CHEM-GRANITE™ Super

- a 2-component anchoring adhesive packaged in a self-mixing injection cartridge
- developed for post-installed anchorages of steel threaded rods and rebar into concrete substrates. Also highly effective for anchorages into rock, solid brick, hollow brick and block
- special acrylated epoxy resin formulation optimises wettablility, temperature tolerance, creep resistance and bond strength

Tenn®
FASTENING SYSTEMS

The Chem-Granite Super cartridge consists of a cylinder within a cylinder. The outer cylinder contains epoxy resin and the inner cylinder is filled with resin hardener. Using a dispensing gun, the resin and hardener components are simultaneously extruded into the mixing nozzle where they react and combine to form the high strength Chem-Granite Super chemical mortar.

An anchorage is accomplished by injecting the mortar into a drilled hole and then rotating a steel rod into it until reaching the bottom of the hole. The twisting motion displaces air, distributes and packs the mortar onto the surfaces of the steel rod and the wall of the hole. The mortar hardens within minutes to solidly and permanently bond the steel to the surrounding substrate.

ADVANTAGES

- *Pre-measured components*
- *One cartridge for all sizes of rebar and threaded rod bolts*
- *Suitable for use in damp conditions: indoor and outdoor*
- *For dynamic, vibratory and static loading*
- *Minimal shrinkage*
- *Excellent long-term performance*
- *Protect, seal and strengthen weak base materials*
- *Excellent chemical resistance, especially in alkaline media*
- *High loads at close spacing and edge distances*

TYPICAL APPLICATIONS

- Starter bars in concrete
- Hold-down bolts for machinery
- Lift guide-rails
- Cladding restraints
- Curtainwalling
- Safety fences
- Structural steel beams and columns
- Highway safety barriers
- Attaching steel angles in brickwork
- Attaching WCs and washbasin brackets

SUITABLE BASE MATERIALS

Concrete
Lightweight concrete
Solid brickwork and blockwork
Rock
Hollow brick and block*

** The use of perforated tubes is required for applications in hollow brick or block.*

MATERIAL PROPERTIES

Basic material:
Epoxy acrylate resin and hardener

Mixing ratio: 10:1

Viscosity: Thixotropic gel

Colour after mixing: Dark grey

Water absorption: None

Shrinkage: Not measurable

Heat deflection temperature (ASTM D 648-82): 63°C

Compressive strength (ASTM 638): 70.9 N/mm^2

Tensile strength (ASTM D 638): 28.4 N/mm^2

Elongation ASTM D638: 0.53%

Flexural strength (ASTM 790): 7 N/mm^2

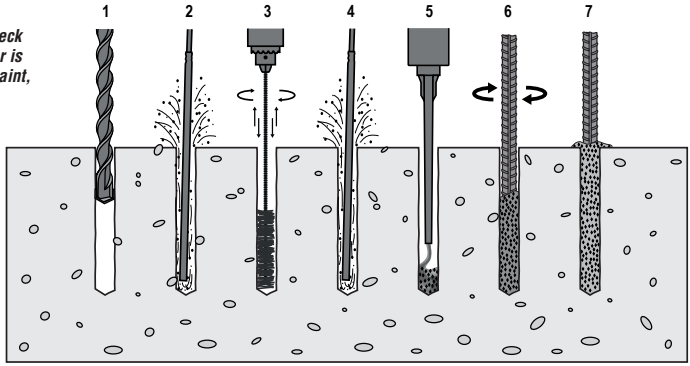
Elastic modulus: 6760 N/mm^2

Flexural modulus: 3250 N/mm^2

Shelf life: 12 months (stored 5°C to 25°C)

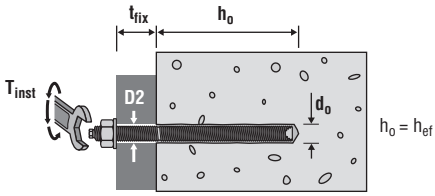
HOW TO USE

Before installing check that the bolt or rebar is free of loose rust, paint, oil and grease.



1. Drill hole to required diameter and depth.
2. Blow out dust.
3. Brush wall of hole with a steel wire brush.
4. Blow out remaining dust.
5. Waste about 50 mm of unblended adhesive or until mixed to a uniform grey colour. ***(Note: Do not use adhesive that is not blended.)*** Inject adhesive from bottom toward top, filling the hole to approximately two-thirds full.
6. Immediately insert steel bolt or rebar into adhesive, turning it slowly by hand. This stirring action is to expel air bubbles, thereby allowing the adhesive to coat the bonding surfaces.
7. Leave undisturbed until the adhesive hardens.

THREADED ROD APPLICATIONS



BOLT DATA

Material	Mechanical properties	
	Ultimate tensile strength f_{uk}	Min. yield stress f_{yk}
	N/mm²	N/mm²
Carbon steel Grade 5.8	500	400
Stainless steel Gr 304 (A2) Gr 316 (A4)		
≤ M16	700	450
≥ M20	500	250

Bolt size d_s	Cross-sectional area A_s	Min. breaking load			
		Carbon steel		Stainless steel	
		Tension $N_{Rk,s}$	Shear $V_{Rk,s}$	Tension $N_{Rk,s}$	Shear $V_{Rk,s}$
mm	mm²	kN	kN	kN	kN
M8	36.6	18.3	10.0	25.6	14.0
M10	58.0	29.0	15.9	40.6	22.3
M12	84.3	42.1	23.1	59.0	32.4
M16	157.0	78.5	43.1	109.9	60.4
M20	245.0	122.5	67.3	122.5	67.3
M24	353.0	176.5	97.0	176.5	97.0

INSTALLATION DATA

Bolt dimensions d_s x l	**Anchorage depth** h_{ef}	**Max. fixture thickness** t_{fix}	**Min. concrete thickness** h	**Drill hole diameter** d_o	**Clearance hole in attachment** D2	**Max. tightening torque** t_{inst}	**Max. number of installations obtainable from one cartridge**[1]
mm	mm	mm	mm	mm	mm	Nm	–
M8 x 110	80	18	120	10	9	11	93
M8 x 130	80	35	120	10	9	11	93
M8 x 130	100	18	150	10	9	11	75
M10 x 130	100	15	150	12	12	22	58
M10 x 160	100	45	150	12	12	22	58
M10 x 160	120	25	180	12	12	22	48
M12 x 160	120	20	180	14	14	38	38
M12 x 200	120	60	180	14	14	38	38
M12 x 200	145	35	200	14	14	38	32
M16 x 190	145	20	200	18	18	95	23
M16 x 240	145	70	200	18	18	95	23
M16 x 240	190	25	250	18	18	95	17
M20 x 260	180	50	250	24	22	170	8
M20 x 300	180	90	250	24	22	170	8
M20 x 300	240	30	300	24	22	170	6
M24 x 300	215	40	280	28	26	260	5
M24 x 360	215	100	280	28	26	260	5
M24 x 360	290	30	360	28	26	260	4

[1] Actual number of installations obtained may vary depending on hole surface roughness, depth drilled and wastage.

DERIVATION OF CHEM-GRANITE™ SUPER CHARACTERISTIC BOND STRESS

Concrete: C20/25		**Notation**	**Units**	**Bolt size** d_s					
				M8	**M10**	**M12**	**M16**	**M20**	**M24**
Anchorage depth		h_{ef}	mm	80	100	120	145	180	215
Bond surface area $A_b = \pi * d_s * h_{ef}$		A_b	mm²	2009	3140	4521	7284	11304	16202
Summary of pull results	#1	N_u^t	kN	22.6	28.6	42.2	86.2	105.5	138.9
	#2			23.1	32.2	39.3	83.2	123.2	130.1
	#3			16.9	20.9	47.7	85.4	126.2	156.6
	#4			18.4	28.7	49.4	78.5	88.4	160.3
	#5			19.6	30.5	51.5	93.7	101.8	132.4
	#6			18.2	29.6	48.2	81.9	114.1	–
	#7			21.8	31.5	44.2	92.8	98.6	–
	#8			20.7	31.0	46.0	77.4	127.1	–
Analysis:									
Number of tests		n	–	8	8	8	8	8	5
Average of results		$N_{u,m}^t$	kN	20.17	29.12	46.06	84.88	110.61	143.66
Standard deviation		σ	kN	2.26	3.56	4.00	5.98	14.27	13.94
Co-efficient of variation		v	%	11.2	12.2	8.6	7.0	12.9	9.7
Constant for n		k	–	2.75	2.75	2.75	2.75	2.75	3.4
Characteristic tension load $N_{Rk\,5\%} = N_{u,m}^t - (k*\sigma)$		$N_{Rk\,5\%}$	kN	13.95	19.33	35.06	68.43	71.36	96.26
Characteristic bond stress $\tau_{Rk} = N_{Rk\,5\%}/A_b$		τ_{Rk}	**N/mm²**	**6.94**	**6.15**	**7.75**	**9.39**	**6.31**	**5.94**

CHARACTERISTIC, DESIGN AND RECOMMENDED LOADS in Concrete ≥ C20/25

Bolt size d_s	Anchorage depth h_{ef}	Characteristic bond stress $\tau_{Rk,m}$	Characteristic load		Design load		Recommended load	
			Tension[1] N_{Rk}	Shear $V_{Rk,s}$	Tension[2] N_{Rd}	Shear[3] $V_{Rk,s}$	Tension[4] N_{rec}	Shear[5] V_{rec}
mm	mm	N/mm²	kN	kN	kN	kN	kN	kN
M8	80	6.94	13.9	10.0	5.5	8.0	3.9	5.7
M8	100	6.94	17.4	10.0	6.9	8.0	4.9	5.7
M10	100	6.15	19.3	15.9	7.6	12.7	5.4	9.0
M10	120	6.15	23.1	15.9	9.1	12.7	6.4	9.0
M12	120	7.76	35.0	23.1	13.8	18.4	9.8	13.1
M12	145	7.76	42.3	23.1	16.7	18.4	11.9	13.1
M16	145	9.39	68.4	43.1	27.1	34.4	19.3	24.5
M16	190	9.39	89.6	43.1	35.5	34.4	25.3	24.5
M20	180	6.31	71.3	67.3	28.2	53.8	20.1	38.4
M20	240	6.31	95.1	67.3	37.7	53.8	26.9	38.4
M24	215	5.94	96.2	97.0	38.1	77.6	27.2	55.4
M24	290	5.94	129.8	97.0	51.5	77.6	36.7	55.4

[1]Characteristic tension load derived from $N_{Rk} = \pi * d_s * h_{ef} * \tau_{Rk}$
[2]Design tension load calculated from N_{Rk}/γ_{Mc} (γ_{Mc} = 2.52)
[3]Design shear load calculated from $V_{Rk,s}/\gamma_{Ms,V}$ ($\gamma_{Ms,V}$ = 1.25)
[4,5]Recommended loads N_{rec} & V_{rec} are obtained by dividing the design loads by an additional safety factor of 1.4.

PARTIAL SAFETY FACTOR γ_{Mc}

γ_{Mc} = partial safety factor for concrete cone failure, splitting failure (γ_{Msp}), pull-out failure (γ_{Mp}), pry-out failure and concrete edge failure

$\gamma_{Mc} = \gamma_c * \gamma_1 * \gamma_2$

where:

γ_c = partial factor for concrete under compression.
$\gamma_c = 1.5$.

γ_1 = partial factor taking into account the scatter of concrete tensile strength across the job-site.
$\gamma_1 = 1.2$.

γ_2 = partial factor for installation safety.
$\gamma_2 = 1.2$ for static loading
$\gamma_2 = 14$ for dynamic loading.

SPACING AND EDGE DISTANCE

Bolt size d_s	Effective embedment depth h_{ef}	Critical edge distance		Critical spacing
		Tension c_{cr},N	Shear c_{cr},V	Tension & Shear s_{cr},N & s_{cr},V
mm	mm	mm	mm	mm
M8	80	80	100	100
M8	100	80	100	100
M10	100	100	130	130
M10	120	100	130	130
M12	120	120	150	150
M12	145	120	150	150
M16	145	145	170	170
M16	190	145	170	170
M20	180	180	200	200
M20	240	180	200	200
M24	215	215	240	240
M24	290	215	240	240

Fig. 1

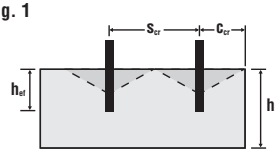
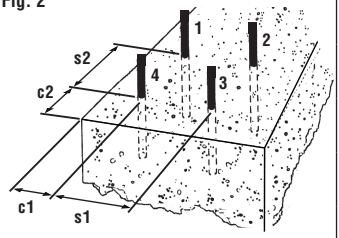
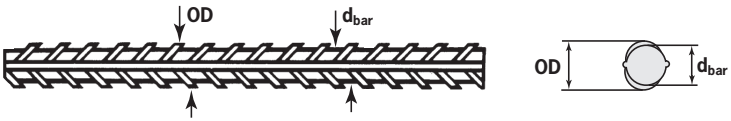


Fig. 2



The critical spacing and edge distances shown above are the minimum required to achieve full load capacity. Where actual distances are less than c_{cr} and s_{cr}, the loads must be reduced by a percentage corresponding to the percentage of reduction in critical spacing/distance. The capacity of a group of 2 or more anchors shall be determined by the capacity of the most unfavourably positioned anchor. In example – Fig. 2 – above, the most unfavourably placed anchor is Anchor #4 being affected by two edges and two spacings.



REBAR DATA

Material	Mechanical properties	
	Ultimate tensile strength f_{uk}	Min. yield stress f_{yk}
	N/mm²	N/mm²
Carbon steel deformed bar Grade B500B	550	500

Rebar size d_{bar}	Outside diameter OD	Cross-sectional area A_s	Relative rib area $f_{R,min}$	Characteristic load[1] $N_{Rk,s}$	Design load[2] $N_{yd,s}$
mm	mm	mm²	–	kN	kN
10	11.5	78.5	0.040	43.1	30.7
12	13.9	113.0	0.040	62.1	44.3
16	18.7	201.0	0.056	110.5	78.9
20	23.4	314.0	0.056	172.7	123.3
25	29.2	490.6	0.056	269.8	192.7

[1] $N_{Rk,s} = A_s * f_{uk}$ (N) [2] $N_{Rd,s} = N_{Rk,s} / \gamma_{Ms,N}$ ($\gamma_{Ms,N} = 1.4$)

INSTALLATION DATA

Rebar size d_{bar}	Drill hole diameter d_o	Anchorage length l_v	Max. number of installations obtainable from one cartridge*
mm	mm	mm	–
10	13	100	53
10	13	150	35
10	13	200	26
12	16	120	27
12	16	180	18
12	16	240	13.5
16	20	160	15
16	20	240	10.5
16	20	320	7.5
20	25	200	8
20	25	300	5
20	25	400	4
25	30	250	5
25	30	375	3.5
25	30	500	2.5

*Actual number of installations obtained may vary depending on hole surface roughness, depth drilled and wastage.

HARDENING TIMES

Temperature in base material (°C)	Open time (minutes)	Minimum hardening time	
		In dry holes (hours)	In wet holes (hours)
25	3	¾	1½
20	5	1	1
15	10	1½	3
10	15	2	2
5	30	4	4
0	40	8	8

Temperature
Hardening times depend on the temperature in the substrate.

Open time
The open time is the time after the adhesive has been injected into the hole and before the adhesive starts to solidify. Insertion of the bolt or rebar must be completed within this time.

Hardening time
The hardening time begins when the adhesive starts to solidify. Leave the installation undisturbed during the hardening time. The anchor may be used after the minimum hardening time has elapsed. Full hardening occurs after 24 hours.

DERIVATION OF CHEM-GRANITE SUPER™ CHARACTERISTIC BOND STRESS VALUES

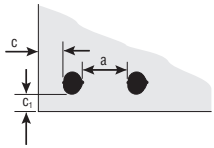
Concrete C20/25	Notation	Units	Rebar size d_{bar}				
			10	12	16	20	25
Embedment length	l_v	mm	100	120	160	200	250
Bond surface area $A_{bond} = \pi * d_{bar} * l_v$	A_{bond}	mm^2	3140	4521	8038	12560	19625
Results of pull tests #1	N_u^t	kN	37.6	54.5	95.7	117.3	179.1
#2			41.7	61.0	86.2	137.1	149.6
#3			37.2	55.6	101.4	133.9	182.5
#4			32.0	49.3	94.9	115.0	162.2
#5			36.9	58.6	90.5	120.4	177.9
Analysis:							
Number of tests	n	–	5	5	5	5	5
Average of results	$N_{u,m}^t$	kN	37.08	55.80	93.74	124.74	170.26
Standard deviation	σ	kN	3.44	4.44	5.72	10.07	13.94
Co-efficient of variation	v	%	9.2	7.9	6.1	8.0	8.1
Constant for n	k	–	3.4	3.4	3.4	3.4	3.4
Characteristic tension load $N_{Rk\,5\%} = N_{u,m}^t - (k*\sigma)$	$N_{Rk\,5\%}$	N/mm^2	25.38	40.70	74.29	90.50	122.86
Average bond stress in test series $\tau_{u,m} = \frac{N_{u,m}^t}{A_{bond}} \cdot \left(\frac{0.08}{f_R}\right)^{0.4}$	$\tau_{u,m}$	N/mm^2	15.58	16.2	13.44	11.45	10.00
Characteristic bond stress $\tau_{Rk} = \frac{N_{Rk\,5\%}}{A_{bond}} \cdot \left(\frac{0.08}{f_R}\right)^{0.4}$	τ_{Rk}	N/mm^2	**10.66**	**11.87**	**10.65**	**8.30**	**7.22**

CHARACTERISTIC & DESIGN LOADS
Based on bond strength

Rebar size d_{bar}	Embedment length l_v	Concrete ≥ C20/25 Characteristic load[1] N_{Rk}	Design load[2] N_{Rd}
mm	mm	kN	kN
10	100	33.4	15.4
10	150	50.2	23.2
10	200	66.9	30.9
12	120	46.9	21.7
12	180	70.4	32.5
12	240	93.8	43.3
16	160	85.6	39.6
16	240	128.4	59.4
16	320	171.2	79.2
20	200	104.2	48.2
20	300	156.3	72.3
20	400	208.4	96.4
25	250	141.6	65.5
25	375	212.5	98.3
25	500	283.3	131.1

[1] $N_{Rk} = \pi * d_{bar} * l_v * \tau_{Rk}$ [2] $N_{Rd} = N_{Rk}/\gamma_{Mc}$ ($\gamma_{Mc} = 2.16$) ($\gamma_{Mc} = \gamma_{Mp}$)

Minimum concrete cover



Minimum edge distance c_{min} to prevent cracking of concrete during drilling:

$c_{min} = 30 + 0.06\ l_v \geq 2\ d_{bar}$ (mm)

Minimum clear spacing a between post-installed bars:

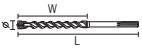
$a = 40\ mm \geq 4\ d_{bar}$ (mm)

Dispensing Gun
Product ID: 166.MDT7000
- Thumb-activated pressure release
- Mechanical advantage 18:1
- Sintered steel catch plate
- Dent-resistant frame and piston rod
- Pre-set for 10:1 mix ratio

Mixing Nozzle
Product ID: KM.10
- With static blender element
- Stackable to increase length

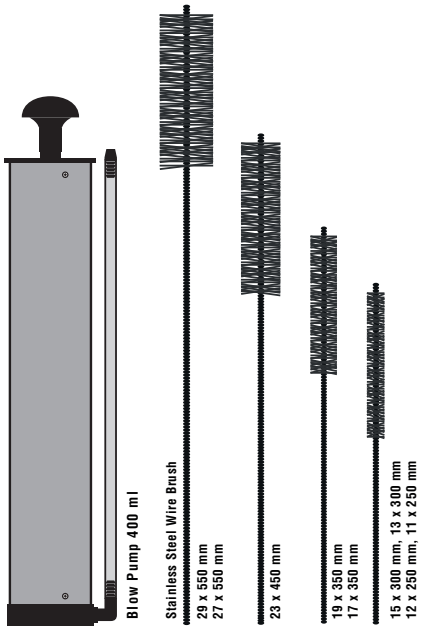
Chem-Granite Injection Cartridge
Product ID: 166.CG.380EA
Cartridge dimensions: 64Ø x 185L mm
Adhesive volume: approx. 410 ml

Hammer Drill Bits



Ø	W	L
4 Plus		
10	150	210
12	150	210
13	150	210
13	200	260
14	150	210
16	250	310
Zentro Plus		
12	200	260
14	200	260
16	200	260
16	250	310
16	400	450
Zentro Max 4		
12	200	340
13	200	340
14	200	340
Zentro Max		
16	200	340
16	400	540
18	200	340
20	400	520
24	200	320
24	400	500
25	200	320
25	400	520
28	250	370
28	450	570
30	250	570
30	600	720

Hole Cleaning Equipment



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