ChemSet™ 801 Xtrem™ XC²

SEISMIC Xtrem™ ANCHOR STUDS - CHEMICAL INJECTION

GENERAL INFORMATION

Performance Related	Material Specification	Installation Related

Product

ChemSet™ 801 Xtrem™ XC² is a heavy duty Vinylester adhesive 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)
- AS1170.4 - Earthquake Actions
- EN1992-4 (formerly ETAG001 Annex C, E & TR045)
- NZS3101 (A3) Section 17 - Seismic Design C2
- Use enclosed data for simplified calculation method

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

Benefits, Advantages and Features

- 50 year working life

Greater productivity:

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

Greater security:

- Strong bond
- Rated for sustained loading

Versatile:

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

Greater safety:

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

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

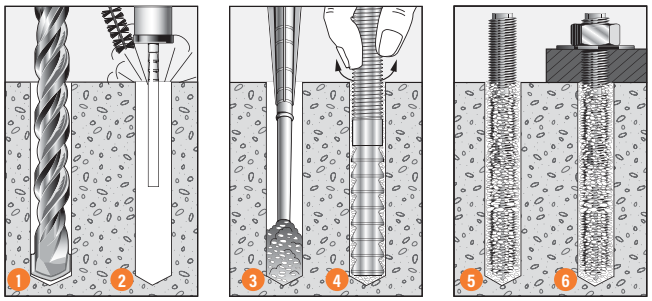
-40°C to 80°C

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			

NOTE: For C2 Certified Performance, only use Anchor Stud Xtrem™ (Multicone) anchors with ChemSet™ 801 Xtrem™ XC².

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

SEISMIC Xtrem™ ANCHOR STUDS - CHEMICAL INJECTION

Installation and performance details: ChemSet™ 801 Xtrem™ XC² and ChemSet™ Anchor Stud Xtrem™ (Multicone)

Anchor size, d_b (mm)	Drilled hole diam. , d_h (mm)	Fixture hole diameter, d_f (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Optimum dimensions*		
					Anchor spacing, a_c (mm)	Edge distance, e_c (mm)	Concrete substrate thickness, b_m (mm)
M12	14	14	60	30	180	90	120
M16	18	18	96	50	288	144	180
M20	22	22	100	150	300	150	200

* 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 8.8 Xtrem™ Steel Studs		Seismic Cracked Concrete C2		
	Shear, $V_{Rd,seis}$ (kN)	Tension, $N_{Rd,s\ seis}$ (kN)***	Tension, $N_{Rd,p,\ seis}$ (kN)**		
			Concrete Compressive Strength, f'_c		
			20 MPa	30 MPa	40 MPa
M12	8.0	33.3	8.0	9.8	10.4
M16	15.0	59.3	16.1	19.8	22.8
M20	23.3	93.3	17.1	21.1	24.3

**Note: Seismic Cracked concrete combined pull-out and concrete cone resistance, tension = $N^0_{Rd,p,seis} = \alpha_{Nseis}\ N^0_{Rk,p,seis}\ /\gamma_{Msp}$
where $\gamma_{Msp} = 1.5$, $\alpha_{Nseis} = 0.85$
***Note: Seismic Cracked Concrete steel resistance, tension = $N_{Rd,s,seis} = \alpha_{Nseis}\ N^0_{Rk,s,seis}\ /\ \gamma_{Ms}$ (Kn) where $\gamma_{Ms} = 1.5$ (Grade 8.8 steel), $\alpha_{Nseis} = 1.0$
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)

Description	Anchor Size	Part No.
ChemSet™ Xtrem™ Anchor Stud M12 x 150mm Zinc	M12	CS12150XT
ChemSet™ Xtrem™ Anchor Stud M16 x 200mm Zinc	M16	CS16200XT
ChemSet™ Xtrem™ Anchor Stud M20 x 270mm Zinc	M20	CS20270XT

ENGINEERING PROPERTIES
ChemSet™ Anchor Studs Xtrem™

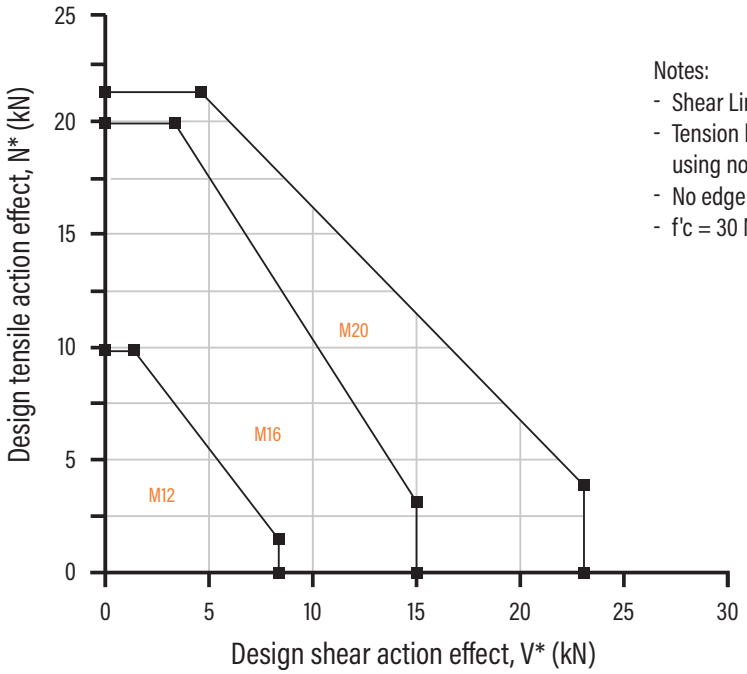
Anchor Size, d_b	Grade 8.8 Anchor stud Xtrem™				Section modulus Z (mm^3)
	Shank diameter, d_s (mm)	Stressed Area (mm^2)	Yield Strength f_y MPa	UTS f_u MPa	
M12	8.9	62.5	640	800	109.2
M16	11.9	111.2	640	800	277.5
M20	14.9	175	640	800	540.9

ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram



Notes:
- Shear Limited by Grade 8.8 steel capacity
- Tension limited by concrete capacity using nominal depths
- No edge or spacing effects
- f'c = 30 MPa

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

Anchor size, d_b M10	M12	M16	M20
Min. Anchor Spacing - a_m	55	60	120
Min. Edge Distance - e_m	55	60	120

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

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)

$$b_m = 2 \times h$$

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

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STRENGTH LIMIT STATE DESIGN

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

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

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

Anchor Size, d_b	M12	M16	M20
Drilled Hole Dia, d_h (mm)	14	18	22
Effective Depth, h (mm)			
60	9.8		
96		19.8	
100			21.1

Flooded Holes: Multiply $N^0_{Rd,p,seis}$ *1.0
For single anchor values: Multiply $N^0_{Rd,p,seis}$*1.17
For optimised performance data, including deeper effective depths, please use Ramset iExpert Anchoring Software.

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

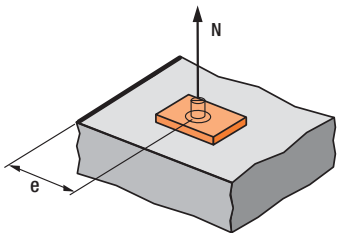
Service temperature (˚C)	X_{ns}
-40˚C to +40˚C	1.00
-40˚C to +80˚C	0.93

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

	Concrete compressive strength effect, tension, X_{nc}		
Anchor size, d_b	M12	M16	M20
f'c (MPa)			
20	0.81	0.81	0.81
25	0.91	0.91	0.91
30	1.00	1.00	1.00
40	1.06	1.15	1.15
50	1.10	1.29	1.29

ChemSet™ 801 Xtrem™ XC²

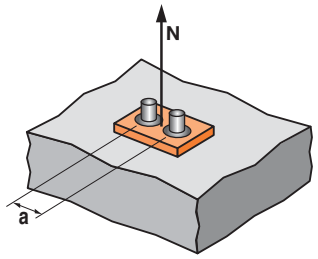
STRENGTH LIMIT STATE DESIGN



$X_{ne} = 0.25 + 0.5*(e/h)$
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 - Seismic cracked concrete Edge distance effect, tension, X_{ne}

Anchor size, d_b	M12	M16	M20
Edge distance, e (mm)			
55	0.71		
60	0.75	0.56	
80	0.92	0.67	
90	1.00	0.72	
100		0.77	
110		0.82	
120		0.88	0.85
135		0.95	0.93
145		1.00	0.98
150			1.00



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

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

Anchor size, d_b	M12	M16	M20
Anchor spacing, a (mm)			
55	0.65		
60	0.67	0.60	
80	0.72	0.64	
90	0.75	0.66	
100	0.78	0.67	
110	0.81	0.69	
120	0.83	0.71	0.70
150	0.92	0.76	0.75
165	0.96	0.79	0.78
185	1.00	0.81	0.80
250		0.93	0.92
290		1.00	0.98
300			1.00

Checkpoint 2

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

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

STEP 3

Verify seismic C2 cracked concrete tensile resistance - per anchor

Table 3a - Seismic Cracked Concrete steel resistance, tensile, $N_{Rd,s,seis} = \alpha_{seis} N_{Rk,s,seis}/\gamma_{Ms}$ (kN)
where $\alpha_{seis} = 1.0$ $\gamma_{Ms} = 1.5$

Anchor size, d_b	M12	M16	M20
Grade 8.8 Anchor Stud Xtrem™	33.3	59.3	93.3

Checkpoint 3

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

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

Check $N^*/N_{Rd,seis} \le 1$,
if not satisfied return to step 1

ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

STEP 4

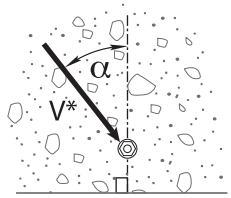
Step 4 - Verify seismic C2 cracked concrete edge shear resistance - per anchor

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

Anchor size, d_b	M12	M16	M20
Effective depth, h (mm)	60	96	100
Edge distance, e_m			
55	1.9		
60		2.5	
120			6.3

Note: Data includes annular gap reduction factor of 0.5

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



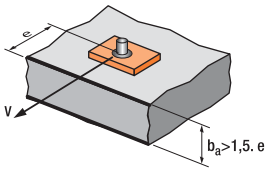
Load direction effect, conc. edge shear, X_{vd}

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

f'_c (MPa)	20	25	30	40	50
X_{vc}	0.82	0.90	1	1.16	1.27

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

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

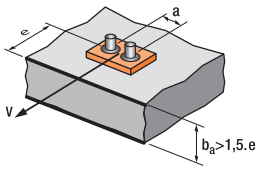


$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

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

For single anchor fastening X_{ve}

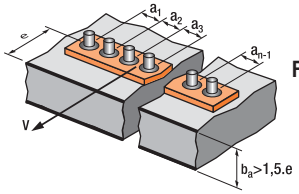
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

For 2 anchors fastening X_{ve}

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



For 3 anchors fastening and more

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

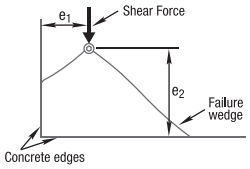
ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

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

Anchor size, d_b	M12	M16	M20
Effective depth, h (mm)	60	96	100
-40˚C to +40˚C	8.7	19.8	21.1
-40˚C to +80˚C	8.1	18.4	19.6

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



ANCHOR AT A CORNER

Table 4f Anchor at a corner effect, seimic 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 seismic cracked concrete edge shear resistance, $V_{Rd,c,seis}$
$= V^0_{Rd,c,seis} * X_{vc} * X_{vd} * X_{ve} * X_{vs}$

Checkpoint 4b

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

STEP 5

Verify seismic C2 cracked concrete shear resistance - per anchor

Table 5a - Seismic Cracked Concrete steel shear resistance, $V^0_{Rd,s,seis} = \alpha_{seis} V_{Rk,s,seis} / \gamma_{Ms}$ (kN)
γ_{Ms} = 1.25 for Grade 8.8 Anchor Stud Xtrem™

Anchor size, d_b	M12	M16	M20
Grade 8.8 Multicone	8.0	15.0	23.3

Note: Data includes annular gap reduction factor of 0.5
For single anchor values: Multiply $V_{Rd,s,seis}$*1.17
Note: Apply reduction factor of 0.5 when using Hot Dip Galvanised Anchor Stud Xtrem™

Checkpoint 5

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

ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

STEP 6 Combined Loading

Checkpoint 6

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

Specifiy - Threaded Multicone Stud Anchors
Ramset™ 801 Xtrem™ XC² with (Anchor Size) grade 8.8 ChemSet™ Anchor Stud Xtrem™ (Anchor Stud Part Number) Drilled Hole Depth to be (h) mm.

Example
Ramset™ 801 Xtrem™ XC² Injection with M16 grade 8.8 ChemSet™ Anchor Stud Xtrem™ (C16200XT). Drilled hole depth to be 125mm. To be installed according to Ramset™ Installation Instructions.

Tension - Sustained loading

Displacments under seiemic tension loading, seismic performance category C2 for CHEMSET™ Xtrem™

Concrete Strength f_c = 20MPa (-40˚C to +80˚C)

CHEMSET™ Xtrem™			M12	M16	M20
Displacement DLS	$\delta_{N,eq}$ (DLS)	[mm]	0.72	0.98	1.15
Displacement ULS	$\delta_{N,eq}$ (ULS)	[mm]	1.65	2.07	3.20

DLS = Damage Limit State
ULS = Ultimate Limit State

Shear - Sustained loading

Displacments under seiemic shear loading, seismic performance category C2 for CHEMSET™ Xtrem™

Concrete Strength f_c = 20MPa (-40˚C to +80˚C)

CHEMSET™ Xtrem™			M12	M16	M20
Displacement DLS	$\delta_{V,eq}$ (DLS)	[mm]	2.01	2.63	2.99
Displacement ULS	$\delta_{V,eq}$ (ULS)	[mm]	3.57	4.67	4.53

DLS = Damage Limit State
ULS = Ultimate Limit State

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