.40	18.22	20.04	21.86	25.50	29.15	32.79	36.43	40.08
		100			13.92	16.24	18.56	20.88	23.20	25.52	27.84	32.47	37.11	41.75	46.39	51.03
24	30	90				15.30	17.49	19.67	21.86	24.05	26.23	30.60	34.98	39.35	43.72	48.09
		100				19.48	22.27	25.05	27.84	30.62	33.40	38.97	44.54	50.10	55.67	61.24
25	30	90				15.94	18.22	20.49	22.77	25.05	27.33	31.88	36.43	40.99	45.54	50.10
		100				20.30	23.20	26.10	29.00	31.89	34.79	40.59	46.39	52.19	57.99	63.79
28	35	90					20.40	22.95	25.50	28.05	30.60	35.71	40.81	45.91	51.01	56.11
		100					25.98	29.23	32.47	35.72	38.97	45.46	51.96	58.45	64.95	71.44
32	40	90						26.23	29.15	32.06	34.98	40.81	46.64	52.47	58.29	64.12
		100						33.40	37.11	40.83	44.54	51.96	59.38	66.80	74.23	81.65
36	45	90						29.51	32.79	36.07	39.35	45.91	52.47	59.02	65.58	72.14
		100						37.58	41.75	45.93	50.10	58.45	66.80	75.16	83.51	91.86
40	50	90						32.79	36.43	40.08	43.72	51.01	58.29	65.58	72.87	80.16
		100						41.75	46.39	51.03	55.67	64.95	74.23	83.51	92.78	102.06
Embedment (mm)			200	250	300	350	400	450	500	550	600	700	800	900	1000	1100

*Note: Minimum concrete cover based on minimum slab thickness of 200mm according to Eurocode 2 Part 1.2 (EN 1992-1-2)
**Note: Performance data based on hammer drilling technique. For data using core drilling technique, please refer to Ramset Engineer.

Note: Design resistance is based on 20 MPa concrete strength. For values in higher concrete strengths, and design optimisation, please refer to Ramset iExpert Anchor Software.

ChemSet™ Reo 502™ Xtrem™

FIRE RATED CHEMICAL ANCHOR - ANCHOR STUDS

AVAILABLE IN AUSTRALIA ONLY

(Australia refer to ChemSet™ Reo502™ Xtrem™ range)

GENERAL INFORMATION

Performance Related	Material Specification	Installation Related
	Zn, GAL, A4 316, HCR	

Product

EPCON™ G5 Xtrem™ is a heavy duty pure Epoxy for anchoring threaded studs and reinforcing bar into cracked and uncracked concrete.

FIRE TESTED · SEISMIC C1 & C2 · 100 YEAR WORKING LIFE · ETA · CRACKED CONCRETE CERTIFIED · FLOODED HOLE APPROVED

Compliance

European Technical Assessment ETA-25/0648

Design according to:

- AS 5216 (formerly TS101)
- EN 1992-4 (formerly ETAG001 Annex C, E & TR045)
- Fire Design according to fire performance data published in ETA-25/0648
- Use enclosed data for simplified calculation method

  Use Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.

Principal Applications

- Threaded Studs
- Starter Bars
- Threaded Inserts
- Over-head installation
- Steel Columns
- Hand Rails
- Road Stitching

Benefits, Advantages and Features

- 100 year working life

Greater productivity:

- Anchors in dry, damp, wet or flooded holes

Greater security:

- Strong bond
- Rated for sustained loading

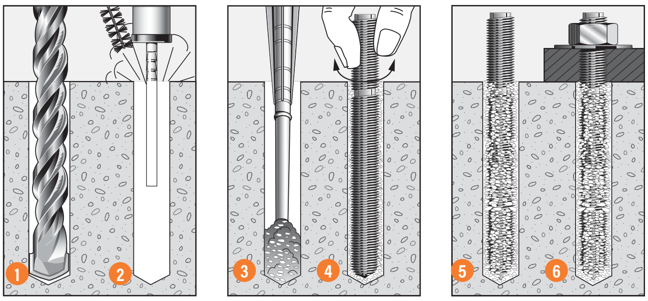
Versatile:

- Anchors in carbide drilled and diamond drilled holes
- Cold and temperate climates

Greater safety:

- Low odour
- VOC Compliant
- Suitable for contact with drinking water

Installation



1. Drill recommended diameter and depth hole.
2. **Important:** For hammer drilling technique clean dust and debris from hole with stiff wire brush and blower in the following sequence: blow x 2, brush x 2, blow x 2, brush x 2, blow x 2.
3. Screw mixing nozzle onto cartridge and dispense adhesive to waste until colour is orange.
   Insert mixing nozzle to bottom of hole.
   Fill hole to 2/3 the hole depth slowly, ensuring no air pockets form.
4. Insert **Ramset**™ ChemSet™ Anchor Stud/rebar to bottom of hole while turning.
5. Allow Chemset™ EPCON™ G5 Xtrem™ to cure as per setting times.
6. Attach fixture.

Installation & Substrate Temperature Range

Minimum	Maximum
5°C	40°C

Service Temperature Limits

T1: -40°C to +40°C
T2: -40°C to +60°C

Setting Times

Temperature of base material	Gel Time	Curing time in dry concrete	Curing time in wet and flooded concrete
5°C	75 min	30h	60 h
10°C	45 min	22h	44 h
15°C	35 min	14h	28 h
20°C	22 min	7h	14 h
25°C	14 min	5h	10 h
30°C	8 min	4h	8 h
35°C	6 min	3h	6h
40°C	4 min	2h 45min	5h 30min

ChemSet™ Reo 502™ Xtrem™

FIRE RATED CHEMICAL ANCHOR - ANCHOR STUDS

Installation and fire performance details: ChemSet™ EPCON™ G5 Xtrem™ and Gr 5.8 ChemSet™ Anchor Studs

Anchor size, d_b (mm)	Installation Details				Optimum dimensions		Characteristic values of resistance to tension loads in 20 MPa to 50 MPa concrete strength - $N_{Rk,p,fi}$ (kN) per anchor *			
	Drilled hole diameter, d_h (mm)	Fixture hole diameter, d_f (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Fire reistance duration = 30 Min.	Fire reistance duration = 60 Min.	Fire reistance duration = 90 Min.	Fire reistance duration = 120 Min.
M10	12	12	90	20	135	270	0.87	0.27	0.01	N/A
M12	14	14	110	30	165	330	2.56	1.01	0.46	0.08
M16	18	18	125	60	187	375	4.25	1.71	0.82	0.23
M20	25	22	150	120	225	450	8.18	3.49	1.93	1.07
			170		255	510	12.92	5.77	3.46	2.25
M24	28	26	160	150	240	480	9.92	4.23	2.29	1.23
			210		315	630	26.77	12.53	7.73	5.44
M30	35	33	280	180	420	840	68.59	35.06	22.79	15.48#

*Note:
Data is valid for Grade 5.8 ChemSet™ Anchor Studs
Data applies to uncracked and cracked reinforced concrete
Data applies to a one-sided fire exposure of the structural elements. For conditions of fire load on several sides, please contact your local Ramset™ engineer
Data is based on concrete cylinder strength between 20 MPa to 50 MPa.
Data is based on a minimum concrete substrate thickness of 2 x h (2 x effective depth).
Data is based on service temperature limit T1: -40°C to +40°C. For performance data on other service temperature limits, please contact your local Ramset™ engineer.

#Note:
M30 data for 120min is based on steel failure of the ChemSet™ Anchor Stud,

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
ChemSet™ EPCON™ G5 Xtrem™	600 ml	CEG5X600

ENGINEERING PROPERTIES

ChemSet™ Anchor Studs

Anchor Size, d_b	Grade 5.8 ChemSet™ Anchor Studs			
	Shank diameter, d_s (mm)	Stressed Area (mm²)	Yield Strength f_y MPa	UTS f_u MPa
M10	8.2	52.8	430	540
M12	10.0	78.5	430	540
M16	14.0	153.9	420	520
M20	17.2	232.4	420	520
M24	20.7	336.5	420	520
M30	-	-	-	-

Legend of Symbols

SPECIFIERS RESOURCE GUIDE

We have developed this set of easily recognisable icons to assist with product selection.

PERFORMANCE RELATED SYMBOLS

Indicates the suitability of product to specific types of performance related situations.

Has good resistance to cyclic and dynamic loading. Resists loosening under vibration.

Anchor has an effective pull-down feature, or is a stud anchor. It has the ability to clamp the fixture to the base material and provide high resistance to cyclic loading.

Suitable for use in seismic design according to ANZ Standards (eg AS/NZ 1170.4) or independent seismic performance data available from either an ICC Evaluation report or European Technical Assesment.

Cracked concrete.

Fire rated in accordance with the applicable standard or independent assessment (i.e. Australian Standards or European Technical Assessment)

May be used close to edges (or another anchor) without risk of splitting the concrete.

Temporary or removable anchor.

MATERIAL SPECIFICATION SYMBOLS

Indicates the base material and surface finish to assist in selection with regard to corrosion or environmental issues.

Zn — Steel Zinc Plated
Minimum thickness 5 micron.
Recommended for internal applications only.

GAL — Steel Hot Dipped Galvanised to AS/NZS4680-2006 and AS/NZS 1214 - 2016.
Minimum thickness 42 micron.
For external applications.

MGAL — Steel Mechanically Galvanised
Minimum thickness 42 micron.
For external applications.

CLS — Climaseal
Minimum thickness 7.5 microns.
For internal applications.

A4 316 — AISI Grade 316 Stainless Steel, resistant to corrosive agents including chlorides and industrial pollutants. Recommended for internal or external applications in marine or corrosive environments.

HCR — Stainless Steel High Corrosion resistance.
HCR Grade 1.4529/1.4565.

NYLON — Corrosion resistant.
Not recommended for direct exposure to sunlight.

INSTALLATION RELATED SYMBOLS

Indicates the suitable positioning and other installation related requirements.

Suitable for floor applications.

Suitable for wall applications.

Suitable for overhead applications.

Suitable for hollow brick/block and hollow core concrete applications.

Anchor can be through fixed into substrate using fixture as template.

Suitable for AAC and lightweight concrete applications.

Anchors suitable for use in dry holes.

Anchors suitable for use in damp holes.

Anchors suitable for use in holes filled with water.

Suitable for use in drilled holes.

Suitable for use in cored holes.

Suitable for contact with drinking water for human consumption.

Notes

DESIGN PROCESS

Customer service

Ramset™ Australia

Sales, Orders and Enquiries

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Email: enquiry@ramset.com.au

Web: www.ramset.com.au

Ramset™ New Zealand

Sales, Orders and Enquiries

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ITW Australia Pty Ltd ABN 63 004 235 063 trading as Ramset™

Ramset™

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