CHEM-GRANITE™

PURE EPOXY MORTAR for ANCHORING REBARS & THREADED RODS to CONCRETE, BRICK & ROCK

- a 2-component anchoring grade adhesive mortar packaged in a self-mixing injection cartridge
- developed for anchoring steel threaded rods and rebar into concrete. Also highly effective for anchorages to rock, solid brick, hollow brick and block. Chem-Granite™ Pure Epoxy bonds to any material in which a hole can be drilled
- the strongest pure epoxy resin formulation…optimises flowability, temperature tolerance, creep resistance and bond strength
- for dynamic, vibratory and static loading
- can be installed in dry, damp or water filled holes
- resistant to most chemicals and solvents
- 15 minute "working time" provides a longer installation time and reduces wastage
- no shrinkage – ideal for large diameter anchors
- contains no VOC's or solvents
- high loads at close spacing and edge distances
- one cartridge for all sizes of threaded rod and rebar

Tenn® FASTENING SYSTEMS

CHEM-GRANITE™ PURE EPOXY ULTIMATE MATERIAL PROPERTIES

Compressive strength ASTM 695	86 N/mm^2
Tensile strength ASTM 638	26 N/mm^2
Flexural strength ASTM 795	44 N/mm^2
Elastic modulus EN 196 p.1	10961 N/mm^2
Flexural modulus EN 196 p.1	4272 N/mm^2
Density after hardening EN ISO 1183	1.40 g/cm^3
Linear coefficient of shrinkage D2566	< 0.003%
Water absorption EN ISO 62 (24-72 hr)	0.19 – 0.41%
Thermal conductivity IEC 60093	0.47 W/(m K)
Electrical resistivity IEC 93	$1.2 \cdot 10^{12}$ Ω·m
Heat deflection temperature ASTM 648	56 °C
UV resistance	Pass
Watertightness	Pass

Colour & Mix Ratio:

Part A - Resin: White
Part B - Hardener: Red
Mix ratio: 3:1
Colour after mixing: Red

Shelf Life

Stored in their original containers, the correct side up, in cool surroundings (between +10 and +25°C), and away from direct sunlight, Chem-Granite™ Pure Epoxy cartridges will have a shelf life of at least 18 months from date of manufacture.

SUITABLE BASE MATERIALS

Uncracked and cracked reinforced concrete, lightweight concrete, solid brickwork and blockwork, rock and stone, hollow brick and block*

TYPICAL APPLICATIONS

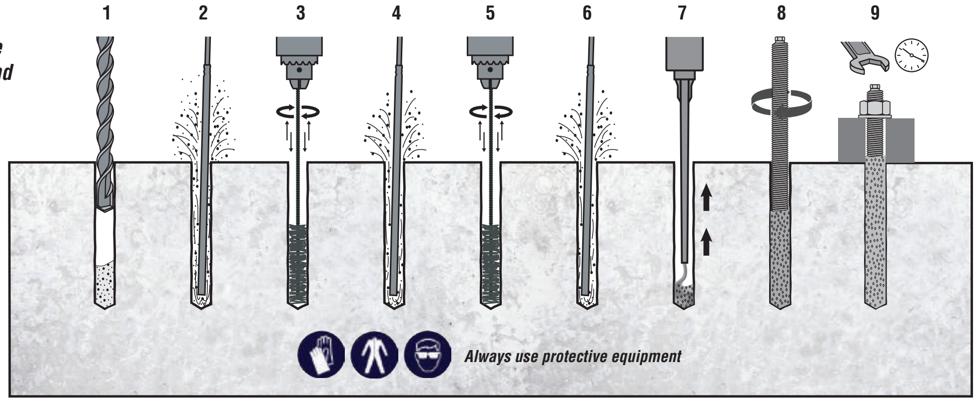
- Formwork support systems
- Starter bars and rebar dowels in concrete
- Hold-down bolts for machinery
- Cladding restraints
- Curtainwalling
- Safety fences, noise barriers
- Structural steel beams and columns
- Highway safety barriers
- Attaching steel angles in brickwork
- Attaching WCs and washbasin brackets
- Street lamps
- Unipoles
- Racking systems
- Platforms

** Perforated sleeves are required when used in hollow brick or block.*

CHEM-GRANITE™ PURE EPOXY: THREADED ROD APPLICATION

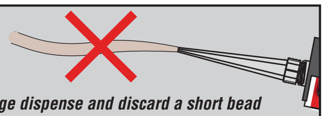
INSTALLATION PROCEDURE

Before installing wipe the rod clean of oil and grease



Note: Hole brushing and blowing should be done just before installation.

1 Drill hole to required diameter and depth.
2 Blow dust out of hole.
3 Brush wall of hole with steel wire brush.
4 Blow dust out of hole.
5 Brush wall of hole with steel wire brush.
6 Blow remaining dust out of hole.
7 Inject adhesive, starting from bottom of hole. Fill hole to 2/3 full.
8 Insert rod, turning it in slowly until reaching the bottom of the hole.
9 Leave the rod undisturbed until minimum loading time has elapsed.



When using a new cartridge dispense and discard a short bead (about 75 mm) of unmixed resin or until a uniform colour is seen.

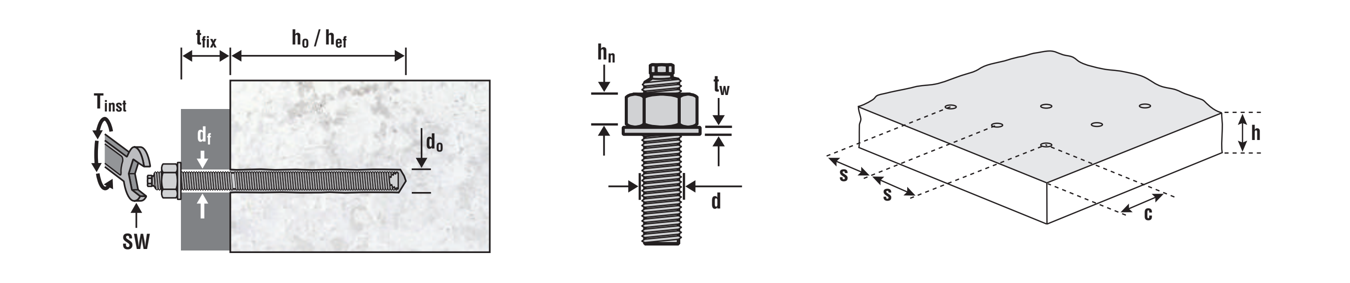
HARDENING TIMES

Temperature in Base Material *(°C)*	Working Time *(minutes)*	Minimum Loading Time *(hours)*	Full Hardening Time *(hours)*
30	12	3.5	7
25	15	4	8
20	16	5	12
15	18	7	30
5	21	10	60

Working Time
The working time is the time after the adhesive has been injected into the hole and before the adhesive starts to solidify. Insertion of the threaded rod must be completed within this time. Leave the rod undisturbed until the minimum loading time has elapsed.

Minimum Loading Time
The anchor rod may be torqued and loaded after the minimum loading time has elapsed. In temperatures above 20°C full hardening occurs after 24 hours.

Table 1. INSTALLATION DATA



Anchor Size/Rod Diameter	d	Units	M8	M10	M12	M16	M20	M24	M30
Drill Hole Diameter	d_o	mm	10	12	14	18	24	28	35
Embedment Depth/Drill Hole Depth	h_{ef}/h_o	mm	80	90	110	125	170	210	280
Baseplate Hole Diameter	d_f	mm	10	12	14	18	22	26	35
Tightening Torque	T_{inst}	Nm	10	20	40	80	150	200	300
Spanner Size	SW	mm	13	16	18	24	30	36	46
Washer Thickness	t_w	mm	1.6	2.0	2.5	3.0	3.0	4.0	4.0
Nut Height	h_n	mm	6.5	8.0	10.0	13.0	16.0	19.0	24.0
Cleaning Brush Diameter	d_b	mm	11	13	15	19	25	29	36
Volume of Chem-Granite™ Pure Epoxy required per cm hole depth	Vs	ml/cm	0.44	0.59	0.75	1.09	2.25	2.87	4.37
Critical Spacing for maximum loads	s_{cr}	mm	$2*h_{ef}$	$2*h_{ef}$	$2*h_{ef}$	$2*h_{ef}$	$2*h_{ef}$	$2*h_{ef}$	$2*h_{ef}$
Minimum Spacing with reduced loads	s_{min}	mm	$0.5*h_{ef}$	$0.5*h_{ef}$	$0.5*h_{ef}$	$0.5*h_{ef}$	$0.5*h_{ef}$	$0.5*h_{ef}$	$0.5*h_{ef}$
Critical Edge Distance for maximum loads	c_{cr}	mm	$1.25*h_{ef}$	$1.25*h_{ef}$	$1.25*h_{ef}$	$1.25*h_{ef}$	$1.25*h_{ef}$	$1.25*h_{ef}$	$1.25*h_{ef}$
Minimum Edge Distance with reduced loads	c_{min}	mm	$0.5*h_{ef}$	$0.5*h_{ef}$	$0.5*h_{ef}$	$0.5*h_{ef}$	$0.5*h_{ef}$	$0.5*h_{ef}$	$0.5*h_{ef}$
Minimum Member Thickness	h_{min}	mm	$1.33*h_{ef}$	$1.33*h_{ef}$	$1.33*h_{ef}$	$1.33*h_{ef}$	$1.25*h_{ef}$	$1.25*h_{ef}$	$1.25*h_{ef}$

CHEM-GRANITE™ PURE EPOXY: THREADED ROD APPLICATION

Tenn Threaded Rods for anchoring and fastening applications with Chem-Granite™ Pure Epoxy are available in high strength carbon steel and stainless steel.

Table 2. TENN THREADED RODS – MECHANICAL PROPERTIES

Material	Steel Strength Class	Ultimate Tensile Strength f_{uk} N/mm^2	Minimum Yield Stress f_{yk} N/mm^2	Minimum Elongation E %
Carbon Steel SWRCH35K	ISO 6.8	600	480	8
Austenitic Stainless Steel A4 (Gr 316) M8 – M16	A4-70	700	400	0.4*d
Austenitic Stainless Steel A4 (Gr 316) M20 – M30	A4-50	500	210	0.6*d

Table 3. TENN THREADED RODS – CHARACTERISTIC TENSION RESISTANCE

Rod Diameter d	Thread Pitch Diameter d_P mm	Tensile Stress Area A_s mm	Characteristic Tension Resistance		
			Carbon Steel	Stainless Steel	
			SWRCH35K $N_{Rk,s}$ kN	A4-70 $N_{Rk,s}$ kN	A4-50 $N_{Rk,s}$ kN
M8	7.19	36.6	22.0	25.6	–
M10	9.03	58.0	34.8	40.6	–
M12	10.86	84.3	50.6	59.0	–
M16	14.70	157.0	94.2	109.9	–
M20	18.38	245.0	147.0	–	122.5
M24	22.05	353.0	211.8	–	176.5
M30	27.73	561.0	336.6	–	280.5

FLAT-TIP   V-TIP

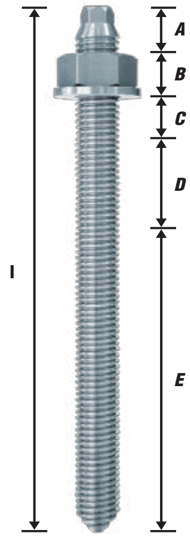
Table 4. TENN STANDARD ANCHOR ROD RANGE

Product ID No.	Dimensions d x l mm
 ***Carbon Steel SWRCH35K (ISO 6.8) Threaded Rod, V-Tip, Zinc Plated, with Hex Nut and Flat Washer***	
116ZP.08110VT	M8 x 110
116ZP.10130VT	M10 x 130
116ZP.12160VT	M12 x 160
116ZP.16190VT	M16 x 190
116ZP.20260VT	M20 x 260
116ZP.24300VT	M24 x 300
116ZP.30380VT	M30 x 380
 ***Carbon Steel SWRCH35K (ISO 6.8) Threaded Rod, Flat Tip, Hot Dip Galvanized to ASTM F2329, with Hex Nut and Flat Washer***	
116HDG.08170FT	M8 x 170
116HDG.10190FT	M10 x 190
116HDG.12220FT	M12 x 220
116HDG.16260FT	M16 x 260
116HDG.20300FT	M20 x 300
116HDG.24360FT	M24 x 360
116HDG.30380FT	M30 x 380

Product ID No.	Dimensions d x l mm
 ***Stainless Steel A4 Threaded Rod, V-Tip, with Hex Nut and Flat Washer, Passivated***	
116A4.70-08110VT	M8 x 110
116A4.70-10130VT	M10 x 130
116A4.70-12160VT	M12 x 160
116A4.70-16190VT	M16 x 190
116A4.50-20260VT	M20 x 260
116A4.50-24300VT	M24 x 300
116A4.50-30380VT	M30 x 380
 ***Stainless Steel A4 Threaded Rod, V-Tip, with Hex Nut and Flat Washer, Passivated***	
116A4.70-08170FT	M8 x 170
116A4.70-10190FT	M10 x 190
116A4.70-12220FT	M12 x 220
116A4.70-16260FT	M16 x 260
116A4.50-20300FT	M20 x 300
116A4.50-24360FT	M24 x 360
116A4.50-30380FT	M30 x 380

ANCHOR ROD LENGTH SELECTION

Select a threaded rod with sufficient length to accommodate A – E (mm)



A. Thread projection length
B. Nut height and washer thickness
C. Fixture thickness
D. Depth of any non-structural rendering or grout pad
*E. Embedment length (Minimum 5*d)*

CHEM-GRANITE™ PURE EPOXY: THREADED ROD APPLICATION

Table 5. DERIVATION OF CHEM-GRANITE™ PURE EPOXY CHARACTERISTIC BOND STRESS

THREADED ROD MATERIAL: CARBON STEEL SWRCH35K

Concrete strength at time of test: 28 N/mm^2	Notation	Unit	Rod Size d						
			M8	M10	M12	M16	M20	M24	M30
Drill hole diameter	d_0	mm	10	12	14	18	24	28	35
Embedment depth	$h_{ef,nom}$	mm	80	90	110	135	170	210	280
Bond surface area $A_b = \pi * d * h_{ef}$	A_b	mm^2	2011	2828	4147	6787	10683	15836	26393
Summary of test results – Test #1	$N_{u,i}$	kN	28.6	46.0	58.2	117.5	157.7	230.7	365.3
Summary of test results – Test #2	$N_{u,i}$	kN	27.3	44.6	64.9	113.3	162.9	226.3	314.2
Summary of test results – Test #3	$N_{u,i}$	kN	26.2	45.4	64.7	118.6	168.5	226.0	371.7
Summary of test results – Test #4	$N_{u,i}$	kN	27.2	39.9	67.4	122.1	140.2	196.5	365.8
Summary of test results – Test #5	$N_{u,i}$	kN	29.3	43.0	65.3	101.7	160.1	218.9	339.6
Total of results	–	–	138.6	218.9	320.5	573.2	789.4	1098.4	1756.6
Number of tests	n	–	5	5	5	5	5	5	5
Mean ultimate load	$N_{u,m}$	kN	27.72	43.78	64.10	114.64	157.88	219.68	351.32
Standard deviation	σ	kN	1.23	2.44	3.47	7.89	10.67	13.63	24.16
Coefficient of variation $V = \sigma / N_{u,m} * 100$	V	%	4.44	5.57	5.41	6.88	6.76	6.20	6.88
Constant for 5 inputs	k	–	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Characteristic tensile load, 5% fractile $N_{Rk,5\%} = N_{u,m} - (k * \sigma)$	$N_{Rk,5\%}$	kN	23.5	35.5	52.3	87.8	121.6	173.3	269.2
Characteristic bond stress $\tau_{Rk,5\%} = N_{Rk,5\%} / A_b$	$\tau_{Rk,5\%}$	kN	11.7	12.5	12.6	12.9	11.4	10.9	10.2

Table 6. PERFORMANCE DATA: THREADED RODS BONDED WITH CHEM-GRANITE™ PURE EPOXY

Threaded Rod Material	Rod Size d mm	Embedment Depth h_{ef} mm	Tension N[1)]			Shear V[1)&2)]		
			Characteristic Tensile Load N_{Rk} kN	Design Load[4)] N_{Rd} kN	Recommended Load[5)] N_{rec} kN	Characteristic Shear Load[3)] $V_{Rk,s}$ kN	Design Load[4)] $V_{Rd,s}$ kN	Recommended Load[5)] V_{rec} kN
Carbon Steel SWRCH35K	M8	80	22.0	14.7	10.5	11.0	8.8	6.3
Stainless Steel A4-70	M8	80	23.5	12.6	9.0	12.8	8.2	5.9
Stainless Steel A4-50	M8	80	–	–	–	–	–	–
Carbon Steel SWRCH35K	M10	90	34.8	23.2	16.6	17.4	13.9	9.9
Stainless Steel A4-70	M10	90	35.5	19.0	13.6	20.3	13.0	9.3
Stainless Steel A4-50	M10	90	–	–	–	–	–	–
Carbon Steel SWRCH35K	M12	110	50.6	33.7	24.1	25.3	20.2	14.4
Stainless Steel A4-70	M12	110	52.3	28.0	20.0	29.5	18.9	13.5
Stainless Steel A4-50	M12	110	–	–	–	–	–	–
Carbon Steel SWRCH35K	M16	135	87.8	58.5	41.8	47.1	37.7	26.9
Stainless Steel A4-70	M16	135	87.8	47.0	33.6	55.0	35.3	25.2
Stainless Steel A4-50	M16	135	–	–	–	–	–	–
Carbon Steel SWRCH35K	M20	170	121.6	81.1	57.9	73.5	58.8	42.0
Stainless Steel A4-70	M20	170	–	–	–	–	–	–
Stainless Steel A4-50	M20	170	121.6	76.0	54.3	61.3	46.1	32.9
Carbon Steel SWRCH35K	M24	210	173.3	115.5	82.5	105.9	87.7	60.5
Stainless Steel A4-70	M24	210	–	–	–	–	–	–
Stainless Steel A4-50	M24	210	173.3	108.3	77.4	88.3	66.4	47.4
Carbon Steel SWRCH35K	M30	280	269.2	179.5	128.2	168.3	134.6	96.1
Stainless Steel A4-70	M30	280	–	–	–	–	–	–
Stainless Steel A4-50	M30	280	269.2	168.3	120.2	140.3	105.5	75.4

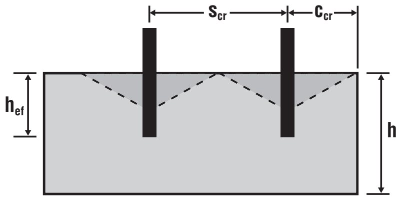
[1)] All loads are for a single anchor in dry or wet non-cracked minimum Grade C20/25 concrete without spacing or edge influences. Temperature range long/short term: 50°C/80°C. For cracked concrete, reduce recommended tensile loads N_{rec} by 30%. [2)] Shear loads are without bending moments. [3)] Characteristic shear load values from $V_{Rk,s} = 0.5 * A_s * f_{uk}$ (N). [4)] See Table below for safety factors. [5)] Recommended loads N_{rec}/V_{rec} include overall safety factor $\gamma_G = 1.4$.

SAFETY FACTORS

Tension Loading	Material	Design Load
	Carbon Steel SWRCH35K	$N_{Rd} = N_{Rk}/1.5$
	Stainless Steel A4-70	$N_{Rd} = N_{Rk}/1.87$
	Stainless Steel A4-50	$N_{Rd} = N_{Rk}/1.6$

Shear Loading	Material	Design Load
	Carbon Steel SWRCH35K	$V_{Rd,s} = V_{Rk,s}/1.25$
	Stainless Steel A4-70	$V_{Rd,s} = V_{Rk,s}/1.56$
	Stainless Steel A4-50	$V_{Rd,s} = V_{Rk,s}/1.33$

LOAD REDUCTION FACTORS



- **Critical Spacing s_{cr} and Critical Edge Distance c_{cr}**

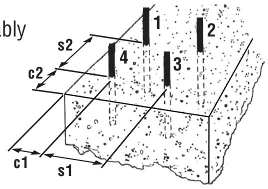
These are the least centre-to-centre spacing and edge distances at which the loads listed on Table 6 are applicable. If the actual spacings and edge distances are less than s_{cr} and c_{cr}, the recommended loads must be adjusted downwards by applying reduction factors. See Tables 7 & 8.

- **Minimum Spacing s_{min} and Minimum Edge Distance c_{min}**

The absolute *minimum* anchor centre-to-centre and centre-to-edge distances allowed.

- **Group Effect**

In this drawing, Anchor 4 is the most unfavourably placed anchor in the group because of its proximity to two edges and two other anchors. It attracts two spacing and two edge reduction factors if the critical spacing and critical edge distance criteria are not met.



Example: Calculation for Reduced Tensile Load Capacity (RLC)

$$RLC = N_{rec} \times RFs_1 \times RFs_2 \times RFc_1 \times RFc_2 = \ldots kN$$

Group Capacity. The capacity of a group of anchors shall be the capacity of the most unfavourably placed anchor in the group *multiplied* by the number of anchors in the group.

Table 7. REDUCTION FACTORS FOR REDUCED SPACING

Actual Spacing s mm	Load Reduction Factors for Reduced Spacing Anchor loaded in tension or shear						
	M8	M10	M12	M16	M20	M24	M30
45	0.52	0.50					
65	0.60	0.57	0.53	0.51			
85	0.69	0.65	0.59	0.56	0.50		
105	0.77	0.72	0.65	0.61	0.54	0.50	
140	0.92	0.85	0.76	0.71	0.61	0.56	0.50
180		1.00	0.88	0.81	0.69	0.62	0.55
220			1.00	0.92	0.76	0.68	0.60
250				1.00	0.82	0.73	0.63
340					1.00	0.87	0.74
420						1.00	0.83

Table 8. REDUCTION FACTORS FOR REDUCED EDGE DISTANCE

Actual Edge Distance c mm	Load Reduction Factors for Reduced Edge Distance Anchor loaded in tension or shear						
	M8	M10	M12	M16	M20	M24	M30
55	0.62	0.57	0.50				
65	0.71	0.65	0.56	0.51			
85	0.87	0.80	0.68	0.62	0.50		
105		0.94	0.80	0.73	0.58	0.50	
125			0.92	0.83	0.66	0.56	
140				0.91	0.72	0.61	0.50
170					0.83	0.71	0.57
210					0.99	0.83	0.67
260						0.99	0.79
290							0.86

BONDED ANCHORS

A bonded anchor, also called a “chemical anchor” or “resin anchor” is a steel bolt, socket, threaded rod or rebar inserted in a hole drilled in hardened concrete and bonded to the concrete with a resin based adhesive mortar.

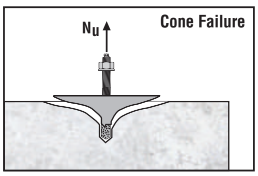
Resin materials. The resins used for bonded anchors are polymeric compounds and fall into two categories: catalytic and non-catalytic. The catalytic resins include unsaturated polyester, acrylated epoxy and methyl methacrylate resins.

Pure epoxy resin is the only non-catalytic resin currently available for chemical anchoring. It cures slower than catalytic resins but has far superior adhesive and mechanical properties providing a stronger bond and higher loading strength. For example, the compressive strength of cured epoxy is 80 N/mm^2 or higher, which is stronger than any of the base materials into which it is likely to be used. By comparison the compressive strength of catalytic resins is typically around 40 N/mm^2.

As pure epoxy is also almost 100% non shrink, it is ideal for larger and deeper holes. It can also be used underwater because it is impervious to water. Epoxy resin has the highest durability of all the resins and the longest shelf life.

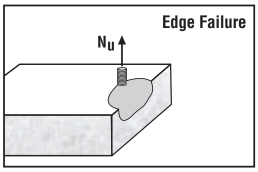
FAILURE MODES OF BONDED ANCHORS

Anchor failures may be caused by faulty installation technique or using the wrong size of anchor. The following are the common failure modes of properly installed bonded anchors loaded in tension.

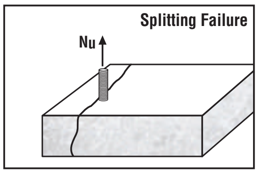


Concrete cone failure. Failure characterised by breakout of a cone of concrete with the anchor rod attached to it. It indicates that the applied load is greater than the concrete tensile strength over the cone failure surface. This failure mode is typical for anchors of shallow embedment ($h_{ef} \leq 5d$).

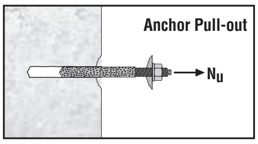
Concrete edge failure. Failure characterised by spalling of the concrete near an unconfined edge. Anchors subjected to shear force towards the edge also may exhibit this failure. Increasing the distance between anchors or from an edge, or providing edge reinforcement can solve this problem.



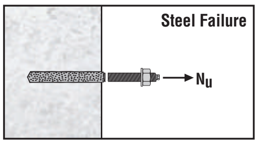
Concrete splitting failure. Failure characterised by splitting of the concrete in a vertical plane passing through the anchor. An anchor loaded in a thin or narrow slab or close to an unconfined edge may exhibit this failure. Insufficient concrete strength can also be a contributory factor.



Bond failure/Anchor pull-out. The anchor debonds and pulls out. This failure mode indicates that the adhesion of the chemical bond is less than the tensile strengths of the concrete and the anchor rod.



Debonding may occur at the concrete/mortar interface with the anchor rod pulling out with a mortar casing around it, or at the mortar/anchor rod interface in which case the rod is pulled out leaving the mortar casing in the hole. Sometimes on a single anchor, there can be debonding between concrete and mortar at the upper part of the embedment and debonding between anchor rod and mortar at the lower part.

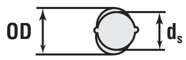


Steel material failure. Failure characterised by elongation or rupture of the anchor rod. It occurs when the the chemical bond is greater than both the tensile strength of the steel rod and the tensile strength of the concrete. The embedment depth required to develop steel failure depends on the bond strength of the mortar, the diameter and steel strength grade of the anchor rod.

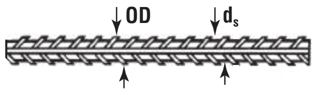
CHEM-GRANITE™ PURE EPOXY: REBAR APPLICATION

Table 9. REBAR DATA

Material
Deformed bar Grade B500B
f_{uk} 550 N/mm^2 f_{yk} 500 N/mm^2

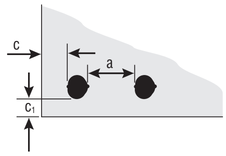


Cross-sectional view



Rebar Size d_s mm	Outside Diameter OD mm	Tensile Stress Area A_s mm	Characteristic Tensile Resistance $N_{Rk,s}$ KN
10	11.5	78.5	43.2
12	13.9	113.0	62.2
16	18.7	201.0	110.5
20	23.4	314.0	172.7
25	29.2	490.6	269.8
32	37.4	803.8	442.1
40	46.0	1256.0	690.8

Minimum Concrete Cover



Minimum edge distance c_{min} to prevent cracking of concrete during drilling:
$c_{min} = 30 + 0.06 * h_{ef} \geq 2 * d_s$ (mm)

Minimum clear spacing a_{min} between post-installed bars:
$a_{min} = 40$ mm $\geq 4 * d_s$ (mm)

Table 10. DERIVATION OF CHEM-GRANITE™ PURE EPOXY CHARACTERISTIC BOND STRESS – REBAR MATERIAL: B500B

Concrete strength at time of test: 28 N/mm^2		Notation	Unit	Rebar Size d_s mm					
				10	12	16	20	25	32
Drill hole diameter		d_0	mm	13	15	20	25	32	40
Embedment depth		$h_{ef,nom}$	mm	100	120	160	200	250	320
Bond surface area $A_b = \pi * d_s * h_{ef}$		A_b	mm^2	3142	4524	8044	12568	19638	32174
Summary of test results	Test #1	$N_{u,i}$	kN	43.8	63.6	118.1	181.1	292.2	430.1
	Test #2			46.5	62.8	109.5	186.3	259.4	388.4
	Test #3			42.7	63.4	106.9	182.6	287.5	420.6
	Test #4			45.8	59.6	113.6	192.1	312.1	437.2
	Test #5			44.4	65.1	114.7	167.5	306.5	411.8
Total of results		–	–	223.2	314.5	562.8	909.6	1457.7	2088.1
Number of tests		n	–	5	5	5	5	5	5
Mean ultimate load		$N_{u,m}$	kN	44.64	62.90	112.56	181.92	291.54	417.62
Standard deviation		σ	kN	1.53	2.03	4.41	9.11	20.59	18.95
Coefficient of variation $V = \sigma / N_{u,m} * 100$		V	%	3.43	3.23	3.92	5.00	7.06	4.54
Constant for 5 tests		k	–	3.4	3.4	3.4	3.4	3.4	3.4
Characteristic tensile load, 5% fractile $N_{Rk,5\%} = N_{u,m} - (k * \sigma)$		$N_{Rk,5\%}$	kN	39.4	56.0	97.6	150.9	221.5	353.2
Characteristic bond stress $\tau_{Rk,5\%} = N_{Rk,5\%} / A_b$		$\tau_{Rk,5\%}$	kN	12.6	12.4	12.1	12.0	11.3	11.0

Table 11. CALCULATED LOADS for REBAR BONDED WITH CHEM-GRANITE™ PURE EPOXY in Concrete ≥ C20/25

Rebar Size d_s mm	Embedment Depth h_{ef} mm	Design Load based on Bond Strength				Design Load based on Steel Strength		
		Characteristic Bond Stress $\tau_{Rk,5\%}$ N/mm^2	Characteristic Pull-out Load# $N_{Rk,p}$ kN	Safety Factor γ_{Mp}	Design Load $N_{Rd,p}$ kN	Characteristic Tensile Resistance $N_{Rk,s}$ kN	Safety Factor γ_{Ms}	Design Load $N_{Rd,s}$ kN
10	100	12	37.7	1.5	25.1	43.2	1.25	34.6
10	150	12	56.6	1.5	37.7	43.2	1.25	34.6
10	300	12	113.1	1.5	75.4	43.2	1.25	34.6
12	120	12	54.3	1.5	36.2	62.2	1.25	49.8
12	180	12	81.4	1.5	54.3	62.2	1.25	49.8
12	300	12	135.7	1.5	90.5	62.2	1.25	49.8
16	160	12	96.5	1.5	64.3	110.5	1.25	88.4
16	240	12	144.8	1.5	96.5	110.5	1.25	88.4
16	300	12	181.0	1.5	120.7	110.5	1.25	88.4
20	200	12	150.8	1.5	100.5	172.7	1.25	138.2
20	300	12	226.2	1.5	150.8	172.7	1.25	138.2
20	400	12	301.6	1.5	201.1	172.7	1.25	138.2
25	250	11	216.0	1.5	144.0	269.8	1.25	215.8
25	375	11	324.0	1.5	216.0	269.8	1.25	215.8
25	500	11	432.0	1.5	288.0	269.8	1.25	215.8
32	320	11	353.9	1.5	235.9	442.1	1.25	353.7
32	480	11	530.9	1.5	353.9	442.1	1.25	353.7
32	640	11	707.8	1.5	471.9	442.1	1.25	353.7

#$N_{Rk,p} = \pi * d_s * h_{ef} * \tau_{Rk,5\%}$

CHEMICAL RESISTANCE OF PURE EPOXY

Chemical	Concentration	Resistant	Not resistant
Acetic acid	40%	–	●
Boric acid, aqueous solution	All	●	–
Citric acid	All	●	–
Formic acid	100%	–	●
Hydrochloric acid	conc.	–	●
Phosphoric acid	85%	●	–
Lactic acid	All	–	●
Nitric acid	10%	–	●
Oleic acid	100%	●	–
Sulfuric acid	30%	–	●
Tartaric acid	All	●	–
Sea water	All	●	–
Turpentine	100%	●	–
Ethyl alchohol, aqueous solution	50%	–	●
Ammonia, aqueous solution	5%	●	–
Chlorine	All	●	–
Chlorine water, swimming pool	All	●	–
Potassium chloride, aqueous	All	●	–
solution		●	–
Toulene	100%	●	–
Tetrachloroethylene	100%	–	●
Trichloroethylene		●	–
Diesel oil	100%	●	–
Petrol		●	–
Glycol (ethylene glycol)		–	●
Benzyl alcohol		–	●
Ethanol		–	●
Ethyl acetate		–	●
Ethyl acetate		●	–
Engine oil			

REBAR DESIGN LOADS IN THE FIRE SITUATION

Rebar Size d_s	Cross-sectional Area A_s	Yield Stress f_{yk}	Tensile Load N_{Rk}	Safety Factor, Fire $\gamma_{s,fi}$	Fire Design Load $N_{Rd,fi}$
mm	mm	N/mm^2	kN	[-]	kN
8	50.3	500	25.2	1.56	16.2
10	78.5	500	39.3	1.56	25.4
12	113.1	500	56.6	1.56	36.5
16	201.1	500	100.6	1.56	65.0
20	314.2	500	157.1	1.56	101.5
25	490.9	500	245.5	1.56	158.7
32	804.2	500	402.1	1.56	260.0
40	1256.6	500	628.3	1.56	406.2

POST-INSTALLED REBARS

"Post-installed" rebars refer to bars that are installed into holes drilled in hardened concrete and bonded to the concrete usually with a polymer based mortar. Post-installed steel bars are needed when an additional structural concrete member is to be connected to existing structure or to increase the section of the existing structure. The term "bond" refers to the adhesion between rebar and the surrounding concrete. An adequate bond ensures composite action between concrete and steel bar where the two materials function as one.

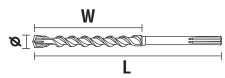
Application examples for post-installed rebars:

- Vertical connections, including new columns or piers, pile caps, or adding reinforcement for structural enhancement of vertical elements
- Structural repairs, including concrete remedial works and structural upgrading of columns, slabs, or beams
- Structural connections to existing reinforced concrete walls or columns, including staircases, corbels, and cantilever connections such as balconies, access platforms, and landings
- Concrete overlays, e.g. bridge deck renovation

PRODUCTS

Each cartridge supplied with 1 pc N18 Blending Nozzle and 1 pc NX200 Nozzle Extension

ROTARY HAMMER DRILL BITS



V-PLUS 2-Cutter

Ø	W	L
10	150	200
10	200	260
12	210	260
12	400	450
13	210	260
13	260	310
13	350	400
14	210	260
15	210	260
15	400	450
18	250	300
20	250	300
20	400	450

ZENTRO MAX 4-Cutter

Ø	W	L
15	400	540
18	200	340
18	400	540
20	300	410
20	350	470
24	250	370
25	340	460
25	450	570
28	270	390
30	420	540
30	550	670
32	410	530
32	550	670
35	330	450
38	530	650
38	700	820
40	530	650
40	700	820

HOLE CLEANING ACCESSORIES

Blow Pump 400 ml

Stainless Steel Wire Brush

41 x 550 mm
36 x 550 mm
33 x 550 mm
29 x 550 mm

26 x 450 mm
25 x 450 mm
21 x 450 mm

19 x 350 mm
16 x 350 mm
15 x 350 mm

14 x 300 mm
13 x 300 mm
11 x 300 mm