Ramset™ CHEMICAL ANCHORING

Specifiers Anchoring Resource Book
Book 3.3 of 3

CHEMICAL ANCHORING

Book 3.3 | 2009

Ramset™
www.ramset.co.nz

Welcome to the Ramset Anchoring Resource Book

These concise and systematically presented books contain the information useful to Architects, Specifiers and Engineers when selecting the masonry anchoring solution that best suits their project.

Selection of a masonry anchoring product is made on the basis of the basic type of fixing (male or female, bolt or stud), macro environment, (eg coastal or inland), micro environment (particular chemicals) and of course the capacity that best meets the design load case.

Where the fixing is simple and does not warrant strength limit state calculations, selection on the basis of load tables for each masonry anchor.

Where more rigorous design and strength limit state a calculation is required, the simplified step-by-step method presented in this booklet will allow rapid selection and verification of the appropriate masonry anchor.

This “Anchoring Technology” booklet contains the design process and anchoring technology information.

This “Chemical Anchoring” booklet contains information relating to the Ramset Chemical Anchor range.

We know that you will find these books both useful and informative.

Table of contents

1 Legend of symbols

Performance related symbols


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


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


Suitable for use in seismic design.


Suitable for elevated temperate applications. Structural anchor components made from steel. Any plastic or non-ferrous parts make no contribution to holding power under elevated temperatures.


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

Material specification symbols

Zinc plated to AS1791-1986 Minimum thickness 6 µm.

Hot dipped galvanized to AS1650-1989 Minimum thickness 42 µm.

Stainless steel, resistant to corrosive agents including chlorides and industrial pollutants.

Installation related symbols


Suitable for floor applications.


Suitable for wall applications.


Suitable for overhead applications.


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


Anchor is cast into substrate by either puddling, attaching to reinforcing or formwork.


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


Suitable for use in dry holes.


Suitable for use in damp holes.


Suitable for use in holes filled with water.


Suitable for use in drilled holes.


Suitable for use in cored holes.


Temporary or removable fixing.

2 Notation

a = actual anchor spacing (mm)

a_c = critical anchor spacing (mm)

a_m = absolute minimum anchor spacing (mm)

A_s = stress area (mm^2)

b_m = minimum substrate thickness (mm)

d_b = bolt diameter (mm)

d_f = fixture hole diameter (mm)

d_h = drilled hole diameter (mm)

e = actual edge distance (mm)

e_c = critical edge distance (mm)

e_m = absolute minimum edge distance (mm)

f'_c = concrete cylinder compressive strength (MPa)

f_u = characteristic ultimate steel tensile strength (MPa)

f_y = characteristic steel yield strength (MPa)

h = anchor effective depth (mm)

L = anchor length (mm)

L_e = anchor effective length (mm)

M^* = design bending action effect (Nmm)

N^* = design tensile action effect (kN)

N_u = ultimate tensile capacity (kN)

N_{uc} = characteristic ultimate concrete tensile capacity (kN)

N_{ur} = design ultimate concrete capacity (kN)

N_{urc} = design ultimate concrete tensile capacity (kN)

N_{us} = characteristic ultimate steel tensile capacity (kN)

t = total thickness of fastened material(s) (mm)

V^* = design shear action effect (kN)

V_u = ultimate shear capacity (kN)

V_{uc} = characteristic ultimate concrete edge shear capacity (kN)

V_{ur} = design ultimate shear capacity (kN)

V_{urc} = design ultimate concrete edge shear capacity (kN)

V_{us} = characteristic ultimate steel shear capacity (kN)

V_{usc} = characteristic ultimate combined concrete/steel sheer capacity (kN)

X_{nae} = anchor spacing effect, end of a row, tension

X_{nai} = anchor spacing effect, internal to a row, tension

X_{nc} = concrete compressive strength effect, tension

X_{ne} = edge distance effect, tension

X_{va} = anchor spacing effect, concrete edge shear

X_{vc} = concrete compressive strength effect, shear

X_{vd} = load direction effect, concrete edge shear

X_{vn} = multiple anchors effect, concrete edge shear

X_{vsc} = concrete compressive strength effect, combined concrete/steel shear

Z = section modulus (mm^3)

ß = concrete cube compressive strength (N/mm^2)

$Ø_c$ = capacity reduction factor, concrete tension recommended as 0.6

$Ø_m$ = capacity reduction factor, steel bending recommended as 0.8

$Ø_n$ = capacity reduction factor, steel tension recommended as 0.8

$Ø_q$ = capacity reduction factor, concrete edge shear recommended as 0.6

$Ø_v$ = capacity reduction factor, steel shear recommended as 0.8

Overview

The key feature of Ramset chemical anchors is that they do not impart 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 Ramset 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 polymer matrix of Ramset 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 superior strength of grade 5.8 carbon steel threaded stud anchors gives the Ramset chemical anchor systems greater steel capacity than regular grade 4.6 threaded rod.

The Ramset 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 Ramset 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, Epcon C6 and Epcon A7

Anchor size, d_b (mm)	Nominal Hole Ø (mm)	Nominal Hole Depth Ø (mm)	Chemset Injection 101 Series / REO 502		Epcon C6	Epcon A7
			380ml	750ml	530 ml	825 ml
M8	10	80	96	195	150	226
M10	12	90	66	133	107	162
M12	14	110	43	87	70	106
M16	18	125	27	55	45	68
M20	24	150	11	22	17	26
M24	26	160	12	24	17	26

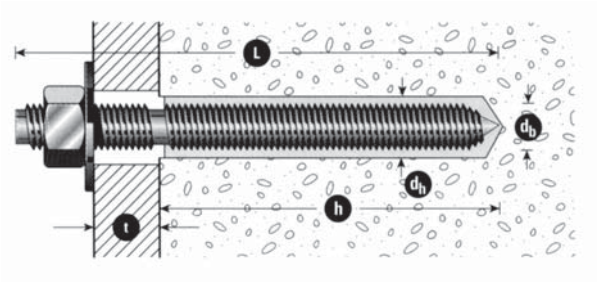
3 Chemset™ Anchor Studs

General Information

Zn GAL A4 316

Product

Steel threaded studs for use with Chemset capsules and Epcon injection mortars.



Features

- Suitable for use with all Ramset chemical anchoring systems.
- Superior performance grade 5.8 carbon steel, greater steel capacity than 4.6 threaded rod.
- Zinc plated, hot dipped galvanized or stainless steel.
- Includes nut, washer and setting tool (for spin capsules).
- Depth setting mark – for correct embedment

Description and Part Numbers

Anchor size, d_b (mm)	Anchor Length, L (mm)	Nominal effective depth h_n (mm)	Nominal fixture thickness, t (mm)	Effective length L_e (mm)	Part No.		
					Zn	Ga	S/S
M10	130	90	25	115	CS10130	CS10130GH	CS10130SS
M12	160	110	30	140	CS12160	CS12160GH	CS12160SS
	180	110	50	160	CS12180	-	-
M16	190	125	40	165	CS16190	CS16190GH	CS16190SS
M20	260	150	75	225	CS20260	CS20260GH	CS20260SS
M24	300	160	105	265	CS24300	CS24300GH	CS24300SS

Engineering Properties

Anchor size, d_b (mm)	Carbon Steel			Stainless Steel			Section modulus,Z (mm^3)
	Stress Area (mm^2)	Yield strength, f_y (MPa)	UTS, f_u (MPa)	Stress Area, A_s (mm^2)	Yield Strength, f_y (MPa)	UTS, f_u (MPa)	
M10	52.8	430	540	58	450	650	62.3
M12	78.5	430	540	84.3	450	650	109.2
M16	153.9	420	520	157	450	650	277.5
M20	232.4	420	520	245	450	650	540.9
M24	336.5	420	520	353	450	650	935.5

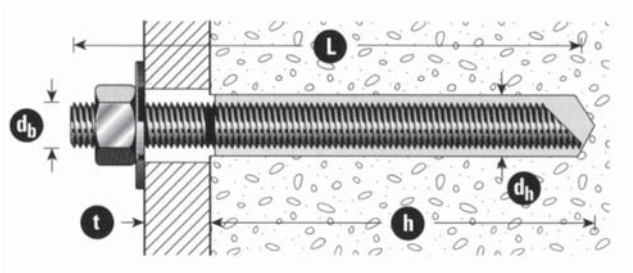
4 Chemset™ Injection Rod

General Information

Zn GAL

Product

Steel threaded studs for use with Chemset 100 series injection mortars.



Features

- Economical grade 4.6 steel.
- Depth setting mark for correct embedment.
- Includes nut and washer.
- Zinc plated or hot dip galvanized to Australian Standards.

Description and Part Numbers

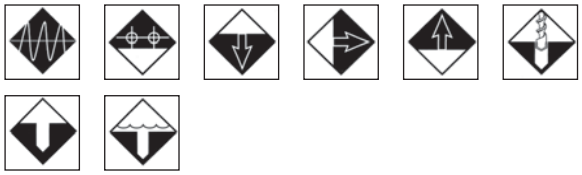
Anchor size, d_b (mm)	Anchor length, L (mm)	Nominal effective depth h_n (mm)	Nominal fixture thickness, t (mm)	Effective length, L_e (mm)	Part No.	
					Zn	Gal
M12	160	110	30	140	CR12160	CR12160GH
M16	190	125	40	165	CR16190	CR16190GH

Engineering Properties

Anchor size, d_b (mm)	Stress are A_s (mm^2)	Yield strength, f_y (MPa)	UTS, f_u (MPa)	Section modulus, Z (mm^3)
M12	84.3	240	400	109.2
M16	157.0	240	400	277.5

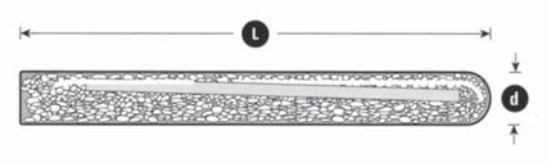
5 Chemset™ Maxima Spin Capsules

General Information



Product

Chemset Maxima Spin Capsules area a chemical anchor system based on epoxy acrylate. The capsule is placed into the hole and the mortar is mixed during the anchor installation.



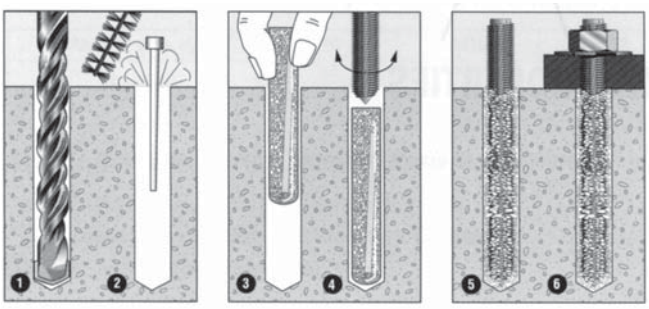
Features

- Epoxy acrylate copolymer.
- Close to edge, stress free anchoring.
- Close anchor spacing.
- Suitable for use with zinc plated, hot dipped galvanized or stainless steel Chemset Anchor Studs.
- Resistant cyclic loading.
- Underwater installation.
- Overhead installation.
- Fast cure.
- Superior strength with grade 5.8 steel Chemset Anchor Studs.

Principal Applications

- Structural beams and columns.
- Batten fixing.
- Installing signs, handrails, balustrades and gates.
- Racking.
- Safety barriers.
- Stadium seating.
- Machinery hold down.

Installation



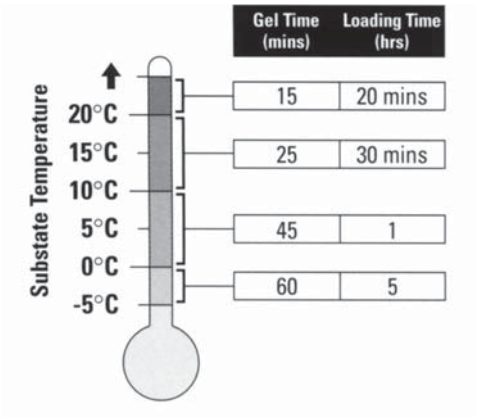
1. Drill recommended diameter and depth hole.
2. Clean hole with hole cleaning brush. Remove all debris using hole blower.
3. Insert correct size Spin capsule into the hole.
4. Using appropriate driver accessories, drive the Chemset Anchor Stud into the hole using a hammer drill (on rotation).
5. Cure as per setting times.
6. Attach fixture and tighten nut in accordance with recommended tightening torque.

Installation temperature limits:
- Substrate: -5°C to 35°C.

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

Service temperature limits:
-23°C to 60°C

Setting Times



5 Chemset™ Maxima Spin Capsules

Installation and Performance Details: Chemset™ Maxima™ Spin Capsules and Chemset™ Anchor Stud

Anchor size, d_b (mm)	Installation details				Minimum dimension*			Reduced Characteristic Capacity			
	Drilled hole Ø, d_h (mm)	Fixture hole Ø, d_f	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	Shear V_a (kN)	Tension N_a (kN)		
								Concrete compressive strength (MPa)			
								20 MPa	20 MPa	32 MPa	40 MPa
M10	12	12	90	20	40	60	120	**14.1**	**16.7**	**19.2**	**20.6**
M12	14	15	110	40	50	70	140	**21.0**	**23.8**	**27.4**	**29.3**
M16	18	19	125	95	65	100	160	**39.7**	**34.8**	**40.1**	**42.9**
M20	24	24	150	180	80	120	190	**59.9**	**55.7**	**64.1**	**68.6**
			170**				220	**59.9**	**63.1**	**72.7**	**77.7**
M24	26	28	160	315	95	145	200	**86.8**	**64.4**	**74.1**	**79.3**
			210**				270	**86.8**	**84.5**	**97.3**	**104.0**

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

Reduced Characteristic

**Note: To achieve these non standard effective depths, use an additional CHEM10 Maxima spin capsule per hole.

Description and Part Numbers - Chemset Maxima Spin Capsules

Capsule dimensions		To suit Chemset Anchor Stud		Capsule Part No.
Nominal Ø, d (mm)	Capsule Length, L (mm)	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

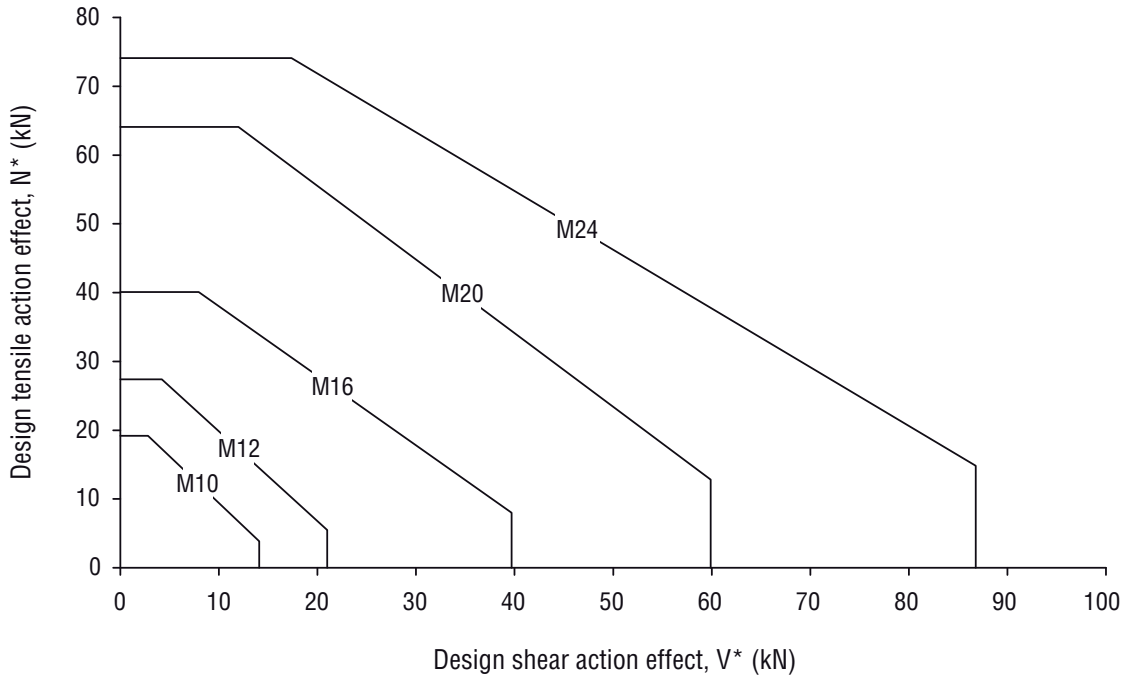
Engineering Properties

Refer to “Engineering Properties” for Chemset Anchor Studs on page 5.

5 Chemset™ Maxima Spin Capsules / **Strength Limit State Design**

Step 1 - Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram



Notes:

- Shear limited by steel capacity.
- Tension limited by concrete capacity.
- No edge or spacing effects.
- f'_c = 32 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	M24
e_m, a_m	30	35	50	60	75

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

Anchor effective depth, h (mm) is read from the "Description and Part Numbers" table for Chemset Maxima Spin Capsules on page 8.

Checkpoint 1

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

5 Chemset™ Maxima Spin Capsules / Strength Limit State Design

Step 2 - Verify concrete tensile capacity – per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, ϕN_{uc} (kN), $\phi_c = 0.6$, $f'_c = 32$ MPa

Anchor size, d_b	M10	M12	M16	M20	M24
Drilled hole dia, d_h (mm)	12	14	18	24	26
Effective depth, h (mm)					
90	19.2				
110		27.4			
125			40.1		
150				64.1	
160					74.1

Note: Effective depth, h must be ⩾ 6 x drilled hole diameter, d_h for anchor to achieve tabled shear capacities.

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

f'_c (MPa)	20	25	32	40	>50
X_{nc}	0.87	0.93	1.00	1.07	1.14

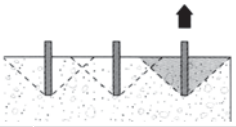


Table 2c Edge distance effect, tension X_{ne} = 1.00

Anchor size, d_b	M10	M12	M16	M20	M24
Edge distance, e (mm)					
30	0.83				
35	0.91	0.81			
40	1.00	0.88			
50		1.00	0.85		
60			0.96	0.83	
65			1.00	0.87	
75				0.96	0.85
80				1.00	0.88
100					1.00

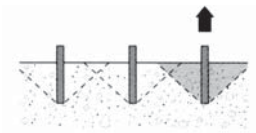


Table 2d Anchor spacing effect, end of a row, tension, X_{nae} = 1.00

Anchor size, d_b	M10	M12	M16	M20	M24
Anchor spacing, a (mm)					
30	0.75				
35	0.79	0.74			
40	0.83	0.78			
50	0.92	0.85	0.76		
60	1.00	0.92	0.81	0.75	
75		1.00	0.89	0.81	0.76
100			1.00	0.92	0.85
120				1.00	0.92
150					1.00

5 Chemset™ Maxima Spin Capsules / Strength Limit State Design

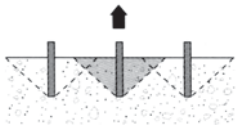


Table 2e Anchor spacing effect, internal to a row, tension, X_{nai} = 1.00

Anchor size, d_b	M10	M12	M16	M20	M24
Spacing, a (mm)					
30	0.50				
35	0.58	0.49			
40	0.67	0.56			
50	0.83	0.69	0.52		
60	1.00	0.83	0.63	0.50	
75		1.00	0.78	0.63	0.52
100			1.00	0.83	0.69
120				1.00	0.83
150					1.00

Checkpoint 2

Design reduced ultimate concrete tensile capacity, $ØN_{urc}$

$ØN_{urc} = ØN_{uc} * X_{nc} * X_{ne} * (X_{nae}$ or $X_{nai})$

Step 3 - Verify anchor tensile capacity – per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n$ = 0.8

Anchor size, d_b	M10	M12	M16	M20	M24
Chemset Anchor Stud Grade 5.8 Carbon Steel	22.7	33.8	64.1	96.5	139.8
Chemset Anchor Stud Grade A4/316 Stainless Steel	26.1	37.9	70.7	110.3	158.9

Step 3b Reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (kN)

Not appropriate for this product.

Checkpoint 3

Design reduced ultimate tensile capacity, $ØN_{ur}$

$ØN_{ur}$ = minimum of $ØN_{urc}$, '$ØN_{us}$

Check $N^* / ØN_{ur} \leqslant 1$,

if not satisfied return to step 1

5 Chemset™ Maxima Spin Capsules / Strength Limit State Design

Step 4 - Verify concrete tensile capacity – per anchor

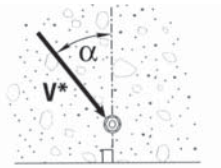
Table 4a Reduced characteristic ultimate concrete edge shear capacity, $\emptyset V_{uc}$ (kN), $\emptyset_q = 0.6\ f'_c = 32$ MPa

Anchor size, d_b	M10	M12	M16	M20	M24
Edge distance, e (mm)					
30	2.4	2.6			
35	3.0	3.2	3.6		
50	5.1	5.5	6.2	7.2	
60	6.7	7.2	8.2	9.4	9.8
75	9.3	10.1	11.4	13.2	13.7
125	20.1	21.7	24.6	28.4	29.5
200	40.6	43.8	49.7	57.4	59.7
300	40.6	80.5	91.3	105.4	109.7
400	40.6	80.5	140.5	162.3	168.9
500	40.6	80.5	140.5	226.8	236.1
600	40.6	80.5	140.5	226.8	310.3
∞	40.6	80.5	140.5	226.8	310.3

Note: Effective depth, h must be ⩾ 6 x drilled hole diameter, d_h for anchor to achieve tabled shear capacities.

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

f'_c (MPa)	20	25	32	40	>50
X_{VC}	0.79	0.88	1.00	1.12	1.25



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

Table 4c Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90-180
X_{Vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

Table 4d Anchor spacing effect concrete edge shear, X_{va} = 1.00

Edge distance, e (mm)	25	30	35	50	60	75	125	200	300	400	500	600
Anchor spacing, a (mm)												
25	0.70	0.67	0.64	0.60	0.58	0.57	0.54					
30	0.74	0.70	0.67	0.62	0.60	0.58	0.55	0.53				
35	0.78	0.73	0.70	0.64	0.62	0.59	0.56	0.54	0.52			
50	0.90	0.83	0.79	0.70	0.67	0.63	0.58	0.55	0.53	0.53		
60	0.98	0.90	0.84	0.74	0.70	0.66	0.60	0.56	0.54	0.53	0.52	
75	1.00	1.00	0.93	0.80	0.75	0.70	0.62	0.58	0.55	0.54	0.53	0.53
150			1.00	1.00	1.00	0.90	0.74	0.65	0.60	0.58	0.56	0.55
200						1.00	0.82	0.70	0.63	0.60	0.58	0.57
300							0.98	0.80	0.70	0.65	0.62	0.60
400							1.00	0.90	0.77	0.70	0.66	0.63
500								1.00	0.83	0.75	0.70	0.67
625									0.92	0.81	0.75	0.71
750									1.00	0.88	0.80	0.75
875										0.94	0.85	0.79
1000										1.00	0.90	0.83
1250											1.00	0.92
1500												1.00

Note: For single anchor designs, X_{va} = 1.0

5 Chemset™ Maxima Spin Capsules / Strength Limit State Design

Table 4e Multiple anchors effect, concrete edge shear, X_{vn} = 1.00

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00

Note: For single anchor designs, X_{vn} = 1.0

Checkpoint 4

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

Step 5 - Verify anchor shear capacity – per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v$ = 0.8

Anchor size, d_b	M10	M12	M16	M20	M24
Chemset Anchor Stud Grade 5.8 Carbon Steel	14.1	21.0	39.7	59.9	86.8
Chemset Anchor Stud Grade A4/316 Stainless Steel	18.7	27.2	50.6	79.0	113.8

Step 5b Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN)

Not appropriate for this product.

Checkpoint 5

Design reduced ultimate shear capacity, $ØV_{ur}$

$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$

Check $V^* / ØV_{ur} \leqslant 1$,

if not satisfied return to step 1

Step 6 - Combined loading and specification

Checkpoint 6

Check

$N^*/ØN_{ur} + V^*/ØV_{ur}, \leqslant 1.2$

if not satisfied return to step 1

Specify – Spin Capsules

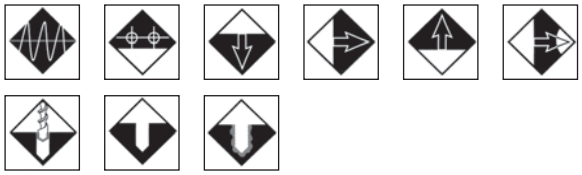
Ramset Chemset Maxima spin capsule, (Capsule Part Number)
with
(Anchor Size) grade 5.8
Chemset Anchor Stud
(Anchor Stud Part Number).

Example

Ramset Chemset Maxima spin capsule,
(CHEM16) with grade 5.8
Chemset Anchor Stud (CA16190).

6 Chemset™ Injection 101 Series

General Information



Product

Chemset Injection 101 Series is a chemical anchor system based on polyester mortar. The two parts are dispensed and mixed in one action through a static mixing nozzle, which allows accurate mixing with no mess.

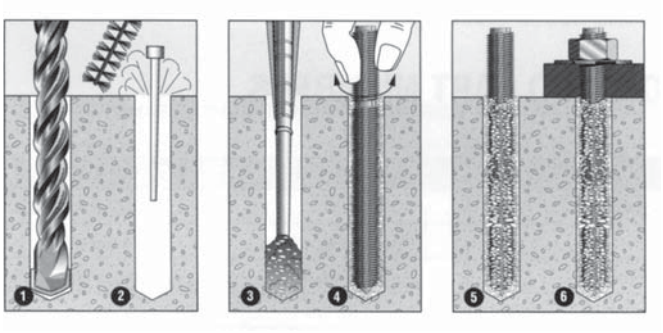
Features

- Close to edge, stress free anchoring.
- Close anchor spacing.
- Suitable for use with zinc plated, hot dipped galvanized or stainless steel Chemset Anchor Studs and Injection Rod
- Resistant to cyclic loading.
- Overhead installation.
- Fast cure.

Principal Application

- Structural beams and columns.
- Batten fixing.
- Installing signs, handrails, balustrades and gates.
- Racking.
- Safety barriers.
- Machinery hold down.

Installation



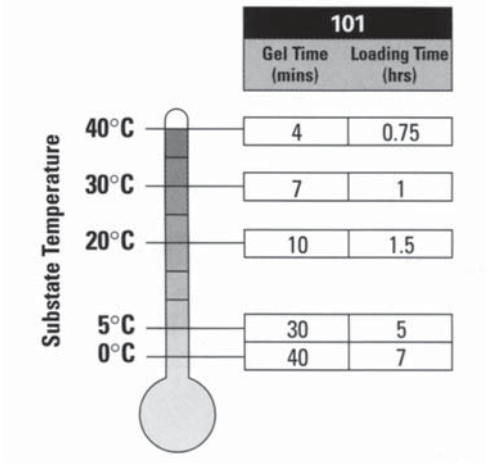
1. Drill recommended diameter and depth hole.
2. Clean hole with hole cleaning brush. Remove all debris using hole blower. Hole may be damp but no water present.
3. Insert mixing nozzle to bottom of hole. Fill hole to $^{3}/_{4}$ the hole depth slowly, ensuring no air pockets form.
4. Insert Ramset Chemset Anchor Stud to bottom of hole while turning.
5. Chemset Injection to cure as per setting times.
6. Attach fixture.

Installation temperature limits:
Substrate: 0°C to 43°C.
Mortar: 15°C to 30°C

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

Service temperature limits:
-10°C to 80°C.

Setting Times



Note: Cartridge temperature minimum 15°C.

6 Chemset™ Injection 101 Series

Installation and Performance Details - Chemset™ Injection 101 Series and Chemset™ Anchor Studs

Anchor size, d_b (mm)	Installation details				Minimum Dimensions*			Reduced Characteristic Capacity			
	Drilled hole Ø, d_h (mm)	Fixture hole Ø, d_f (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	Shear V_a (kN)	Tension N_a (kN)		
								Concrete compressive strength (MPa)			
								20 MPa	20 MPa	32 MPa	40 MPa
M8	10	10	80	10	35	50	100	**8.9**	**6.1**	**8.2**	**9.3**
M10	12	12	90	20	40	60	115	**14.1**	**8.1**	**10.8**	**12.2**
M12	14	15	110	40	50	75	140	**21.0**	**11.6**	**15.5**	**17.5**
M16	18	19	125	95	65	95	160	**39.7**	**18.1**	**24.2**	**27.5**
M20	24	24	150	180	80	120	190	**59.9**	**29.9**	**40.1**	**45.4**
			170				215	**59.9**	**33.9**	**45.4**	**51.4**
M24	26	28	160	315	95	145	200	**86.8**	**44.0**	**58.8**	**66.7**
			210				265	**86.8**	**57.7**	**77.2**	**87.5**

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

Reduced Characteristic

Installation and Performance Details - Chemset™ Injection 101 Series and Chemset™ Injection Rod Anchors

Anchor size, d_b (mm)	Installation details				Minimum Dimensions*			Reduced Characteristic Capacity			
	Drilled hole Ø, d_h (mm)	Fixture hole Ø, d_f (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	Shear V_a (kN)	Tension N_a (kN)		
								Concrete compressive strength (MPa)			
								20 MPa	20 MPa	32 MPa	40 MPa
M12	14	15	110	40	50	75	140	**16.8**	**11.6**	**15.5**	**17.5**
M16	18	19	125	95	65	95	160	**31.2**	**18.1**	**24.2**	**27.5**

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

Reduced Characteristic

Description and Part Numbers

Description	Cartridge Size	Part No.
Chemset 101 Cartridge	400 ml	C101C
Mixer Nozzle for 100 Series	-	ISNP

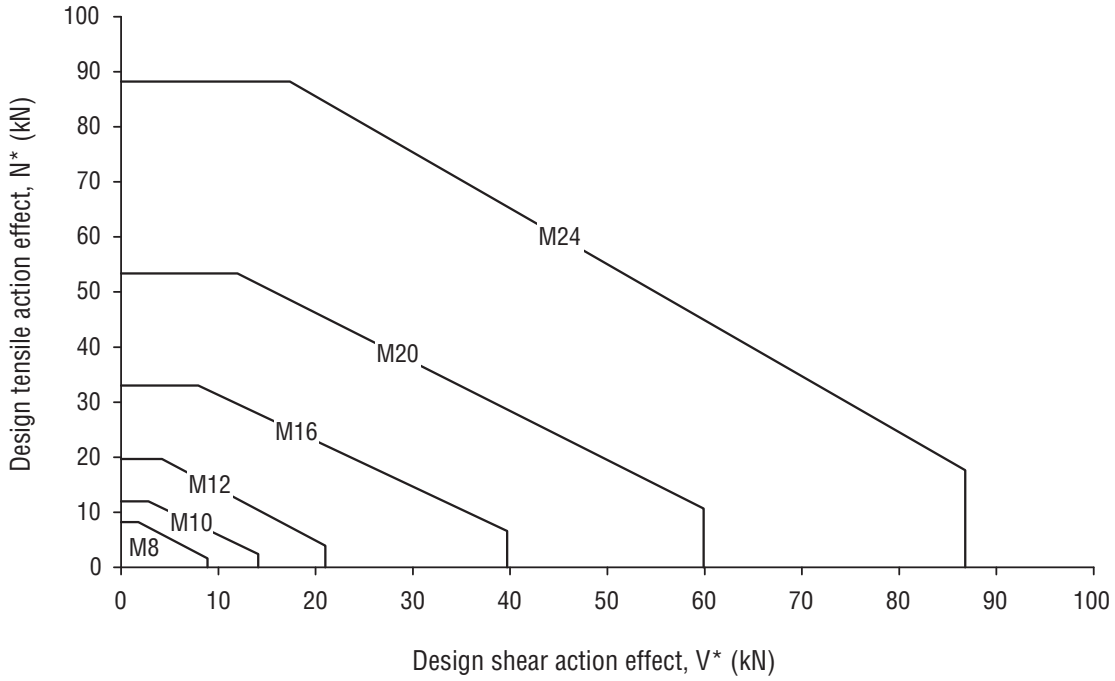
Engineering Properties

Refer to “Engineering Properties” for Chemset Anchor Studs on page 5 and Chemset Injection Rod on page 6.

6 Chemset™ Injection 101 Series / Strength Limit State Design

Step 1 - Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram



Notes:
- Shear limited by grade 5.8 steel capacity.
- Tension limited by concrete capacity using nominal depths.
- No edge or spacing effects.
- f'_c = 32 MPa

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

Anchor size, d_b	M8	M10	M12	M16	M20	M24
e_m, a_m	25	30	35	50	60	75

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

Refer to “Description and Part Numbers” table for either Chemset Anchor Studs (page 5) or Chemset Injection Rod (page 6).

Effective depth, h (mm)

Preferred h = h_n otherwise,

$h = L_e - t$
$h \geq 6 * d_h$

t = total thickness material(s) being fastened.

Checkpoint 1

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

Step 2 - Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, $\emptyset N_{uc}$ (kN), $\emptyset_c$ = 0.6, f'_c = 32 MPa

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Drilled hole dia., d_h (mm)	10	12	14	18	24	26
Effective depth, h (mm)						
60	6.1					
70	7.2	8.4				
80	**8.2**	9.6				
90		**10.8**	12.7			
100		12.0	14.1			
110			**15.5**	21.3		
120			16.9	23.3		
125			17.6	**24.2**		
140			19.7	27.1	37.4	
150				29.1	**40.1**	55.2
160				31.0	42.7	**58.8**
170				33.0	45.4	62.5
180					48.1	66.2
190					50.7	69.9
200					53.4	73.5
210						77.2
220						80.9
230						84.6
240						88.2

Bold values are at Chemset Anchor Stud and Injection Rod nominal depths.

Note: Effective depth, h must be ⩾ 6 x drilled hole diameter, d_h for anchor to achieve tabled shear capacities.

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

f'_c (MPa)	20	25	32	40	>50
X_{nc}	0.87	0.93	1.00	1.07	1.14

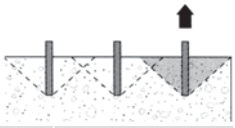


Table 2c Edge distance effect, tension X_{ne} = 1.00

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Edge distance, e (mm)						
25	0.85					
30	0.96	0.83				
35	1.00	0.91	0.81			
40		1.00	0.88			
50			1.00	0.85		
60				0.96	0.83	
65				1.00	0.87	
75					0.96	0.85
80					1.00	0.88
100						1

6 Chemset™ Injection 101 Series / Strength Limit State Design

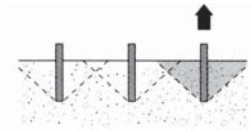


Table 2d Anchor spacing effect, end of a row, tension, X_{nae} = 1.00

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Anchor spacing, a (mm)						
25	0.76					
30	0.81	0.75				
35	0.86	0.79	0.74			
40	0.92	0.83	0.78			
50	1.00	0.92	0.85	0.76		
60		1.00	0.92	0.81	0.75	
75			1.00	0.89	0.81	0.76
100				1.00	0.92	0.85
120					1.00	0.92
150						1.00

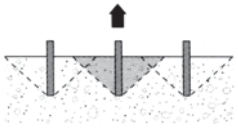


Table 2e Anchor spacing effect, internal to a row, tension, X_{nai} = 1.00

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Anchor spacing, a (mm)						
25	0.52					
30	0.63	0.50				
35	0.73	0.58	0.49			
40	0.83	0.67	0.56			
50	1.00	0.83	0.69	0.52		
60		1.00	0.83	0.63	0.50	
75			1.00	0.78	0.63	0.52
100				1.00	0.83	0.69
120					1.00	0.83
150						1.00

Checkpoint 2

Design reduced ultimate concrete tensile capacity, $ØN_{urc}$

$ØN_{urc} = ØN_{uc} * X_{nc} * X_{ne} * (X_{nae}$ or $X_{nai})$

Step 3 - Verify anchor tensile capacity – per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n = 0.8$

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Chemset Injection Rod Grade 4.6 Carbon Steel	-	-	27.0	50.2	-	-
Chemset Anchor Stud Grade 5.8 Carbon Steel	14.2	22.7	33.8	64.1	96.5	139.8
Chemset Anchor Stud Grade A4/316 Stainless Steel	16.5	26.1	37.9	70.7	110.3	158.9

Step 3b Reduced characteristic ultimate bolt steel tensile capacity, ϕN_{tf} (kN)
Not appropriate for this product.

Checkpoint 3

Design reduced ultimate tensile capacity, ϕN_{ur}
ϕN_{ur} = minimum of ϕN_{urc} ‘ϕN_{us}
Check $N^* / \phi N_{ur} \leqslant 1$,

if not satisfied return to step 1

Step 4 - Verify concrete shear capacity – per anchor

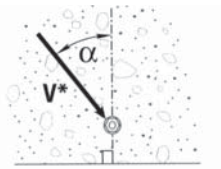
Table 4a Reduced characteristic ultimate concrete edge shear capacity, ϕV_{uc} (kN), $\phi_q = 0.6\ f'_c = 32$ MPa

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Edge distance, e (mm)						
25	1.6					
30	2.2	2.4	2.6			
35	2.7	3.0	3.2	3.6		
50	4.6	5.1	5.5	6.2	7.2	
60	6.1	6.7	7.2	8.2	9.4	9.8
75	8.5	9.3	10.1	11.4	13.2	13.7
125	18.3	20.1	21.7	24.6	28.4	29.5
200	18.3	40.6	43.8	49.7	57.4	59.7
300	18.3	40.6	80.5	91.3	105.4	109.7
400	18.3	40.6	80.5	140.5	162.3	168.9
500	18.3	40.6	80.5	140.5	226.8	236.1
600	18.3	40.6	80.5	140.5	226.8	310.3
∞	18.3	40.6	80.5	140.5	226.8	310.3

Note: Effective depth, h must be ⩾ 6 x drilled hole diameter, d_h for anchor to achieve tabled shear capacities.

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

f'_c (MPa)	20	25	32	40	>50
X_{VC}	0.79	0.88	1.00	1.12	1.25



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

Table 4c Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90-180
X_{Vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

6 Chemset™ Injection 101 Series / Strength Limit State Design

Table 4d Anchor spacing effect concrete edge shear, X_{va} = 1.00

Edge distance, e (mm)	25	30	35	50	60	75	125	200	300	400	500	600
Anchor spacing, a (mm)												
25	0.70	0.67	0.64	0.60	0.58	0.57	0.54					
30	0.74	0.70	0.67	0.62	0.60	0.58	0.55	0.53				
35	0.78	0.73	0.70	0.64	0.62	0.59	0.56	0.54	0.52			
50	0.90	0.83	0.79	0.70	0.67	0.63	0.58	0.55	0.53	0.53		
60	0.98	0.90	0.84	0.74	0.70	0.66	0.60	0.56	0.54	0.53	0.52	
75	1.00	1.00	0.93	0.80	0.75	0.70	0.62	0.58	0.55	0.54	0.53	0.53
150			1.00	1.00	1.00	0.90	0.74	0.65	0.60	0.58	0.56	0.55
200						1.00	0.82	0.70	0.63	0.60	0.58	0.57
300							0.98	0.80	0.70	0.65	0.62	0.60
400							1.00	0.90	0.77	0.70	0.66	0.63
500								1.00	0.83	0.75	0.70	0.67
625									0.92	0.81	0.75	0.71
750									1.00	0.88	0.80	0.75
875										0.94	0.85	0.79
1000										1.00	0.90	0.83
1250											1.00	0.92
1500												1.00

Note: For single anchor designs,X_{va} = 1.0

Table 4e Multiple anchors effect, concrete edge shear, X_{vn} = 1.00

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00

Note: For single anchor designs, X_{vn} = 1.0

Checkpoint 4

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

Step 5 - Verify anchor shear capacity – per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v$ = 0.8

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Chemset Injection Rod Grade 4.6 Carbon Steel	-	-	16.7	31.1	-	-
Chemset Anchor Stud Grade 5.8 Carbon Steel	8.9	14.1	21.0	39.7	59.9	86.8
Chemset Anchor Stud Grade A4/316 Stainless Steel	11.8	18.7	27.2	50.6	79.0	113.8

Step 5b Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN)
Not appropriate for this product.

Checkpoint 5

Design reduced ultimate shear capacity, $ØV_{ur}$
$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$
Check $V^* / ØV_{ur} \leqslant 1$,

if not satisfied return to step 1

Step 6 - Combined loading and specification

Checkpoint 6

Check
$N^*/ØN_{ur} + V^*/ØV_{ur}, \leqslant 1.2$
if not satisfied return to step 1

Specify – Threaded Stud Anchors

Ramset Chemset Injection 101 series with (Anchor Size) grade 5.8
Chemset Anchor Stud ((Anchor Stud Part Number)).
Drilled hole depth to be (h) mm.

Example

Ramset Chemset Injection 101 series with M16 grade 5.8
Chemset Anchor Stud (CS16190). Drilled hole depth to be 125 mm.

Specify – Injection Rod

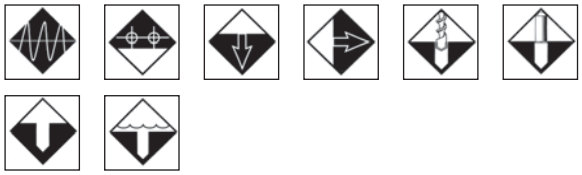
Ramset Chemset Injection 101 series with (Anchor Size) grade 4.6
Chemset Injection Rod ((Injection Rod Part Number)).
Drilled hole depth to be (h) mm.

Example

Ramset Chemset Injection 101 series with M16 grade 4.6
Chemset Injection Rod (CR16190). Drilled hole depth to be 125 mm.

7 Epcon™ C6 Series

General Information



Product

Epcon C6 Series are a chemical anchor system based on epoxy mortar. The two parts are dispensed and mixed in one action through a static mixing nozzle, which allows accurate mixing with no mess.

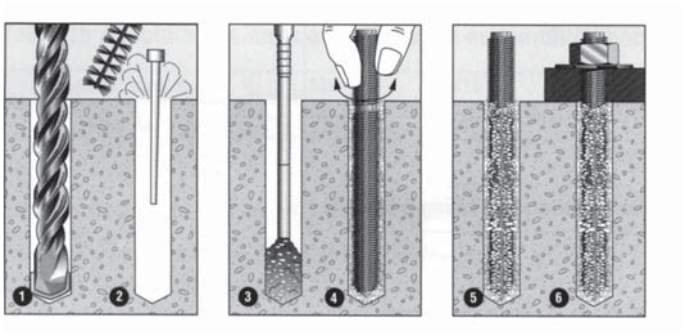
Features

- Superior strength in shallow embedment.
- Close to edge, stress free anchoring.
- Suitable for use with zinc plated, hot dipped galvanized or stainless steel Chemset Anchor Studs.
- Resistant to cyclic loading and vibration.
- Resistant to alkaline conditions.
- Suitable for use in core drilled holes.
- Superior strength with grade 5.8 steel Chemset Anchor Studs.
- Suitable for underwater installations.

Principal Application

- Structural beams and columns.
- Bottom plate and batten fixing.
- Installing sings, handrails, balustrades and gates.
- Racking.
- Safety barriers.
- Stadium seating.
- Machinery and heavy plant hold down.

Installation

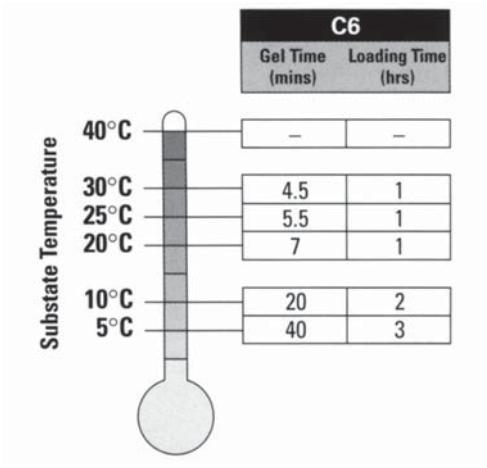


1. Drill recommended diameter and depth hole.
2. Clean hole with hole cleaning brush. Remove all debris using hole blower.
3. Insert mixing nozzle to bottom of hole. Fill hole to ¾ the hole depth slowly, ensuring no air pockets form.
4. Insert Ramset Chemset Anchor Stud to bottom of hole while turning.
5. Epcon to cure as per setting times.
6. Attach fixture.

Installation temperature limits:
Substrate: 5°C to 40°C.
Mortar: 18°C to 35°C

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

Setting Times



Note: Cartridge temperature minimum 15°C.

7 Epcon™ C6 Series

Installation and Performance Details - Epcon™ C6 Series and Chemset™ Anchor Studs

Anchor size, d_b (mm)	Installation details				Minimum Dimensions*			Reduced Characteristic Capacity			
	Drilled hole Ø, d_h (mm)	Fixture hole Ø, d_f (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	Shear V_a (kN)	Tension N_a (kN)		
								Concrete compressive strength (MPa)			
								20 MPa	20 MPa	32 MPa	40 MPa
M8	10	10	80	10	30	50	100	**8.9**	**11.8**	**13.7**	**14.3**
M10	12	12	90	20	40	60	120	**14.1**	**15.4**	**17.8**	**19.0**
M12	14	15	110	40	50	70	140	**21.0**	**22.4**	**25.9**	**27.6**
M16	18	19	125	95	65	100	160	**39.7**	**30.5**	**35.2**	**37.5**
M20	24	24	150	180	80	120	190	**59.9**	**43.8**	**50.6**	**53.9**
			170				220	**59.9**	**52.8**	**61.1**	**65.0**
M24	26	28	160	315	95	145	200	**86.8**	**51.9**	**60.0**	**63.9**
			210				270	**86.8**	**78.0**	**90.2**	**96.1**

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

Reduced Characteristic

Description and Part Numbers

Description	Cartridge Size	Part No.
C6-18 Cartridge	530 ml	C6-18
C6-18 Nozzles	-	E24XL

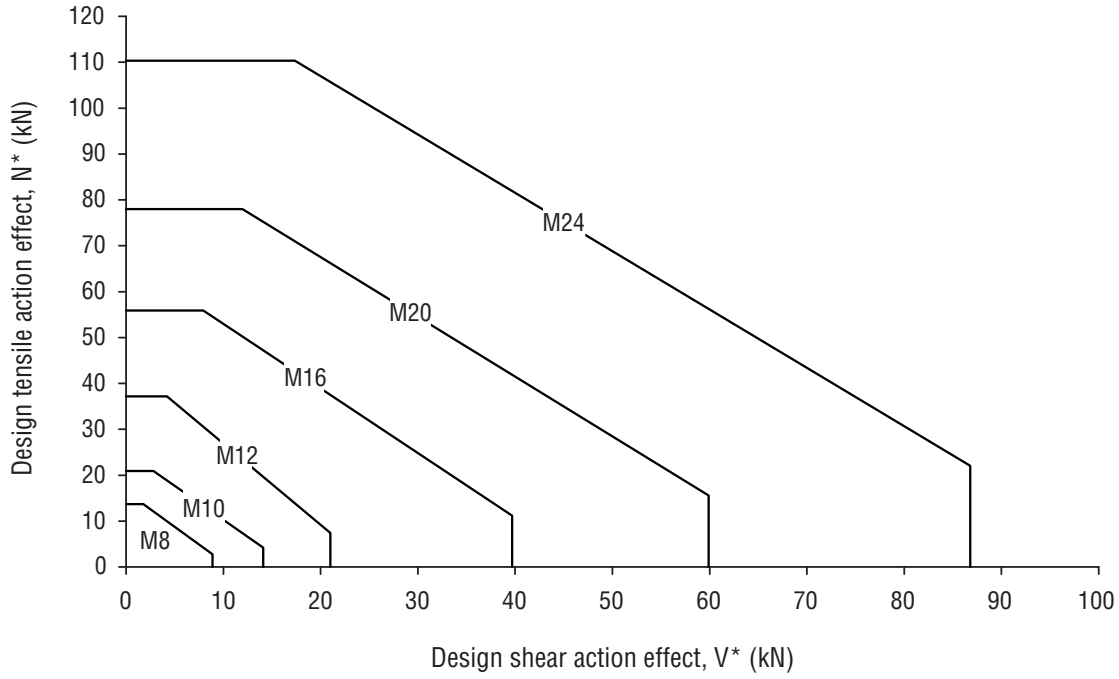
Engineering Properties

Refer to “Engineering Properties” for Chemset Anchor Studs on page 5.

7 Epcon™ C6 Series / Strength Limit State Design

Step 1 - Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram



Notes:

- Shear limited by steel capacity.
- Tension limited by concrete capacity using nominal depths.
- No edge or spacing effects.
- f'_c = 32 MPa

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

Anchor size, d_b	M8	M10	M12	M16	M20	M24
e_m, a_m	25	30	35	50	60	75

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

Refer to “Description and Part Numbers” table for Chemset Anchor Studs on page 5.

Effective depth, h (mm)

Preferred h = h_n otherwise,

$h = L_e - t$
$h \geq 6 * d_h$

t = total thickness material(s) being fastened.

Checkpoint 1

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

Step 2 - Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, ϕN_{uc} (kN), $\phi_c = 0.6$, $f'_c = 32$ MPa

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Drilled hole dia., d_h (mm)	10	12	14	18	24	26
Effective depth, h (mm)						
50						
60	8.9					
70	11.2	12.2				
80	**13.7**	15.0				
90		**17.8**	19.2			
100		20.9	22.5			
110			**25.9**	29.1		
120			29.5	33.1		
125			31.4	**35.2**	38.5	
140			37.2	41.8	45.7	
150				46.3	**50.6**	54.5
160				51.0	55.8	**60.0**
170				55.9	61.1	65.7
180					66.6	71.6
190					72.2	77.7
200					78.0	83.9
210						90.2
220						96.8
230						103.4
240						110.3

Bold values are at Chemset Anchor Stud nominal depths.

Note: Effective depth, h must be ⩾ 6 x drilled hole diameter, d_h for anchor to achieve tabled shear capacities.

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

f'_c (MPa)	20	25	32	40	>50
X_{nc}	0.87	0.93	1.00	1.07	1.14

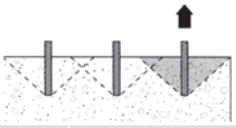


Table 2c Edge distance effect, tension X_{ne} = 1.00

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Edge distance, e (mm)						
25	0.85					
30	0.96	0.83				
35	1.00	0.91	0.81			
40		1.00	0.88			
50			1.00	0.85		
60				0.96	0.83	
65				1.00	0.87	
75					0.96	0.85
80					1.00	0.88
100						1.00

7 Epcon™ C6 Series / Strength Limit State Design

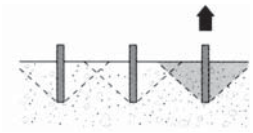


Table 2d Anchor spacing effect, end of a row, tension, X_{nae} = 1.00

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Anchor spacing, a (mm)						
25	0.76					
30	0.81	0.75				
35	0.86	0.79	0.74			
40	0.92	0.83	0.78			
50	1.00	0.92	0.85	0.76		
60		1.00	0.92	0.81	0.75	
75			1.00	0.89	0.81	0.76
100				1.00	0.92	0.85
120					1.00	0.92
150						1.00

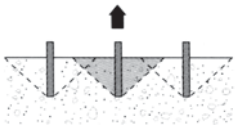


Table 2e Anchor spacing effect, internal to a row, tension, X_{nai} = 1.00

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Anchor spacing, a (mm)						
25	0.52					
30	0.63	0.50				
35	0.73	0.58	0.49			
40	0.83	0.67	0.56			
50	1.00	0.83	0.69	0.52		
60		1.00	0.83	0.63	0.50	
75			1.00	0.78	0.63	0.52
100				1.00	0.83	0.69
120					1.00	0.83
150						1.00

Checkpoint 2

Design reduced ultimate concrete tensile capacity, $ØN_{urc}$

$ØN_{urc} = ØN_{uc} * X_{nc} * X_{ne} * (X_{nae}$ or $X_{nai})$

Step 3 - Verify anchor tensile capacity – per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n = 0.8$

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Chemset Anchor Stud Grade 5.8 Carbon Steel	14.2	22.7	33.8	64.1	96.5	139.8
Chemset Anchor Stud Grade A4/316 Stainless Steel	16.5	26.1	37.9	70.7	110.3	158.9

Step 3b Reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (kN)
Not appropriate for this product.

Checkpoint 3

Design reduced ultimate tensile capacity, $ØN_{ur}$
$ØN_{ur}$ = minimum of $ØN_{urc}$ ‘$ØN_{us}$
Check $N^* / ØN_{ur} \leqslant 1$,

if not satisfied return to step 1

Step 4 - Verify concrete shear capacity – per anchor

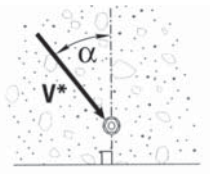
Table 4a Reduced characteristic ultimate concrete edge shear capacity, $ØV_{uc}$ (kN), $Ø_q = 0.6\ f'_c = 32$ MPa

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Edge distance, e (mm)						
25	1.6					
30	2.2	2.4	2.6			
35	2.7	3.0	3.2	3.6		
50	4.6	5.1	5.5	6.2	6.9	
60	6.1	6.7	7.2	8.2	9.0	9.8
75	8.5	9.3	10.1	11.4	12.6	13.7
125	18.3	20.1	21.7	24.6	27.1	29.5
200	18.3	40.6	43.8	49.7	54.9	59.7
300	18.3	40.6	80.5	91.3	100.9	109.7
400	18.3	40.6	80.5	140.5	155.4	168.9
500	18.3	40.6	80.5	140.5	217.2	236.1
600	18.3	40.6	80.5	140.5	217.2	310.3
∞	18.3	40.6	80.5	140.5	217.2	310.3

Note: Effective depth, h must be ⩾ 6 x drilled hole diameter, d_h for anchor to achieve tabled shear capacities.

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

f'_c (MPa)	20	25	32	40	50
X_{VC}	0.79	0.88	1.00	1.12	1.25



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

Table 4c Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90-180
X_{Vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

7 Epcon™ C6 Series / Strength Limit State Design

Table 4d Anchor spacing effect concrete edge shear, X_{va} = 1.00

Edge distance, e (mm)	25	30	35	50	60	75	125	200	300	400	500	600
Anchor spacing, a (mm)												
25	0.70	0.67	0.64	0.60	0.58	0.57	0.54					
30	0.74	0.70	0.67	0.62	0.60	0.58	0.55	0.53				
35	0.78	0.73	0.70	0.64	0.62	0.59	0.56	0.54	0.52			
50	0.90	0.83	0.79	0.70	0.67	0.63	0.58	0.55	0.53	0.53		
60	0.98	0.90	0.84	0.74	0.70	0.66	0.60	0.56	0.54	0.53	0.52	
75	1.00	1.00	0.93	0.80	0.75	0.70	0.62	0.58	0.55	0.54	0.53	0.53
150			1.00	1.00	1.00	0.90	0.74	0.65	0.60	0.58	0.56	0.55
200						1.00	0.82	0.70	0.63	0.60	0.58	0.57
300							0.98	0.80	0.70	0.65	0.62	0.60
400							1.00	0.90	0.77	0.70	0.66	0.63
500								1.00	0.83	0.75	0.70	0.67
625									0.92	0.81	0.75	0.71
750									1.00	0.88	0.80	0.75
875										0.94	0.85	0.79
1000										1.00	0.90	0.83
1250											1.00	0.92
1500												1.00

Note: For single anchor designs,X_{va} = 1.0

Table 4e Multiple anchors effect, concrete edge shear, X_{vn} = 1.00

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00

Note: For single anchor designs, X_{vn} = 1.0

Checkpoint 4

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

Step 5 - Verify anchor shear capacity – per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v$ = 0.8

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Chemset Anchor Stud Grade 5.8 Carbon Steel	8.9	14.1	21.0	39.7	59.9	86.8
Chemset Anchor Stud Grade A4/316 Stainless Steel	11.8	18.7	27.2	50.6	79.0	113.8

Step 5b Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN)
Not appropriate for this product.

Checkpoint 5

Design reduced ultimate shear capacity, $ØV_{ur}$
$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$
Check $V^* / ØV_{ur} \leqslant 1$,

if not satisfied return to step 1

Step 6 - Combined loading and specification

Checkpoint 6

Check
$N^*/ØN_{ur} + V^*/ØV_{ur}, \leqslant 1.2$
if not satisfied return to step 1

Specify – Threaded Stud Anchors

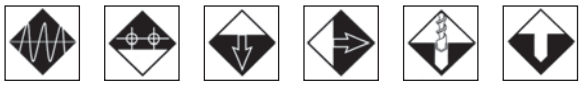
Ramset Epcon C6 series with (Anchor Size) grade 5.8.
Chemset Anchor Stud ((Anchor Stud Part Number)).
Drilled hole depth to be (h) mm.

Example

Ramset Epcon C6 series with M16 grade 5.8
Chemset Anchor Stud (CS16190). Drilled hole depth to be 125 mm.

8 Epcon™ A7 Series

General Information



Product

Epcon A7 Series are a chemical anchor system based on methyl methacrylate mortar. The two parts are dispensed and mixed in one action through a static mixing nozzle, which allows accurate mixing with no mess.

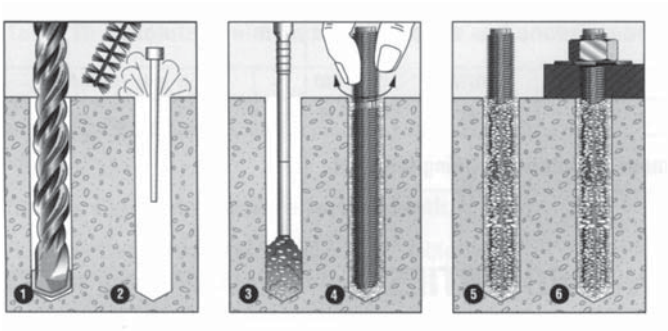
Features

- High strength in shallow embedment.
- Close to edge, stress free anchoring.
- No pre-warming of cartridge required in cold environments.
- Suitable for use with zinc plated, hot dipped galvanized or stainless steel Chemset Anchor Studs.
- Resistant to cyclic loading and vibration.
- High strength with grade 5.8 steel Chemset Anchor Studs.

Principal Application

- Structural beams and columns.
- Batten fixing.
- Installing sings, handrails, balustrades and gates.
- Racking.
- Safety barriers.
- Stadium seating.
- Machinery and heavy plant hold down.

Installation

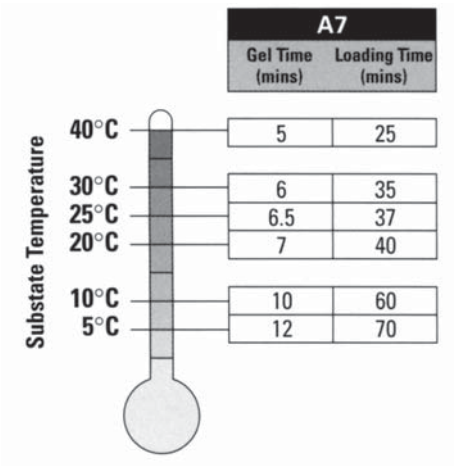


1. Drill recommended diameter and depth hole.
2. Clean hole with hole cleaning brush. Remove all debris using hole blower. Hole may be damp but no water present.
3. Insert mixing nozzle to bottom of hole. Fill hole to ¾ the hole depth slowly, ensuring no air pockets form.
4. Insert Ramset Chemset Anchor Stud/rebar to bottom of hole while turning.
5. Epcon A7 to cure as per setting times.
6. Attach fixture.

Installation temperature limits:
Substrate: -20°C to 40°C.
Mortar: 0°C to 40°C

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

Approximate Setting Times



8 Epcon™ A7 Series

Installation and Performance Details - Epcon™ A7 Series and Chemset™ Anchor Studs

Anchor size, d_b (mm)	Installation details				Minimum Dimensions*			Reduced Characteristic Capacity			
	Drilled hole Ø, d_h (mm)	Fixture hole Ø, d_f (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	Shear V_a (kN)	Tension N_a (kN)		
								Concrete compressive strength (MPa)			
								20 MPa	20 MPa	32 MPa	40 MPa
M8	10	10	80	10	30	50	100	**8.9**	**10.6**	**12.3**	**13.1**
M10	12	12	90	20	40	60	120	**14.1**	**13.9**	**16.0**	**17.1**
M12	14	15	110	40	50	70	140	**21.0**	**20.2**	**23.3**	**24.8**
M16	18	19	125	95	65	100	160	**39.7**	**27.4**	**31.7**	**33.8**
M20	24	24	150	180	80	120	190	**59.9**	**39.4**	**45.5**	**48.5**
			170				220	**59.9**	**47.5**	**55.0**	**58.5**
M24	26	28	160	315	95	145	200	**86.8**	**46.7**	**54.0**	**57.5**
			210				270	**86.8**	**70.2**	**81.2**	**86.4**

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

Reduced Characteristic

Description and Part Numbers

Description	Cartridge Size	Part No.
A7-28 Cartridge	825 ml	A7-28
A7-28 Nozzles	-	A50
A7-10 Cartridge	275 ml	A7-10
A7-10 Nozzles	-	A24

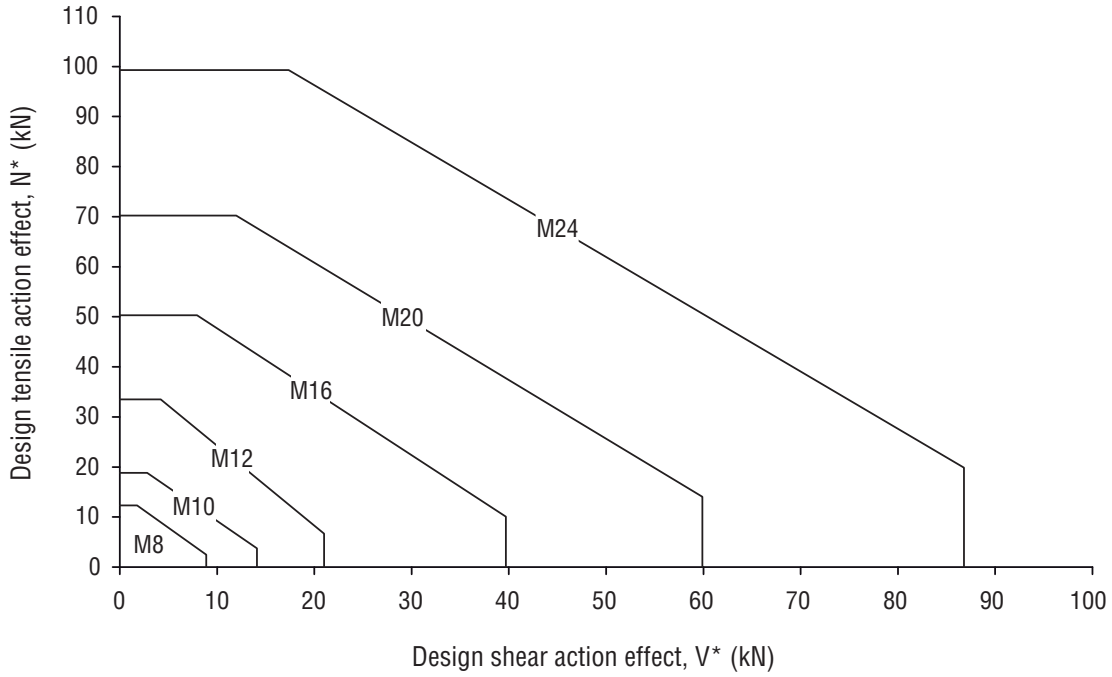
Engineering Properties

Refer to “Engineering Properties” for Chemset Anchor Studs on page 5.

8 Epcon™ A7 Series / Strength Limit State Design

Step 1 - Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram



Notes:

- Shear limited by steel capacity.
- Tension limited by concrete capacity using nominal depths.
- No edge or spacing effects.
- f'_c = 32 MPa

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

Anchor size, d_b	M8	M10	M12	M16	M20	M24
e_m, a_m	25	30	35	50	60	75

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

Refer to “Description and Part Numbers” table for Chemset Anchor Studs on page 5.

Effective depth, h (mm)

Preferred h = h_n otherwise,

$h = L_e - t$
$h \geq 6 * d_h$

t = total thickness material(s) being fastened.

Checkpoint 1

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

Step 2 - Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, $\emptyset N_{uc}$ (kN), $\emptyset_c$ = 0.6, f'_c = 32 MPa

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Drilled hole dia., d_h (mm)	10	12	14	18	24	26
Effective depth, h (mm)						
50						
60	8.0					
70	10.1	11.0				
80	**12.3**	13.5				
90		**16.0**	17.3			
100		18.8	20.3			
110			**23.3**	26.2		
120			26.6	29.8		
125			28.3	**31.7**	34.7	
140			33.5	37.6	41.1	
150				41.7	**45.5**	49.1
160				45.9	50.2	**54.0**
170				50.3	**55.0**	59.1
180					59.9	64.4
190					65.0	69.9
200					70.2	75.5
210						**81.2**
220						87.1
230						93.1
240						99.3

Bold values are at Chemset Anchor Stud nominal depths.
Note: Effective depth, h must be ⩾ 6 x drilled hole diameter, d_h for anchor to achieve tabled shear capacities.

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

f'_c (MPa)	20	25	32	40	>50
X_{nc}	0.87	0.93	1.00	1.07	1.14

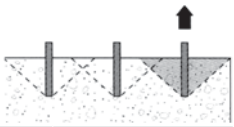


Table 2c Edge distance effect, tension X_{ne} = 1.00

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Edge distance, e (mm)						
25	0.85					
30	0.96	0.83				
35	1.00	0.91	0.81			
40		1.00	0.88			
50			1.00	0.85		
60				0.96	0.83	
65				1.00	0.87	
75					0.96	0.85
80					1.00	0.88
100						1.00

8 Epcon™ A7 Series / Strength Limit State Design

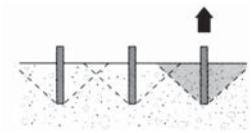


Table 2d Anchor spacing effect, end of a row, tension, X_{nae} = 1.00

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Anchor spacing, a (mm)						
25	0.76					
30	0.81	0.75				
35	0.86	0.79	0.74			
40	0.92	0.83	0.78			
50	1.00	0.92	0.85	0.76		
60		1.00	0.92	0.81	0.75	
75			1.00	0.89	0.81	0.76
100				1.00	0.92	0.85
120					1.00	0.92
150						1.00

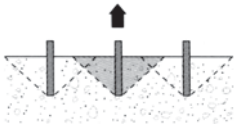


Table 2e Anchor spacing effect, internal to a row, tension, X_{nai} = 1.00

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Anchor spacing, a (mm)						
25	0.52					
30	0.63	0.50				
35	0.73	0.58	0.49			
40	0.83	0.67	0.56			
50	1.00	0.83	0.69	0.52		
60		1.00	0.83	0.63	0.50	
75			1.00	0.78	0.63	0.52
100				1.00	0.83	0.69
120					1.00	0.83
150						1.00

Checkpoint 2

Design reduced ultimate concrete tensile capacity, $ØN_{urc}$

$ØN_{urc} = ØN_{uc} * X_{nc} * X_{ne} * (X_{nae}$ or $X_{nai})$

Step 3 - Verify anchor tensile capacity – per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n = 0.8$

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Chemset Anchor Stud Grade 5.8 Carbon Steel	14.2	22.7	33.8	64.1	96.5	139.8
Chemset Anchor Stud Grade A4/316 Stainless Steel	16.5	26.1	37.9	70.7	110.3	158.9

Step 3b Reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (kN)
Not appropriate for this product.

Checkpoint 3

Design reduced ultimate tensile capacity, $ØN_{ur}$
$ØN_{ur}$ = minimum of $ØN_{urc}$ ‘$ØN_{us}$
Check $N^* / ØN_{ur} \leqslant 1$,

if not satisfied return to step 1

Step 4 - Verify concrete shear capacity – per anchor

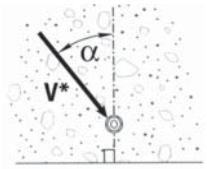
Table 4a Reduced characteristic ultimate concrete edge shear capacity, $ØV_{uc}$ (kN), $Ø_q = 0.6\ f'_c = 32$ MPa

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Edge distance, e (mm)						
25	1.6					
30	2.2	2.4	2.6			
35	2.7	3.0	3.2	3.6		
50	4.6	5.1	5.5	6.2	6.9	
60	6.1	6.7	7.2	8.2	9.0	9.8
75	8.5	9.3	10.1	11.4	12.6	13.7
125	18.3	20.1	21.7	24.6	27.1	29.5
200	18.3	40.6	43.8	49.7	54.9	59.7
300	18.3	40.6	80.5	91.3	100.9	109.7
400	18.3	40.6	80.5	140.5	155.4	168.9
500	18.3	40.6	80.5	140.5	217.2	236.1
600	18.3	40.6	80.5	140.5	217.2	310.3
∞	18.3	40.6	80.5	140.5	217.2	310.3

Note: Effective depth, h must be ⩾ 6 x drilled hole diameter, d_h for anchor to achieve tabled shear capacities.

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

f'_c (MPa)	20	25	32	40	50
X_{VC}	0.79	0.88	1.00	1.12	1.25



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

Table 4c Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90-180
X_{Vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

8 Epcon™ A7 Series / Strength Limit State Design

Table 4d Anchor spacing effect concrete edge shear, X_{va} = 1.00

Edge distance, e (mm)	25	30	35	50	60	75	125	200	300	400	500	600
Anchor spacing, a (mm)												
25	0.70	0.67	0.64	0.60	0.58	0.57	0.54					
30	0.74	0.70	0.67	0.62	0.60	0.58	0.55	0.53				
35	0.78	0.73	0.70	0.64	0.62	0.59	0.56	0.54	0.52			
50	0.90	0.83	0.79	0.70	0.67	0.63	0.58	0.55	0.53	0.53		
60	0.98	0.90	0.84	0.74	0.70	0.66	0.60	0.56	0.54	0.53	0.52	
75	1.00	1.00	0.93	0.80	0.75	0.70	0.62	0.58	0.55	0.54	0.53	0.53
150			1.00	1.00	1.00	0.90	0.74	0.65	0.60	0.58	0.56	0.55
200						1.00	0.82	0.70	0.63	0.60	0.58	0.57
300							0.98	0.80	0.70	0.65	0.62	0.60
400							1.00	0.90	0.77	0.70	0.66	0.63
500								1.00	0.83	0.75	0.70	0.67
625									0.92	0.81	0.75	0.71
750									1.00	0.88	0.80	0.75
875										0.94	0.85	0.79
1000										1.00	0.90	0.83
1250											1.00	0.92
1500												1.00

Note: For single anchor designs,X_{va} = 1.0

Table 4e Multiple anchors effect, concrete edge shear, X_{vn} = 1.00

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00

Note: For single anchor designs, X_{vn} = 1.0

Checkpoint 4

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

Step 5 - Verify anchor shear capacity – per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v$ = 0.8

Anchor size, d_b	M8	M10	M12	M16	M20	M24
Chemset Threaded Stud Grade 5.8 Carbon Steel	8.9	14.1	21.0	39.7	59.9	86.8
Chemset Threaded Stud A4/316 Stainless Steel	11.8	18.7	27.2	50.6	79.0	113.8

Step 5b Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN)
Not appropriate for this product.

Checkpoint 5

Design reduced ultimate shear capacity, $ØV_{ur}$
$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$
Check $V^* / ØV_{ur} \leqslant 1$,

if not satisfied return to step 1

Step 6 - Combined loading and specification

Checkpoint 6

Check
$N^*/ØN_{ur} + V^*/ØV_{ur}, \leqslant 1.2$
if not satisfied return to step 1

Specify – Threaded Stud Anchors

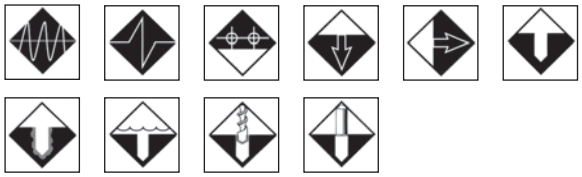
Ramset Epcon A7 series with (Anchor Size)
grade 5.8
Chemset Anchor Stud ((Anchor Stud Part Number)).
Drilled hole depth to be (h) mm.

Example

Ramset Epcon A7 series with M16 grade 5.8
Chemset Anchor Stud (CS16190). Drilled hole depth to be 125 mm.

9 Chemset™ REO 502

General Information



Product

Chemset™ REO 502 is a long working time, fast cure, heavy duty, aliphatic amine / epoxy injection anchor.

Features

Greater productivity
- Shorter 500 MPa bar development lengths from high bond strength - faster installation.
- Anchors in dry, damp, wet or flooded holes - no weather delays.
- Fast 3 hour cure time.
- Easy dispensing

Greater security
- AS3600 - 2001 500 MPa bar development lengths certified to AS/NZS4671 -2001.
- Specially formulated for AS/NZS4671 -2001 Grade 500 reinforcing bars.
- Long 15 minute working time to allow full bar insertion.

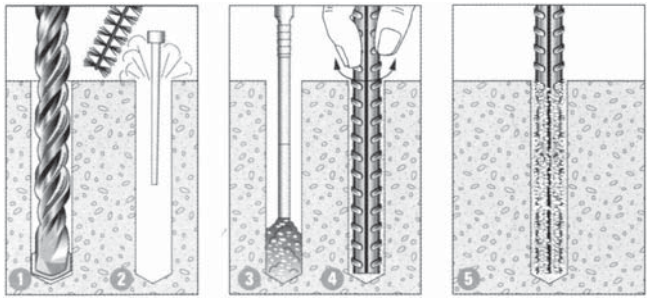
Versatile
- Anchors in dry, damp, wet and flooded holes.
- Anchors in carbide drilled and diamond core holes.
- For tropical and temperate climates.

Greater safety
- Low odour.
- Non-flammable.

Principal Application

- Grade 500 reinforcing bars.
- Starter bars.
- Deformed bars.

Installation



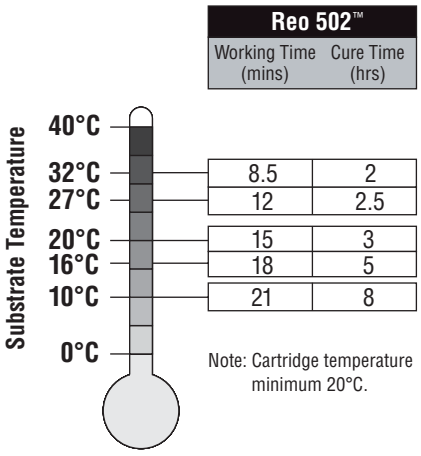
1. Drill recommended diameter and depth hole.
2. Clean hole with hole cleaning brush. Remove all debris using hole blower.
3. Insert mixing nozzle to bottom of hole. Fill hole to ¾ the hole depth slowly, ensuring no air pockets form.
4. Insert Grade 500 reinforcing bar to bottom of hole while turning.
5. Allow Chemset™ REO 502 to cure as per setting times.

Installation temperature limits:
Substrate: 5°C to 40°C.
Mortar: 20°C to 32°C.

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

Service temperature limits:
-10°C to 80°C

Approximate Setting Times



9 Chemset™ REO 502

Description and Part Numbers

Description	Cartridge Size	Part No.	Working time @ 20ºC	Cure time @ 20ºC
Chemset REO 502J	750mL	REO502J	15 mins	3 hours

For detailed description see Ramset Chemset REO 502 Addendum 1.0

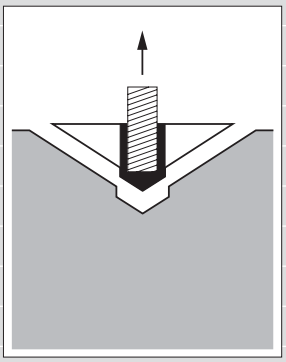
Bar Ø	10	12	16	20	25	32	40
Reduced (0.8) Ultimate Tensile Capacity kN (500E)	31.4	45.2	80.4	125.6	196.4	321.6	504.0
Hole Ø (mm)	14	16	20	25	30	40	50

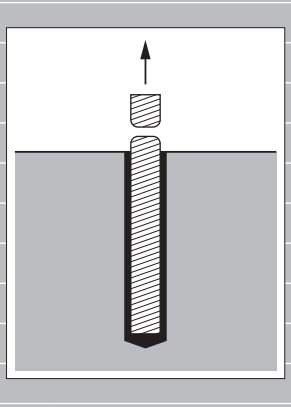
Step 1

Table 1a Nominal steel yield development length $L_{sy.t}$ (nom) of Grade 500 reinforcing bar in tension post installed in 32MPa concrete with Chemset REO502J

= Yield

Bar Ø	10	12	16	20	25	32	40
$L_{sy.t}$ (nom)	Reduce Characteristic Ultimate Tensile Capacity of Concrete and Reinforcing (kN)						
102.0	18.8						
120	22.2						
140	25.9	27.1					
170*	31.4	33.0					
180	Yield	34.9					
207.6		40.3	48.2				
233.1*		45.2	54.1				
290		Yield	67.3	80.4			
310			71.9	85.9			
346.5*			80.4	96.0			
385			Yield	106.7	123.5		
435				120.6	139.5		
453.2*				125.6	145.3		
565				Yield	181.2	228.0	
580					186.0	234.1	
612.5*					196.4	247.2	
680					Yield	274.2	328.0
740						298.7	356.9
796.8*						321.6	384.3
850						Yield	410.0
920							443.7
1045*							504.0
1100							Yield





* Nominal steel yield development length for Grade 500 Bar

9 Chemset™ REO 502

Table 1b concrete compressive strength

fc (MPa)	20	25	32	>40
X_{nc}	1.10	1.05	1.00	0.96

Table 1c effect of steel grade, Xs_g

Steel Grade	300	500
X_{sg}	0.60	1.00

Table 1d effect of water in hole, X_{wh}

Condition	Dry	Wet
X_{wh}	0.60	1.00

Checkpoint 1

Note: Anchoring Resource Book design worksheet not applicable for this product.
Design reinforcing bar steel development length $L_{sy.t}$
$L_{sy.t} = L_{sy.t}$ (nom) $*X_{nc} *X_{sg} *X_{wh}$
$L_{sy.t}$ = _____* _____* _____* _____ mm
$L_{sy.t}$ = _____ mm

Checkpoint 2

Is there sufficient concrete thickness to install bar
$L_{sy.t}$ = Available concrete thickness ☐ OK
Apply factors and other design limitations as per:
NZS3101:Part 1:2006

Specify – Chemset REO 502

Ramset Chemset REO 502 with (Bar Size) deformed (Bar Grade) reinforcing bar. Drill hole diameter () to depth ($L_{sy.t}$)mm

Example

Ramset Chemset RE0 502 with 12mm deformed 500E reinforcing bar. Drilled hole diameter 16mm to depth 350mm.

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5J Miro Place, Albany
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e northshore@ramset.co.nz

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e auckland@ramset.co.nz

Auckland - Henderson
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f 09 837 3014
e henderson@ramset.co.nz

Auckland - East Tamaki
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f 09 272 4703
e easttamaki@ramset.co.nz

Whangarei
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f 09 438 9188
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Hamilton
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f 07 847 9980
e hamilton@ramset.co.nz

Tauranga - Mt Maunganui
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p 07 572 0520
f 07 572 0530
e tauranga@ramset.co.nz

Rotorua
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f 07 348 9200
e rotorua@ramset.co.nz

New Plymouth
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f 06 759 8983
e newplymouth@ramset.co.nz

Palmerston North
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f 06 357 6775
e palmerstonnorth@ramset.co.nz

Napier - Onekawa
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f 06 843 0043
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