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

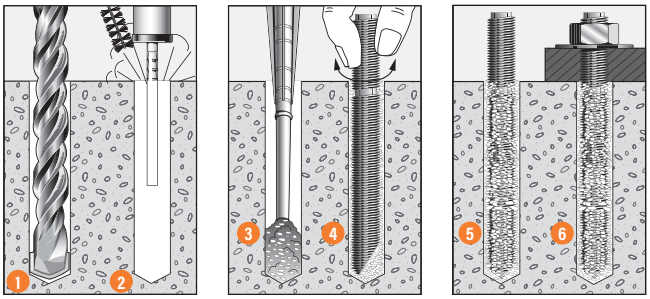
Service Temperature Limits

-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

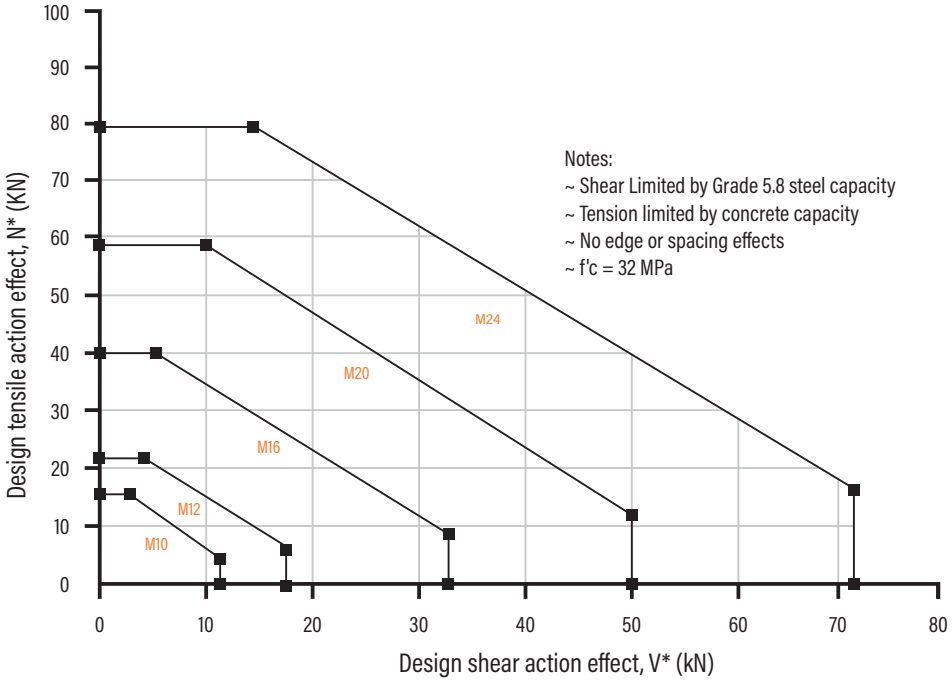


Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

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}

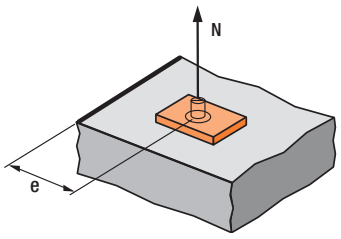
Service temperature (˚C)	-40˚C to +80˚C
X_{ns}	1.00

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

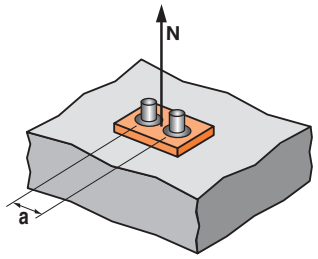
STRENGTH LIMIT STATE DESIGN



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

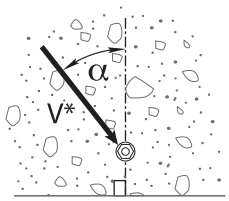
Table 4a Reduced characteristic ultimate concrete edge shear capacity, ϕV_{uc} (kN), ϕ = 1/1.5 =0.67, f'_c = 32 MPa

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

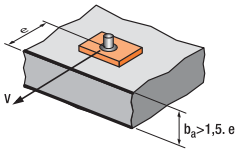
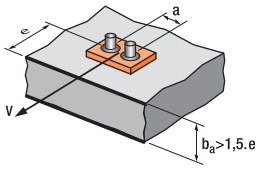


Table 4d - Concrete anchor spacing and edge distance effect, concrete edge shear, X_{ve}

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

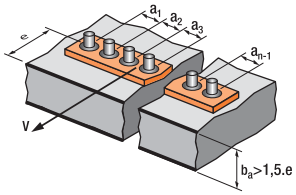
$$X_{ve} = e/e_m * \sqrt{e/e_m}$$



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

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

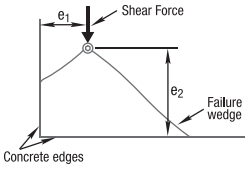
$$X_{ve} = \frac{3*e + a_1 + a_2 + a_3 + \ldots + a_{n-1}}{3*n*e_m} * \sqrt{e/e_m}$$

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.