Introduction

CHEMICAL ANCHORING - ANCHOR STUDS

The key advantage of ChemSet™ chemical anchors is that they do not impact an expansion stress on the surrounding substrate. This makes chemical anchoring ideal for close to edge fixings or for close anchor spacings.

The superior bond of ChemSet™ chemical anchors makes them ideal for installing starter bars, because the required pull out strength is achieved in shallower holes than is possible with cementitious mortars.

The ability of ChemSet™ chemical anchors to sustain cyclic tensile loads depends on adhesive bond, not on preload or tightening torque.

The adhesive bond does not deteriorate or change over time making Chemset™ chemical anchors ideal for cyclic and vibrating load cases.

The superior strength of grade 5.8 carbon steel threaded stud anchors gives the ChemSet™ chemical anchor systems greater steel capacity than regular grade 4.6 threaded rod.

The **Ramset**™ ChemSet™ range of chemical anchoring systems provide different options of cost and performance for the designer and for the applicator.

For the designer, selection of the correct chemical anchoring solution to his or her design problem will often be based upon the strength capacity of the system, but may also involve issues such as chemical resistance.

The following section introduces the designer and/or engineer to the components of the ChemSet™ chemical anchoring range and provides information to allow selection of the anchor with the right capacity for various environmental conditions.

Estimating Chart

Fixings per cartridge for ChemSet™ Injection:

Anchor size	Nominal hole diameter (mm)	Nominal hole depth mm	Number of fixings						
			Epcon™ C8	Reo 502™ Plus	Epcon™ C6 Plus	ChemSet™ 801		ChemSet™ 101	
			450ml	600ml	600ml	Cartridge	Jumbo	Cartridge	Jumbo
M10	12	90	76	103	103	62	132	66	133
M12	14	110	49	67	67	41	86	43	87
M16	18	125	31	43	43	26	54	27	55
M20	24	150	12	17	17	10	22	11	22
M24	26	160	13	18	18	11	24	12	24

ChemSet™ Anchor Studs

CHEMICAL ANCHORING - ANCHOR STUDS

General Information

Product

Steel threaded studs for use with all ChemSet™ anchoring products, capsules and injection adhesives.

Benefits, Advantages and Features

Ensures maximum performance from ChemSet™ chemical anchors:
Zinc plated and Hot Dip Gal Chemset™ Anchor studs made from high performance Grade 5.8 Steel.

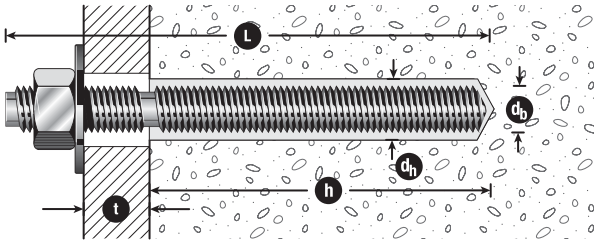
Superior corrosion resistance:
Stainless Steel Chemset™ Anchor studs made from AISI 316(A4) Stainless Steel

Outstanding exterior resistance:
- 42 micron Hot Dip Galvanised.

Convenient:
- Supplied with nuts and washers and setting tool for spin capsules.
- Depth setting mark to ensure correct embedment.

Material Specification

Zn GAL A4 316 HCR



Description and Part Numbers

ChemSet™ Anchor Studs

Thread Size	Description	Zn ZINC	GAL Galvanised	A4 316 Stainless Steel 316	Box Quantity
M10	ChemSet™ Anchor Stud M10 x 130	CS10130	CS10130GH	CS10130SS	10
M12	ChemSet™ Anchor Stud M12 x 160	CS12160	CS12160GH	CS12160SS	10
M12	ChemSet™ Anchor Stud M12 x 180	CS12180			10
M16	ChemSet™ Anchor Stud M16 x 190	CS16190	CS16190GH	CS16190SS	10
M20	ChemSet™ Anchor Stud M20 x 260	CS20260	CS20260GH	CS20260SS	6
M24	ChemSet™ Anchor Stud M24 x 300	CS24300	CS24300GH	CS24300SS	6

Other sizes and steel types available on request. (Maybe subject to lead time)

Engineering Properties

ChemSet™ Anchor Studs - Typical Properties

See working loads of each anchoring adhesive in previous pages				Carbon Steel		Stainless Steel		
Thread Size	Overall Length, L (mm)	Effective Length, L_e (mm)	Max Fixture Thickness, t (mm)	Yield Strength, f_y (MPa)	Carbon Steel UTS, f_u (MPa)	Yield Strength, f_y (MPa)	Stainless Steel UTS, f_u (MPa)	Section Modulus, Z (mm^3)
M10	130	115	25	430	540	450	650	62.3
M12	160	140	30	430	540	450	650	109.2
M12	180	160	50	430	540	450	650	109.2
M16	190	165	40	420	520	450	650	277.5
M20	260	225	80	420	520	450	650	540.9
M24	300	265	105	420	520	450	650	935.5

ChemSet™ Reo 502™ PLUS

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

AVAILABLE IN AUSTRALIA ONLY

(New Zealand refer to EPCON™ C6 PLUS range)

GENERAL INFORMATION

Performance Related	Material Specification	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

European Technical Assessment (option 1) - ETA-18/0675

Design according to:

- AS5216 (formerly TS101)
- EN1992-4 (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
- Easy dispensing even in cold weather

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

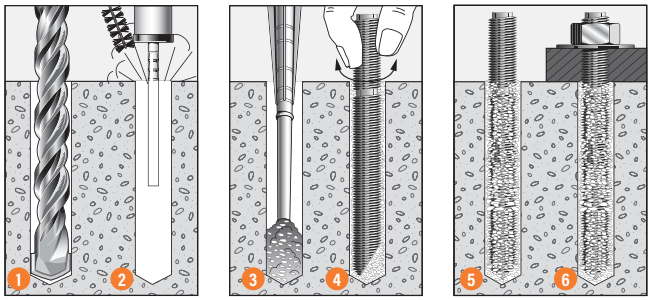
Principal Applications

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

Recommended Installation Temperatures

	Minimum	Maximum
Substrate	5°C	40°C
Adhesive	10°C	40°C

Installation



1. Drill recommended diameter and depth hole.
2. **Important:** Use **Ramset™** Dustless Drilling System to ensure holes are clean. Alternativly 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, brush x 2, blow x 2.
3. Screw mixing nozzle onto cartridge and 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™ Reo 502™ PLUS to cure as per setting times.
6. Attach fixture.

Service Temperature Limits

-40°C to 70°C

Setting Times

Temperature of base material	Cartridge Temperature	Gel Time	Curing time in dry and wet concrete
5°C	Minimum 10°C	300 min	24 h
10°C	10°C	150 min	18 h
15°C	15°C	40 min	12 h
20°C	20°C	25 min	8 h
25°C	25°C	18 min	6 h
30°C	30°C	12 min	4 h
40°C	40°C	6 min	2 h
Note: Cartridge temperature minimum +10°C			

Note

*Performance of cored & oversized holes was not included in the ETAG test program and therefore is based on testing conducted at Ramset™ Product Engineering Laboratory.

ChemSet™ Reo 502™ PLUS

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

AVAILABLE IN AUSTRALIA ONLY

Installation and performance details: ChemSet™ Reo 502™ PLUS 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	40	165	330	140
M16	18	18	125	80	187.5	375	160
M20	22	22	150	120	225	450	190
			170		255	510	220
M24	26	26	160	160	240	480	200
			210		315	630	270
M30	35	33	280	200	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)**		
	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	Concrete Compressive Strength, f'_c		
							20 MPa	32 MPa	40 MPa
M10	11.8	18.9	17.5	28.2	14.2	19.8	28.0	29.4	30.3
M12	17.5	28.1	26.0	41.9	21.1	29.5	37.8	43.1	44.4
M16	33.1	53.9	50.9	82.1	41.4	57.7	45.8	52.3	53.8
M20	49.9	81.3	76.8	123.9	62.4	87.1	60.2	76.2	80.7
							72.6	88.9	91.4
M24	72.3	117.8	111.3	179.5	90.4	126.2	66.3	84.0	94.0
							99.7	126.2	135.5
M30	-	-	185.5	299.2	-	-	153.5	173.8	178.8

**Note: Reduced characteristic ultimate concrete tensile capacity = ϕN_{uc} where ϕ = 0.67 and N_{uc} = Characteristic ultimate concrete tensile capacity.
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 +70°C
All data relevant for Dry, Wet and Flooded Holes.
For optimised performance data, please use Ramset iExpert Anchoring Software.

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
ChemSet Reo 502 PLUS	600ml	REO502P600

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 (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 on page 141.

ChemSet™ Reo 502™ PLUS

STRENGTH LIMIT STATE DESIGN

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STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

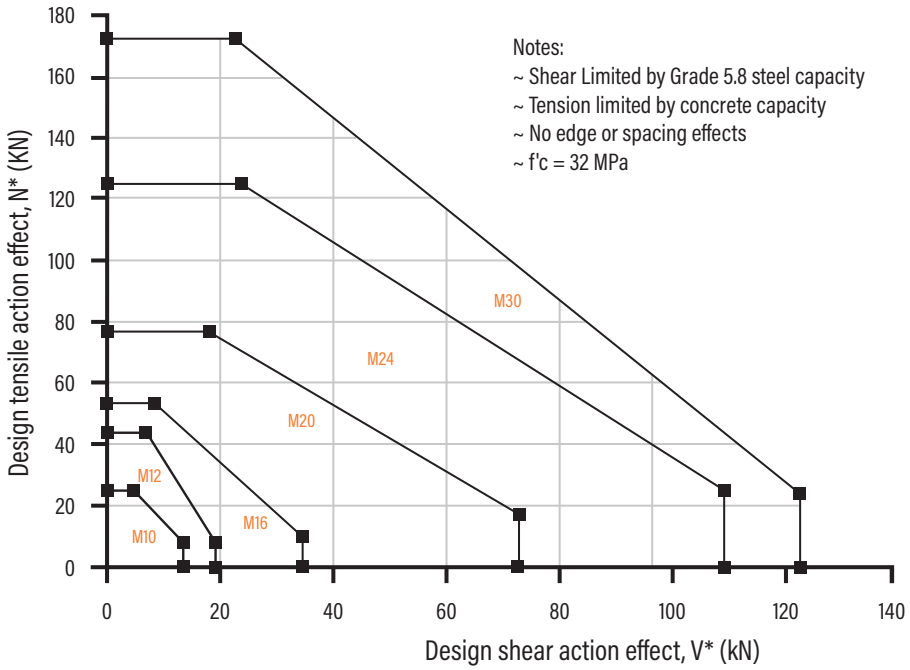

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b M10	M10	M12	M16	M20	M24	M30
Min. Anchor Spacing - a_m	40	40	40	50	50	60
Min. Edge Distance - e_m	40	40	40	50	50	60

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

Refer to "Description and Part Numbers" table for ChemSet® Anchor Studs page in the SARB ANZ on page 141.

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.

ChemSet™ Reo 502™ PLUS

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), $\phi_c = 1/1.5 = 0.67$, $f'_c = 32$ 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	22	26	35	
Effective Depth, h (mm)							
70	22.9						24.3
80	26.1						29.7
90	**29.4**	35.3					35.4
100	32.7	39.2					41.5
110	35.9	**43.1**	46.0				47.9
120	39.2	47.0	50.2				54.5
125	40.8	49.0	**52.3**				58.0
140	45.7	54.9	58.5				68.7
150	49.0	58.8	62.7	78.4			76.2
160	52.3	62.7	66.9	83.6	100.4		84.0
170	55.5	66.7	71.1	**88.9**	106.6		91.9
180	58.8	70.6	75.3	94.1	112.9		100.2
190	62.1	74.5	79.5	99.3	119.2		108.6
200	65.3	78.4	83.6	104.6	125.5		117.3
210		82.3	87.8	109.8	**131.7**	130.4	126.2
240		94.1	100.4	125.5	150.6	149.0	154.2
280			117.1	146.4	175.6	**173.8**	194.4
320			133.8	167.3	200.7	198.6	237.5
350				183.0	219.6	217.3	271.6
400				209.1	250.9	248.3	331.9
450					282.3	279.4	396.0
480					301.1	298.0	436.3
550						341.4	535.1
600						372.5	609.7

For optimised performance data, 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	0.67	0.67	0.79	0.75	0.75	0.63	0.70

Bold values are at Chemset Anchor Stud nominal Depths

For Sustained Loads MULTIPLY ϕN_{uc} x 0.6 (100 years) or ϕN_{uc} x 0.72 (50 years)

All data relevant for Dry, Wet and Flooded Holes

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)							
-40˚C to +70˚C	1.00						1.00

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

	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	0.96	0.96	0.96	0.96	0.96	0.96	0.79
25	0.98	0.98	0.98	0.98	0.98	0.98	0.88
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.03	1.03	1.03	1.03	1.03	1.03	1.12
50	1.05	1.05	1.05	1.05	1.05	1.05	1.25

ChemSet™ Reo 502™ PLUS

STRENGTH LIMIT STATE DESIGN

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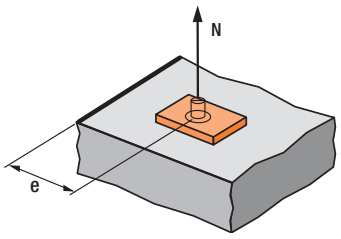
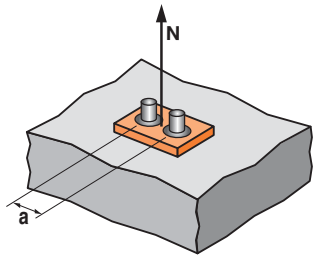


$X_{ne} = 0.25 + 0.5*(e/h)$
Where $e_m \le e \le e_c$
$e_c = 1.5*h$
Note: Tabled values are based on the nominal effective depth, h shown in the installation details. For other values of X_{ne}, please use equation shown above.

Table 2c - 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	0.41			
45	0.50	0.45	0.43			
50	0.53	0.48	0.45	0.40	0.36	
55	0.56	0.50	0.47	0.41	0.38	
65	0.61	0.55	0.51	0.44	0.40	0.37
70	0.64	0.57	0.53	0.46	0.42	0.38
80	0.69	0.61	0.57	0.49	0.44	0.39
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	0.56	0.55			
45	0.58	0.57	0.56			
50	0.59	0.58	0.57	0.55	0.53	
55	0.60	0.58	0.57	0.55	0.54	
65	0.62	0.60	0.59	0.56	0.55	0.54
85	0.66	0.63	0.61	0.58	0.57	0.55
100	0.69	0.65	0.63	0.60	0.58	0.56
125	0.73	0.69	0.67	0.62	0.60	0.57
150	0.78	0.73	0.70	0.65	0.62	0.59
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 ϕN_{ucp} *X_{ncr} *X_{ns} *X_{nc} *X_{ne} *X_{na} and ϕN_{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 StudA4/316 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™ PLUS

STRENGTH LIMIT STATE DESIGN

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STEP 4

Step 4 - Verify concrete shear capacity - per anchor

Table 4a 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	5.4			
50				8.2	8.8	
60						12.7

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					

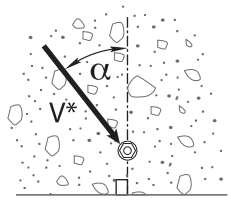
For Non-cracked concrete X_{vcr} = 1.0

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

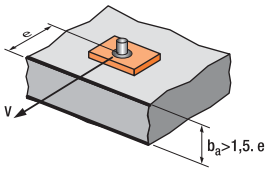


Load direction effect, conc. edge shear, X_{vd}

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

For single anchor fastening X_{ve}

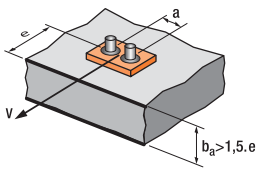
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

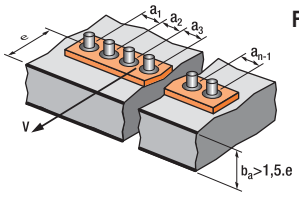
For 2 anchors fastening X_{ve}

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



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

For 3 anchors fastening and more



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

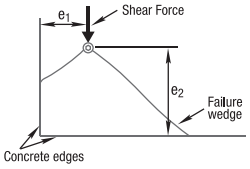
ChemSet™ Reo 502™ PLUS

STRENGTH LIMIT STATE DESIGN

AVAILABLE IN AUSTRALIA ONLY

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 +70˚C	58.8	86.3	104.6	177.7	263.5	335.2



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 $V^*/\phi Vur \leq 1.0$,

if not satisfied return to step 1

ChemSet™ Reo 502™ PLUS

STRENGTH LIMIT STATE DESIGN

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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™ PLUS 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™ PLUS 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.

EPCON™ C8 Xtrem™

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

GENERAL INFORMATION

Performance Related	Material Specification	Installation Related

Product

EPCON™ C8 Xtrem™ is a High Performance Pure Epoxy Anchoring adhesive for use in Cracked and Non-Cracked concrete. For structures subject to external exposure, permanently damp or aggressive conditions.

Compliance

European Technical Assessment (option 1) - ETA-10/0309

Design according to:

- AS5216 (formerly TS101)
- EN1992-4 (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

- 50 year working life

Greater productivity:

- Anchors in dry, damp, wet or flooded holes
- No weather delays
- Fast, easy dispensing with high flow mixer

Greater security:

- Highest performance in cracked concrete
- Rated for sustained loading

Versatile

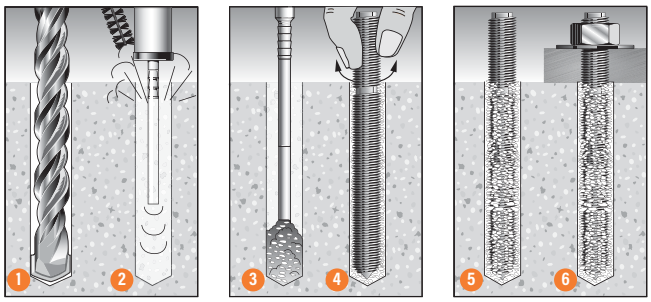
- Anchors all stud & bar diameters in all directions
- Oversized holes*
- Anchors in carbide drilled and diamond cored holes*
- For tropical and Cold weather conditions

Greater safety:

- Low odour

Fire Rated : Refer Fire rated anchoring section

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, brush x2, blow x2.
3. Screw mixing nozzle onto cartridge and 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 EPCON™ C8 Xtrem™ to cure as per setting times.
6. Attach fixture.

Principal Applications

- Anchoring into cracked & non cracked concrete
- Road barrier hold down bolts
- Bridge refurbishment
- Road & Rail tunnel construction
- Reinforcing bar from 10 to 32mm
- Starter Bars
- Threaded Studs from M8 to M30
- Threaded Stud material: Zn, A4 316, HCR steels
- Threaded Stud material: 5.8, 8.8, 10.9 grade

Recommended Installation Temperatures

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

Load should not be applied to anchor until the chemical has sufficiently cured as specified.

Service Temperature Limits

-40°C to 80°C

Setting Times EPCON™ C8 Xtrem™

Temperature of base material	Gel Time	Curing time in dry concrete	Curing time in wet concrete
5°C - 9°C	20 min	30 h	60 h
10°C - 19°C	14 min	23 h	46 h
20°C - 24°C	11 min	16 h	32 h
25°C - 29°C	8 min	12 h	24 h
30°C - 39°C	5 min	8 h	16 h
40°C	5 min	6 h	12 h

Note

*Performance of cored & oversized holes was not included in the ETAG test program and therefore is based on testing conducted at Ramset™ Product Engineering Laboratory.

EPCON™ C8 Xtrem™

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

Installation and performance details: EPCON™ C8 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	200	240	480	200
			210		315	630	270
M30	35	33	280	400	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	25.1	26.6	28.1
M12	17.5	28.1	26.0	41.9	21.1	29.5	36.9	39.4	41.7
M16	33.1	53.9	50.9	82.1	41.4	57.7	38.2	48.3	53.6
M20	49.9	81.3	76.8	123.9	62.4	87.1	50.2	63.5	70.5
							60.5	76.6	85.1
M24	72.3	117.8	111.3	179.5	90.4	126.2	55.3	70.0	77.7
							83.1	105.2	116.8
M30	-	-	185.5	299.2	-	-	128.0	162.0	179.8

**Note: Reduced characteristic ultimate concrete tensile capacity = ϕN_{uc} where ϕ = 0.56 and N_{uc} = Characteristic ultimate concrete tensile capacity.
For conversion to Working Load Limit MULTIPLY ϕN_{uc} x 0.6
***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
FLOODED HOLES: Multiply ϕN_{uc} x 0.69.
For optimised performance data, please use Ramset iExpert Anchoring Software.

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
EPCON™ C8 Xtrem™	450ml	C8-450

Drilled hole depth, h_1 (mm)
h_1 = h
h = Effective depth

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 (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 on page 141.

EPCON™ C8 Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Table 1a - Indicative combined loading - interaction diagram

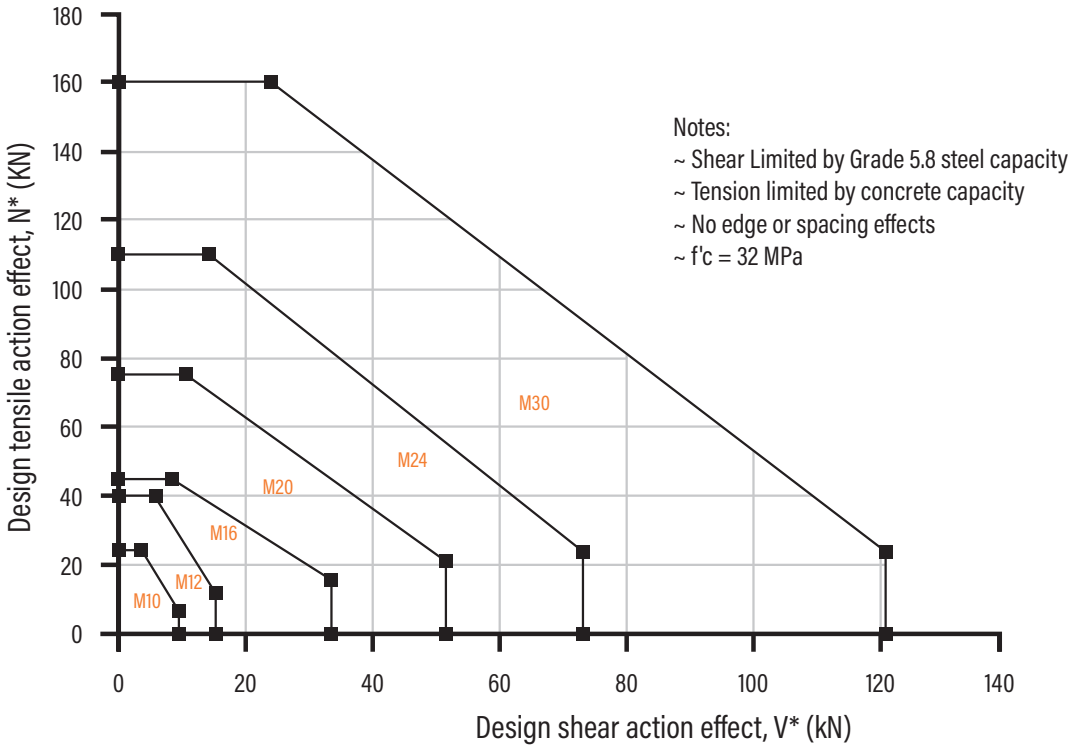


Table 1b - Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm) for cracked concrete

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Min. Anchor spacing - a_m	50	60	80	100	120	150
Min. Edge Distance - e_m	50	60	80	100	120	150

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

Refer to "Description and Part Numbers" table for ChemSet® Anchor Studs in the SARB ANZ on page 141.

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.

EPCON™ C8 Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, ϕN_{uc} (kN), $\phi_c = 1/1.8 = 0.56$, $f'_c = 32$ 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	20.7						20.2
80	23.7						24.7
90	**26.6**	32.3					29.5
100	29.6	35.9					34.6
110	32.6	**39.4**	50.2				39.9
120	35.5	43.0	54.8				45.4
125	37.0	44.8	**57.1**				48.3
140	41.4	50.2	63.9				57.3
150	44.4	53.8	68.5	81.4			63.5
160	47.4	57.4	73.1	86.8	98.5		70.0
170	50.3	61.0	77.6	**92.2**	104.6		76.6
180	53.3	64.5	82.2	97.6	110.8		83.5
190	56.2	68.1	86.7	103.1	116.9		90.5
200	59.2	71.7	91.3	108.5	123.1		97.8
210		75.3	95.9	113.9	**129.2**	165.8	105.2
240		86.1	109.6	130.2	147.7	189.5	128.5
280			127.8	151.9	172.3	**221.1**	162.0
320			146.1	173.6	196.9	252.7	197.9
350				189.9	215.4	276.4	226.4
400				217.0	246.1	315.8	276.6
450					276.9	355.3	330.0
480					295.4	379.0	363.5
550						434.3	445.9
600						473.8	508.1

For optimised performance data, 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	0.59	0.55	0.52	0.56	0.60	0.53	**0.70**

Bold values are at Chemset Anchor Stud nominal Depths

For Sustained Loads MULTIPLY ϕN_{uc} x 0.6 FLOODED HOLES: Multiply ϕN_{uc} x 0.69 For Non-cracked concrete $X_{ncr} = 1$

If Service temperature limit is -40°C to +40°C then Refer to Checkpoint 2	If Service temperature limit is -40°C to +80°C then $\phi N_{uc} = \phi N_{ucp}$

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

	Service temperature limits effect, tension, X_{ns} where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)						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)							
-40˚C to +40˚C	1.00	1.00	1.00	1.00	1.00	1.00	1.00
-40˚C to +80˚C	0.56	0.55	0.52	0.52	0.52	0.53	1.00

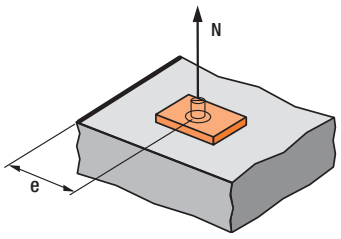
Table 2b-2 Concrete compressive strength effect, tension, X_{nc}

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	0.94	0.93	0.92	0.90	0.88	0.86	0.79
25	0.97	0.96	0.95	0.95	0.94	0.92	0.86
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.06	1.06	1.07	1.09	1.11	1.13	1.11
50	1.08	1.09	1.12	1.14	1.17	1.22	1.22

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	0.94	0.93	0.92	0.91	0.79
25	0.97	0.97	0.97	0.96	0.95	0.95	0.86
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.03	1.04	1.05	1.07	1.06	1.08	1.11
50	1.05	1.07	1.08	1.09	1.10	1.14	1.22

EPCON™ C8 Xtrem™

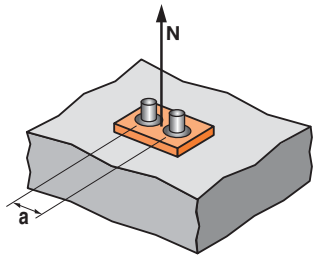
STRENGTH LIMIT STATE DESIGN



$X_{ne} = 0.25 + 0.5*(e/h)$
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)						
50	0.53					
60	0.58	0.52				
80	0.69	0.61	0.57			
90	0.75	0.66	0.61			
100	0.81	0.70	0.65	0.54		
120	0.92	0.80	0.73	0.60	0.54	
135	1.00	0.86	0.79	0.65	0.57	
150		0.93	0.85	0.69	0.61	0.52
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 - Concrete anchor spacing effect, tension, X_{na}

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Anchor spacing, a (mm)						
50	0.59					
60	0.61	0.59				
80	0.65	0.62	0.61			
100	0.69	0.65	0.63	0.60		
120	0.72	0.68	0.66	0.62	0.60	
150	0.78	0.73	0.70	0.65	0.62	0.59
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 2

Design reduced ultimate concrete tensile capacity, ϕN_{urc}
$\phi N_{urc} = \phi N_{uc} * X_{ncr} * X_{ns} * X_{nc} * X_{ne} * X_{na}$
If Service temperature limit is -40°C to +40°C then
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

EPCON™ C8 Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 4

Step 4 - Verify concrete shear capacity - per anchor

Table 4a Reduced characteristic ultimate concrete edge shear capacity, $\phi V_{uc\,(kN)}$, 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						
50	5.7					
60		7.9				
80			12.6			
100				18.8		
120					24.8	
150						36.6

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					

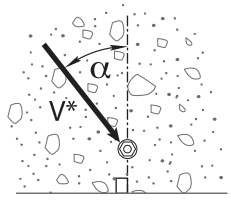
For Non-cracked concrete X_{vcr} = 1.0

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

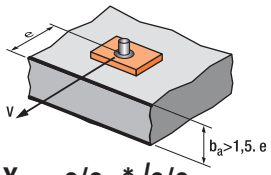
f'_c (MPa)	20	25	32	40	50
X_{vc}	0.79	0.86	1.0	1.11	1.22

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



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

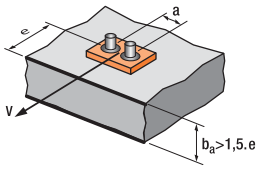


$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

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

For single anchor fastening X_{ve}

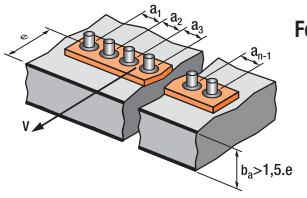
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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

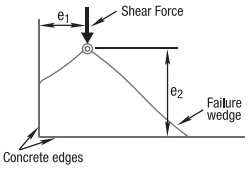
$$X_{ve} = \frac{3*e + a_1 + a_2 + a_3 + \ldots + a_{n-1}}{3*n*e_m} * \sqrt{e/e_m}$$

EPCON™ C8 Xtrem™

STRENGTH LIMIT STATE DESIGN

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	60.3	88.5	125.7	199.4	274.4	457.4
-40˚C to +80˚C	33.9	49.8	71.2	113.9	158.3	246.3



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)	50	60	75	125	200	300	400	600	900
Edge distance, e_1 (mm)									
50	0.86	0.77	0.67	0.52	0.44	0.39	0.37	0.35	0.33
60	0.97	0.86	0.75	0.57	0.47	0.41	0.38	0.36	0.34
75	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	0.86	0.65	0.53	0.48	0.42	0.38
200	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	0.86	0.72	0.58	0.49
400	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	0.77	0.61
600	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	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 concrete 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 Stud A4/316 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 $V^*/\phi V_{ur} \leq 1$,
if not satisfied return to step 1

EPCON™ C8 Xtrem™

STRENGTH LIMIT STATE DESIGN

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™ EPCON™ C8 Xtrem™ with (Anchor Size) grade 5.8 ChemSet™ Anchor Stud (Anchor Stud Part Number) Drilled Hole Depth to be (h) mm.

Example
Ramset™ EPCON™ C8 Xtrem™ 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.

EPCON™ C6 PLUS

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

AVAILABLE IN NEW ZEALAND ONLY

(Australia refer to ChemSet™ Reo502™ PLUS range)

GENERAL INFORMATION

Performance Related	Material Specification	Installation Related

Product

EPCON™ C6 PLUS 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-18/0675

Design according to:

- EN1992-4 (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
- Easy dispensing even in cold weather

Greater security:

- Strong bond
- Rated for sustained loading

Versatile:

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

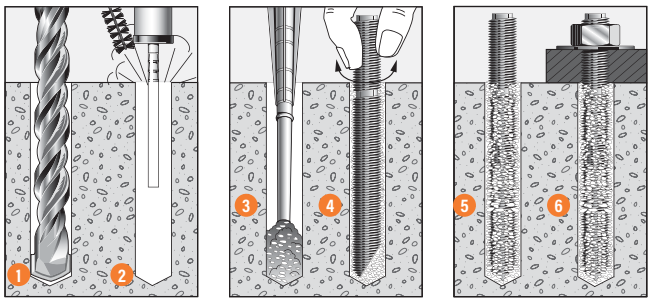
Greater safety:

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

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. Alternativly 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, brush x 2, blow x 2.
3. Screw mixing nozzle onto cartridge and 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 EPCON™ C6 PLUS to cure as per setting times.
6. Attach fixture.

Recommended Installation Temperatures

	Minimum	Maximum
Substrate	5°C	40°C
Adhesive	10°C	40°C

Service Temperature Limits

-40°C to 70°C

Setting Times

Temperature of base material	Cartridge Temperature	Gel Time	Curing time in dry and wet concrete
5°C	Minimum 10°C	300 min	24 h
10°C	10°C	150 min	18 h
15°C	15°C	40 min	12 h
20°C	20°C	25 min	8 h
25°C	25°C	18 min	6 h
30°C	30°C	12 min	4 h
40°C	40°C	6 min	2 h
Note: Cartridge temperature minimum +10°C			

Note

*Performance of cored & oversized holes was not included in the ETAG test program and therefore is based on testing conducted at Ramset™ Product Engineering Laboratory.

EPCON™ C6 PLUS

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

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Installation and performance details: EPCON™ C6 PLUS 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	40	165	330	140
M16	18	18	125	80	187.5	375	160
M20	22	22	150	120	225	450	190
			170		255	510	220
M24	26	26	160	160	240	480	200
			210		315	630	270
M30	35	33	280	200	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		
	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	Tension, ϕN_{uc} (kN)**		
							Concrete Compressive Strength, f'_c		
							20 MPa	32 MPa	40 MPa
M10	11.8	18.9	17.5	28.2	14.2	19.8	28.0	29.4	30.3
M12	17.5	28.1	26.0	41.9	21.1	29.5	37.8	43.1	44.4
M16	33.1	53.9	50.9	82.1	41.4	57.7	45.8	52.3	53.8
M20	49.9	81.3	76.8	123.9	62.4	87.1	60.2	76.2	80.7
							72.6	88.9	91.4
M24	72.3	117.8	111.3	179.5	90.4	126.2	66.3	84.0	94.0
							99.7	126.2	135.5
M30	-	-	185.5	299.2	-	-	153.5	173.8	178.8

**Note: Reduced characteristic ultimate concrete tensile capacity = ϕN_{uc} where ϕ = 0.67 and N_{uc} = Characteristic ultimate concrete tensile capacity.
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 +70°C
All data relevant for Dry, Wet and Flooded Holes
For optimised performance data, please use Ramset iExpert Anchoring Software.

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
EPCON C6 PLUS	600ml	EC6P600

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 (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 on page 141.

EPCON™ C6 PLUS

STRENGTH LIMIT STATE DESIGN

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STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

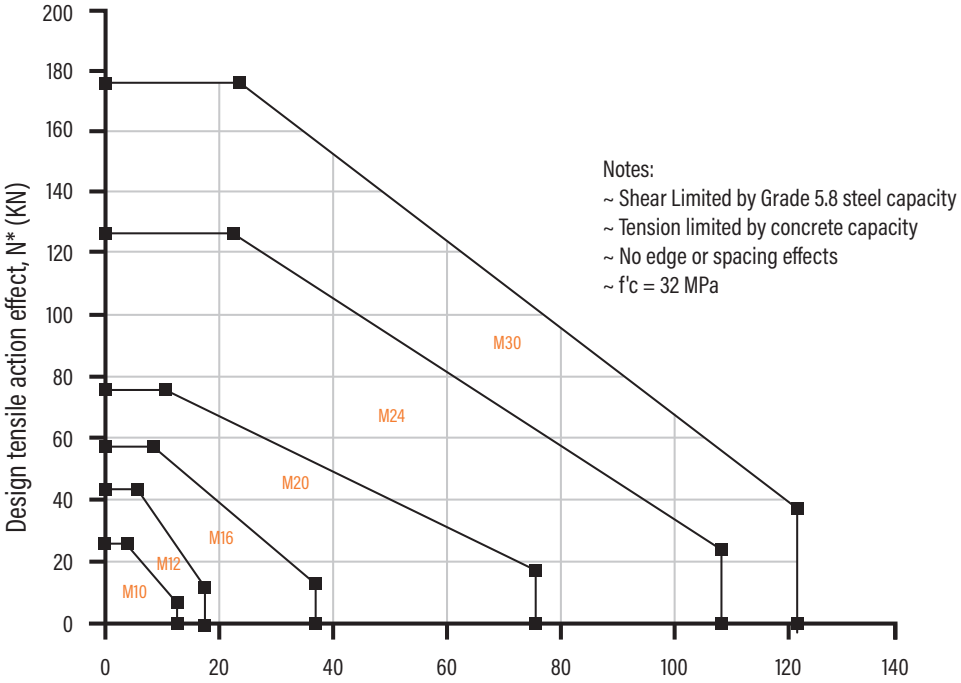

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b M10	M10	M12	M16	M20	M24	M30
Min. Anchor Spacing - a_m	40	40	40	50	50	60
Min. Edge Distance - e_m	40	40	40	50	50	60

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

Refer to "Description and Part Numbers" table for ChemSet® Anchor Studs page in the SARB ANZ on page 141.

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.

EPCON™ C6 PLUS

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	22	26	35	
Effective Depth, h (mm)							
70	22.9						24.3
80	26.1						29.7
90	**29.4**	35.3					35.4
100	32.7	39.2					41.5
110	35.9	**43.1**	46.0				47.9
120	39.2	47.0	50.2				54.5
125	40.8	49.0	**52.3**				58.0
140	45.7	54.9	58.5				68.7
150	49.0	58.8	62.7	78.4			76.2
160	52.3	62.7	66.9	83.6	100.4		84.0
170	55.5	66.7	71.1	**88.9**	106.6		91.9
180	58.8	70.6	75.3	94.1	112.9		100.2
190	62.1	74.5	79.5	99.3	119.2		108.6
200	65.3	78.4	83.6	104.6	125.5		117.3
210		82.3	87.8	109.8	**131.7**	130.4	126.2
240		94.1	100.4	125.5	150.6	149.0	154.2
280			117.1	146.4	175.6	**173.8**	194.4
320			133.8	167.3	200.7	198.6	237.5
350				183.0	219.6	217.3	271.6
400				209.1	250.9	248.3	331.9
450					282.3	279.4	396.0
480					301.1	298.0	436.3
550						341.4	535.1
600						372.5	609.7

For optimised performance data, 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	0.67	0.67	0.79	0.75	0.75	0.63	0.70

Bold values are at Chemset Anchor Stud nominal Depths

For Sustained Loads MULTIPLY ϕN_{uc} x 0.6 (100 years) or ϕN_{uc} x 0.72 (50 years)

All data relevant for Dry, Wet and Flooded Holes.

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)							
-40˚C to +70˚C	1.00						1.00

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

	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	0.96	0.96	0.96	0.96	0.96	0.96	0.79
25	0.98	0.98	0.98	0.98	0.98	0.98	0.88
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.03	1.03	1.03	1.03	1.03	1.03	1.12
50	1.05	1.05	1.05	1.05	1.05	1.05	1.25

EPCON™ C6 PLUS

STRENGTH LIMIT STATE DESIGN

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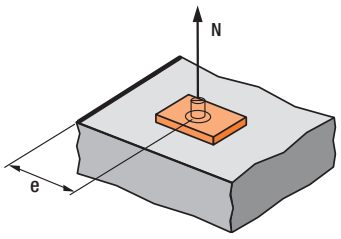
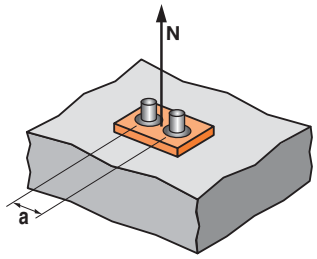


$X_{ne} = 0.25 + 0.5*(e/h)$
Where $e_m \leq e \leq e_c$
$e_c = 1.5*h$
Note: Tabled values are based on the nominal effective depth, h shown in the installation details. For other values of X_{ne}, please use equation shown above.

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	0.41			
45	0.50	0.45	0.43			
50	0.53	0.48	0.45	0.40	0.36	
55	0.56	0.50	0.47	0.41	0.38	
65	0.61	0.55	0.51	0.44	0.40	0.37
70	0.64	0.57	0.53	0.46	0.42	0.38
80	0.69	0.61	0.57	0.49	0.44	0.39
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 $a_m \leq a \leq a_c$
$a_c = 3*h$
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	0.56	0.55			
45	0.58	0.57	0.56			
50	0.59	0.58	0.57	0.55	0.53	
55	0.60	0.58	0.57	0.55	0.54	
65	0.62	0.60	0.59	0.56	0.55	0.54
85	0.66	0.63	0.61	0.58	0.57	0.55
100	0.69	0.65	0.63	0.60	0.58	0.56
125	0.73	0.69	0.67	0.62	0.60	0.57
150	0.78	0.73	0.70	0.65	0.62	0.59
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 ϕN_{ucp} *X_{ncr} *X_{ns} *X_{nc} *X_{ne} *X_{na} and ϕN_{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 $N^*/\phi N_{ur} \leq 1.0$,
if not satisfied return to step 1

EPCON™ C6 PLUS

STRENGTH LIMIT STATE DESIGN

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STEP 4

Step 4 - Verify concrete shear capacity - per anchor

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

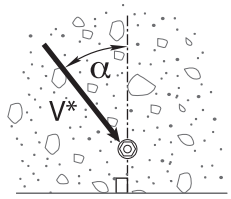
Anchor size, d_b	M10	M12	M16	M20	M24	M30
Effective depth, h (mm)	70 - 200	90 - 240	110 - 320	150 - 400	160 - 480	210 - 600
Edge distance, e_m						
40	4.3	4.7	5.4			
50				8.2	8.8	
60						12.7

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



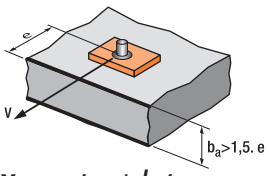
Load direction effect, conc. edge shear, X_{vd}

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

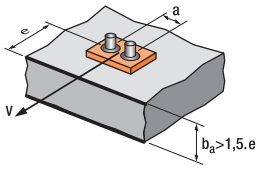


$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

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

For single anchor fastening X_{ve}

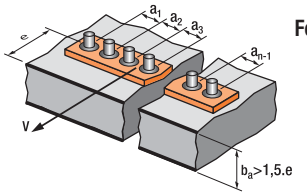
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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

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

EPCON™ C6 PLUS

STRENGTH LIMIT STATE DESIGN

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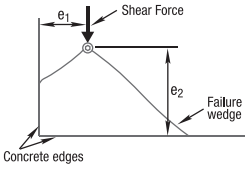
Table 4e Reduced characteristic ultimate concrete pryout capacity, ϕV_{ucp} (kN), ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Effective depth, h (mm)	90	110	125	170	210	280
-40˚C to +70˚C	58.8	86.3	104.6	177.7	263.5	335.2



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 Stud A4/316 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 $V^*/\phi Vur \leq 1.0$,

if not satisfied return to step 1

EPCON™ C6 PLUS

STRENGTH LIMIT STATE DESIGN

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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™ EPCON™ C6 PLUS with (Anchor Size) grade 5.8 Chemset™ Anchor Stud (Anchor Stud Part Number) Drilled Hole Depth to be (h) mm.

Example
Ramset™ EPCON™ C6 PLUS 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™ 801 Xtrem™ XC²

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

GENERAL INFORMATION

Performance Related	Material Specification	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

European Technical Assessment (option 1) - ETA-18/0045
Design according to:

- AS5216 (formerly TS101)
- EN1992-4 (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

- 50 year working Life
- Flooded Holes
- Fire rated

Greater productivity:

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

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

Principal Applications

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

Recommended Installation Temperatures

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

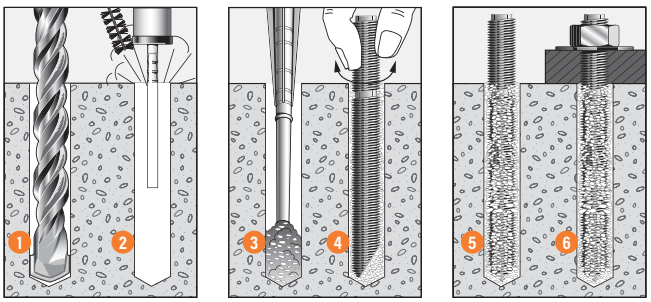
Service Temperature Limits

-40°C to 80°C

Setting Times

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			

Installation



1. Drill recommended diameter and depth hole.
2. **Important:** Use **Ramset™** Dustless Drilling System to ensure holes are clean. Alternativly 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.
6. Attach fixture.

ChemSet™ 801 Xtrem™ XC²

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

Installation and performance details: ChemSet™ 801 Xtrem™ XC² 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	375	160
M20	25	22	150	120	225	450	190
			170		255	510	220
M24	28	26	160	200	240	480	200
			210		315	630	270
M30	35	33	280	400	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	29.4	30.3
M12	17.5	28.1	26.0	41.9	21.1	29.5	37.8	43.1	44.4
M16	33.1	53.9	50.9	82.1	41.4	57.7	45.8	56.6	58.3
M20	49.9	81.3	76.8	123.9	62.4	87.1	60.2	76.2	85.0
							72.6	87.7	96.3
M24	72.3	117.8	111.3	179.5	90.4	126.2	66.3	84.0	94.0
							93.4	118.2	129.8
M30	-	-	185.5	299.2	-	-	149.5	175.0	197.4

**Note: Reduced characteristic ultimate concrete tensile capacity = ϕN_{uc} where ϕ = 0.67 and N_{uc} = Characteristic ultimate concrete tensile capacity.
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 +70°C
Flooded Holes: Multiply ϕN_{uc} x 0.75, Max Embedment is limlited to 12d for flooded holes.
For optimised performance data, please use Ramset iExpert Anchoring Software.

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
ChemSet™ 801 Xtrem™ XC²	750ml	C801X750 (AU & NZ)
ChemSet™ 801 Xtrem™ XC²	380ml	C801X380 (AU Only)

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 (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 on page 143

ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

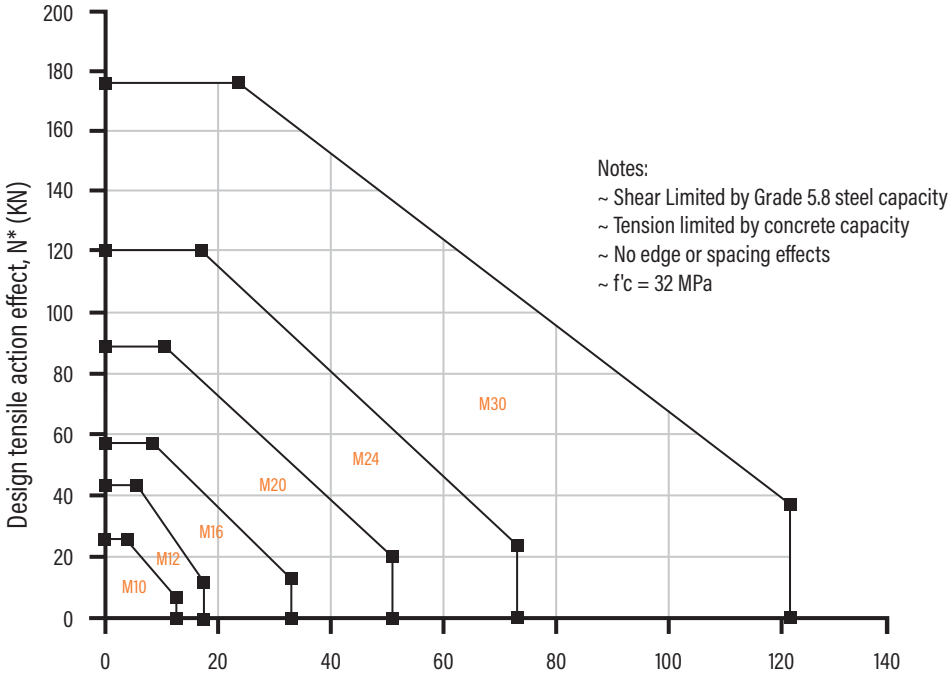


Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Min. Anchor Spacing - a_m	50	60	75	90	115	140
Min. Edge Distance - e_m	45	45	50	55	60	80

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

Refer to "Description and Part Numbers" table for ChemSet™ Anchor Studs page in the SARB ANZ on page 141.

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	M20	M24	M30
h + 30mm ≥ 100mm		h + (2 x d_h)			

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

ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

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	22.9						24.3
80	26.1						29.7
90	**29.4**	35.3					35.4
100	32.7	39.2					41.5
110	35.9	**43.1**	49.8				47.9
120	39.2	47.0	54.4				54.5
125	40.8	49.0	**56.6**				58.0
140	45.7	54.9	63.4				68.7
150	49.0	58.8	68.0	77.4			76.2
160	52.3	62.7	72.5	82.6			84.0
170	55.5	66.7	77.0	**87.7**	95.7		91.9
180	58.8	70.6	81.6	92.9	101.3		100.2
190	62.1	74.5	86.1	98.1	107.0		108.6
200	65.3	78.4	90.6	103.2	112.6		117.3
210		82.3	95.1	108.4	**118.2**	131.2	126.2
240		94.1	108.7	123.9	135.1	150.0	154.2
280			126.9	144.5	157.6	**175.0**	194.4
320			145.0	165.1	180.2	200.0	237.5
350				180.6	197.0	218.7	271.6
400				206.4	225.2	249.9	331.9
450					253.3	281.2	396.0
480					270.2	299.9	436.3
550						343.7	535.1
600						374.9	609.7

For optimised performance data, 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	0.43	0.43	0.50	0.59	0.65	0.68	0.70

Bold values are at Chemset Anchor Stud nominal Depths
For Sustained Loads MULTIPLY ϕN_{uc} x 0.6
Flooded Holes: Multiply ϕN_{uc} x 0.75
For Non-cracked concrete X_{ncr} = 1.
Note:The maximum embedment depth shall be reduced to $12d_b$ for installation in flooded holes

If Service temperature limit is -40°C to +40°C then Refer to Checkpoint 2	If Service temperature limit is -40°C to +80°C then $\phi N_{uc} = \phi N_{ucp}$

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

	Service temperature limits effect, tension, X_{ns} where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)						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)							
-40˚C to +40˚C	1.00						1.00
-40˚C to +80˚C	0.90						1.00

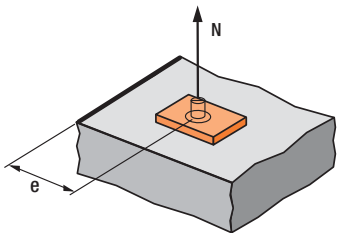
Table 2b-2 Concrete compressive strength effect, tension, X_{nc}

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	0.96	0.96	0.96	0.89	0.89	0.85	0.79
25	0.96	0.96	0.96	0.89	0.89	0.85	0.88
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.03	1.03	1.03	1.10	1.10	1.13	1.12
50	1.05	1.05	1.05	1.16	1.16	1.21	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	0.96	0.96	0.96	0.89	0.89	0.85	0.79
25							0.88
32							1.00
40							1.12
50							1.25

ChemSet™ 801 Xtrem™ XC²

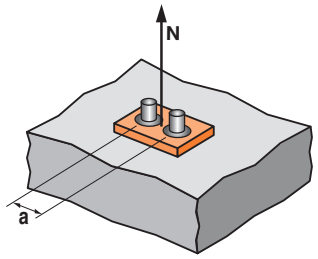
STRENGTH LIMIT STATE DESIGN



$X_{ne} = 0.25 + 0.5*(e/h)$
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)						
45	0.50	0.45				
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	
80	0.69	0.61	0.57	0.49	0.44	0.39
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
120	0.92	0.80	0.73	0.60	0.54	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)						
50	0.59					
60	0.61	0.59				
75	0.64	0.61	0.60			
90	0.67	0.64	0.62	0.59		
115	0.71	0.67	0.65	0.61	0.59	
130	0.74	0.70	0.67	0.63	0.60	
140	0.76	0.71	0.69	0.64	0.61	0.58
150	0.78	0.73	0.70	0.65	0.62	0.59
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}

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

If Service temperature limit is -40°C to +40°C then

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: ϕn = 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 $N^*/\phi N_{ur} \le 1$,
if not satisfied return to step 1

ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

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	170 - 480	210 - 600
Edge distance, e_m						
45	5.0	5.5				
50			7.0			
55				9.1		
60					11.0	
80						17.4

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

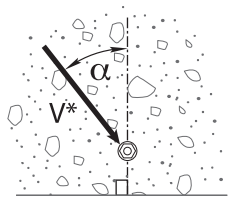
Table 4a-2 Cracked Concrete effect, shear, X_{vcr}

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

For Non-cracked concrete X_{vcr} = 1.0

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

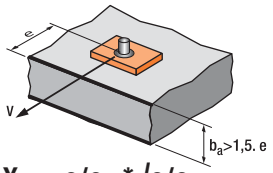
f'_c (MPa)	20	25	32	40	50
X_{vc}	0.79	0.86	1.0	1.11	1.22



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

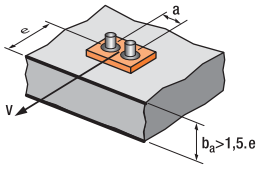


$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

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

For single anchor fastening X_{ve}

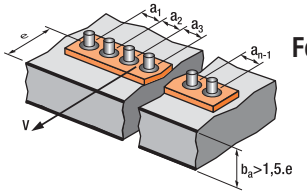
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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

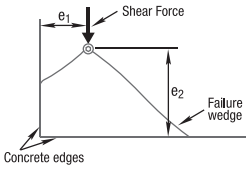
$$X_{ve} = \frac{3*e + a_1 + a_2 + a_3 + \ldots + a_{n-1}}{3*n*e_m} * \sqrt{e/e_m}$$

ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

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	56.5	82.9	108.9	156.7	211.1	288.4
-40˚C to +80˚C	52.8	77.4	100.5	142.4	190.0	271.4



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 Stud A4/316 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 $V^*/\phi V_{ur} \leq 1$,

if not satisfied return to step 1

ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

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™ 801 Xtrem™ XC² with (Anchor Size) grade 5.8 ChemSet™ Anchor Stud (Anchor Stud Part Number) Drilled Hole Depth to be (h) mm.

Example

Ramset™ 801 Xtrem™ XC² 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™ 101 PLUS

CHEMICAL INJECTION - NON-CRACKED CONCRETE

GENERAL INFORMATION

Performance Related	Material Specification	Installation Related

Product

ChemSet™ Injection 101 PLUS is a marine grade polyester adhesive anchor.

Benefits, Advantages and Features

Design according to AS5216 (formerly TS101) and European design method EN1992-4 (formerly TR029)

- Certified Performance European Technical Assessment EAD 330499 - Option 7

Fast installation:

- Load in 50 minutes (at 20°C)
- Easy cold weather dispensing

Versatile:

- Suitable for anchoring into a wide variety of substrates
- Solid concrete, hollow block and brick
- Flooded holes
- Styrene Free
- Cold and temperate climates
- VOC Compliant

Australian Made

Principal Applications

- **Hollow brick and block**
- **Stadium seating**
- **Starter Bars**
- **Balustrades**

Recommended Installation Temperatures

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

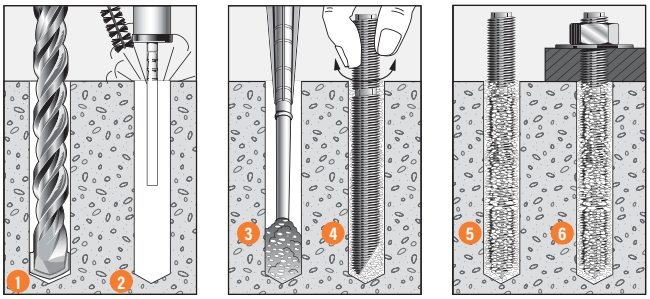
Service Temperature Limits

-40°C to 80°C

Setting Times

Temperature of base material	Cartridge Temperature	Gel Time	Curing time in dry and wet concrete
5°C	5°C	18 min	145 min
10°C	10°C	10 min	85 min
20°C	20°C	6 min	50 min
25°C	25°C	5 min	40 min
+30°C	+30°C	5 min	35 min
Note: Cartridge temperature minimum +5°C			

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 4, brush x 3, blow x 4, brush x 3, blow x 4.
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. ChemSet™ Injection to cure as per setting times.
6. Attach fixture.

ChemSet™ 101 PLUS

CHEMICAL INJECTION - NON-CRACKED CONCRETE

Installation and performance details: ChemSet™ 101 Plus 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	40	165	330	140
M16	18	18	125	80	187	375	160
M20	22	22	170	150	255	510	220
M24	26	26	210	200	315	630	270

* 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)***	20-25 MPa	32-40 MPa	50 MPa
M10	11.8	18.9	17.5	28.2	14.2	19.8	12.6	14.1	16.3
M12	17.5	28.1	26.0	41.9	21.1	29.5	20.7	23.2	27.0
M16	33.1	53.9	50.9	82.1	41.4	57.7	33.2	37.1	43.1
M20	49.9	81.3	76.8	123.9	62.4	87.1	50.4	56.5	65.6
M24	72.3	117.8	111.3	179.5	90.4	126.2	70.4	78.8	91.5

**Note: Reduced characteristic ultimate concrete tensile capacity = ϕN_{uc} where ϕ = 0.56 and N_{uc} = Characteristic ultimate concrete tensile capacity.

For conversion to Working Load Limit MULTIPLY ϕN_{uc} x 0.6

***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 +80°C

All data relevant for Non-Cracked Concrete, Dry, Wet and Flooded Holes

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

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
ChemSet™ 101 PLUS Cartridge	380 ml	C101C
ChemSet™ 101 PLUS Cartridge	750 ml	C101J
ChemSet™ 101 PLUS Kit	2 x 380 ml	ISKP
Mixer Nozzle for 101 PLUS	-	ISNP

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 (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

Engineering Properties" for ChemSet™ Anchor Studs Grade 5.8 and AISI 316 Stainless Steel in the SARB ANZ on page 141.

ChemSet™ 101 PLUS

STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

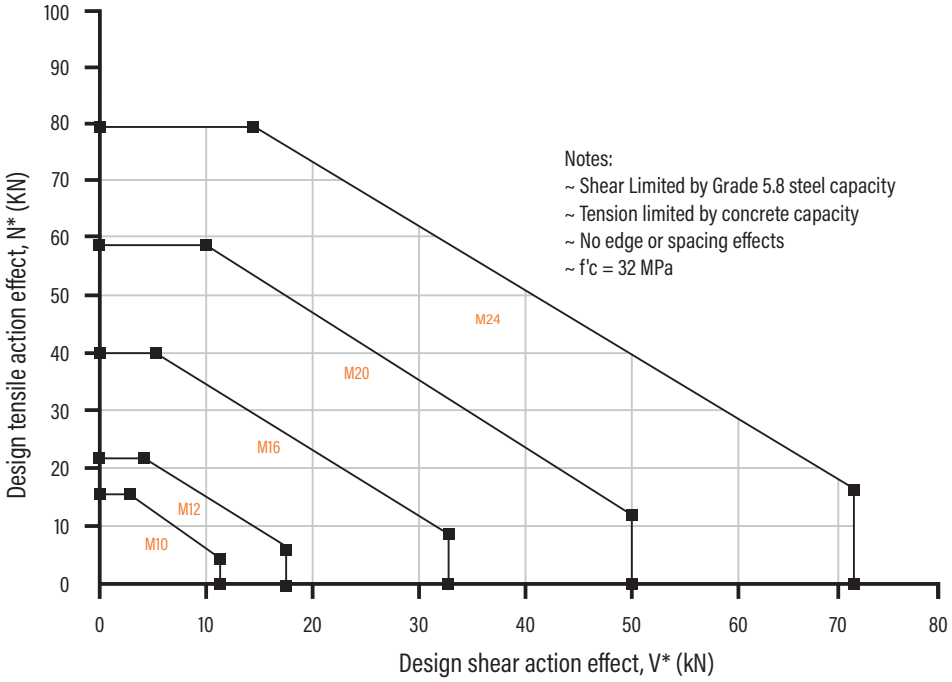


Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b	M10	M12	M16	M20	M24
Min. Anchor Spacing - a_m	40	50	65	80	96
Min. Edge Distance - e_m	40	50	65	80	96

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

Refer to "Description and Part Numbers" table for ChemSet Anchor Studs page in the SARB ANZ on page 141.

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	M20	M24
h + 30mm ≥ 100mm			h + (2 x d_h)	

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

ChemSet™ 101 PLUS

STRENGTH LIMIT STATE DESIGN

STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, ϕN_{uc} (kN), ϕ_c = 1/1.8 = 0.56, f'_c = 32 MPa

	Combined pull-out and concrete cone resistance - ϕN_{ucp}				
Anchor Size, d_b	M10	M12	M16	M20	M24
Drilled Hole Dia, d_h (mm)	12	14	18	22	26
Effective Depth, h (mm)					
80	12.5				
85	13.3				
90	**14.1**				
100	15.6	21.1			
110	17.2	**23.2**			
120	18.8	25.3			
125		26.4	**37.1**		
140		29.6	41.6		
145		30.6	43.1		
160			47.5	53.2	
170			50.5	**56.5**	
180			53.5	59.8	
190			56.5	63.1	71.3
200				66.5	75.1
210				69.8	**78.8**
240				79.8	90.1
280					105.1
290					108.8

Bold values are at Chemset Anchor Stud nominal Depths

For Sustained Loads MULTIPLY ϕN_{uc} x 0.6

All data relevant for Non-Cracked Concrete, Dry, Wet and Flooded Holes

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

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

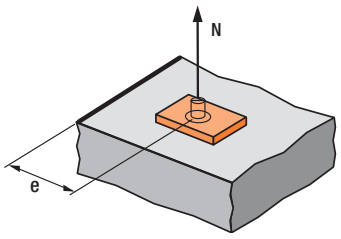
Service temperature (˚C)	-40˚C to +80˚C
X_{ns}	1.00

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

f'c (MPa)	20	25	32	40	50
X_{nc}	0.89	0.89	1.00	1.00	1.16

ChemSet™ 101 PLUS

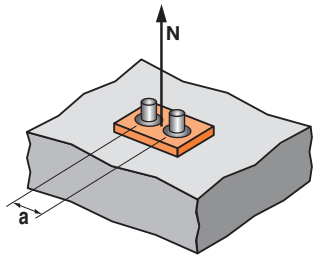
STRENGTH LIMIT STATE DESIGN



$X_{ne} = 0.25 + 0.5*(e/h)$
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
Edge distance, e (mm)					
40	0.47				
50	0.53	0.48			
55	0.56	0.50			
65	0.61	0.54	0.51		
80	0.69	0.61	0.57	0.49	
90	0.75	0.66	0.61	0.51	
100	0.81	0.70	0.65	0.54	0.49
120	0.92	0.80	0.73	0.60	0.54
135	1	0.86	0.79	0.65	0.57
165		1	0.91	0.74	0.64
187			1	0.80	0.70
255				1	0.86
315					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
Anchor spacing, a (mm)					
40	0.57				
50	0.59	0.57			
65	0.62	0.59	0.58		
80	0.64	0.62	0.60	0.57	
100	0.68	0.65	0.63	0.59	0.57
130	0.74	0.70	0.67	0.63	0.60
140	0.76	0.71	0.69	0.64	0.61
150	0.78	0.73	0.70	0.65	0.62
200	0.87	0.80	0.77	0.70	0.66
270	1	0.91	0.86	0.76	0.71
330		1	0.94	0.82	0.76
375			1	0.87	0.80
510				1	0.90
630					1

Checkpoint 2

Design reduced ultimate concrete tensile capacity, ϕN_{urc}
$\phi N_{urc} = \phi N_{uc} * X_{ns} * X_{nc} * X_{ne} * X_{na}$

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
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

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™ 101 PLUS

STRENGTH LIMIT STATE DESIGN

STEP 4

Step 4 - Verify concrete shear capacity - per anchor

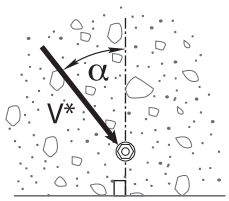
Table 4a Reduced characteristic ultimate concrete edge shear capacity, ϕV_{uc} (kN), ϕ = 1/1.5 =0.67, f'_c = 32 MPa

Anchor size, d_b	M10	M12	M16	M20	M24
Effective depth, h (mm)	80 - 120	100 -145	125 - 190	160 - 240	190 - 290
Edge distance, e_m					
40	4.4				
50		6.4			
65			10.0		
80				14.5	
100					20.8

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

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

f'_c (MPa)	20	25	32	40	50
X_{vc}	0.79	0.86	1.0	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

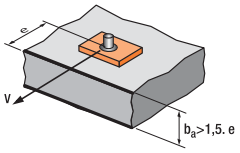
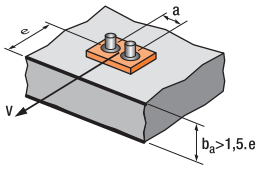


Table 4d - Concrete anchor spacing and edge distance effect, concrete edge shear, X_{ve}

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

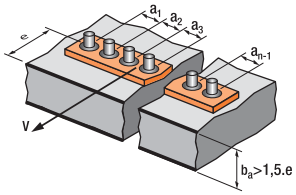
$$X_{ve} = e/e_m * \sqrt{e/e_m}$$



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

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

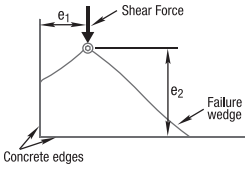
$$X_{ve} = \frac{3*e + a_1 + a_2 + a_3 + \ldots + a_{n-1}}{3*n*e_m} * \sqrt{e/e_m}$$

ChemSet™ 101 PLUS

STRENGTH LIMIT STATE DESIGN

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
Effective depth, h (mm)	90	110	125	170	210
-40˚C to +80˚C	33.8	55.7	89.1	135.6	189.2



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}

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

Checkpoint 4b

Design reduced ultimate concrete pryout capacity, ϕV_{urcp}

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

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
ChemSet™ Anchor Stud Grade 5.8 Carbon Steel	11.8	17.5	33.1	49.9	72.3
ChemSet™ Anchor Stud A4/316 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

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

ChemSet™ 101 PLUS

STRENGTH LIMIT STATE DESIGN

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™ 101 PLUS with (Anchor Size) grade 5.8 ChemSet™ Anchor Stud (Anchor Stud Part Number) Drilled Hole Depth to be (h) mm.

Example
Ramset™ ChemSet™ 101 PLUS 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™ Maxima™

SPIN CAPSULES - NON-CRACKED CONCRETE

GENERAL INFORMATION

Performance Related	Material Specification	Installation Related

Product

ChemSet™ Maxima™ Spin Capsule is a heavy duty, acrylic capsule anchor.

Benefits, Advantages and Features

Design according to AS5216 (formerly TS101) and European design method EN1992-4 (formerly TR029)

Certified Performance

European Technical Assessment EAD 330499 - Option 7.

No measuring, no mess, no waste:

- Adhesive is contained in pre-measured capsules.

Versatile:

- Use in damp or flooded holes or even underwater.

Fast installation:

- Cures in minutes and can be loaded in 20 min (at 20°C).

High bond strength:

- Acrylic adhesive.

High corrosion resistance:

(See page 20 and 21.)

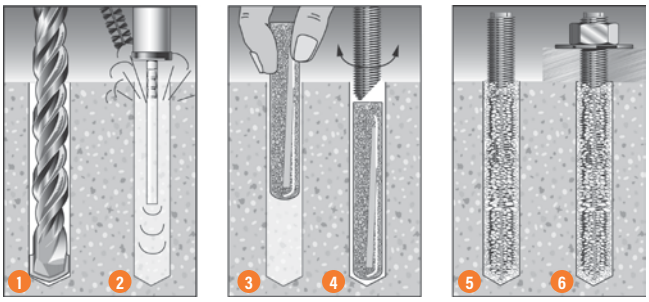
Rated for Sustained Loading

VOC Compliant

Principal Applications

- **Structural steel**
- **Machine hold down**
- **Factory fit out**
- **Fencing**
- **Stadium seating**
- **Balustrades**
- **Signs**
- **Applications requiring a set number of fixings**

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 4, brush x 3, blow x 4, brush x 3, blow x 4.
3. Insert correct size Spin capsule into the hole.
4. Using appropriate driver accessories, drive the ChemSet™ Anchor Stud into the hole using a hammer drill (on rotation).
5. Cure as per setting times.
6. Attach fixture and tighten nut in accordance with recommended tightening torque.

Recommended Installation Temperatures

	Minimum	Maximum
Substrate	0°C	35°C

Service Temperature Limits

-40°C to 80°C

Setting Times

Temperature of base material	Curing time in dry concrete	Curing time in wet concrete
≥ +0°C	5 h	10 h
≥ +5°C	1 h	2 h
≥ +20°C	20 min	40 min
≥ +30°C	10 min	20 min

ChemSet™ Maxima™

SPIN CAPSULES - NON-CRACKED CONCRETE

Installation and performance details: ChemSet™ Maxima™ 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	40	165	330	140
M16	18	18	125	80	187	375	160
M20	22	22	170	120	255	510	220
M24	26	26	210	180	315	630	270

* 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	18.8	21.5	23.8
M12	17.5	28.1	26.0	41.9	21.1	29.5	27.6	31.5	34.8
M16	33.1	53.9	50.9	82.1	41.4	57.7	41.9	47.8	52.8
M20	49.9	81.3	76.8	123.9	62.4	87.1	67.6	77.1	85.2
M24	72.3	117.8	111.3	179.5	90.4	126.2	100.3	114.3	126.4

**Note: Reduced characteristic ultimate concrete tensile capacity = ϕN_{uc} where ϕ = 0.67 and N_{uc} = Characteristic ultimate concrete tensile capacity.
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 +80°C
All data relevant for Non-Cracked Concrete - DO NOT USE IN FLOODED HOLES
For optimised performance data, please use Ramset iExpert Anchoring Software.

DESCRIPTION AND PART NUMBERS

Capsule Dimensions (mm)		To suit ChemSet™ Anchor Stud		Capsule Part No.
Capsule Dimensions (mm)	Capsule length, L	Anchor Size, d_b	Effective depth, h (mm)	
11	80	M10	90	CHEM10
13	95	M12	110	CHEM12
17	95	M16	125	CHEM16
21.5	115	M20	150	CHEM2024
21.5	115	M24	160	CHEM2024

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 (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

Engineering Properties" for ChemSet™ Anchor Studs Grade 5.8 and AISI 316 Stainless Steel in the SARB ANZ on page 141.

ChemSet™ Maxima™

STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

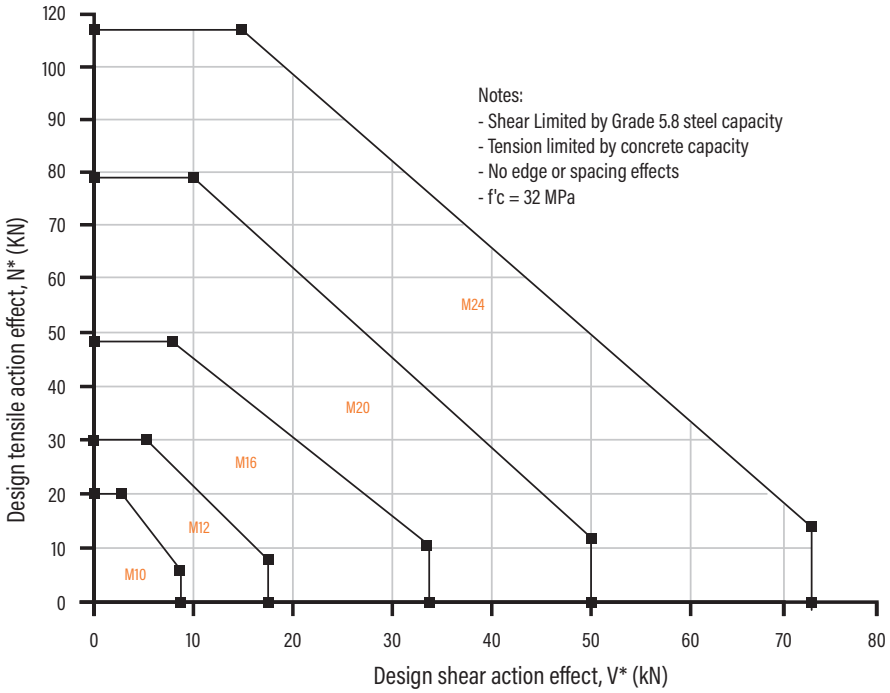


Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b	M10	M12	M16	M20	M24
Min. Anchor Spacing - a_m	45	55	65	85	105
Min. Edge Distance - e_m	45	55	65	85	105

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

Refer to "Description and Part Numbers" table for ChemSet® Anchor Studs page in the SARB ANZ on page 141.

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

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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}				
Anchor Size, d_b	**M10**	**M12**	**M16**	**M20**	**M24**
Drilled Hole Dia, d_h (mm)	**12**	**14**	**18**	**22**	**26**
Effective Depth, h (mm)					
90	21.5				
110		31.5			
125			47.8		
170				77.1	
210					114.3

For Sustained Loads MULTIPLY ϕN_{uc} x 0.6
All data relevant for Non-Cracked Concrete
DO NOT USE IN FLOODED HOLES
For optimised performance data, please use Ramset iExpert Anchoring Software.

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

Service temperature (˚C)	-40˚C to +80˚C
X_{ns}	1.00

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

f'c (MPa)	20	25	32	40	50
X_{nc}	0.88	0.93	1.00	1.11	1.18

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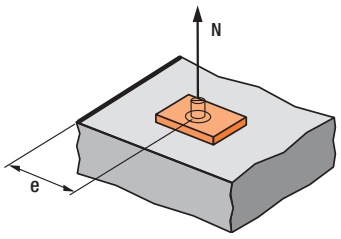
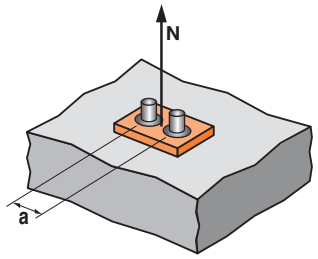


$X_{ne} = 0.25 + 0.5*(e/h)$
Where $e_m \le e \le e_c$
$e_c = 1.5*h$
Note: Tabled values are based on the nominal effective depth,
h shown in the installation details. For other values of X_{ne}, please use equation shown above.

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

Anchor size, d_b	M10	M12	M16	M20	M24
Edge distance, e (mm)					
45	0.50				
50	0.53				
55	0.56	0.50			
65	0.61	0.54	0.51		
85	0.72	0.63	0.59	0.50	
90	0.75	0.66	0.61	0.51	
105	0.83	0.72	0.67	0.55	0.50
120	0.92	0.80	0.73	0.60	0.54
135	1	0.86	0.79	0.65	0.57
165		1	0.91	0.74	0.64
187			1	0.80	0.70
255				1	0.86
315					1
420					



$X_{na} = 0.5 + a/(6*h)$
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
Anchor spacing, a (mm)					
45	0.58				
55	0.60	0.58			
65	0.62	0.59	0.58		
85	0.65	0.62	0.61	0.58	
105	0.69	0.65	0.64	0.60	0.58
130	0.74	0.70	0.67	0.63	0.60
140	0.76	0.71	0.69	0.64	0.61
150	0.78	0.73	0.70	0.65	0.62
200	0.87	0.80	0.77	0.70	0.66
270	1	0.91	0.86	0.76	0.71
330		1	0.94	0.82	0.76
375			1	0.87	0.80
510				1	0.90
630					1

Checkpoint 2

Design reduced ultimate concrete tensile capacity, ϕN_{urc}
$\phi N_{urc} = \phi N_{uc} * X_{ns} * X_{nc} * X_{ne} * X_{na}$

STEP 3

Verify anchor shear 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
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

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

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STEP 4

Step 4 - Verify concrete shear capacity - per anchor

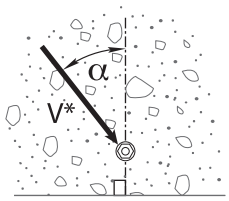
Table 4a Reduced characteristic ultimate concrete edge shear capacity, ϕV_{uc} (kN),ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

Anchor size, d_b	M10	M12	M16	M20	M24
Effective depth, h (mm)	90	110	125	170	210
Edge distance, e_m					
45	5.3				
55		7.4			
65			10.0		
85				15.6	
105					22.7

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

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

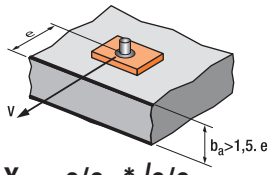
f'_c (MPa)	20	25	32	40	50
X_{vc}	0.79	0.86	1.0	1.11	1.22



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

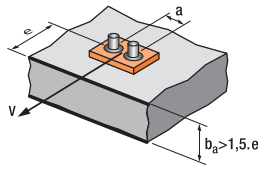


$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

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

For single anchor fastening X_{ve}

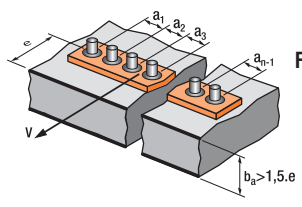
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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

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

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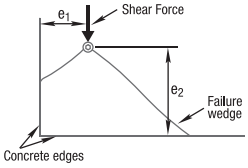
Table 4e Reduced characteristic ultimate concrete pryout capacity, ϕV_{ucp} (kN), ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

Anchor size, d_b	M10	M12	M16	M20	M24
Effective depth, h (mm)	90	110	125	170	210
-40˚C to +80˚C	43.0	63.0	95.5	154.2	228.6



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}

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

Checkpoint 4b

Design reduced ultimate concrete pryout capacity, ϕV_{urcp}

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

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
ChemSet™ Anchor Stud Grade 5.8 Carbon Steel	11.8	17.5	33.1	49.9	72.3
ChemSet™ Anchor Stud A4/316 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

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™ Maxima with (Anchor Size) grade 5.8 ChemSet™ Anchor Stud (Anchor Stud Part Number) Drilled Hole Depth to be (h) mm.

Example

Ramset™ Maxima Spin Capsule with M16 grade 5.8 ChemSet™ Anchor Stud (CS16190GH). Drilled hole depth to be 125mm. To be installed according to Ramset™ Installation Instructions.