Reo502™

Heavy Duty Epoxy Anchoring

Ramset™

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Reo502 - Heavy Duty Epoxy Anchoring

You don't have to waste your valuable time waiting for longer cure times or waste money disposing of dried up nozzles. Reo 502 is the solution to your problem.

The epoxy resin and hardener are thoroughly and evenly mixed as they are dispensed from the dual cartridge through a static mixing nozzle, directly into the anchor hole.

With an extended working time and a full cure within 3 hours, your crew can keep working more efficiently, not waiting, saving you time and money.

Advantages

HIGH PERFORMANCE EPOXY: Shallower embedment depth required

FIRE RESISTANT STRUCTURES: Tested up to 4 hours FRP according to Eurocode 2, with standardised fire curve (ISO 834)

FAST CURE FORMULA: 3-hour cure time at 40°C for same day loading of anchors

COST SAVINGS: Less delay of work, Less nozzles used

HIGH STRENGTH NON SHRINK: Suitable for cored and oversized holes

VOC COMPLIANT: Virtually odorless, can be used indoors. LEED Tested, Styrene free

WATER INSENSITIVITY: Works in wet, flooded holes and underwater applications

Specifications

EPOXY CHEMICAL:

- Two component, 100% solids (containing no solvents), non-sag paste, insensitive to moisture, grey in colour
- Mixed Density: 1.5 g/cm^3 (ASTM D 1875 @ +20°C)
- Hardness > Shore D 80
- Compressive strength, ASTM D695: 95 MPa at 7 days
- Heat Distortion Temperature: Approx 80°C
- Water solubility: None
- Dielectric constant 3.95

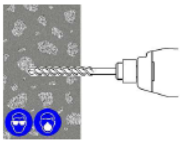
PACKAGING:

- Disposable, self-contained 600ml cartridge system capable of despensing both epoxy components in the proper mixing ratio.
- Epoxy components dispensed through a static mixing nozzle that thoroughly mixes the material and places the epoxy at the base of the pre-drilled hole.
- Cartridge markings: Include manufacturer's name, batch number and best-used-by date, mix ratio by volume, ANSI hazard classification, and appropriate ANSI handling precautions.

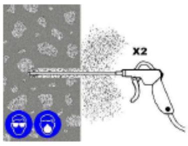
INSTALLATION PROCEDURE

Before commencing installation ensure the operative is equipped with appropriate personal protection equipment, SDS Hammer Drill, Air, Hole Cleaning Brush, good quality Dispensing Tool – either manual or power operated, Chemical cartridge with mixing nozzle and extension tube, if needed.

1. Using the SDS Hammer Drill in rotary hammer mode for drilling, with a carbide tipped drill bit of the appropriate size, drill the hole to the specified hole diameter and depth.

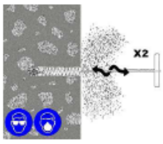


2. Insert the Air Lance to the bottom of the hole and depress the trigger for 2 seconds. The compressed air must be clean – free from water and oil



Perform the blowing operation twice.

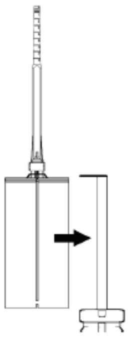
3. Select the correct size Hole Cleaning Brush. Ensure that the brush is in good condition and the correct diameter. Insert the brush to the bottom of the hole, using a brush extension if needed to reach the bottom of the hole and withdraw with a twisting motion. *There should be positive interaction between the steel bristles of the brush and the sides of the drilled hole.*



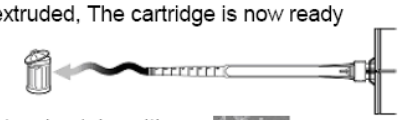
Perform the brushing operation twice.

4. Repeat 2
5. Repeat 3
6. Repeat 2
7. Select the appropriate static mixer nozzle, checking that the mixing elements are present and correct **(do not modify the mixer)**. Attach mixer nozzle to the cartridge. Check the Dispensing Tool is in good working order. Place the cartridge into the dispensing tool.

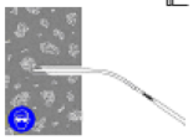
   Note: The QH nozzle is in two sections. One section contains the mixing elements and the other section is an extension piece. Connect the extension piece to the mixing section by pushing the two sections firmly together until a positive engagement is felt.



8. Extrude some resin to waste until an even-colored mixture is extruded, The cartridge is now ready for use

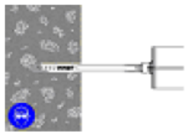


9. Attach an extension tube with resin stopper (if required) to the end of the mixing nozzle with a push fit

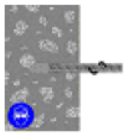


   (The extension tubes may be pushed into the resin stoppers and are held in place with a coarse internal thread).

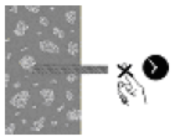
10. Insert the mixing nozzle to the bottom of the hole. Extrude the resin and slowly withdraw the nozzle from the hole. **Ensure no air voids are created** as the nozzle is withdrawn. Inject resin until the hole is approximately 1/2 full and remove the nozzle from the hole.



11. Select the steel anchor element ensuring it is free from oil or other contaminants, and mark with the required embedment depth. Insert the steel element into the hole using a back and forth twisting motion to ensure complete cover, until it reaches the bottom of the hole. Excess resin will be expelled from the hole evenly around the steel element and there shall be no gaps between the anchor element and the wall of the drilled hole.

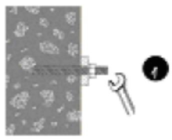


12. Clean any excess resin from around the mouth of the hole.
13. Do not disturb the anchor until at least the minimum cure time has elapsed. Refer to the Working and Load Timetable to determine the appropriate cure time.



14. Position the fixture and tighten the anchor to the appropriate installation torque.

    Do not over-torque the anchor as this could adversely affect its performance.



METHOD STATEMENT FOR NON-DESTRUCTIVE TENSILE TEST ON RAMSET RAMSET Reo502 CHEMICAL WITH REBARS INSTALLED

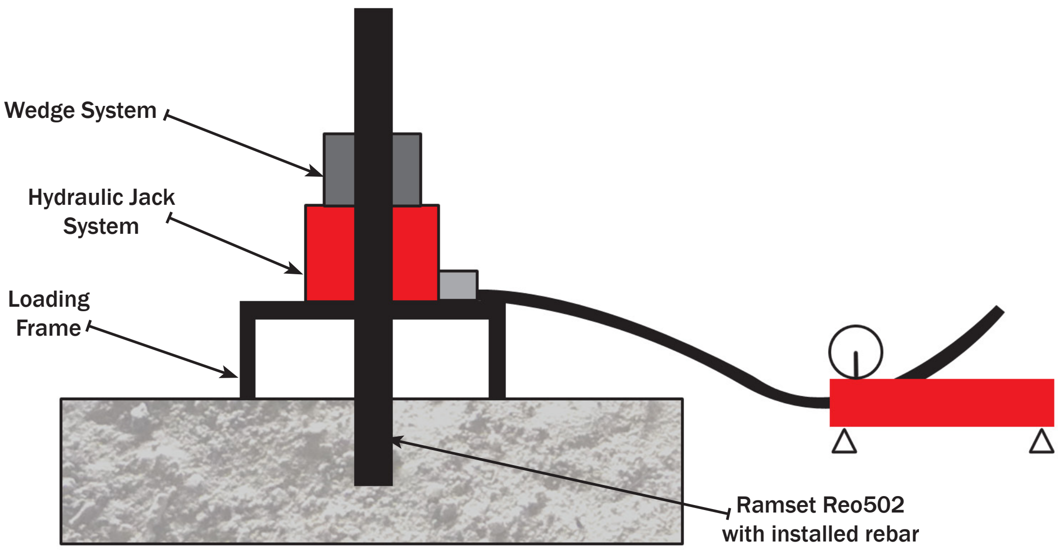
1. Prior to carrying out the test, the test equipment (Hydraulic Jack System with calibration certification attached) must be setup in position according to BS8539.

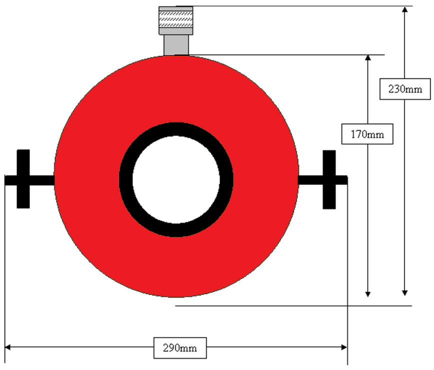
2. The loading frame is placed through the rebar and sits directly on the base concrete. The appropriate type of hydraulic jack is mounted on top of the loading frame and wedged in place with a corresponding wedge system to engage the rebar tightly at the end of the setup before applying the load.

3. A central load is applied gradually by means of the hydraulic jack system, via a hollow piston cylinder onto the wedges to create a reaction force equaling to a tensile pull-out effect, up to the required design test load.

4. The load achieved is indicated in the calibrated pressure gauge, usually expressed in KiloNewtons (kN) for ease of load determination. During or at the end of the loading, the achieved load and the mode of failure, if any, are recorded in the field test record form. The recorded field test record form shall be acknowledged by all parties present, namely the tester, the contractor and the consultant and shall form part of the final test report to be submitted to the contractor for filing purpose.

TEST SETUP (N.T.S.)





DIMENSION OF HOLLOW JACK

** For different diameters of anchors, the dimensions of the hollow jack may vary*

RAMSET REO 502 (EXPORT)

Chemwatch Independent Material Safety Data Sheet
Issue Date: 3-Aug-2012
9317SP(cs)

CHEMWATCH 4773-56
Version No:4.1.1.1
CD 2012/2 Page 1 of 11

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
RAMSET REO 502 (EXPORT)

SYNONYMS
"Product Code: REO502M400, REO502M600"

PROPER SHIPPING NAME
AMINES, LIQUID, CORROSIVE, N.O.S. or POLYAMINES, LIQUID, CORROSIVE, N.O.S.(contains N-aminoethylpiperazine and 1,3-cyclohexanebis(methylamine))

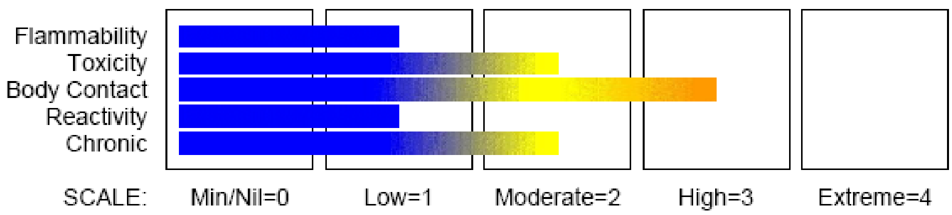
PRODUCT USE
■ - Material is mixed and used in accordance with manufacturers directions.

SUPPLIER
Company: ITW Australia Pty Ltd (Ramset)
Address:
1 Ramset Drive
Chirnside Park
VIC, 3116
Australia
Telephone: 1300 780 063
Telephone: +61 3 9726 6222
Emergency Tel:**1800 039 008 (24 hrs)**
Email: www.ramset.com.au

Section 2 - HAZARDS IDENTIFICATION

STATEMENT OF HAZARDOUS NATURE
HAZARDOUS SUBSTANCE. DANGEROUS GOODS. According to the Criteria of NOHSC, and the ADG Code.
COMBUSTIBLE LIQUID, regulated under AS1940 for Bulk Storage purposes only.

CHEMWATCH HAZARD RATINGS



RISK

Risk Codes	Risk Phrases
R22	• Harmful if swallowed.
R34	• Causes burns.
R41	• Risk of serious damage to eyes.
R42/43	• May cause SENSITISATION by inhalation and skin contact.
R51/53	• Toxic to aquatic organisms, may cause long- term adverse effects in the aquatic environment.

SAFETY

Safety Codes	Safety Phrases
S01	• Keep locked up.
S23	• Do not breathe gas/fumes/vapour/spray.
S24	• Avoid contact with skin.
S25	• Avoid contact with eyes.
S36	• Wear suitable protective clothing.
S37	• Wear suitable gloves.
S39	• Wear eye/face protection.
S29	• Do not empty into drains.
S401	• To clean the floor and all objects contaminated by this material, use water

continued...

RAMSET REO 502 (EXPORT)

	and detergent.
S35	• This material and its container must be disposed of in a safe way.
S27	• Take off immediately all contaminated clothing.
S26	• In case of contact with eyes, rinse with plenty of water and contact Doctor or Poisons Information Centre.
S45	• In case of accident or if you feel unwell IMMEDIATELY contact Doctor or Poisons Information Centre (show label if possible).
S57	• Use appropriate container to avoid environmental contamination.
S61	• Avoid release to the environment. Refer to special instructions/Safety data sheets.
S60	• This material and its container must be disposed of as hazardous waste.
S63	• In case of accident by inhalation: remove casualty to fresh air and keep at rest.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
cartridge containing both parts dispensed together		
Part A contains		
bisphenol A/ epichlorohydrin resin	25068-38-6	25-35
phenyl glycidyl ether/ formaldehyde copolymer	28064-14-4	5-15
1, 6- hexanediol diglycidyl ether	16096-31-4	5-15
Part B contains		
phenol, styrenated	61788-44-1	5-15
N- aminoethylpiperazine	140-31-8	5-15
1, 3- cyclohexanebis(methylamine)	2579-20-6	0-5
salicylic acid	69-72-7	0-5

Section 4 - FIRST AID MEASURES

SWALLOWED

■ - For advice, contact a Poisons Information Centre or a doctor at once.
- Urgent hospital treatment is likely to be needed.
- If swallowed do NOT induce vomiting.
- If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.

EYE

■ If this product comes in contact with the eyes:
- Immediately hold eyelids apart and flush the eye continuously with running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Continue flushing until advised to stop by the Poisons Information Centre or a doctor, or for at least 15 minutes.
- Transport to hospital or doctor without delay.

SKIN

■ If skin or hair contact occurs:
- Immediately flush body and clothes with large amounts of water, using safety shower if available.
- Quickly remove all contaminated clothing, including footwear.
- Wash skin and hair with running water. Continue flushing with water until advised to stop by the Poisons Information Centre.
- Transport to hospital, or doctor.

INHALED

■ - If fumes or combustion products are inhaled remove from contaminated area.
- Lay patient down. Keep warm and rested.
- Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
- Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
- Inhalation of vapours or aerosols (mists, fumes) may cause lung oedema.
- Corrosive substances may cause lung damage (e.g. lung oedema, fluid in the lungs).
- As this reaction may be delayed up to 24 hours after exposure, affected individuals need complete rest (preferably in semi-recumbent posture) and must be kept under medical observation even if no symptoms are (yet) manifested.
- Before any such manifestation, the administration of a spray containing a dexamethasone derivative or beclomethasone derivative may be considered.

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NOTES TO PHYSICIAN

■ Treat symptomatically.
For acute or short-term repeated exposures to highly alkaline materials:
- Respiratory stress is uncommon but present occasionally because of soft tissue edema.
- Unless endotracheal intubation can be accomplished under direct vision, cricothyroidotomy or tracheotomy may be necessary.
- Oxygen is given as indicated.
- The presence of shock suggests perforation and mandates an intravenous line and fluid administration.

If exposure has been severe and/or symptoms marked, observation in hospital for 48 hours should be considered due to possibility of delayed pulmonary oedema.
For acute or short term repeated exposures to phenols/ cresols:
- Phenol is absorbed rapidly through lungs and skin. [Massive skin contact may result in collapse and death]*
- [Ingestion may result in ulceration of upper respiratory tract; perforation of oesophagus and/or stomach, with attendant complications, may occur. Oesophageal stricture may occur.]*
- An initial excitatory phase may present. Convulsions may appear as long as 18 hours after ingestion. Hypotension and ventricular tachycardia that require vasopressor and antiarrhythmic therapy, respectively, can occur.
- Respiratory arrest, ventricular dysrhythmias, seizures and metabolic acidosis may complicate severe phenol exposures so the initial attention should be directed towards stabilisation of breathing and circulation with ventilation, intubation, intravenous lines, fluids and cardiac monitoring as indicated.

for non-steroidal anti-inflammatories (NSAIDs)
- Symptoms following acute NSAIDs overdoses are usually limited to lethargy, drowsiness, nausea, vomiting, and epigastric pain, which are generally reversible with supportive care. Gastrointestinal bleeding can occur. Hypertension, acute renal failure, respiratory depression, and coma may occur, but are rare. Anaphylactoid reactions have been reported with therapeutic ingestion of NSAIDs, and may occur following an overdose.
- Patients should be managed by symptomatic and supportive care following a NSAIDs overdose.
- There are no specific antidotes.
- Emesis and/or activated charcoal (60 to 100 grams in adults, 1 to 2 g/kg in children), and/or osmotic cathartic may be indicated in patients seen within 4 hours of ingestion with symptoms or following a large overdose (5 to 10 times the usual dose).

Section 5 - FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

■ - Foam.
- Dry chemical powder.
- BCF (where regulations permit).
- Carbon dioxide.

FIRE FIGHTING

■ - Alert Fire Brigade and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- Use fire fighting procedures suitable for surrounding area.

FIRE/EXPLOSION HAZARD

■ - Combustible.
- Slight fire hazard when exposed to heat or flame.
- Heating may cause expansion or decomposition leading to violent rupture of containers.
- On combustion, may emit toxic fumes of carbon monoxide (CO).

Combustion products include: carbon dioxide (CO_2), aldehydes, nitrogen oxides (NOx), other pyrolysis products typical of burning organic material.
NOTE: Burns with intense heat. Produces melting, flowing, burning liquid and dense acrid black smoke.
May emit corrosive fumes.

FIRE INCOMPATIBILITY

■ - Avoid contamination with oxidising agents i.e. nitrates, oxidising acids, chlorine bleaches, pool chlorine etc. as ignition may result.

HAZCHEM

2X

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS

■ - Drains for storage or use areas should have retention basins for pH adjustments and dilution of spills before discharge or disposal of material.
- Check regularly for spills and leaks.

Small spills should be covered with inorganic absorbents and disposed of properly. Organic absorbents have been known to ignite when contaminated with amines in closed containers.

continued...

Section 6 - ACCIDENTAL RELEASE MEASURES

- Clean up all spills immediately.
- Avoid breathing vapours and contact with skin and eyes.
- Control personal contact with the substance, by using protective equipment.
- Contain and absorb spill with sand, earth, inert material or vermiculite.

MAJOR SPILLS

■ Chemical Class: amines, alkyl
For release onto land: recommended sorbents listed in order of priority.

SORBENT TYPE	RANK	APPLICATION	COLLECTION	LIMITATIONS

.
- Clear area of personnel and move upwind.
- Alert Fire Brigade and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.

Personal Protective Equipment advice is contained in Section 8 of the MSDS.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

■ - Most acrylic monomers have low viscosity therefore pouring, material transfer and processing of these materials do not necessitate heating.
- Viscous monomers may require heating to facilitate handling. To facilitate product transfer from original containers, product must be heated to no more than 60 deg. C. (140 F.), for not more than 24 hours.
- Do NOT use localised heat sources such as band heaters to heat/ melt product.
- Do NOT use steam .
- DO NOT allow clothing wet with material to stay in contact with skin.
- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- Avoid contact with moisture.

SUITABLE CONTAINER

■ - Lined metal can, lined metal pail/ can.
- Plastic pail.
- Polyliner drum.
- Packing as recommended by manufacturer.

For low viscosity materials
- Drums and jerricans must be of the non-removable head type.
- Where a can is to be used as an inner package, the can must have a screwed enclosure. <</>.

STORAGE INCOMPATIBILITY

■ - Avoid reaction with amines, mercaptans, strong acids and oxidising agents.

N-aminoethylpiperazine:
- is a strong base in aqueous solutions
- is incompatible wit strong oxidisers, organic anhydrides, acrylates, alcohols, aldehydes, alkylene oxides, substituted allyls, cellulose nitrate, cresols, caprolactam solution, epichlorohydrin, ethylene dichloride, isocyanates, ketones, glycols, nitrates, organic halides, phenols, vinyl acetate
- decomposes exothermically with maleic anhydride
- may increase the explosive sensitivity of nitromethane.
- Avoid contact with copper, aluminium and their alloys.

For acrylic and methacrylic acid esters:
- Avoid contact with strong acids, strong alkalies, oxidising agents, polymerisation initiators (peroxides, persulfates), iron or rust
- Avoid heat, flame, sunlight, x-rays or ultra-violet radiation.
- Polymerisation may occur at elevated temperature and in presence of ignition sources - polymerisation of large quantities may be violent (even explosive).

STORAGE REQUIREMENTS

■ for bulk storages:
- If slight coloration of the ethyleneamine is acceptable, storage tanks may be made of carbon steel or black iron, provided they are free of rust and mill scale. However, if the amine is stored in such tanks, color may develop due to iron contamination. If iron contamination cannot be tolerated, tanks constructed of types 304 or 316 stainless steel should be used. (Note: Because they are quickly corroded by amines, do not use copper, copper alloys, brass, or bronze in tanks or lines.)

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RAMSET REO 502 (EXPORT)

- This product should be stored under a dry inert gas blanket, such as nitrogen, to minimize contamination resulting from contact with air and water.
- Store in original containers.
- Keep containers securely sealed.
- Store in a cool, dry, well-ventilated area.
- Store away from incompatible materials and foodstuff containers.
- DO NOT store near acids, or oxidising agents.
- No smoking, naked lights, heat or ignition sources.

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

The following materials had no OELs on our records

• bisphenol A/ epichlorohydrin resin:	CAS:25068- 38- 6
• phenyl glycidyl ether/ formaldehyde copolymer:	CAS:28064- 14- 4 CAS:42616- 71- 7 CAS:59029- 73- 1 CAS:94422- 39- 6
• 1, 6- hexanediol diglycidyl ether:	CAS:16096- 31- 4
• phenol, styrenated:	CAS:61788- 44- 1 CAS:9010- 16- 6
• N- aminoethylpiperazine:	CAS:140- 31- 8
• 1, 3- cyclohexanebis(methylamine):	CAS:2579- 20- 6
• salicylic acid:	CAS:69- 72- 7

MATERIAL DATA

1,6-HEXANEDIOL DIGLYCIDYL ETHER:
N-AMINOETHYLPIPERAZINE:

■ Sensory irritants are chemicals that produce temporary and undesirable side-effects on the eyes, nose or throat. Historically occupational exposure standards for these irritants have been based on observation of workers' responses to various airborne concentrations.

1,6-HEXANEDIOL DIGLYCIDYL ETHER:
PHENYL GLYCIDYL ETHER/ FORMALDEHYDE COPOLYMER:

■ For epichlorohydrin
Odour Threshold Value: 0.08 ppm
NOTE: Detector tubes for epichlorohydrin, measuring in excess of 5 ppm, are commercially available.
Exposure at or below the recommended TLV-TWA is thought to minimise the potential for adverse respiratory, liver, kidney effects.
Odour Safety Factor (OSF)
OSF=0.54 (EPICHLOROHYDRIN).

BISPHENOL A/ EPICHLOROHYDRIN RESIN:
PHENOL, STYRENATED:

■ No exposure limits set by NOHSC or ACGIH.

RAMSET REO 502 (EXPORT):

Not available

PHENYL GLYCIDYL ETHER/ FORMALDEHYDE COPOLYMER:

■ for phenyl glycidyl ether (PGE)
The TLV-TWA is based on the dermal toxicity (alopecia) observed in rats after subchronic inhalation exposure at 5 ppm and based on the no-observed-adverse effect-level (NOAEL) in a lifetime rodent inhalation oncogenicity bioassay. This limit is thought to be protective against the significant risk of sensitisation, skin and respiratory tract irritation, testicular damage and liver necrosis.
Toxicological responses to PGE result from repeated, prolonged exposures and are closely associated with total absorbed doses rather than peak concentrations.

1,6-HEXANEDIOL DIGLYCIDYL ETHER:

■ None assigned. Refer to individual constituents.

PHENOL, STYRENATED:

■ Odour Threshold Value for phenol: 0.060 ppm (detection)
NOTE: Detector tubes for phenol, measuring in excess of 1 ppm, are commercially available.
Systemic absorption by all routes may induce convulsions with damage to the lungs and central nervous system.<</>.

1,3-CYCLOHEXANEBIS(METHYLAMINE):

■ For benzene-1,3-dimethanamine (m-xylene-alpha,alpha'-diamine)
Saturates in air at 219.5 mg/m3 (39.5 ppm) at 25 deg C.
The substance is a gastrointestinal irritant and skin sensitiser in humans.

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SALICYLIC ACID:

■ Airborne particulate or vapour must be kept to levels as low as is practicably achievable given access to modern engineering controls and monitoring hardware. Biologically active compounds may produce idiosyncratic effects which are entirely unpredictable on the basis of literature searches and prior clinical experience (both recent and past).

PERSONAL PROTECTION

RESPIRATOR

•Type AK-P Filter of sufficient capacity. (AS/NZS 1716 & 1715, EN 143:2000 & 149:2001, ANSI Z88 or national equivalent)

EYE

■ - Chemical goggles.
- Full face shield may be required for supplementary but never for primary protection of eyes
- Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lens or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59], [AS/NZS 1336 or national equivalent].

HANDS/FEET

■ - When handling corrosive liquids, wear trousers or overalls outside of boots, to avoid spills entering boots.
NOTE:
- The material may produce skin sensitisation in predisposed individuals. Care must be taken, when removing gloves and other protective equipment, to avoid all possible skin contact.
- Contaminated leather items, such as shoes, belts and watch-bands should be removed and destroyed.
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality which vary from manufacturer to manufacturer. Where the chemical is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.
The exact break through time for substances has to be obtained from the manufacturer of the protective gloves and has to be observed when making a final choice.
Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include:.
- Leather wear not recommended: Contaminated leather footwear, watch bands, should be destroyed, i.e. burnt, as they cannot be adequately decontaminated.
- When handling liquid-grade epoxy resins wear chemically protective gloves (e.g nitrile or nitrile-butatoluene rubber), boots and aprons.
- DO NOT use cotton or leather (which absorb and concentrate the resin), polyvinyl chloride, rubber or polyethylene gloves (which absorb the resin).
- DO NOT use barrier creams containing emulsified fats and oils as these may absorb the resin; silicone-based barrier creams should be reviewed prior to use.

OTHER

■ - Overalls.
- PVC Apron.
- PVC protective suit may be required if exposure severe.
- Eyewash unit.

ENGINEERING CONTROLS

■ Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection.
The basic types of engineering controls are:
Process controls which involve changing the way a job activity or process is done to reduce the risk.
Enclosure and/or isolation of emission source which keeps a selected hazard "physically" away from the worker and ventilation that strategically "adds" and "removes" air in the work environment.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE

Two parts in separate chambers of a single plastic cartridge and dispensed together. Part A and Part B are both liquids; not miscible with water.

PHYSICAL PROPERTIES

Liquid.
Does not mix with water.
Sinks in water.

continued...

Corrosive.

State	Liquid	Molecular Weight	Not Applicable
Melting Range (℃)	Not Available	Viscosity	>60s Hardener (ISO2431) cSt@40℃
Boiling Range (℃)	>200 (resin)	Solubility in water (g/L)	Im miscible
Flash Point (℃)	>100 (resin)	pH (1% solution)	Not Available
Decomposition Temp (℃)	Not Available	pH (as supplied)	Not A vailable
Autoignition Temp (℃)	Not Available	Vapour Pressure (kPa)	Not Available
Upper Explosive Limit (%)	Not Available	Specific Gravity (water=1)	1.2 (resin); 1.8 (hardener)
Lower Explosive Limit (%)	Not Available	Relative Vapour Density (air=1)	Not Available
Volatile Component (%vol)	Not Available	Evaporation Rate	Not Available

Section 10 - STABILITY AND REACTIVITY

CONDITIONS CONTRIBUTING TO INSTABILITY
■ - Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerisation will not occur.
For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED
■ Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 gram may be fatal or may produce serious damage to the health of the individual.
The material can produce chemical burns within the oral cavity and gastrointestinal tract following ingestion.
Ingestion of amine epoxy-curing agents (hardeners) may cause severe abdominal pain, nausea, vomiting or diarrhoea. The vomitus may contain blood and mucous. If death does not occur within 24 hours there may be an improvement in the patients condition for 2-4 days only to be followed by the sudden onset of abdominal pain, boardlike abdominal rigidity or hypo-tension; this indicates that delayed gastric or oesophageal corrosive damage has occurred.
High oral doses of salicylates, such as aspirin, may cause a mild burning pain in the throat and stomach, causing vomiting. This is followed (within hours) by deep, rapid breathing, tiredness, nausea and further vomiting, thirst and diarrhoea. The central nervous system is first stimulated, and then depression from failure occurs. Stimulation produces vomiting, hyperventilation, headache, ringing in the ears, confusion, behaviour and mood changes, and generalised convulsions. Respiratory failure and cardiovascular collapse can result in death. There may also be sweating, skin eruptions, internal bleeding, kidney failure and inflamed pancreas. There may be bloody stools, purple skin spots or blood in the vomit. Many of these symptoms are due to disturbances in blood chemistry. A dose of 300 mg/kg can cause serious effects while 500 mg/kg can be lethal.
Amines without benzene rings when swallowed are absorbed throughout the gut. Corrosive action may cause damage throughout the gastrointestinal tract. They are removed through the liver, kidney and intestinal mucosa by enzyme breakdown.
High molecular weight material; on single acute exposure would be expected to pass through gastrointestinal tract with little change / absorption. Occasionally accumulation of the solid material within the alimentary tract may result in formation of a bezoar (concretion), producing discomfort.
Non-steroidal anti-inflammatory drug (NSAID) overdose may produce nausea, vomiting, indigestion and upper abdominal pain. Other effects may include drowsiness, dizziness, confusion, disorientation, lethargy, "pins and needles", intense headache, blurred vision, ringing in the ears, muscle twitching, convulsions, stupor and coma. There have been other reported effects, such as sweating, decreased urination frequency or absence of urine, increased heart rate, low or high blood pressure and kidney damage.

EYE
■ The material can produce chemical burns to the eye following direct contact. Vapours or mists may be extremely irritating.
If applied to the eyes, this material causes severe eye damage.
Vapours of volatile amines irritate the eyes, causing excessive secretion of tears, inflammation of the conjunctiva and slight swelling of the cornea, resulting in "halos" around lights. This effect is temporary, lasting only for a few hours. However this condition can reduce the efficiency of undertaking skilled tasks, such as driving a car. Direct eye contact with liquid volatile amines may produce eye damage, permanent for the lighter species.

SKIN
■ The material can produce chemical burns following direct contactwith the skin.
Amine epoxy-curing agents (hardeners) may produce primary skin irritation and sensitisation dermatitis in predisposed

continued...

RAMSET REO 502 (EXPORT)

individuals. Cutaneous reactions include erythema, intolerable itching and severe facial swelling. Blistering, with weeping of serous fluid, and crusting and scaling may also occur. Individuals exhibiting "amine dermatitis" may experience a dramatic reaction upon re-exposure to minute quantities. Highly sensitive persons may even react to cured resins containing trace amounts of unreacted amine hardener. Minute quantities of air-borne amine may precipitate intense dermatological symptoms in sensitive individuals. Prolonged or repeated exposure may produce tissue necrosis.
Volatile amine vapours produce irritation and inflammation of the skin. Direct contact can cause burns. They may be absorbed through the skin and cause similar effects to swallowing, leading to death. The skin may exhibit whiteness, redness and wheals.
Open cuts, abraded or irritated skin should not be exposed to this material.
Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.
The material may cause moderate inflammation of the skin either following direct contact or after a delay of some time. Repeated exposure can cause contact dermatitis which is characterised by redness, swelling and blistering.

INHALED

■ Inhalation of aerosols (mists, fumes), generated by the material during the course of normal handling, may be damaging to the health of the individual.
Inhalation of epoxy resin amine hardeners (including polyamines and amine adducts) may produce bronchospasm and coughing episodes lasting several days after cessation of the exposure. Even faint traces of these vapours may trigger an intense reaction in individuals showing "amine asthma". The literature records several instances of systemic intoxications following the use of amines in epoxy resin systems.
Inhalation of amine vapours may cause irritation of the mucous membrane of the nose and throat, and lung irritation with respiratory distress and cough. Swelling and inflammation of the respiratory tract is seen in serious cases; with headache, nausea, faintness and anxiety. There may also be wheezing.
Inhalation hazard is increased at higher temperatures.
There is some evidence to suggest that the material can cause respiratory irritation in some persons. The body's response to such irritation can cause further lung damage.

CHRONIC HEALTH EFFECTS

■ Repeated or prolonged exposure to corrosives may result in the erosion of teeth, inflammatory and ulcerative changes in the mouth and necrosis (rarely) of the jaw. Bronchial irritation, with cough, and frequent attacks of bronchial pneumonia may ensue. Gastrointestinal disturbances may also occur. Chronic exposures may result in dermatitis and/or conjunctivitis.
Inhaling this product is more likely to cause a sensitisation reaction in some persons compared to the general population.
Skin contact with the material is more likely to cause a sensitisation reaction in some persons compared to the general population.
Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure.
Prolonged use of non-steroidal analgesics damages the lining of the gastrointestinal tract, causing ulcers and bleeding. There may be diarrhoea or constipation, perforations causing serious infection, and blood in the vomit or stools. Kidney damage can result in blood or pus in the urine, changes in urine chemistry, change in the frequency of urination, insufficiency of kidney function, destruction of the kidney lining and kidney inflammation. Occasionally, the liver may be affected, causing inflammation (hepatitis) and jaundice. There may be changes in blood cell distribution, and disturbance in platelet function. Sensitivity to light may occur. Anaphylactic-like syndrome is characterised by rash with redness, spots and blisters, itching, and fainting. The eyes, ears and urinary tract can all be affected. Asthma and anaemia may be exacerbated. These drugs can cause circulatory defects in the foetus and newborn. Once the kidney has been damaged, there is an increased likelihood that cancers could develop there.
There is some evidence that inhaling this product is more likely to cause a sensitisation reaction in some persons compared to the general population.

TOXICITY AND IRRITATION

■ Contact allergies quickly manifest themselves as contact eczema, more rarely as urticaria or Quincke's oedema. The pathogenesis of contact eczema involves a cell-mediated (T lymphocytes) immune reaction of the delayed type. Other allergic skin reactions, e.g. contact urticaria, involve antibody-mediated immune reactions. The significance of the contact allergen is not simply determined by its sensitisation potential: the distribution of the substance and the opportunities for contact with it are equally important. A weakly sensitising substance which is widely distributed can be a more important allergen than one with stronger sensitising potential with which few individuals come into contact. From a clinical point of view, substances are noteworthy if they produce an allergic test reaction in more than 1% of the persons tested.
Allergic reactions involving the respiratory tract are usually due to interactions between IgE antibodies and allergens and occur rapidly. Allergic potential of the allergen and period of exposure often determine the severity of symptoms. Some people may be genetically more prone than others, and exposure to other irritants may aggravate symptoms. Allergy causing activity is due to interactions with proteins.
Attention should be paid to atopic diathesis, characterised by increased susceptibility to nasal inflammation, asthma and eczema. Exogenous allergic alveolitis is induced essentially by allergen specific immune-complexes of the IgG type; cell-mediated reactions (T lymphocytes) may be involved. Such allergy is of the delayed type with onset up to four hours following exposure.
No significant acute toxicological data identified in literature search.
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
The material may cause severe skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin. Repeated exposures may produce severe ulceration.
Asthma-like symptoms may continue for months or even years after exposure to the material ceases. This may be due to a non-allergenic condition known as reactive airways dysfunction syndrome (RADS) which can occur following exposure to high levels of highly irritating compound.
UV (ultraviolet)/ EB (electron beam) acrylates are generally of low toxicity

continued...

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UV/EB acrylates are divided into two groups; "stenomeric" and "eurymeric" acrylates.
The first group consists of well-defined acrylates which can be described by a simple idealised chemical;they are low molecular weight species with a very narrow weight distribution profile.
The eurymeric acrylates cannot be described by an idealised structure and may differ fundamentally between various suppliers; they are of relatively high molecular weigh and possess a wide weight distribution.
Stenomeric acrylates are usually more hazardous than the eurymeric substances.

Section 12 - ECOLOGICAL INFORMATION

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
This material and its container must be disposed of as hazardous waste.
Avoid release to the environment.
Refer to special instructions/ safety data sheets.

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
bisphenol A/ epichlorohydrin resin	No Data Available	No Data Available		
phenyl glycidyl ether/ formaldehyde copolymer	No Data Available	No Data Available		
1, 6- hexanediol diglycidyl ether	No Data Available	No Data Available		
phenol, styrenated	HIGH	No Data Available	LOW	LOW
N- aminoethylpiperazine	HIGH	No Data Available	LOW	MED
1, 3- cyclohexanebis(methylamine)	LOW	No Data Available	LOW	MED
salicylic acid	LOW	No Data Available	LOW	HIGH

Section 13 - DISPOSAL CONSIDERATIONS

■ - Containers may still present a chemical hazard/ danger when empty.
- Return to supplier for reuse/ recycling if possible.
Otherwise:
- If container can not be cleaned sufficiently well to ensure that residuals do not remain or if the container cannot be used to store the same product, then puncture containers, to prevent re-use, and bury at an authorised landfill.
- Where possible retain label warnings and MSDS and observe all notices pertaining to the product.
Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area.
A Hierarchy of Controls seems to be common - the user should investigate:
- Reduction.
- DO NOT allow wash water from cleaning or process equipment to enter drains.
- It may be necessary to collect all wash water for treatment before disposal.
- In all cases disposal to sewer may be subject to local laws and regulations and these should be considered first.
- Where in doubt contact the responsible authority.
- Recycle wherever possible.
- Consult manufacturer for recycling options or consult local or regional waste management authority for disposal if no suitable treatment or disposal facility can be identified.
- Treat and neutralise at an approved treatment plant.
- Treatment should involve: Neutralisation with suitable dilute acid followed by: burial in a land-fill specifically licenced to accept chemical and / or pharmaceutical wastes or Incineration in a licenced apparatus (after admixture with suitable combustible material).

Section 14 - TRANSPORTATION INFORMATION

Labels Required: CORROSIVE

HAZCHEM:
2X (ADG7)

continued...

RAMSET REO 502 (EXPORT)

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Section 14 - TRANSPORTATION INFORMATION

ADG7:

Class or Division:	8	Subsidiary Risk:	None
UN No.:	2735	Packing Group:	III
Special Provision:	223 274	Limited Quantity:	5 L
Portable Tanks & Bulk Containers - Instruction:	T7	Portable Tanks & Bulk Containers - Special Provision:	TP1 TP28
Packagings & IBCs - Packing Instruction:	None	Packagings & IBCs - Special Packing Provision:	P001 IBC03 LP01

Name and Description: AMINES, LIQUID, CORROSIVE, N.O.S. or POLYAMINES, LIQUID, CORROSIVE, N.O.S. (contains N-aminoethylpiperazine and 1,3-cyclohexanebis(methylamine))

Land Transport UNDG:

Class or division:	8	Subsidiary risk:	None
UN No.:	2735	UN packing group:	III

Shipping Name:AMINES, LIQUID, CORROSIVE, N.O.S. or POLYAMINES, LIQUID, CORROSIVE, N.O.S. (contains N-aminoethylpiperazine and 1,3-cyclohexanebis(methylamine))

Air Transport IATA:

ICAO/IATA Class:	8	ICAO/IATA Subrisk:	None
UN/ID Number:	2735	Packing Group:	III
Special provisions:	A3A803		
Cargo Only Packing Instructions:	856	Maximum Qty/Pack:	60 L
Passenger and Cargo Packing Instructions:	852	Passenger and Cargo Maximum Qty/Pack:	5 L
Passenger and Cargo Limited Quantity Packing Instructions:	Y841	Passenger and Cargo Limited Quantity Maximum Qty/Pack:	1 L

Shipping name:AMINES, LIQUID, CORROSIVE, N.O.S. or POLYAMINES, LIQUID, CORROSIVE, N.O.S.(contains N-aminoethylpiperazine and 1 cyclohexanebis(methylamine))

Maritime Transport IMDG:

IMDG Class:	8	IMDG Subrisk:	None
UN Number:	2735	Packing Group:	III
EMS Number:	F- A, S- B	Special provisions:	223 274
Limited Quantities:	5 L	Marine Pollutant:	Yes

Shipping name:AMINES, LIQUID, CORROSIVE, N.O.S. or POLYAMINES, LIQUID, CORROSIVE, N.O.S.(contains N-aminoethylpiperazine and 1 cyclohexanebis(methylamine))

Section 15 - REGULATORY INFORMATION

POISONS SCHEDULE S5

REGULATIONS

Regulations for ingredients

No data for Ramset REO 502 (Export) (CW: 4773-56)

Section 16 - OTHER INFORMATION

Denmark Advisory list for selfclassification of dangerous substances

Substance	CAS	Suggested codes
1, 6- hexanediol diglycidyl ether	16096- 31- 4	Carc3; R40 R43 Xi; R38 R52/53
1, 3- cyclohexanebis(methylamine)	2579- 20- 6	Xn; R22 R43 Xi; R38
salicylic acid	69- 72- 7	Xn; R22

continued...

RAMSET REO 502 (EXPORT)

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Section 16 - OTHER INFORMATION

INGREDIENTS WITH MULTIPLE CAS NUMBERS

Ingredient Name	CAS
phenyl glycidyl ether/ formaldehyde copolymer	28064- 14- 4, 42616- 71- 7, 59029- 73- 1, 94422- 39- 6
phenol, styrenated	61788- 44- 1, 9010- 16- 6

■ Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.
A list of reference resources used to assist the committee may be found at:
www.chemwatch.net/references.

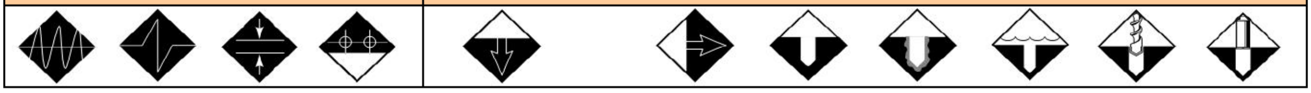
■ The (M)SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings.

Issue Date: 3-Aug-2012
Print Date: 3-Aug-2012

This is the end of the MSDS.

REBAR (FE460)

PERFORMANCE	INSTALLATION

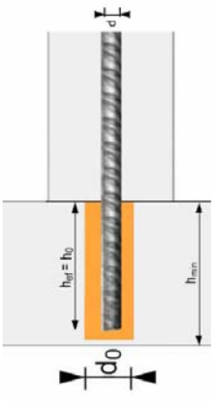


ETA Option 1
ICC-ES
EVALUATION
REPORT

Technical data

RAMSET Reo502		T8	T10	T12	T13	T16	T20	T25	T28	T32	T40
Minimum Effective Depth (mm)	$h_{ef,min}$	-	60	70	70	80	90	100	-	128	160
Standard Effective Depth (mm)	$h_{ef,std}$	80	90	110	110	125	170	210	270	300	360
∅ Rebar Diameter (mm)	d	8	10	12	13	16	20	25	28	32	40
∅ Recommend Drill Bit Diameter (mm)	d_o	12	13 - 14	15 - 16	16 - 18	20 - 22	25 - 28	30 - 32	35 - 38	40 - 42	50 - 52
Standard Drill depth (mm)	h_o	80	90	110	110	125	170	210	270	300	400
Min thick of base material (mm)	h_{min}	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm
Ramset power tool code		DD544	DD544	DD544	DD544	DD544	DD576	DD576	DD576	DD576	DD576
Drill bit type-size		R3 PLUS	R3 PLUS	R3 PLUS	R3 PLUS	R3 PLUS	R3 MAX	R3 MAX	R3 MAX	R3 MAX	R3 MAX

RAMSET Reo502 Two part cartridge, 100% epoxy resin - vol. 600ml



Anchor mechanical properties

FE460	T8	T10	T12	T13	T16	T20	T25	T28	T32	T40
f_{yk} (N/mm^2) Yield strength	460	460	460	460	460	460	460	460	460	460
As (mm^2) Stressed cross-section	50.3	78.6	113.1	132.7	201.1	314.2	490.9	615.8	804.4	1,256.8
$N_{Rk,s}$ (kN) Characteristic Yield	23.1	36.1	52.0	61.1	92.5	144.5	225.8	283.3	370.0	578.1
$N_{Rd,s}$ (kN) Design Yield	20.1	31.4	45.2	53.1	80.4	125.7	196.4	246.3	321.7	502.7

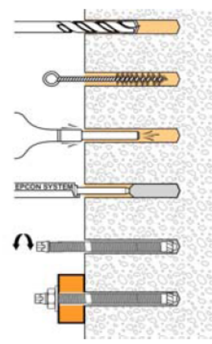
Setting time before applying load

Ambient temperature (°C)	Max time for installation (mins)	Waiting time before applying load (hr)
40°C	3	3
35°C	4	4
30°C	6	5
25°C	8	6
20°C	15	8
10°C	20	12

MATERIAL

Grade 460

INSTALLATION



REBAR (FE460)

Number of anchors per cartridge

Rebar diameter	10	12	13	16	20	25	28	32	40
Drilling ∅ (mm)	13	15	16	20	25	30	35	40	50
Drilling depth (mm)	90	110	110	125	170	210	270	300	360
No. of anchors per cartridge									
REO 502 (600ml)	100.4	61.7	54.3	30.6	14.4	8.1	4.6	3.2	1.7

Ultimate Loads ($N_{Ru,m}$, $V_{Ru,m}$) / Characteristic Loads (N_{Rk}, V_{Rk}) in kN

TENSILE @ Concrete Strength 30 N/mm^2

Rebar size	T8	T10	T12	T13	T16
h_{ef} (mm)	80	90	110	110	125
$N_{Ru,m}$ (kN)	25.0	39.0	56.2	65.9	99.9
N_{Rk} (kN)	23.1	36.1	52.0	61.1	92.5

Rebar size	T20	T25	T28	T32	T40
h_{ef} (mm)	170	210	270	300	360
$N_{Ru,m}$ (kN)	156.1	243.9	305.9	399.6	624.4
N_{Rk} (kN)	144.5	225.8	283.3	370.0	578.1

SHEAR @ Concrete Strength 30 N/mm^2

Rebar size	T8	T10	T12	T13	T16
$V_{Ru,m}$ (kN)	15.0	23.4	33.7	39.6	59.9
V_{Rk} (kN)	13.9	21.7	31.2	36.6	55.5

Rebar size	T20	T25	T28	T32	T40
$V_{Ru,m}$ (kN)	93.7	146.3	183.6	239.8	374.6
V_{Rk} (kN)	86.7	135.5	170.0	222.0	346.9

Design Loads (N_{Rd}, V_{Rd}) for one anchor without edge or spacing influence in kN

TENSILE @ Concrete Strength 30 N/mm^2

Rebar size	T8	T10	T12	T13	T16
h_{ef} (mm)	80	90	110	110	125
N_{Rd} (kN)	15.4	24.1	34.7	40.7	61.7

Rebar size	T20	T25	T28	T32	T40
h_{ef} (mm)	170	210	270	300	360
N_{Rd} (kN)	96.4	150.6	188.9	246.7	385.4

γ_{Mc} = 1.5 *(steel failure)*

SHEAR @ Concrete Strength 30 N/mm^2

Rebar size	T8	T10	T12	T13	T16
V_{Rd} (kN)	11.1	17.3	25.0	29.3	44.4

Rebar size	T20	T25	T28	T32	T40
V_{Rd} (kN)	69.4	108.4	136.0	177.6	277.5

γ_{Ms} = 1.25

Recommended Loads (N_{rec}, V_{rec}) for one anchor without edge or spacing influence in kN

TENSILE @ Concrete Strength 30 N/mm^2

Rebar size	T8	T10	T12	T13	T16
h_{ef} (mm)	80	90	110	110	125
N_{rec} (kN)	11.0	17.2	24.8	29.1	44.0

Rebar size	T20	T25	T28	T32	T40
h_{ef} (mm)	170	210	270	300	360
N_{rec} (kN)	68.8	107.5	134.9	176.2	275.3

SHEAR @ Concrete Strength 30 N/mm^2

Rebar size	T8	T10	T12	T13	T16
V_{rec} (kN)	7.9	12.4	17.8	20.9	31.7

Rebar size	T20	T25	T28	T32	T40
V_{rec} (kN)	49.6	77.4	97.1	126.9	198.2

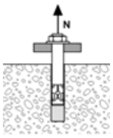
γ_F = 1.4
γ_{Ms} = 1.25

Steel failure

REBAR (FE460)

RAMSET CC-Method

TENSILE in kN



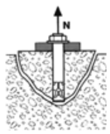
Pull-out resistance
Concrete strength C25/30

$N_{Rd,p} = N^0_{Rd,p} \cdot f_B \cdot f_T$

$N^0_{Rd,p}$ Design pull-out resistance					
Rebar size	**T8**	**T10**	**T12**	**T13**	**T16**
h_{ef} (mm)	80	90	110	110	125
$N^0_{Rd,p}$ (kN)	14.8	20.8	30.5	33.0	46.2

$N^0_{Rd,p}$ Design pull-out resistance					
Rebar size	**T20**	**T25**	**T28**	**T32**	**T40**
h_{ef} (mm)	170	210	270	300	360
$N^0_{Rd,p}$ (kN)	78.5	121.2	174.5	188.1	278.8

$\gamma_{Mc,N} = 1.8$



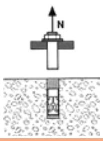
Concrete cone resistance
Concrete strength C25/30

$N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_T \cdot \Psi_s \cdot \Psi_{c,N}$

$N^0_{Rd,c}$ Design cone resistance					
Rebar size	**T8**	**T10**	**T12**	**T13**	**T16**
h_{ef} (mm)	80	90	110	110	125
$N^0_{Rd,c}$ (kN)	26.3	31.4	42.5	42.5	51.4

$N^0_{Rd,c}$ Design cone resistance					
Rebar size	**T20**	**T25**	**T28**	**T32**	**T40**
h_{ef} (mm)	170	210	270	300	360
$N^0_{Rd,c}$ (kN)	81.6	112.0	163.3	191.3	294.5

$\gamma_{Mc,N} = 1.5$



Steel resistance

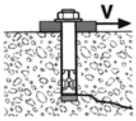
$N_{Rd,s}$ Steel design tensile resistance					
Rebar size	**T8**	**T10**	**T12**	**T13**	**T16**
$N_{Rd,s}$ (kN)	15.4	24.1	34.7	40.7	61.7

$N_{Rd,s}$ Steel design tensile resistance					
Rebar size	**T20**	**T25**	**T28**	**T32**	**T40**
$N_{Rd,s}$ (kN)	96.4	150.6	188.9	246.7	385.4

$\gamma_{Ms,N} = 1.5$

$N_{Rd} = \min(N_{Rd,p} ; N_{Rd,c} ; N_{Rd,s})$
$\beta N = N_{Sd} / N_{Rd} \leq 1$

SHEAR in kN



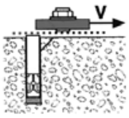
Concrete edge resistance
Concrete strength C25/30

$V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_{\beta,V} \cdot \Psi_{s\text{-}c,V}$

$V^0_{Rd,c}$ Design concrete edge resistance at a minimum edge distance (c_{min})					
Rebar size	**T8**	**T10**	**T12**	**T13**	**T16**
h_{ef} (mm)	80	90	110	110	125
c_{min}	40	45	55	55	63
s_{min}	40	45	55	55	63
$V^0_{Rd,c}$ (kN)	2.6	3.4	5.1	5.2	6.9

$V^0_{Rd,c}$ Design concrete edge resistance at a minimum edge distance (c_{min})					
Rebar size	**T20**	**T25**	**T28**	**T32**	**T40**
h_{ef} (mm)	170	210	270	300	360
c_{min}	85	105	135	150	180
s_{min}	85	105	135	150	180
$V^0_{Rd,c}$ (kN)	12.4	18.9	30.0	37.4	65.2

$\gamma_{Mc,V} = 1.5$

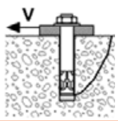


Steel resistance

$V_{Rd,s}$ Steel design shear resistance					
Rebar size	**T8**	**T10**	**T12**	**T13**	**T16**
$V_{Rd,s}$ (kN)	11.1	17.3	25.0	29.3	44.4

$V_{Rd,s}$ Steel design shear resistance					
Rebar size	**T20**	**T25**	**T28**	**T32**	**T40**
$V_{Rd,s}$ (kN)	69.4	108.4	136.0	177.6	277.5

$\gamma_{Ms,V} = 1.25$



Concrete pry-out failure
Concrete Strength C25/30

$V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot \Psi_s \cdot \Psi_{c,N}$

$V^0_{Rd,cp}$ Design pry-out resistance					
Rebar size	**T8**	**T10**	**T12**	**T13**	**T16**
$V^0_{Rd,cp}$ (kN)	52.7	62.9	84.9	84.9	102.9

$V^0_{Rd,cp}$ Design pry-out resistance					
Rebar size	**T20**	**T25**	**T28**	**T32**	**T40**
$V^0_{Rd,cp}$ (kN)	163.2	224.0	326.6	382.5	588.9

$\gamma_{Mc,V} = 1.5$

$V_{Rd} = \min(V_{Rd,c} ; V_{Rd,s} ; V_{Rd,cp})$
$\beta V = V_{Sd} / V_{Rd} \leq 1$

$\beta N + \beta V \leq 1.2$

f_B INFLUENCE OF CONCRETE

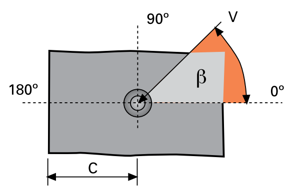
Concrete Grade	f_B	Concrete Grade	f_B
C16/20	0.81	C35/45	1.21
C20/25	0.90	C40/50	1.28
C25/30	1.00	C45/55	1.34
C30/37	1.10	C50/60	1.40

f_T INFLUENCE OF EMBEDMENT DEPTH

$$f_T = \frac{h_{act}}{h_{ef}}$$

$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

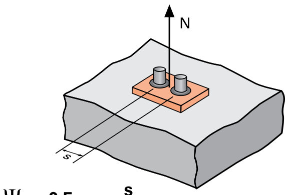
Angle β [°]	$f_{\beta,V}$
0~50	1.0
60	1.1
70	1.2
80	1.5
90~180	2.0



REBAR (FE460)

RAMSET CC-Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE



$$\Psi_s = 0.5 + \frac{s}{4h_{ef}}$$

$s < s_{cr,N}$

$s_{min} = 0.5h_{ef}$

$s_{cr,N} = 2h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

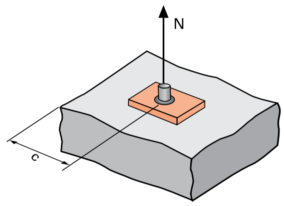
Spacing, s — Reduction Factor Ψ_s — Cracked / Non-cracked concrete

Spacing, s	T8	T10	T12	T13	T16
40	0.63				
45	0.64	0.63			
55	0.67	0.65	0.63	0.63	
65	0.70	0.68	0.65	0.65	0.63
85	0.77	0.74	0.69	0.69	0.67
105	0.83	0.79	0.74	0.74	0.71
140	0.94	0.89	0.82	0.82	0.78
160	1.00	0.94	0.86	0.86	0.82
180		1.00	0.91	0.91	0.86
220			1.00	1.00	0.94
250					1.00

Spacing, s — Reduction Factor Ψ_s — Cracked / Non-cracked concrete

Spacing, s	T20	T25	T28	T32	T40
85	0.63				
105	0.65	0.63			
140	0.71	0.67	0.63		
160	0.74	0.69	0.65	0.63	
210	0.81	0.75	0.69	0.68	0.63
250	0.87	0.80	0.73	0.71	0.66
300	0.94	0.86	0.78	0.75	0.69
350	1.00	0.92	0.82	0.79	0.72
420		1.00	0.89	0.85	0.76
540			1.00	0.95	0.84
600				1.00	0.88
700					0.94
800					1.00

$\Psi_{c,N}$ INFLUENCE OF EDGE FOR CONCRETE



$$\Psi_{c,N} = 0.275 + 0.725 \cdot \frac{c}{h_{ef}}$$

$c < c_{cr,N}$

$c_{min} = 0.5h_{ef}$

$c_{cr,N} = h_{ef}$

$\Psi_{c,N}$ must be used for each distance influenced the anchors group

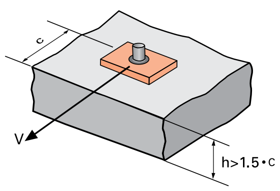
Edge, c — Reduction Factor $\Psi_{c,N}$ — Cracked / Non-cracked concrete

Edge, c	T8	T10	T12	T13	T16
40	0.63				
45	0.68	0.63			
55	0.77	0.71	0.63	0.63	
63	0.84	0.78	0.69	0.69	
80	1.00	0.91	0.80	0.80	
85		0.95	0.83	0.83	0.63
90		1.00	0.86	0.86	0.65
110			1.00	1.00	0.74
125					0.80
170					1.00

Edge, c — Reduction Factor $\Psi_{c,N}$ — Cracked / Non-cracked concrete

Edge, c	T20	T25	T28	T32	T40
85	0.63				
105	0.72	0.63			
135	0.85	0.74	0.63		
150	0.91	0.79	0.67	0.63	
170	1.00	0.86	0.73	0.68	
200		0.96	0.81	0.75	0.63
210		1.00	0.83	0.78	0.65
270			1.00	0.92	0.76
300				1.00	0.81
400					1.00

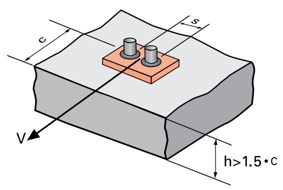
$\Psi_{s\text{-}c,V}$ INFLUENCED OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



$$\Psi_{s\text{-}c,V} = \frac{c}{c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

FOR SINGLE ANCHOR FASTENING — Reduction Factor $\Psi_{s\text{-}c,V}$ — Cracked / Non-cracked concrete

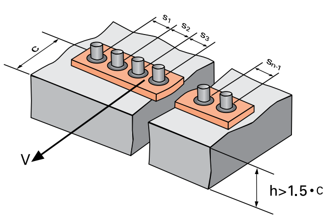
c/c_{min}	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$\Psi_{s\text{-}c,V}$	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



$$\Psi_{s\text{-}c,V} = \frac{3c + s}{6c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

FOR 2 ANCHORS FASTENING — Reduction Factor $\Psi_{s\text{-}c,V}$ — Cracked / Non-cracked concrete

s/c_{min} \ c/c_{min}	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16
1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
2.5	0.92	1.11	1.32	1.54	1.77	2.00	2.25	2.50	2.77	3.04	3.32	3.61
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35
5.5						2.71	2.99	3.28	3.57	3.88	4.19	4.50
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65



FOR OTHER CASE OF FASTENINGS

$$\Psi_{s\text{-}c,V} = \frac{3c + s_1 + s_2 + s_3 + ... + s_{n-1}}{3nc_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

REBAR (FE460)

INSTALLATION IN G30 REINFORCED CONCRETE

Design embedment depth $L_{b,rqd}$ and Design Tensile Load Table N_{Rd}

Rebar Ø (mm)	10	12	13	16	20	25	28	32	40
Hole Ø (mm)	13-14	15-16	16-18	20-22	25-28	30-32	35-38	40-42	50-52
Design Yield, $N_{Rd,s}$ (kN)	31.4	45.2	53.1	80.4	125.7	196.3	246.3	321.7	502.7
$L_{b,rqd}$ (mm)	140	165	180	220	275	340	385	515	725
$n=L_{b,rqd}$/Rebar Ø	14	14	14	14	14	14	14	17	19
Min Edge Distance (mm)	50	55	55	60	65	75	80	85	95
Min Spacing Distance (mm)	55	65	70	85	105	130	150	170	210
L_b (mm)	kN								
100	23.1								
110	25.4								
120	27.7	33.2							
125	28.9	34.6							
130	30.0	36.0	39.0						
140	32.3	38.8	42.0						
145		40.2	43.5						
160		44.3	48.0	59.1					
165		45.7	49.5	61.0					
180			54.0	66.5					
190				70.2					
200				73.9	92.4				
205				75.7	94.7				
220				81.3	101.6				
250					115.4	144.3			
255					117.8	147.2			
275					127.0	158.7			
280						161.6	181.0		
315						181.8	203.6		
320						184.7	206.9	200.6	
340						196.3	219.8	213.2	
360							232.7	225.7	
385							248.9	241.4	
395								247.6	
400								250.8	278.8
440								275.9	306.7
485								304.1	338.0
515								322.9	359.0
570									397.3
595									414.7
650									453.1
725									505.3

Safety Factor for Bond γ_B = 1.8
Safety Factor for Concrete $\gamma_{Mc,N}$ = 1.5
Safety Factor for Steel $\gamma_{Ms,N}$ = 1.15
Min Edge Distance is based on 30mm concrete cover

Tensile development length L_b using Reo502:
where the $F_{Rd} \leq N_{Rd,s}$:

$$L_b = \frac{L_{b,rqd}}{f_B} \bullet \frac{F_{Rd}}{N_{Rd,s}}$$

f_B INFLUENCE OF CONCRETE

Concrete Grade	f_B	Concrete Grade	f_B
C16/20	0.81	C35/45	1.21
C20/25	0.90	C40/50	1.28
C25/30	1.00	C45/55	1.34
C30/37	1.10	C50/60	1.40

Note: For splitting and splice calculation, please refer to ITW Technical Engineers.

REBAR (FE460)

INSTALLATION IN G40 REINFORCED CONCRETE

Design embedment depth $L_{b,rqd}$ and Design Tensile Load Table N_{Rd}

Rebar Ø (mm)	10	12	13	16	20	25	28	32	40
Hole Ø (mm)	13-14	15-16	16-18	20-22	25-28	30-32	35-38	40-42	50-52
Design Yield, $N_{Rd,s}$ (kN)	31.4	45.2	53.1	80.4	125.7	196.3	246.3	321.7	502.7
$L_{b,rqd}$ (mm)	125	145	160	200	250	300	340	455	640
n=$L_{b,rqd}$/Rebar Ø	13	13	13	13	13	12	13	15	16
L_b (mm)	kN								
90	23.1								
100	25.4								
105	27.7								
110	28.9	34.6							
115	30.0	36.0	39.0						
125	31.4	38.8	42.0						
130		40.2	43.5						
140		44.3	48.0	59.1					
145		45.2	49.5	61.0					
160			53.1	66.5					
170				70.2					
175				73.9	92.4				
180				75.7	94.7				
200				80.4	101.6				
220					115.4	144.3			
225					117.8	147.2			
250					125.7	158.7			
245						161.6			
235						173.2			
275						181.8	203.6		
280						184.7	206.9		
300						196.3	219.8	213.2	
320							232.7	225.7	
340							246.3	241.4	
350								247.6	
355								250.8	
390								275.9	
425								304.1	338.1
455								321.7	359.0
500									397.4
525									414.8
570									453.1
640									502.7

Safety Factor for Bond $\gamma_B = 1.8$
Safety Factor for Concrete $\gamma_{Mc,N} = 1.5$
Safety Factor for Steel $\gamma_{Ms,N} = 1.15$
Min Edge Distance is based on 30mm concrete cover

Tensile development length L_b using Reo502:
where the $F_{Rd} \leq N_{Rd,s}$:

$$L_b = \frac{L_{b,rqd}}{f_B} \bullet \frac{F_{Rd}}{N_{Rd,s}}$$

f_B **INFLUENCE OF CONCRETE**

Concrete Grade	f_B	Concrete Grade	f_B
C16/20	0.81	C35/45	1.21
C20/25	0.90	C40/50	1.28
C25/30	1.00	C45/55	1.34
C30/37	1.10	C50/60	1.40

REBAR (FE460)

Rebar Application Under ETA Rule - Intended Use

Overlap Joint

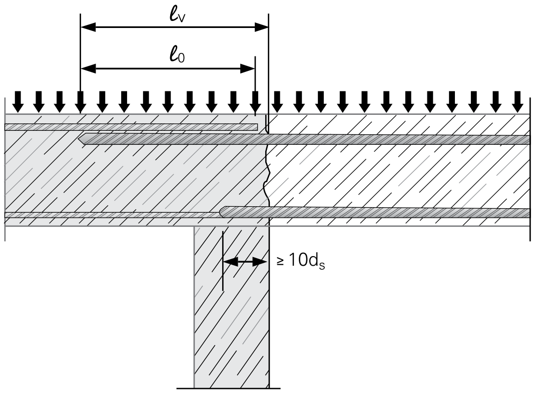


Figure 1.1: Overlap joint for rebar connections of slabs and beams.

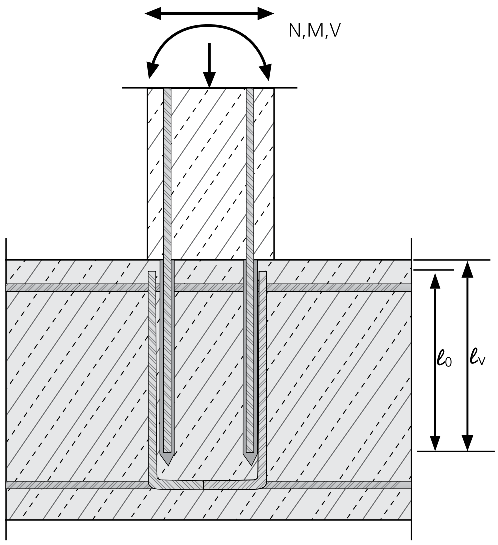


Figure 1.2: Overlap joint at a foundation of a column or wall where the rebars are stressed in tension

Anchoring Bar

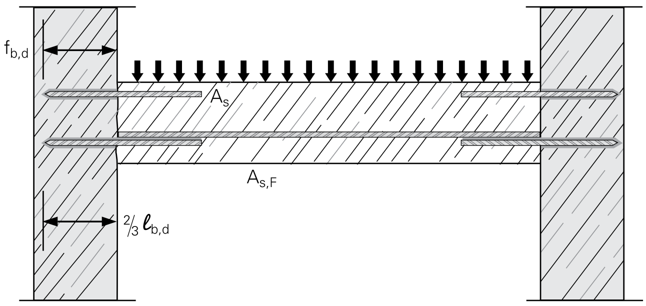


Figure 1.3: End anchoring of slabs or beams design as simply supported.

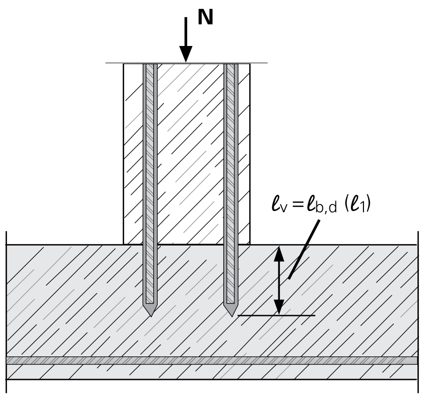


Figure 1.4: Rebar connection for components stressed primarily in compression. The rebars are stressed in compression.

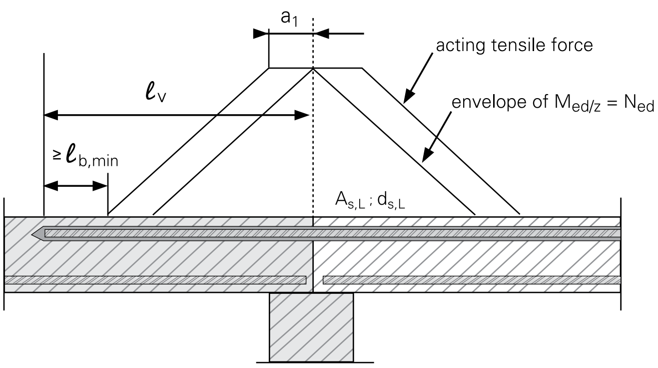
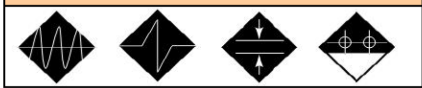


Figure 1.5: Anchoring of reinforcement to cover the line of acting tensile force.

REBAR (BSt 500 S)

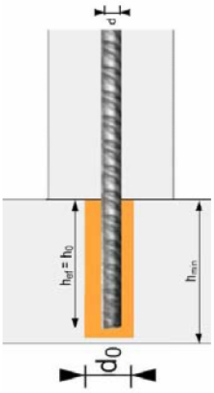
PERFORMANCE	INSTALLATION
	

Technical data

ETA Option 1
ICC-ES
EVALUATION
REPORT

		T8	T10	T12	T13	T16	T20	T25	T28	T32	T40
Minimum Effective Depth (mm)	$h_{ef,min}$	-	60	70	70	80	90	100	-	128	160
Standard Effective Depth (mm)	$h_{ef,std}$	80	90	110	110	125	170	210	270	300	360
∅ Rebar Diameter (mm)	d	8	10	12	13	16	20	25	28	32	40
∅ Recommend Drill Bit Diameter (mm)	d_o	12	13 - 14	15 - 16	16 - 18	20 - 22	25 - 28	30 - 32	35 - 38	40 - 42	50 - 52
Standard Drill depth (mm)	h_o	80	90	110	110	125	170	210	270	300	400
Min thick of base material (mm)	h_{min}	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm
Ramset power tool code		DD544	DD544	DD544	DD544	DD544	DD576	DD576	DD576	DD576	DD576
Drill bit type-size		R3 PLUS	R3 PLUS	R3 PLUS	R3 PLUS	R3 PLUS	R3 MAX	R3 MAX	R3 MAX	R3 MAX	R3 MAX

EPCON GRANITE 5 Two part cartridge, 100% epoxy resin - vol. 650ml



Anchor mechanical properties

Grade 500 Steel	T8	T10	T12	T13	T16	T20	T25	T28	T32	T40
f_{uk} (N/mm^2) Nominal Tensile Strength	550	550	550	550	550	550	550	550	550	550
f_{yk} (N/mm^2) Yield strength	500	500	500	500	500	500	500	500	500	500
As (mm^2) Stressed cross-section	50.3	78.5	113.1	132.7	201.1	314.2	490.9	615.8	804.4	1,256.8

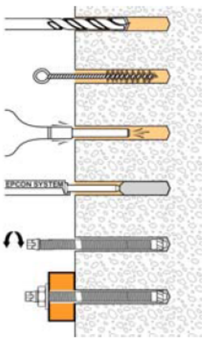
Setting time before applying load

Ambient temperature (°C)	Max time for installation (mins)	Waiting time before applying load (hr)
40°C	3	3
35°C	4	4
30°C	6	5
25°C	8	6
20°C	15	8
10°C	20	12

MATERIAL

Grade 500 Steel

INSTALLATION



REBAR (BSt 500 S)

Number of anchors per cartridge

Rebar diameter	10	12	13	16	20	25	28	32	40
Drilling ∅ (mm)	13	15	16	20	25	30	35	40	50
Drilling depth (mm)	90	110	110	125	170	210	270	300	360
No. of anchors per cartridge									
REO 502 (600ml)	100.4	61.7	54.3	30.6	14.4	8.1	4.6	3.2	1.7

Ultimate Loads ($N_{Ru,m}$, $V_{Ru,m}$) / Characteristic Loads (N_{Rk}, V_{Rk}) in kN

TENSILE @ Concrete Strength 30 N/mm²

Rebar size	*T8	T10	T12	T13	T16
h_{ef} (mm)	80	90	110	110	125
$N_{Ru,m}$ (kN)	39.2	60.2	86.8	86.8	155.4
N_{Rk} (kN)	28.0	43.0	62.0	62.0	111.0

Rebar size	T20	T25	T32	* T40
h_{ef} (mm)	170	210	300	360
$N_{Ru,m}$ (kN)	242.2	378.0	618.8	644.0
N_{Rk} (kN)	173.0	270.0	442.0	460.0

SHEAR @ Concrete Strength 30 N/mm²

Rebar size	*T8	T10	T12	T13	T16
$V_{Ru,m}$ (kN)	21.0	30.8	43.4	43.4	77.0
V_{Rk} (kN)	15.0	22.0	31.0	31.0	55.0

Rebar size	T20	T25	T32	* T40
$V_{Ru,m}$ (kN)	120.4	189.0	309.4	504.0
V_{Rk} (kN)	86.0	135.0	221.0	360.0

Design Loads (N_{Rd}, V_{Rd}) for one anchor without edge or spacing influence in kN

TENSILE @ Concrete Strength 30 N/mm²

Rebar size	*T8	T10	T12	T13	T16
h_{ef} (mm)	80	90	110	110	125
N_{Rd} (kN)	18.7	28.7	41.3	41.3	74.0

Rebar size	T20	T25	T32	*T40
h_{ef} (mm)	170	210	300	360
N_{Rd} (kN)	115.3	180.0	294.7	306.7

y = 1.5 *Partial Safety factor*

SHEAR @ Concrete Strength 30 N/mm²

Rebar size	*T8	T10	T12	T13	T16
V_{Rd} (kN)	12.0	17.6	24.8	24.8	44.0

Rebar size	T20	T25	T32	*T40
V_{Rd} (kN)	68.8	108.0	176.8	288.0

y = 1.25 *Partial Safety factor*

Recommended Loads (N_{rec}, V_{rec}) for one anchor without edge or spacing influence in kN

TENSILE @ Concrete Strength 30 N/mm²

Rebar size	*T8	T10	T12	T13	T16
h_{ef} (mm)	80	90	110	110	125
N_{rec} (kN)	12.4	19.1	27.6	27.6	49.3

Rebar size	T20	T25	T32	*T40
h_{ef} (mm)	170	210	300	360
N_{rec} (kN)	76.9	120.0	196.4	204.4

y = 1.5 *Partial Safety factor*

SHEAR @ Concrete Strength 30 N/mm²

Rebar size	*T8	T10	T12	T13	T16
V_{rec} (kN)	9.6	14.1	19.8	19.8	35.2

Rebar size	T20	T25	T32	*T40
V_{rec} (kN)	55.0	86.4	141.4	230.4

y = 1.25 *Partial Safety factor*

[shaded box] = steel failure

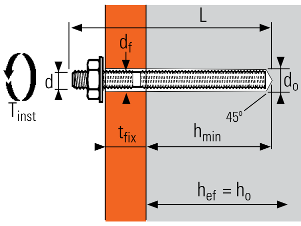
* = ITW RAMSET Additional Information

ZINC COATED ANCHOR STUD(G5.8) / CHEMSET™

Performance	Material	Installation

Technical Data

RAMSET Reo502 with Chemset Stud	Anchor depth (mm)	Max thick of fixture (mm)	Drill depth (mm)	Thick of base material (mm)	Ø Thread (mm)	Ø Drill bit (mm)	Total anchor length (mm)	Tighten torque (Nm)	Chemset stud code	Ramset power tool code	Drill bit type-size
	$h_{ef,min}$	t_{fix}	h_o	h_{min}	d	d_o	L	T_{inst}			
M8	80	15	80	100	8	10	110	10	CS08110	DD544	R3 PLUS-10
M10	90	20	90	115	10	12	130	20	CS10130	DD544	R3 PLUS-12
M12	110	25	110	140	12	14	160	30	CS12160	DD544	R3 PLUS-14
M16	125	35	125	160	16	18	190	60	CS16190	DD544	R3 PLUS-18
M20	170	65	170	215	20	25	260	120	CS20260	DD565	R3 MAX-25
M24	210	63	210	270	24	28	300	200	CS24300	DD565	R3 MAX-28
M30	280	70	280	350	30	35	380	400	CS30380	DD565	R3 MAX-35



Anchor Mechanical Properties

CARBON STEEL Grade 5.8	M8	M10	M12	M16	M20	M24	M30
f_{uk} (N/mm2) Min. tensile strength	540	540	540	520	520	520	520
f_{yk} (N/mm2) Yield strength	430	430	430	420	420	420	420
A_s (mm2) Stressed cross-section	36.6	58	84.3	157	245	353	522.8
W_{el} (mm3) Elastic section modulus	31.2	62.3	109.2	277.5	540.9	935.5	1,686.0
$M^0_{Rk,s}$ (Nm) Characteristic bending moment	20.2	40.4	70.7	173.1	337.5	583.8	1,052.1
M (Nm) Recommended bending moment	16.2	32.3	56.6	138.5	270.0	467.0	841.7

MATERIAL

Stud / Chemset™:
Grade 5.8

Hexagonal Nut:
Grade 6 or 8

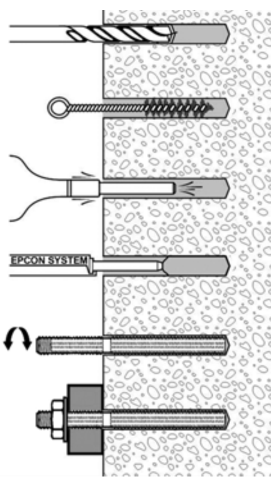
Washer:
Steel

Coating:
Zinc Coated 5µm

Setting Time before applying load

Ambient temperature (°C)	Max time for installation (mins)	Waiting time before applying load (hr)
40°C	3	3
35°C	4	4
30°C	6	5
25°C	8	6
20°C	15	8
10°C	20	12

INSTALLATION



ZINC COATED ANCHOR STUD(G5.8) / CHEMSET™

Number of Anchors per cartridge

Stud diameter	8	10	12	16	20	24	30
Drilling Ø (mm)	10	12	14	18	25	28	35
Drilling depth (mm)	80	90	110	125	170	210	280
No. of anchors per cartridge							
RAMSET Reo502 (600ml)	190.9	117.9	70.9	37.8	14.4	9.3	4.4

Ultimate Loads ($N_{Ru,m}$, $V_{Ru,m}$) / Characteristic Loads (N_{Rk}, V_{Rk}) in kN

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef} (mm)	80	90	110	125	170	210	280
$N_{Ru,m}$ (kN)	21.3	33.8	49.2	88.2	137.6	198.2	293.6
N_{Rk} (kN)	19.8	31.3	45.5	81.6	127.4	183.6	271.9

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
$V_{Ru,m}$ (kN)	12.8	20.3	29.5	52.9	82.6	118.9	176.2
V_{Rk} (kN)	11.9	18.8	27.3	49.0	76.4	110.1	163.1

Design Loads (N_{Rd}, V_{Rd}) for one anchor without edge or spacing influence in kN

$$N_{Rd} = \frac{N_{Rk}}{\gamma_{Ms,N}}$$

$$V_{Rd} = \frac{V_{Rk}}{\gamma_{Ms,V}}$$

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef} (mm)	80	90	110	125	170	210	280
N_{Rd} (kN)	13.2	20.9	30.3	54.4	84.9	122.4	181.2

$\gamma_{Ms,N}$ = 1.5 *(steel failure)*

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
V_{Rd} (kN)	9.5	15.0	21.9	39.2	61.2	88.1	130.5

$\gamma_{Ms,V}$ = 1.25

Recommended Loads (N_{rec}, V_{rec}) for one anchor without edge or spacing influence in kN

$$N_{rec} = \frac{N_{Rk}}{\gamma_{Ms,N} \cdot \gamma_F}$$

$$V_{rec} = \frac{V_{Rk}}{\gamma_{Ms,V} \cdot \gamma_F}$$

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef} (mm)	80	90	110	125	170	210	280
N_{rec} (kN)	9.4	14.9	21.7	38.9	60.7	87.4	129.5

γ_F = 1.4

$\gamma_{Ms,N}$ = 1.5 *(steel failure)*

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
V_{rec} (kN)	6.8	10.7	15.6	28.0	43.7	62.9	93.2

γ_F = 1.4

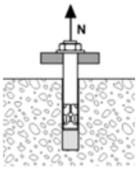
$\gamma_{Ms,V}$ = 1.25

steel failure

ZINC COATED ANCHOR STUD(G5.8) / CHEMSET™

RAMSET CC-Method

TENSILE in kN

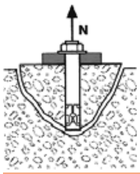


Pull-out resistance
Concrete strength C25/30

$N_{Rd,p} = N^0_{Rd,p} \cdot f_B \cdot f_T$

$N^0_{Rd,p}$	Design pull-out resistance						
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef}	80	90	110	125	170	210	280
$N^0_{Rd,p}$ (kN)	15.3	26.7	33.8	45.5	59.1	90.1	150.1

$\gamma_{Mc,N} = 1.8$

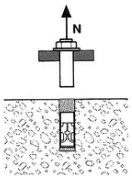


Concrete cone resistance
Concrete strength C25/30

$N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_T \cdot \Psi_s \cdot \Psi_{c,N}$

$N^0_{Rd,c}$	Design cone resistance						
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef} (mm)	80	90	110	125	170	210	280
$N^0_{Rd,c}$ (kN)	26.3	31.4	42.5	51.4	81.6	112.0	172.5

$\gamma_{Mc,N} = 1.5$

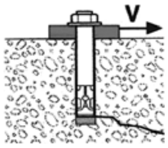


Steel resistance

$N_{Rd,s}$	Steel design tensile resistance						
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
$N_{Rd,s}$ (kN)	13.2	20.9	30.3	54.4	84.9	122.4	181.2

$\gamma_{Ms,N} = 1.5$

SHEAR in kN

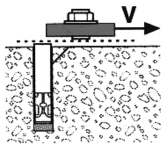


Concrete edge resistance
Concrete strength C25/30

$V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_{\beta,V} \cdot \Psi_{s\text{-}c,V}$

$V^0_{Rd,c}$	Design concrete edge resistance at a minimum edge distance (c_{min})						
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef} (mm)	80	90	110	125	170	210	280
c_{min}	40	45	55	65	85	105	140
s_{min}	40	45	55	65	85	105	140
$V^0_{Rd,c}$ (kN)	2.6	3.4	5.1	7.3	12.4	18.7	32.6

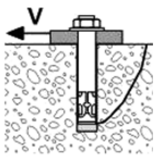
$\gamma_{Mc,V} = 1.5$



Steel resistance

$V_{Rd,s}$	Steel design shear resistance						
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
$V_{Rd,s}$ (kN)	9.5	15.0	21.9	39.2	61.2	88.1	130.5

$\gamma_{Ms,V} = 1.25$



Concrete pry-out failure
Concrete Strength C25/30

$V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot \Psi_s \cdot \Psi_{c,N}$

$V^0_{Rd,cp}$	Design pry-out resistance						
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
$V^0_{Rd,cp}$ (kN)	52.7	62.9	84.9	102.9	163.2	224.0	344.9

$\gamma_{Mc,V} = 1.5$

$N_{Rd} = \min (N_{Rd,p} ; N_{Rd,c} ; N_{Rd,s})$
$\beta N = N_{Sd} / N_{Rd} \leq 1$

$V_{Rd} = \min (V_{Rd,c} ; V_{Rd,s} ; V_{Rd,cp})$
$\beta V = V_{Sd} / V_{Rd} \leq 1$

$\beta N + \beta V \leq 1.2$

f_B INFLUENCE OF CONCRETE

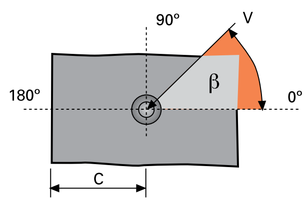
Concrete Grade	f_B	Concrete Grade	f_B
C16/20	0.81	C35/45	1.21
C20/25	0.90	C40/50	1.28
C25/30	1.00	C45/55	1.34
C30/37	1.10	C50/60	1.40

f_T INFLUENCE OF EMBEDMENT DEPTH

$$f_T = \frac{h_{act}}{h_{ef}}$$

$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

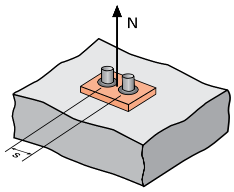
Angle β [°]	$f_{\beta,V}$
0~50	1.0
60	1.1
70	1.2
80	1.5
90~180	2.0



ZINC COATED ANCHOR STUD(G5.8) / CHEMSET™

RAMSET CC-Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE



$$\Psi_s = 0.5 + \frac{s}{4h_{ef}}$$

$s < s_{cr,N}$

$s_{min} = 0.5h_{ef}$

$s_{cr,N} = 2h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

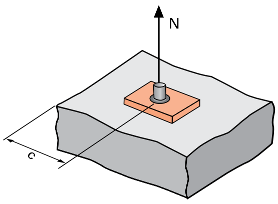
Spacing, s — Reduction Factor Ψ_s — Cracked / Non-cracked concrete

Spacing, s	M8	M10	M12	M16
40	0.63			
45	0.64	0.63		
55	0.67	0.65	0.63	
65	0.70	0.68	0.65	0.63
85	0.77	0.74	0.69	0.67
105	0.83	0.79	0.74	0.71
140	0.94	0.89	0.82	0.78
160	1.00	0.94	0.86	0.82
180		1.00	0.91	0.86
220			1.00	0.94
250				1.00

Spacing, s — Reduction Factor Ψ_s — Cracked / Non-cracked concrete

Spacing, s	M20	M24	M30
85	0.63		
105	0.65	0.63	
140	0.71	0.67	0.63
160	0.74	0.69	0.64
180	0.76	0.71	0.66
220	0.82	0.76	0.70
250	0.87	0.80	0.72
300	0.94	0.86	0.77
340	1.00	0.90	0.80
370		0.94	0.83
420		1.00	0.88
560			1.00

$\Psi_{c,N}$ INFLUENCE OF EDGE FOR CONCRETE



$$\Psi_{c,N} = 0.275 + 0.725 \cdot \frac{c}{h_{ef}}$$

$c < c_{cr,N}$

$c_{min} = 0.5h_{ef}$

$c_{cr,N} = h_{ef}$

$\Psi_{c,N}$ must be used for each distance influenced the anchors group

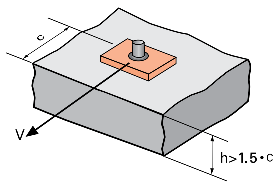
Edge, c — Reduction Factor $\Psi_{c,N}$ — Cracked / Non-cracked concrete

Edge, c	M8	M10	M12	M16
40	0.63			
45	0.68	0.63		
55	0.77	0.71	0.63	
65	0.86	0.79	0.70	0.65
80	1.00	0.91	0.80	0.73
90		1.00	0.86	0.79
110			1.00	0.91
125				1.00

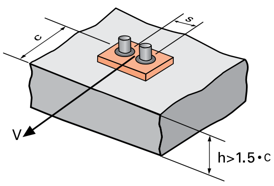
Edge, c — Reduction Factor $\Psi_{c,N}$ — Cracked / Non-cracked concrete

Edge, c	M20	M24	M30
85	0.63		
105	0.72	0.63	
120	0.78	0.68	
140	0.87	0.75	0.63
170	1.00	0.86	0.71
210		1.00	0.81
250			0.92
280			1.00

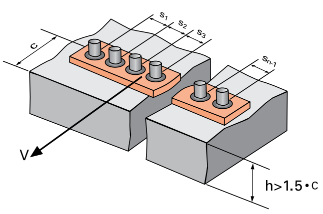
$\Psi_{s\text{-}c,V}$ INFLUENCED OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



$$\Psi_{s\text{-}c,V} = \frac{c}{c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$



$$\Psi_{s\text{-}c,V} = \frac{3c + s}{6c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$



FOR SINGLE ANCHOR FASTENING

Reduction Factor $\Psi_{s\text{-}c,V}$ — Cracked / Non-cracked concrete

$\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$\Psi_{s\text{-}c,V}$	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72

FOR 2 ANCHORS FASTENING

Reduction Factor $\Psi_{s\text{-}c,V}$ — Cracked / Non-cracked concrete

$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16
1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
2.5	0.92	1.11	1.32	1.54	1.77	2.00	2.25	2.50	2.77	3.04	3.32	3.61
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35
5.5						2.71	2.99	3.28	3.57	3.88	4.19	4.50
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65

FOR OTHER CASE OF FASTENINGS

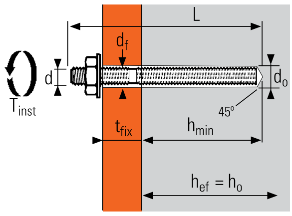
$$\Psi_{s\text{-}c,V} = \frac{3c + s_1 + s_2 + s_3 + \ldots + s_{n-1}}{3nc_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

ZINC COATED ANCHOR STUD(G8.8) / CHEMSET™

Performance	Material	Installation
	Zn	

Technical Data

RAMSET Reo502	Anchor depth (mm)	Max thick of fixture (mm)	Drill depth DD565 (mm)	Thick of base material (mm)	Ø Thread (mm)	Ø Drill bit (mm)	Total anchor length (mm)	Tighten torque (Nm)	Ramset power tool code	Drill bit type-size
	$h_{ef,min}$	t_{fix}	h_o	h_{min}	d	d_o	L	T_{inst}		
M8	80	15	80	100	8	10	110	10	DD544	R3 PLUS-10
M10	90	20	90	115	10	12	130	20	DD544	R3 PLUS-12
M12	110	25	110	140	12	14	160	30	DD544	R3 PLUS-14
M16	125	35	125	160	16	18	190	60	DD544	R3 PLUS-18
M20	170	65	170	215	20	25	260	120	DD576	R3 MAX-25
M24	210	63	210	270	24	28	300	200	DD576	R3 MAX-28
M27	240	60	240	300	27	30	340	300	DD576	R3 MAX-30
M30	280	70	280	350	30	35	380	400	DD576	R3 MAX-35
M33	300	80	300	375	33	38	420	1200	DD576	R3 MAX-38
M36	330	90	330	413	36	40	460	1500	DD576	R3 MAX-40
M39	360	100	360	450	39	45	510	1800	DD576	R3 MAX-45



Anchor Mechanical Properties

CARBON STEEL Grade 8.8	M8	M10	M12	M16	M20	M24
f_{uk} (N/mm2) Min. tensile strength	800	800	800	800	800	800
f_{yk} (N/mm2) Yield strength	640	640	640	640	640	640
A_s (mm2) Stressed cross-section	36.6	58	84.3	157	245	353
W_{el} (mm3) Elastic section modulus	31.2	62.3	109.2	277.5	540.9	935.5
$M^0_{Rk,s}$ (Nm) Characteristic bending moment	30.0	59.8	104.8	266.4	519.3	898.1
M (Nm) Recommended bending moment	24.0	47.8	83.9	213.1	415.4	718.5

CARBON STEEL Grade 8.8	M27	M30	M33	M36	M39
f_{uk} (N/mm2) Min. tensile strength	800	800	800	800	800
f_{yk} (N/mm2) Yield strength	640	640	640	640	640
A_s (mm2) Stressed cross-section	427	522.8	647	759	913
W_{el} (mm3) Elastic section modulus	1,245.0	1,668.0	2,322.0	2,951.0	3,860.0
$M^0_{Rk,s}$ (Nm) Characteristic bending moment	1,195.2	1,601.3	2,229.1	2,833.0	3,705.6
M (Nm) Recommended bending moment	956.2	1,281.0	1,783.3	2,266.4	2,964.5

MATERIAL

Stud / Chemset™:
Grade 8.8

Hexagonal Nut:
Grade 8 or 10

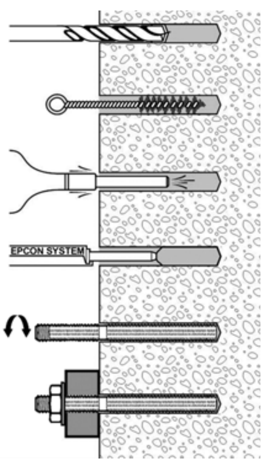
Washer:
Steel

Coating:
Zinc Coated 5µm

Setting Time before applying load

Ambient temperature (°C)	Max time for installation (mins)	Waiting time before applying load (hr)
40°C	3	3
35°C	4	4
30°C	6	5
25°C	8	6
20°C	15	8
10°C	20	12

INSTALLATION



ZINC COATED ANCHOR STUD(G8.8) / CHEMSET™

Number of Anchors per cartridge

Stud diameter	8	10	12	16	20	24	27	30	33	36	39
Drilling Ø (mm)	10	12	14	18	25	28	30	35	38	35	45
Drilling depth (mm)	80	90	110	125	170	210	240	280	300	330	360
No. of anchors per cartridge											
RAMSET Reo502 (600ml)	190.9	117.9	70.9	37.8	14.4	9.3	7.1	4.4	3.5	2.9	2.1

Ultimate Loads ($N_{Ru,m}$, $V_{Ru,m}$) / Characteristic Loads (N_{Rk}, V_{Rk}) in kN

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24
h_{ef} (mm)	80	90	110	125	170	210
$N_{Ru,m}$ (kN)	31.6	50.1	72.8	109.1	141.8	216.2
N_{Rk} (kN)	29.3	46.4	67.4	81.8	106.3	162.1

Anchor size	M27	M30	M33	M36	M39
h_{ef} (mm)	240	280	300	330	360
$N_{Ru,m}$ (kN)	264.7	360.3	419.1	485.3	595.6
N_{Rk} (kN)	198.5	270.2	314.3	364.0	446.7

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24
$V_{Ru,m}$ (kN)	19.0	30.1	43.7	81.4	127.0	183.0
V_{Rk} (kN)	17.6	27.8	40.5	75.4	117.6	169.4

Anchor size	M27	M30	M33	M36	M39
$V_{Ru,m}$ (kN)	221.4	271.0	335.4	393.5	473.3
V_{Rk} (kN)	205.0	250.9	310.6	364.3	438.2

Design Loads (N_{Rd}, V_{Rd}) for one anchor without edge or spacing influence in kN

$$N_{Rd} = \frac{N_{Rk}}{\gamma_{Mc,N}} \text{ or } \frac{N_{Rk}}{\gamma_{Ms,N}}$$

$$V_{Rd} = \frac{V_{Rk}}{\gamma_{Ms,V}}$$

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24
h_{ef} (mm)	80	90	110	125	170	210
N_{Rd} (kN)	19.5	30.9	45.0	45.5	59.1	90.1

Anchor size	M27	M30	M33	M36	M39
h_{ef} (mm)	240	280	300	330	360
N_{Rd} (kN)	110.3	150.1	174.6	202.2	248.2

$\gamma_{Mc,N}$ = 1.8
$\gamma_{Ms,N}$ = 1.5 *(steel failure)*

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24
V_{Rd} (kN)	14.1	22.3	32.4	60.3	94.1	135.6

Anchor size	M27	M30	M33	M36	M39
V_{Rd} (kN)	164.0	200.8	248.4	291.5	350.6

$\gamma_{Ms,V}$ = 1.25

Recommended Loads (N_{rec}, V_{rec}) for one anchor without edge or spacing influence in kN

$$N_{rec} = \frac{N_{Rk}}{\gamma_{Mc,N} \cdot \gamma_F} \text{ or } \frac{N_{Rk}}{\gamma_{Ms,N} \cdot \gamma_F}$$

$$V_{rec} = \frac{V_{Rk}}{\gamma_{Ms,V} \cdot \gamma_F}$$

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24
h_{ef} (mm)	80	90	110	125	170	210
N_{rec} (kN)	13.9	22.1	32.1	32.5	42.2	64.3

Anchor size	M27	M30	M33	M36	M39
h_{ef} (mm)	240	280	300	330	360
N_{rec} (kN)	78.8	107.2	124.7	144.4	177.3

γ_F = 1.4
$\gamma_{Mc,N}$ = 1.8
$\gamma_{Ms,N}$ = 1.5 *(steel failure)*

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24
V_{rec} (kN)	10.0	15.9	23.1	43.1	67.2	96.8

Anchor size	M27	M30	M33	M36	M39
V_{rec} (kN)	117.1	143.4	177.5	208.2	250.4

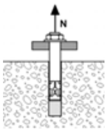
γ_F = 1.4
$\gamma_{Ms,V}$ = 1.25

steel failure (shaded cells: M8, M10, M12 $N_{Ru,m}$ and N_{Rk})

ZINC COATED ANCHOR STUD(G8.8) / CHEMSET™

RAMSET CC-Method

TENSILE in kN



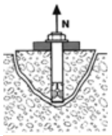
Pull-out resistance
Concrete strength C25/30

$N_{Rd,p} = N^0_{Rd,p} \cdot f_B \cdot f_T$

$N^0_{Rd,p}$	Design pull-out resistance					
Anchor size	M8	M10	M12	M16	M20	M24
h_{ef}	80	90	110	125	170	210
$N^0_{Rd,p}$ (kN)	15.3	26.7	33.8	45.5	59.1	90.1

$N^0_{Rd,p}$	Design pull-out resistance				
Anchor size	M27	M30	M33	M36	M39
h_{ef}	240	280	300	330	360
$N^0_{Rd,p}$ (kN)	110.3	150.1	174.6	202.2	248.2

$\gamma_{Mc,N} = 1.8$



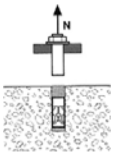
Concrete cone resistance
Concrete strength C25/30

$N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_T \cdot \Psi_s \cdot \Psi_{c,N}$

$N^0_{Rd,c}$	Design cone resistance					
Anchor size	M8	M10	M12	M16	M20	M24
h_{ef} (mm)	80	90	110	125	170	210
$N^0_{Rd,c}$ (kN)	26.3	31.4	42.5	51.4	81.6	112.0

$N^0_{Rd,c}$	Design cone resistance				
Anchor size	M27	M30	M33	M36	M39
h_{ef} (mm)	240	280	300	330	360
$N^0_{Rd,c}$ (kN)	136.9	172.5	191.3	220.6	251.4

$\gamma_{Mc,N} = 1.5$



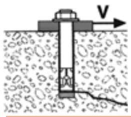
Steel resistance

$N_{Rd,s}$	Steel design tensile resistance					
Anchor size	M8	M10	M12	M16	M20	M24
$N_{Rd,s}$ (kN)	19.5	30.9	45.0	83.7	130.7	188.3

$N_{Rd,s}$	Steel design tensile resistance				
Anchor size	M27	M30	M33	M36	M39
$N_{Rd,s}$ (kN)	227.7	278.8	345.1	404.8	486.9

$\gamma_{Ms,N} = 1.5$

SHEAR in kN



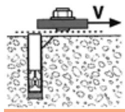
Concrete edge resistance
Concrete strength C25/30

$V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_{\beta,V} \cdot \Psi_{s\text{-}c,V}$

$V^0_{Rd,c}$	Design concrete edge resistance at a minimum edge distance (c_{min})					
Anchor size	M8	M10	M12	M16	M20	M24
h_{ef} (mm)	80	90	110	125	170	210
c_{min}	40	45	55	65	85	105
s_{min}	40	45	55	65	85	105
$V^0_{Rd,c}$ (kN)	2.6	3.4	5.1	7.3	12.4	18.7

$V^0_{Rd,c}$	Design concrete edge resistance at a minimum edge distance (c_{min})				
Anchor size	M27	M30	M33	M36	M39
h_{ef} (mm)	240	280	300	330	360
c_{min}	120	140	150	165	180
s_{min}	120	140	150	165	180
$V^0_{Rd,c}$ (kN)	24.3	32.6	37.8	45.6	54.1

$\gamma_{Mc,V} = 1.5$

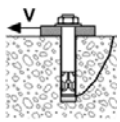


Steel resistance

$V_{Rd,s}$	Steel design shear resistance					
Anchor size	M8	M10	M12	M16	M20	M24
$V_{Rd,s}$ (kN)	14.1	22.3	32.4	60.3	94.1	135.6

$V_{Rd,s}$	Steel design shear resistance				
Anchor size	M27	M30	M33	M36	M39
$V_{Rd,s}$ (kN)	164.0	200.8	248.4	291.5	350.6

$\gamma_{Ms,V} = 1.25$



Concrete pry-out failure
Concrete Strength C25/30

$V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot \Psi_s \cdot \Psi_{c,N}$

$V^0_{Rd,cp}$	Design pry-out resistance					
Anchor size	M8	M10	M12	M16	M20	M24
$V^0_{Rd,cp}$ (kN)	52.7	62.9	84.9	102.9	163.2	224.0

$V^0_{Rd,cp}$	Design pry-out resistance				
Anchor size	M27	M30	M33	M36	M39
$V^0_{Rd,cp}$ (kN)	273.7	344.9	382.5	441.3	502.8

$\gamma_{Mc,V} = 1.5$

$N_{Rd} = \min(N_{Rd,p}\,;\,N_{Rd,c}\,;\,N_{Rd,s})$

$\beta N = N_{Sd} / N_{Rd} \le 1$

$V_{Rd} = \min(V_{Rd,c}\,;\,V_{Rd,s}\,;\,V_{Rd,cp})$

$\beta V = V_{Sd} / V_{Rd} \le 1$

$\beta N + \beta V \le 1.2$

f_B INFLUENCE OF CONCRETE

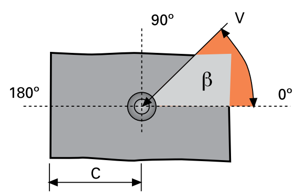
Concrete Grade	f_B	Concrete Grade	f_B
C16/20	0.81	C35/45	1.21
C20/25	0.90	C40/50	1.28
C25/30	1.00	C45/55	1.34
C30/37	1.10	C50/60	1.40

f_T INFLUENCE OF EMBEDMENT DEPTH

$$f_T = \frac{h_{act}}{h_{ef}}$$

$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

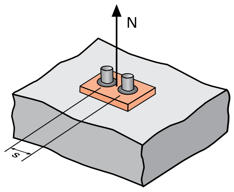
Angle β [°]	$f_{\beta,V}$
0~50	1.0
60	1.1
70	1.2
80	1.5
90~180	2.0



ZINC COATED ANCHOR STUD(G8.8) / CHEMSET™

RAMSET CC-Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE



$$\Psi_s = 0.5 + \frac{s}{4h_{ef}}$$

$s < s_{cr,N}$

$s_{min} = 0.5h_{ef}$

$s_{cr,N} = 2h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

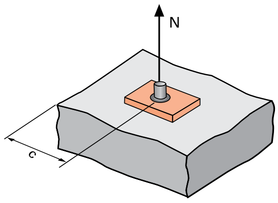
Spacing, s — Reduction Factor Ψ_s — Cracked / Non-cracked concrete

Spacing, s	M8	M10	M12	M16	M20	M24
40	0.63					
45	0.64	0.63				
55	0.67	0.65	0.63			
65	0.70	0.68	0.65	0.63		
85	0.77	0.74	0.69	0.67	0.63	
105	0.83	0.79	0.74	0.71	0.65	0.63
140	0.94	0.89	0.82	0.78	0.71	0.67
160	1.00	0.94	0.86	0.82	0.74	0.69
180		1.00	0.91	0.86	0.76	0.71
220			1.00	0.94	0.82	0.76
250				1.00	0.87	0.80
340					1.00	0.90
420						1.00

Spacing, s — Reduction Factor Ψ_s — Cracked / Non-cracked concrete

Spacing, s	M27	M30	M33	M36	M39
120	0.63				
140	0.65	0.63			
155	0.66	0.64	0.63		
165	0.67	0.65	0.64	0.63	
180	0.69	0.66	0.65	0.64	0.63
300	0.81	0.77	0.75	0.73	0.71
400	0.92	0.86	0.83	0.80	0.78
480	1.00	0.93	0.90	0.86	0.83
560		1.00	0.97	0.92	0.89
600			1.00	0.95	0.92
660				1.00	0.96
720					1.00

$\Psi_{c,N}$ INFLUENCE OF EDGE FOR CONCRETE



$$\Psi_{c,N} = 0.275 + 0.725 \cdot \frac{c}{h_{ef}}$$

$c < c_{cr,N}$

$c_{min} = 0.5h_{ef}$

$c_{cr,N} = h_{ef}$

$\Psi_{c,N}$ must be used for each distance influenced the anchors group

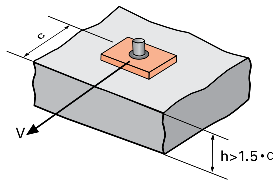
Edge, c — Reduction Factor $\Psi_{c,N}$ — Cracked / Non-cracked concrete

Edge, c	M8	M10	M12	M16	M20	M24
40	0.63					
45	0.68	0.63				
55	0.77	0.71	0.63			
63	0.84	0.78	0.69	0.64		
80	1.00	0.91	0.80	0.73		
85		0.95	0.83	0.76	0.63	
90		1.00	0.86	0.79	0.65	
105			0.96	0.88	0.72	0.63
110			1.00	0.91	0.74	0.65
125				1.00	0.80	0.70
150					0.91	0.79
170					1.00	0.86
210						1.00

Edge, c — Reduction Factor $\Psi_{c,N}$ — Cracked / Non-cracked concrete

Edge, c	M27	M30	M33	M36	M39
120	0.63				
140	0.69	0.63			
150	0.72	0.66	0.63		
165	0.77	0.70	0.67	0.63	
180	0.81	0.74	0.71	0.67	0.63
240	1.00	0.89	0.85	0.80	0.75
250		0.92	0.87	0.82	0.77
280		1.00	0.95	0.89	0.83
300			1.00	0.93	0.87
330				1.00	0.93
360					1.00

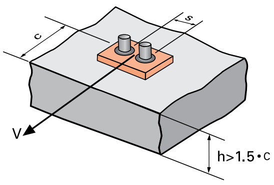
$\Psi_{s-c,V}$ INFLUENCED OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



$$\Psi_{s-c,V} = \frac{c}{c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

FOR SINGLE ANCHOR FASTENING — Reduction Factor $\Psi_{s-c,V}$ — Cracked / Non-cracked concrete

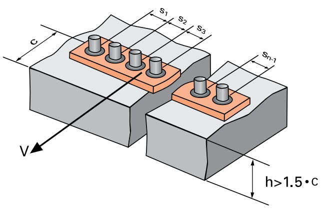
$\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$\Psi_{s-c,V}$	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



$$\Psi_{s-c,V} = \frac{3c + s}{6c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

FOR 2 ANCHORS FASTENING — Reduction Factor $\Psi_{s-c,V}$ — Cracked / Non-cracked concrete

$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16
1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
2.5	0.92	1.11	1.32	1.54	1.77	2.00	2.25	2.50	2.77	3.04	3.32	3.61
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35
5.5						2.71	2.99	3.28	3.57	3.88	4.19	4.50
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65

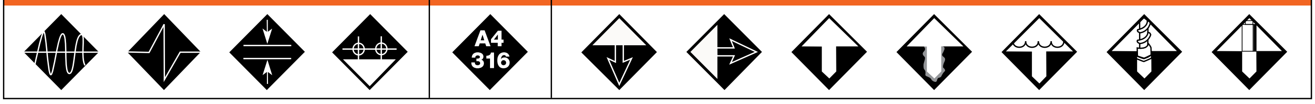


FOR OTHER CASE OF FASTENINGS

$$\Psi_{s-c,V} = \frac{3c + s_1 + s_2 + s_3 + \ldots + s_{n-1}}{3nc_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

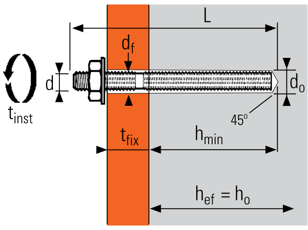
STAINLESS STEEL ANCHOR STUD(SS316) / CHEMSET™

Performance	Material	Installation



Technical Data

Ramset Reo502 with Chemset Stud SS	Anchor depth (mm)	Max thick of fixture (mm)	Drill depth (mm)	Thick of base material (mm)	Ø Thread (mm)	Ø Drill bit (mm)	Total anchor length (mm)	Tighten torque (Nm)	Chemset stud code	Ramset power tool code	Drill bit type-size
	h_{ef}	t_{fix}	h_o	h_{min}	d	d_o	L	T_{inst}			
M8	80	15	80	100	8	10	110	10	CS08110SS	DD544	R3 PLUS-10
M10	90	20	90	115	10	12	130	20	CS10130SS	DD544	R3 PLUS-12
M12	110	25	110	140	12	14	160	30	CS12160SS	DD544	R3 PLUS-14
M16	125	35	125	160	16	18	190	60	CS16190SS	DD544	R3 PLUS-18
M20	170	65	170	215	20	25	260	120	CS20260SS	DD576	R3 MAX-25
M24	210	63	210	270	24	28	300	200	CS24300SS	DD576	R3 MAX-28
M30	280	70	280	350	30	35	380	400	CS30380SS	DD576	R3 MAX-35



Anchor Mechanical Properties

STAINLESS STEEL SUS316	M8	M10	M12	M16	M20	M24	M30
f_{uk} (N/mm2) Min. tensile strength	650	650	650	650	650	650	500
f_{yk} (N/mm2) Yield strength	450	450	450	450	450	450	250
A_s (mm2) Stressed cross-section	36.6	58	84.3	157	245	353	522.8
W_{el} (mm3) Elastic section modulus	31.2	62.3	109.2	277.5	540.9	935.5	1,686.0
$M^0_{Rk,s}$ (Nm) Characteristic bending moment	24.4	48.6	85.2	216.4	421.9	729.7	1,011.6
M (Nm) Recommended bending moment	15.7	31.4	54.9	139.6	272.2	470.8	652.6

MATERIAL

Stud / Chemset™ :
SUS316

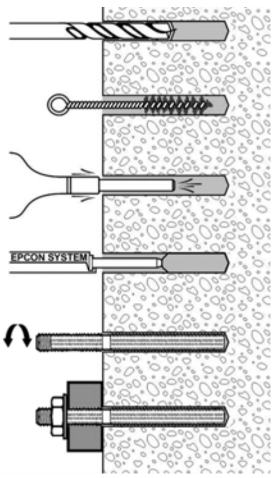
Hexagonal Nut:
SUS316

Washer:
SUS316

Setting Time before applying load

Ambient temperature (°C)	Max time for installation (mins)	Waiting time before applying load (hr)
40°C	3	3
35°C	4	4
30°C	6	5
25°C	8	6
20°C	15	8
10°C	20	12

INSTALLATION



STAINLESS STEEL ANCHOR STUD(SS316) / CHEMSET™

Number of Sealings per cartridge

Stud diameter	8	10	12	16	20	24	30
Drilling Ø (mm)	10	12	14	18	25	28	35
Drilling depth (mm)	80	90	110	125	170	210	280
No. of anchors per cartridge							
RAMSET Reo502 (600ml)	190.9	117.9	70.9	37.8	14.4	9.3	4.4

Ultimate Loads ($N_{Ru,m}$, $V_{Ru,m}$) / Characteristic Loads (N_{Rk}, V_{Rk}) in kN

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef} (mm)	80	90	110	125	170	210	280
$N_{Ru,m}$ (kN)	25.7	40.7	59.2	110.2	141.8	216.2	360.3
N_{Rk} (kN)	23.8	37.7	54.8	102.1	106.3	162.1	270.2

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
$V_{Ru,m}$ (kN)	15.4	24.4	35.5	66.1	103.2	148.7	169.4
V_{Rk} (kN)	14.3	22.6	32.9	61.2	95.6	137.7	156.8

Design Loads (N_{Rd}, V_{Rd}) for one anchor without edge or spacing influence in kN

$$N_{Rd} = \frac{N_{Rk}}{\gamma_{Mc,N}} \quad \text{or} \quad \frac{N_{Rk}}{\gamma_{Ms,N}}$$

$$V_{Rd} = \frac{V_{Rk}}{\gamma_{Ms,V}}$$

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef} (mm)	80	90	110	125	170	210	280
N_{Rd} (kN)	15.3	24.3	35.4	65.8	59.1	90.1	150.1

$\gamma_{Mc,N}$ = 1.8
$\gamma_{Ms,N}$ = 1.55 *(steel failure)*
$\gamma_{Mc,N}$ = 2.00 *(steel failure ≥ M30)*

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
V_{Rd} (kN)	9.2	14.6	21.2	39.5	61.6	88.8	78.4

$\gamma_{Ms,V}$ = 1.55 for M8 to M24
$\gamma_{Ms,V}$ = 2.00 for M30

Recommended Loads (N_{rec}, V_{rec}) for one anchor without edge or spacing influence in kN

$$N_{rec} = \frac{N_{Rk}}{\gamma_{Mc,N} \cdot \gamma_F} \quad \text{or} \quad \frac{N_{Rk}}{\gamma_{Ms,N} \cdot \gamma_F}$$

$$V_{rec} = \frac{V_{Rk}}{\gamma_{Ms,V} \cdot \gamma_F}$$

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef} (mm)	80	90	110	125	170	210	280
N_{rec} (kN)	11.0	17.4	25.3	47.0	42.2	64.3	107.2

γ_F = 1.4
$\gamma_{Mc,N}$ = 1.8
$\gamma_{Ms,N}$ = 1.55 *(steel failure M8 - M24)*
$\gamma_{Mc,N}$ = 2.00 *(steel failure ≥ M30)*

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
V_{rec} (kN)	6.6	10.4	15.2	28.2	44.0	63.4	56.0

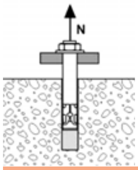
γ_F = 1.4
$\gamma_{Ms,V}$ = 1.55 for M8 to M24
$\gamma_{Ms,V}$ = 2.00 for M30

steel failure (shaded cells: $N_{Ru,m}$ and N_{Rk} for M8–M16)

STAINLESS STEEL ANCHOR STUD(SS316) / CHEMSET™

RAMSET CC-Method

TENSILE in kN

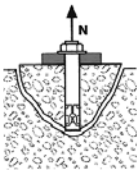


Pull-out resistance
Concrete strength C25/30

$N_{Rd,p} = N^0_{Rd,p} \cdot f_B \cdot f_T$

$N^0_{Rd,p}$	Design pull-out resistance						
Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef} (mm)	80	90	110	125	170	210	280
$N^0_{Rd,p}$ (kN)	15.3	26.7	33.8	45.5	59.1	90.1	150.1

$\gamma_{Mc,N} = 1.8$

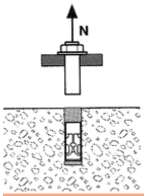


Concrete cone resistance
Concrete strength C25/30

$N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_T \cdot \Psi_s \cdot \Psi_{c,N}$

$N^0_{Rd,p}$	Design cone resistance						
Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef} (mm)	80	90	110	125	170	210	280
$N^0_{Rd,c}$ (kN)	26.3	31.4	42.5	51.4	81.6	112.0	172.5

$\gamma_{Mc,N} = 1.5$

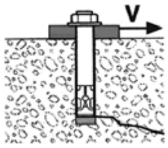


Steel resistance

$N_{Rd,s}$	Steel design tensile resistance						
Anchor size	M8	M10	M12	M16	M20	M24	M30
$N_{Rd,s}$ (kN)	15.3	24.3	35.4	65.8	102.7	148.0	130.7

$\gamma_{Ms,N} = 1.55$ for M8 to M24
$\gamma_{Ms,N} = 2.00$ for M30

SHEAR in kN

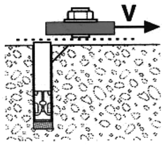


Concrete edge resistance
Concrete strength C25/30

$V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_{\beta,V} \cdot \Psi_{s\text{-}c,V}$

$V^0_{Rd,c}$	Design concrete edge resistance at a minimum edge distance (c_{min})						
Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef} (mm)	80	90	110	125	170	210	280
c_{min}	40	45	55	65	85	105	140
s_{min}	40	45	55	65	85	105	140
$V^0_{Rd,c}$ (kN)	2.6	3.4	5.1	7.3	12.4	18.7	32.6

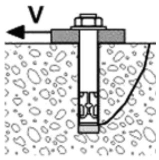
$\gamma_{Mc,V} = 1.5$



Steel resistance

$V_{Rd,s}$	Steel design shear resistance						
Anchor size	M8	M10	M12	M16	M20	M24	M30
$V_{Rd,s}$ (kN)	9.2	14.6	21.2	39.5	61.6	88.8	78.4

$\gamma_{Ms,V} = 1.55$ for M8 to M24
$\gamma_{Ms,V} = 2.00$ for M30



Concrete pry-out failure
Concrete Strength C25/30

$V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot \Psi_s \cdot \Psi_{c,N}$

$V^0_{Rd,cp}$	Design pry-out resistance						
Anchor size	M8	M10	M12	M16	M20	M24	M30
$V^0_{Rd,cp}$ (kN)	52.7	62.9	84.9	102.9	163.2	224.0	344.9

$\gamma_{Ms,V} = 1.5$

$N_{Rd} = \min(N_{Rd,p}\ ;\ N_{Rd,c}\ ;\ N_{Rd,s})$
$\beta N = N_{Sd} / N_{Rd} \leq 1$

$V_{Rd} = \min(V_{Rd,c}\ ;\ V_{Rd,s};\ V_{Rd,cp})$
$\beta V = V_{Sd} / V_{Rd} \leq 1$

$\beta N + \beta V \leq 1.2$

f_B INFLUENCE OF CONCRETE

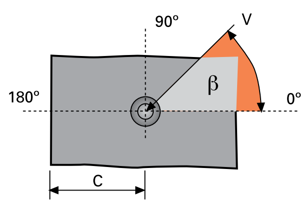
Concrete Grade	f_B	Concrete Grade	f_B
C16/20	0.81	C35/45	1.21
C20/25	0.90	C40/50	1.28
C25/30	1.00	C45/55	1.34
C30/37	1.10	C50/60	1.40

f_T INFLUENCE OF EMBEDMENT DEPTH

$$f_T = \frac{h_{act}}{h_{ef}}$$

$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

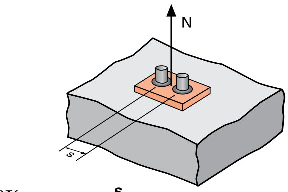
Angle β [°]	$f_{\beta,V}$
0~50	1.0
60	1.1
70	1.2
80	1.5
90~180	2.0



STAINLESS STEEL ANCHOR STUD(SS316) / CHEMSET™

RAMSET CC-Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE



$\Psi_s = 0.5 + \frac{s}{4h_{ef}}$

$s < s_{cr,N}$

$s_{min} = 0.5h_{ef}$

$s_{cr,N} = 2h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

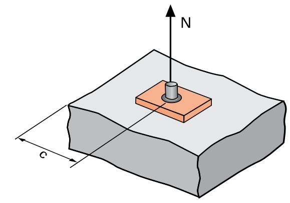
Spacing, s — Reduction Factor Ψ_s — Cracked / Non-cracked concrete

	M8	M10	M12	M16
40	0.63			
45	0.64	0.63		
55	0.67	0.65	0.63	
65	0.70	0.68	0.65	0.63
85	0.77	0.74	0.69	0.67
105	0.83	0.79	0.74	0.71
140	0.94	0.89	0.82	0.78
160	1.00	0.94	0.86	0.82
180		1.00	0.91	0.86
220			1.00	0.94
250				1.00

Spacing, s — Reduction Factor Ψ_s — Cracked / Non-cracked concrete

	M20	M24	M30
85	0.63		
105	0.65	0.63	
140	0.71	0.67	0.63
160	0.74	0.69	0.64
180	0.76	0.71	0.66
220	0.82	0.76	0.70
250	0.87	0.80	0.72
300	0.94	0.86	0.77
340	1.00	0.90	0.80
370		0.94	0.83
420		1.00	0.88
560			1.00

$\Psi_{c,N}$ INFLUENCE OF EDGE FOR CONCRETE



$\Psi_{c,N} = 0.275 + 0.725 \cdot \frac{c}{h_{ef}}$

$c < c_{cr,N}$

$c_{min} = 0.5h_{ef}$

$c_{cr,N} = h_{ef}$

$\Psi_{c,N}$ must be used for each distance influenced the anchors group

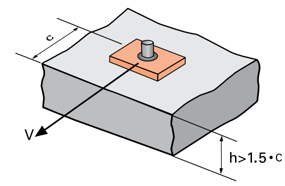
Edge, c — Reduction Factor $\Psi_{c,N}$ — Cracked / Non-cracked concrete

	M8	M10	M12	M16
40	0.63			
45	0.68	0.63		
55	0.77	0.71	0.63	
65	0.86	0.79	0.70	0.65
80	1.00	0.91	0.80	0.73
90		1.00	0.86	0.79
110			1.00	0.91
125				1.00

Edge, c — Reduction Factor $\Psi_{c,N}$ — Cracked / Non-cracked concrete

	M20	M24	M30
85	0.63		
105	0.72	0.63	
120	0.78	0.68	
140	0.87	0.75	0.63
170	1.00	0.86	0.71
210		1.00	0.81
250			0.92
280			1.00

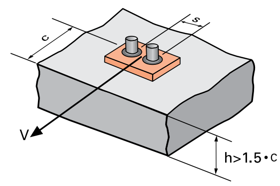
$\Psi_{s\text{-}c,V}$ INFLUENCED OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



$\Psi_{s\text{-}c,V} = \frac{c}{c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$

FOR SINGLE ANCHOR FASTENING — Reduction Factor $\Psi_{s\text{-}c,V}$ — Cracked / Non-cracked concrete

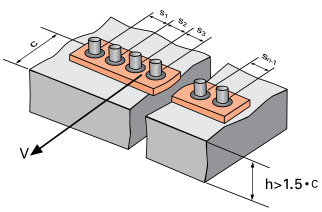
$\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$\Psi_{s\text{-}c,V}$	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



$\Psi_{s\text{-}c,V} = \frac{3c + s}{6c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$

FOR 2 ANCHORS FASTENING — Reduction Factor $\Psi_{s\text{-}c,V}$ — Cracked / Non-cracked concrete

$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16
1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
2.5	0.92	1.11	1.32	1.54	1.77	2.00	2.25	2.50	2.77	3.04	3.32	3.61
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35
5.5						2.71	2.99	3.28	3.57	3.88	4.19	4.50
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65

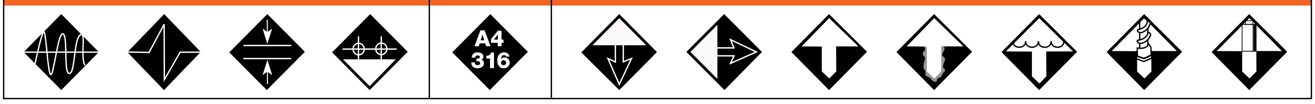


FOR OTHER CASE OF FASTENINGS

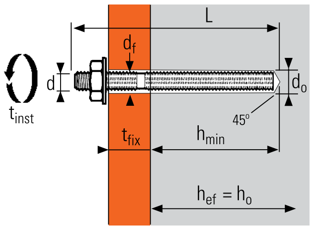
$$\Psi_{s\text{-}c,V} = \frac{3c + s_1 + s_2 + s_3 + \ldots + s_{n-1}}{3nc_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

STAINLESS STEEL CHEMSET™ A4-80

Performance	Material	Installation



ICC ES



Technical Data

		M10	M12	M16	M20	M24	M30
Minimum Effective Depth (mm)	$h_{ef,min}$	60	70	80	90	96	120
Standard Effective Depth (mm)	$h_{ef,std}$	90	110	125	170	210	280
∅ Chemset Diameter (mm)	d	10	12	16	20	24	30
∅ Recommend Drill Bit Diameter (mm)	d_o	12	14	18	25	28	35
Standard Drill depth (mm)	h_o	90	110	125	170	210	280
Min thick of base material (mm)	h_{min}	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm	hef + 2d ≥ 100mm
Ramset power tool code		DD544	DD544	DD544	DD544	DD576	DD576
Drill bit type-size		R3 PLUS	R3 PLUS	R3 PLUS	R3 PLUS	R3 MAX	R3 MAX

REO 502 Two part cartridge, 100% epoxy resin - vol. 650ml

MATERIAL

Stud / Chemset™ :
A4-80

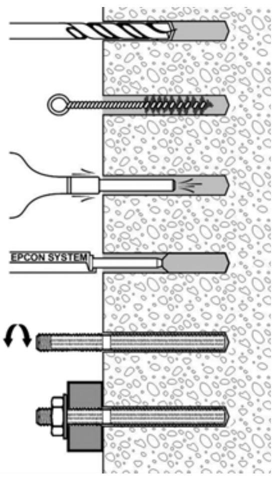
Hexagonal Nut:
A4-80

Washer:
A4-80

Anchor mechanical properties

Chemset A4-80	M10	M12	M16	M20	M24	M30
f_{uk} (N/mm^2) Nominal Tensile Strength	800	800	800	800	800	800
f_{yk} (N/mm^2) Yield strength	600	600	600	600	600	600
As (mm^2) Stressed cross-section	58.0	84.3	157.0	245.0	353.0	522.8

INSTALLATION



Setting Time before applying load

Ambient temperature (°C)	Max time for installation (mins)	Waiting time before applying load (hr)
40°C	3	3
35°C	4	4
30°C	6	5
25°C	8	6
20°C	15	8
10°C	20	12

STAINLESS STEEL CHEMSET™ A4-80

Number of anchors per cartridge

Chemset diameter	10	12	16	20	24	30
Drilling ∅ (mm)	12	14	18	25	28	35
Drilling depth (mm)	90	110	125	170	210	280
No. of anchors per cartridge						
REO 502 (600ml)	117.9	70.9	37.7	14.4	9.3	4.5

Ultimate Loads ($N_{Ru,m,}$ $V_{Ru,m}$) / Characteristic Loads (N_{Rk}, V_{Rk}) in kN

TENSILE @ Concrete Strength 30 N/mm²

Rebar size	M10	M12	M16	M20	M24
h_{ef} (mm)	90	110	125	170	210
$N_{Ru,m}$ (kN)	73.6	107.2	201.6	313.6	451.2
N_{Rk} (kN)	46.0	67.0	126.0	196.0	282.0

Rebar size	M30
h_{ef} (mm)	280
$N_{Ru,m}$ (kN)	718.4
N_{Rk} (kN)	449.0

SHEAR @ Concrete Strength 30 N/mm²

Rebar size	M10	M12	M16	M20	M24
$V_{Ru,m}$ (kN)	30.6	45.2	83.8	130.3	187.5
V_{Rk} (kN)	23.0	34.0	63.0	98.0	141.0

Rebar size	M30
$V_{Ru,m}$ (kN)	297.9
V_{Rk} (kN)	224.0

Design Loads (N_{Rd}, V_{Rd}) for one anchor without edge or spacing influence in kN

TENSILE @ Concrete Strength 30 N/mm²

Rebar size	M10	M12	M16	M20	M24
h_{ef} (mm)	90	110	125	170	210
N_{Rd} (kN)	30.7	44.7	84.0	130.7	188.0

Rebar size	M30
h_{ef} (mm)	170
N_{Rd} (kN)	299.3

y = 1.5 *Partial Safety factor*

SHEAR @ Concrete Strength 30 N/mm²

Rebar size	M10	M12	M16	M20	M24
V_{Rd} (kN)	18.4	27.2	50.4	78.4	112.8

Rebar size	M30
V_{Rd} (kN)	179.2

y = 1.25 *Partial Safety factor*

Recommended Loads (N_{rec}, V_{rec}) for one anchor without edge or spacing influence in kN

TENSILE @ Concrete Strength 30 N/mm²

Rebar size	M10	M12	M16	M20	M24
h_{ef} (mm)	90	110	125	170	210
N_{rec} (kN)	20.4	29.8	56.0	87.1	125.3

Rebar size	T20
h_{ef} (mm)	170
N_{rec} (kN)	199.6

y = 1.5 *Partial Safety factor*

SHEAR @ Concrete Strength 30 N/mm²

Rebar size	M10	M12	M16	M20	M24
V_{rec} (kN)	14.7	21.8	40.3	62.7	90.2

Rebar size	M30	T25	T32	*T40
V_{rec} (kN)	143.4	0.0	0.0	0.0

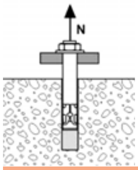
y = 1.25 *Partial Safety factor*

[shaded box] = steel failure

STAINLESS STEEL CHEMSET™ A4-80

RAMSET CC-Method

TENSILE in kN

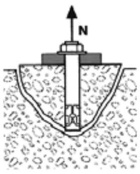


Pull-out resistance
Concrete strength C25/30

$N_{Rd,p} = N^0_{Rd,p} \cdot f_B \cdot f_T$

$N^0_{Rd,p}$				Design pull-out resistance			
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef} (mm)	80	90	110	125	170	210	280
$N^0_{Rd,p}$ (kN)	15.3	26.7	33.8	45.5	59.1	90.1	150.1

$\gamma_{Mc,N} = 1.8$

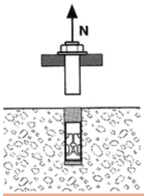


Concrete cone resistance
Concrete strength C25/30

$N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_T \cdot \Psi_s \cdot \Psi_{c,N}$

$N^0_{Rd,p}$				Design cone resistance			
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef} (mm)	80	90	110	125	170	210	280
$N^0_{Rd,c}$ (kN)	26.3	31.4	42.5	51.4	81.6	112.0	172.5

$\gamma_{Mc,N} = 1.5$



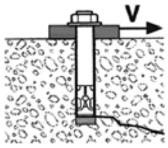
Steel resistance

$N_{Rd,s}$				Steel design tensile resistance			
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
$N_{Rd,s}$ (kN)	15.3	24.3	35.4	65.8	102.7	148.0	130.7

$\gamma_{Ms,N} = 1.55$ for M8 to M24

$\gamma_{Ms,N} = 2.00$ for M30

SHEAR in kN

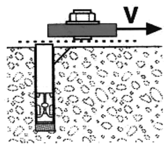


Concrete edge resistance
Concrete strength C25/30

$V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_{\beta,V} \cdot \Psi_{s\text{-}c,V}$

$V^0_{Rd,c}$			Design concrete edge resistance at a minimum edge distance (c_{min})				
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef} (mm)	80	90	110	125	170	210	280
c_{min}	40	45	55	65	85	105	140
s_{min}	40	45	55	65	85	105	140
$V^0_{Rd,c}$ (kN)	2.6	3.4	5.1	7.3	12.4	18.7	32.6

$\gamma_{Mc,V} = 1.5$

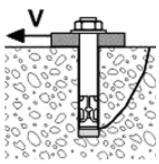


Steel resistance

$V_{Rd,s}$				Steel design shear resistance			
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
$V_{Rd,s}$ (kN)	9.2	14.6	21.2	39.5	61.6	88.8	78.4

$\gamma_{Ms,V} = 1.55$ for M8 to M24

$\gamma_{Ms,V} = 2.00$ for M30



Concrete pry-out failure
Concrete Strength C25/30

$V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot \Psi_s \cdot \Psi_{c,N}$

$V^0_{Rd,cp}$				Design pry-out resistance			
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
$V^0_{Rd,cp}$ (kN)	52.7	62.9	84.9	102.9	163.2	224.0	344.9

$\gamma_{Ms,V} = 1.5$

$N_{Rd} = \min(N_{Rd,p} ; N_{Rd,c} ; N_{Rd,s})$

$\beta N = N_{Sd} / N_{Rd} \leq 1$

$V_{Rd} = \min(V_{Rd,c} ; V_{Rd,s} ; V_{Rd,cp})$

$\beta V = V_{Sd} / V_{Rd} \leq 1$

$\beta N + \beta V \leq 1.2$

f_B INFLUENCE OF CONCRETE

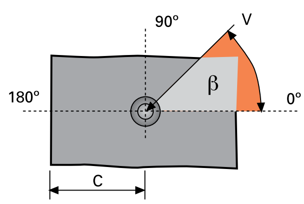
Concrete Grade	f_B	Concrete Grade	f_B
C16/20	0.81	C35/45	1.21
C20/25	0.90	C40/50	1.28
C25/30	1.00	C45/55	1.34
C30/37	1.10	C50/60	1.40

f_T INFLUENCE OF EMBEDMENT DEPTH

$$f_T = \frac{h_{act}}{h_{ef}}$$

$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0~50	1.0
60	1.1
70	1.2
80	1.5
90~180	2.0



SETSCO SERVICES PTE LTD
18 Teban Gardens Crescent
Singapore 608925
Tel : (65) 6566 7777
Fax: (65) 6566 7718
Website: www.setsco.com
Business Reg. No. 196900269D

Page : 1 of 2
Date : 13/11/2014

TEST REPORT

(This Report is issued subject to the terms & conditions set out below)

Your Ref.: Endorsed Sales Quotation No : 37194 - CQ

Our Ref : ST-15383/3

Subject : Tensile Pull Out Testing of T10, T13, T16, T20, T25, T32 and T40 rebars installed into grade 30* concrete mock up block using RE0502 as requested by ITW Construction Products (Singapore) Pte Ltd.

Tested For : **ITW Construction Products (Singapore) Pte Ltd**
4 Changi South Lane
#06-01 Nan Wah Building
Singapore 486127
Attn : Mr. Tham K .C

Project Reference/ Test Location : No. 4, Changi South Lane - Nan Wah Building

Date of Test : 07th November 2014

Sample Description : A total of Two (02) nos. each of T10, T13, T16, T20, T25, T32 and T40 rebars installed using RE0502 were tested. The installation of the rebars was undertaken by the contractor on site.

Method of Test : Load was applied axially to the installed T10, T13, T16, T20, T25, T32 and T40 by a centre-pull hydraulic jacking system to the ultimate load. The maximum load shall then be recorded and the mode of failure noted.

Note :- '' Information provided by the client.*
*Note :- '**' (1) No displacement measurements were taken during the course of loading.*
(2) Size of system supports is smaller than that recommended.

Refer to the table on page 2 for test results.

ST-15383/3 (14 rebars) ITW/nurul

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ST - 15383/3 Page 2 of 3

Results : **Table : Tensile Proof Load Test on T10, T13, T16, T20, T25, T32 and T40 Rebars using RE0502**

Sample Ref.	Test Member	Fixing Type	Applied Tensile Proof Load (kN)	Observation
T1	Mock Up Block Grade 30*	T10	33.2	No Failure
			42.0	Rebar Slippage
T2		T10	33.2	No Failure
			42.0	Rebar Slippage
T3		T13	53.1	No Failure
			61.9	Rebar Slippage
T4		T13	53.1	No Failure
			61.9	Rebar Slippage
T5		T16	81.7	No Failure
			97.1	Rebar Slippage
T6		T16	81.7	No Failure
			106.0	Rebar Slippage
T7		T20	130.46	No Failure
			177.87	Rebar Slippage
T8		T20	130.46	No Failure
			201.57	Rebar Slippage
T9		T25	201.57	No Failure
			266.76	Rebar Slippage
T10		T25	201.57	No Failure
			254.91	Rebar Slippage

ST-15383/3 (14 rebars) ITW/nurul

SETSCO

ST - 15383/3

Page 3 of 3

Results : **Table : Tensile Proof Load Test on T10, T13, T16, T20, T25, T32 and T40 Rebars using RE0502**

Sample Ref.	Test Member	Fixing Type	Applied Tensile Proof Load (kN)	Observation
T11	Mock Up Block Grade 30*	T32	330.05	No Failure
			492.45	No Failure
T12		T32	214.05	Rebar Slippage
T13		T40	562.05 (Max. capacity of jack reached)	No Failure
T14				

Note ''* *Information provided by the client.*

Witness (es) :

(1) K. C Tham (ITW Construction)

Test Conducted By : Kon Chan Loong

HOW YONG MENG
Assistant Manager
Structural & Integrity Testing Dept.
Construction Technology Division

ST-15383/3 (14 rebars) ITW/nurul

SETSCO SERVICES PTE LTD
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Website: www.setsco.com
Business Reg. No. 196900269D

Page : 1 of 2
Date : 13/11/2014

TEST REPORT

(This Report is issued subject to the terms & conditions set out below)

Your Ref.: Endorsed Sales Quotation No : 37194 - CQ **Our Ref :** ST-15383/5

Subject : Tensile Pull Out Testing of M8, M10, M12, M16, M20, M24 and M30 bolts installed into grade 30* concrete mock up block using chemset as requested by ITW Construction Products (Singapore) Pte Ltd.

Tested For : **ITW Construction Products (Singapore) Pte Ltd**
4 Changi South Lane
#06-01 Nan Wah Building
Singapore 486127
Attn : Mr. Tham K .C

Project Reference/ Test Location : No. 4, Changi South Lane - Nan Wah Building

Date of Test : 07th November 2014

Sample Description : One (01) no. each of M8, M10, M12, M16, M20, M24 and M30 bolts installed using chemset were tested. The installation of the bolts was undertaken by the contractor on site.

Method of Test : **Adopted from BS 5080: Part 1: 1993****
Load was applied axially to the installed M8, M10, M12, M16, M20, M24 and M30 by a centre-pull hydraulic jacking system to the ultimate load. The maximum load shall then be recorded and the mode of failure noted.

Note :- '' Information provided by the client.*
*Note :- '**' (1) No displacement measurements were taken during the course of loading.*
(2) Size of system supports is smaller than that recommended.

Refer to the table on page 2 for test results.

ST-15383/5 (7 bolts) ITW/nurul

SETSCO

ST - 15383/5

Page 2 of 2

Results : **Table : Tensile Proof Load Test on M8, M10, M12, M16, M20, M24 and M30 bolts using chemset**

Sample Ref.	Test Member	Fixing Type	Applied Tensile Proof Load (kN)	Observation
B01	Mock Up Block Grade 30*	M8	17.8	Bolt Slippage
B02		M10	31.0	No Failure
			42.0	Bolt Slippage
B03		M12	46.4	No Failure
			64.1	Bolt Slippage
B04		M16	46.4	No Failure
			86.1	Bolt Fracture
B05		M20	106.8	No Failure
			183.8	Bolt Fracture
B06		M24	166.02	No Failure
			296.39	No Failure
B07		M30	376.45	No Failure

Note ''* *Information provided by the client.*

Witness (es) :

(1) K. C Tham (ITW Construction)

Test Conducted By : Kon Chan Loong

HOW YONG MENG
Assistant Manager
Structural & Integrity Testing Dept.
Construction Technology Division

ST-15383/5 (7 bolts) ITW/nurul

ChemSetTM Reo502TM has been tested on major construction sites by leading construction materials testing company Al-futtaim Bodycote. The following test report supports the product performance data quoted in this submittal.

www.ramset.com.au

الفطيم باديكوت
Al-Futtaim Bodycote

فحص المواد
Materials Testing
www.bodycote.com
www.middleeast.bodycote.com

REPORT OF TESTS

Description	Pull Out Test		
Tested for	Ramset , Post Box 293794 Dubai , UAE		
Lab Ref. No.	WR08- 03895 (Page 1 of 1)	Request No.	W08-01879
Date Received	30.01.2008	Date Reported	30.01.2008

Client's reference : Request dtd. 30.01.2008
Project Name : Mirdiff City Center
Test Loc. : Tower Crane Foundation
Sample Description : 25mm ϕ rebar at 300mm embedment in 40 MPa concrete/ Chemset REO502 epoxy injection
AFBT Sample No. : W08-01879 / 1-2

1.0 Introduction

Further to the test work instructions received from Ramset Dubai, dated 30.01.2008, representatives of Al Futtaim Bodycote Testing LLC visited the site on 28th January 2008.

The purpose of the visit was to carry out pull out test.

2.0 Pull Out Test

Test Method: The test was carried out in general accordance with BS 1881 Part 207 using a calibrated hollow jack attached with hydraulic pump. The existing rebar was inserted to the hollow cylinder jack and lock washers and bolts. The pressure was applied through the hydraulic pump until it reaches the required load. The pressure was hold for 1 minute or until failure occurred or pull out of which stage the test can be terminated.

Test Ref.	Diameter (mm)	Direction	Load applied / Kn	Failure mode
1	25	Vertical up	124	*Intact
2	25	Vertical up	262	**Intact

Remarks: * tested up to required load / ** same rebar retested for the second time

For and on behalf of Al Futtaim Bodycote Testing LLC.
Tested by: P. Pogata   Date Tested: 30.01.2008

This report shall only be reproduced in full. Approval of the testing laboratory is required for partial reproduction.
Samples will be retained for a period of one month only, unless otherwise requested.
The test results relate only to the samples tested.

Al Futtaim Bodycote Testing LLC · P.O. Box 34924 · Dubai · United Arab Emirates
Tel: +971 (0)4 885 1001 · Fax: +971 (0)4 885 4004 · E-mail: dubai.lab@bodycote.com

Al-Futtaim Bodycote
الفطيم TESTING (L.L.C.)
باديكوت تيستينغ (ذ.م.م)
P.O. Box: 34924 - DUBAI - U.A.E.

Technical and Test Institute for Construction Prague
Prosecká 811/76a
190 00 Prague
Czech Republic
eota@tzus.cz

Designated according to Article 29 of Regulation (EU) No 305/2011

Member of EOTA
www.eota.eu

European Technical Assessment

ETA 14/0174 of 04/09/2014

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011	Technical and Test Institute for Construction Prague
Trade name of the construction product	Reo 502 steel bonded anchor
Product family to which the construction product belongs	Product area code: 33 Bonded injection type anchor for use in cracked and non-cracked concrete
Manufacturer	ITW Construction System International 1 Ramset Drive Chirnside Park Melbourne 3116 Australia
Manufacturing plant	ITW Construction System International
This European Technical Assessment contains	23 pages including 19 Annexes which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	ETAG 001-Part 1 and Part 5, edition 2013, used as European Assessment Document (EAD)

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European Technical Assessment

ETA 14/0326 of 22/08/2014

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011	Technical and Test Institute for Construction Prague
Trade name of the construction product	Reo 502 for rebar connection
Product family to which the construction product belongs	Product area code: 33 Post installed rebar connections with Reo 502 injection mortar
Manufacturer	ITW Construction System International 1 Ramset Drive Chirnside Park Melbourne 3116 Australia
Manufacturing plant	ITW Construction System International
This European Technical Assessment contains	17 pages including 13 Annexes which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	ETAG 001-Part 1 and Part 5, edition 2013, used as European Assessment Document (EAD)

HOUSING & DEVELOPMENT BOARD

Your Ref: ____________ Our Ref: CBR/Anchor/ITW/14/003T(C)-Retest Date: 24 Apr 2014

TEST REPORT

Subject	:	Determination of tensile load on Chemset REO 502+M10x160 Chemical Injection Anchor installed onto a concrete block.
Client	:	**Ms ITW CONSTRUCTION PRODUCT SINGAPORE PTE LTD** 4 Changi South Lane #06-01, Nan Wah Building Singapore (486127)
Method of Test	:	**Adopted ETAG 001**
Description of Samples	:	1. A set of five (05) Chemset REO 502+M10x160 anchors was re-tested for their tensile load capacity. 2. All the M10 Chemical Injection anchors were installed onto a concrete block of grade 20 with dimensions 4.05m(L) x 0.8m(B) x 0.26m(H) cast on 17 Apr 14 by HDB Centre of Building Research. 3. All the test samples were as supplied by the Client.
Installation Procedures	:	All the test specimens were installed by the Client prior to the test.
Testing Procedures	:	1. An axial tensile force was applied to each specimen by means of a servo-hydraulic jack through a bolt jig. 2. A transducer measured the relative displacement between the anchor and concrete block with accuracy better than 0.001mm. 3. The load was applied at a rate of 0.03mm/sec until failure occurred, and the test was terminated when the load dropped to approximately 50% of its ultimate value. 4. All the test data were automatically captured electronically.
Test Results	:	1. The summary of test results and load-displacement relationships are as attached.

(Signed electronically)
STE Nor Rashidi
Testing Officer

(Signed electronically)
PE Winston Toh
Laboratory Manager

Page1 Of 5

This is a computer generated test report which does not require signature

HOUSING & DEVELOPMENT BOARD

Your Ref: ____________ Our Ref: CBR/Anchor/ITW/13/007S(C) Date : 05 Mar 2014

TEST REPORT

Subject : Determination of shear load on Chemset REO 502+M10x160 Chemical Injection Anchor installed onto a concrete block.

Client : **Ms ITW CONSTRUCTION PRODUCT SINGAPORE PTE LTD**
4 Changi South Lane
#06-01, Nan Wah Building
Singapore (486127)

Method of Test : **Adopted ETAG 001**

Description of Samples :

1. A set of five (05) Chemset REO 502+M10x160 was tested for their shear load capacity.
2. All the M10 Chemical Injection anchors were installed onto a concrete block of grade 20 with dimensions 2.1m(L) x 0.55m(B) x 0.75m(H) cast 27 Feb 14 by HDB Centre of Building Research.
3. All the test samples were as supplied by the Client.

Installation Procedures : All the test specimens were installed by the Client's prior to the test.

Testing Procedures :

1. A shear force was applied to each specimen by means of a servo-hydraulic jack through a shear jig.
2. The relative displacement between anchor and concrete block were recorded.
3. The load was applied at a rate of 0.06mm/sec until failure occurred, and the test was terminated when the load dropped to approximately 50% of its ultimate value, or when the anchor shear off.
4. All the test data were automatically captured electronically.

Test Results :

1. The summary of test results and load-displacement relationships are as attached.

(Signed electronically)
STE Nor Rashidi
Testing Officer

(Signed electronically)
PE Winston Toh
Laboratory Manager

This is a computer generated test report which does not require signature

Page 1 of 5

CSTB
le futur en construction
DEPARTEMENT SECURITE, STRUCTURES et FEU
Division Etudes et Essais Résistance au feu

REPORT No 26047782/B – Reo 502

on

Reo 502 injection system

in conjunction with concrete reinforcing bar (ϕ 8 to 40mm)

and subjected to fire exposure

REQUESTED BY:

ITW Construction Systems International
1 Ramset Drive, Chirnside Park,
Melbourne 3116,
Australia

It comprises 38 pages numbered from 1/38 to 38/38

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Melbourne 3116, Australia

Report Number: ESP015831P.1
Date: March 11, 2014
Page: 1 of 15

REO 502 Adhesive Anchor System
AC308 Sustained Load Test

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Registered Engineer under the laws of the State of Minnesota.

Thomas A. Kolden
Registration No. 24080

Prepared By:

Thomas A. Kolden, P.E.
Project Manager
Phone: 651-659-7340

Reviewed By:

John D. Lee, P.E., LEED AP
Manager, Building Products Evaluation
Phone: 651-659-7408

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Melbourne 3116, Australia

Report Number: ESP015831P.2
Date: March 20, 2014
Page: 1 of 6

REO 502 Adhesive Anchor System
AC308 Criteria for Durability

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Registered Engineer under the laws of the State of Minnesota.

Thomas A. Kolden
Registration No. 24080

Prepared By:

Thomas A. Kolden, P.E.
Technical Manager
Phone: 651-659-7340

Reviewed By:

John D. Lee, P.E., LEED AP
Manager, Building Products Evaluation
Phone: 651-659-7408

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EAR CONTROLLED

Chemical Resistance

Chemical Environment	Concentration	Resistant (Yes or No)
Acetic Acid Aqueous Solution	10%	Yes
Aqueous Solution Aluminium Chloride	Saturated	Yes
Aqueous Solution Aluminium Nitrate	10%	Yes
Ammonia Solution	5%	Yes
Benzene	100%	Yes
Benzoic Acid	Saturated	Yes
Butyl Alcohol	100%	Yes
Calcium Sulphate Aqueous Solution	Saturated	Yes
Carbon Monoxide	Gas	Yes
Carbon Tetrachloride	100%	Yes
Citric Acid Aqueous Solution	Saturated	Yes
Cyclohexanol	100%	Yes
Diesel fuel	100%	Yes
Diethylene Glycol	100%	Yes
Ethanol Aqueous Solution	20%	Yes
Heptane	100%	Yes
Hexane	100%	Yes
Hydrochloric Acid	10%	Yes
Hydrochloric Acid	15%	Yes
Hydrochloric Acid	25%	Yes
Hydrogen Sulphide Gas	100%	Yes
Jet Fuel	100%	Yes
Linseed Oil	100%	Yes

Chemical Environment	Concentration	Resistant (Yes or No)
Lubricating Oil	100%	Yes
Mineral Oil	100%	Yes
Parafin / Kerosene (Domestic)	100%	Yes
Phenol Aqueous Solution	1%	Yes
Phosphoric Acid	50%	Yes
Potassium Hydroxide (Caustic Potash)	10% / pH 13	Yes
Sea Water	100%	Yes
Sodium Hypochlorite Solution	5 - 15%	Yes
Styrene	100%	Yes
Sulphur Dioxide (40°C)	5%	Yes
Sulphur Dioxide Solution	10%	Yes
Sulphuric Acid	10%	Yes
Sulphuric Acid	50%	Yes
Turpentine	100%	Yes
Water	100%	Yes
White Spirit	200%	Yes
Xylene	100%	Yes
Acetone	100%	No
Benzyl Alcohol	100%	No
Chlorine Water	Saturated	No
Chloro Benzene	100%	No
Ethanol	95%	No
Isopropyl Alcohol	100%	No

CHEMSET™ REO502™
EPOXY ANCHORING ADHESIVE

Date	6/2/13
Reference	003
Product Manager	Wayne Starkey

RAMSET™ ITEM NUMBERS: REO502M600

Product Type According to Green Star – Office Design V3 IEQ-13:

Multi-Purpose Construction Adhesive

VOC determined in accordance with USEPA Method 24 as referenced in South Coast Air Quality Management District (California, U.S.) – Rule 1168:

TVOC = 4.5 grams / Litre

TVOC Maximum Limit According to Green Star – Office Design V3 IEQ-13:

70 grams / Litre

Wayne Starkey BSc
Product Chemist

September 26, 2014

ITW Australia Pty Limited
ABN 63 004 235 063

www.ramset.com.au

To Whom It May Concern

Re: Test Results for Ramset™ Reo 502™ Pure Epoxy Chemical Anchoring Adhesive

Dear Sir / Madame,

Physical properties of Ramset™ Reo 502™ (Item Numbers REO502M600 and REO502M400) were assessed internally by ITW and results were obtained as follows:

Property		Unit	Value	Test Standard
Mixed Density		g/cm³	1.5	ASTM D 1875 @ +20°c / +72°F
Compressive Strength	24 hours	N/mm²	75	ASTM D 695 @ +20°C / +72°F
	7 days		95	
Tensile Strength	24 hours	N/mm²	18	ASTM D 638 @ +20°C / +72°F
	7 days		23	
Elongation at Break	24 hours	%	6.6	ASTM D 638 @ +20°C / +72°F
	7 days		5.9	
Tensile Modulus	24 hours	GN/m²	5.7	ASTM D 638 @ +20°C / +72°F
	7 days		5.5	
Flexural Strength	24 hours	N/mm²	45	ASTM D 790 @ +20°C / +72°F
HDT	7 days	°C	49	ASTM D 648 @ +20°C / +72°F
VOC		g/L	4.5	ASTM D 2369

Sincerely,

Wayne Starkey
Business Manager – Chemical ANZ

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PROJECT	APPLICATION	CONTRACTOR
	TRANSPORTATION FACILITIES	
MRT A&A DSMRT545K0	Square Steel Hollow Section Fixing	OKH Construction
Circle Line C822	Starter bar – beams / slabs	Econ-NCC JV
Circle Line C823	Strut Fixing	Nishimatsu-LumChang JV
Circle Line C828	Bracket Fixing	Gin Lee Construction
Circle Line C853	Starter bar - slabs	Taisei Corporation
Circle Line C856	Starter bar – slabs	Sembawang E&C
Circle Line C8282	Starter bar – slabs	Chye Joo Construction
Downtown line C901	Starter bar – slabs	Hock Lian Seng
Downtown line C905	Starter bar - slabs	Shimizu
Downtown line C907	Starter bar - slabs	Wai Fong Construction
Downtown line C909	Starter bar - slabs	VSL
Downtown line C912	Starter bar - slabs	Lum Chang Building Contractors
Downtown line C929A	Starter bar - slabs	Nishimatsu
Downtown line C935	Starter bar - slabs	Leighton Offshore / John Holland
Downtown line 3 C923	Starter bar - slabs	Samsung C & T Corporation
Downtown line 3 C933	Starter bar - slabs	Penta Ocean Construction Co Ltd
Tuas MRT Extension	Starter bar	Shanghai Tunnel
Bridge Upgrading RD111	Starter bar – beams	Singapore Piling & Civil Engineering
Bridge Upgrading RD113	Starter bar – beams	Singapore Piling & Civil Engineering
Bridge Upgrading RD138	Starter bar – beams	Singapore Piling & Civil Engineering
Bridge Upgrading RD107	Starter bar – beams / slab	Chye Joo Construction
Bridge Widening RD104	Starter bar – beams / slab	Chye Joo Construction
RD145	Starter bar – beams	Chye Joo Construction
KPE C421	Starter bar – slabs	Sembcorp E&C
KPE C424	Starter bar – slabs	Taisei Corporation
KPE C425	Starter bar – slabs	Chan & Chan Construction
KPE C426	Starter bar - slabs	Chye Joo Construction
ER102	Starter bar	Sato Kogyo (S)
C114 Bridge Walkway	Covered walkway posts	Diethelm Singapore
BM101 Bridge Walkway	Covered walkway posts	Win Kiong Engineering Service
PPSE C3223A	Railings Fixings	United Central Engineering
Terminal 3	Railings Fixings	United Central Engineering
	GOVERNMENT BUILDINGS	
New Supreme Court	Starter bar - CBP Wall	Sato Kogyo (S)
Redevelopment of Singapore Museum	Starter bar - columns	Sato Kogyo (S)
Singapore Arts Centre	Starter bar - slabs	Sato Kogyo (S)
New Civil Service Club, Bukit Batok	Starter bar – beams	Lian Soon Construction
Law Enforcement Agency Singapore	Starter bar – CBP wall	Lian Soon Construction
		Tiong Seng Construction

PROJECT	APPLICATION	CONTRACTOR
	EDUCATION FACILITIES	
Yishun Secondary School	Starter bars – cantilever slabs	Lian Soon Construction
Nanyang Junior College	Starter bar	Quek Hock Seng Construction
Victoria School	Starter bar	Kay Lim Construction & Trading
Changkat Primary School	Starter bar	Kay Lim Construction & Trading
Saint Andrew Village A&A	Starter bar	SEF Construction
		China Construction (SP)
NTU School of Biological Science	Starter bar	China Construction (SP)
Raffles Junior College	Starter bar – cantilever staircase	Guan Ho Construction Co.
Eunos Primary School	Starter bar	Chiu Teng Construction
Dunman Secondary School	Starter bar	Chiu Teng Construction
NTU Teaching & Laboratory Facilities	Starter bar	Sato Kogyo (S)
SMU	Starter bar	Koon Seng Construction
Queenstown Secondary School	Starter bar	Quek Hock Seng Construction
Maha Bohdi School	Starter bar	Chiu Teng Enterprise BCEG JV
Australia International School	Starter bar – slab extension	G. James Singapore
Yong Loo Lin School of Medcine (NUS)		Lian Soon Construction
St. Andrew Autism Centre		Kian Hiap Construction
Prince Charles Primary School		Kwan Yong Construction Pte Ltd
Ngee Ann Polytechnic		Kwan Yong Construction Pte Ltd
SIT at Singapore Polytechnic		Koon Seng Construction Pte Ltd
Yale-NUS College		Ssangyong Engineering & Construction
Co Ltd		
	PUBLIC WATER FACILITIES	
Changi Water Reclamation Plant	Starter bar – Diaphragm Wall / slabs	LTH Engineering
		Sembcorp E&C
		Singapore Piling & Civil Engineering
Deep Tunnel System		Koh Brothers Construction
		Sembcorp E&C
New Water Pipeline	Pipeline Bracket Fixings	Toh Ban Seng Contractor
		HSC Pipeline Engineering

PROJECT	APPLICATION	CONTRACTOR
	RESIDENTIAL BUILDINGS	
Hamilton Scotts	Starter bar - beam / slabs	Yau Lee Construction
Compassvale View	Starter bar - beam / columns	Qingdao Construction
Fernvale Vista	Starter bar - beam / columns	Qingdao Construction
HDB Punggol C5A	Starter bar – slabs / pilecaps	Kay Lim Construction
HDB Sengkang N2C36		Kay Lim Construction
HDB Punggol W C7	Starter bar - beam	Kay Lim Construction
HDB Seng Kang N4C24		QingJian International
BTO at Punggol		Poh Cheong Concrete Product Pte. Ltd.
LUP42A	Starter bar – slab / wall	Hock Guan Cheong
Water Bay		QingJian International
Topiary		QingJian International
Caribbean	Bracket Fixing	Yodai Windows System Engineering
Saint Regis Hotels & Apartments	Starter bar – CBP wall / slabs / beams	Kajima-Tiong Seng JV
Riveria	Starter bar	Chip Eng Seng Contractors (1988)
Newton Suite	Starter bar	Kajima Overseas Asia
Admore Park	Starter bar – slabs	Shimizu Corporation
The Metz		Shimizu Corporation
Evelyn		Shimizu Corporation
RiverEdge	Starter bar – slabs	Tiong Seng Contractors
Hillview Regency		Poh Lian Construction
Paterson Residence	Starter bar – CBP wall	China Construction (SP)
One Amber	Starter bar - CBP Wall	China Construction (SP)
The Chuan	Starter bar – CBP wall	Low Keng Huat (S)
Orange Groove Condominium	Starter bar – CBP wall / slabs	Wee Hur Construction
La-Belle Townhouse		Wai Fong Construction
2rvg	Starter bar – CBP wall / slabs	Chiu Teng Enterprises
No.11 Astrid Hill		Daiya Engineering & Construction
Balestier Scenic Heights		Dbcorp Industries
Solitaire Condominium	Starter bar–retaining wall/slab/beam	Poh Lian Construction
Draycott Condominium	Starter slab – CBP wall	Tiong Seng Contractors
Nova 88 Condominium		Admin Construction
Nova 48 Condominium		Admin Construction
Halia Cluster Housing		GTMS Construction
Alexis Condominium	Starter slab – CBP wall	Kian Hiap Construction
D'Leedon Condominium	Starter bar	Woh Hup (Private) Ltd.
Leedon Heights	Starter bar	Woh Hup (Private) Ltd.
EuHabitat	Starter bar	Woh Hup (Private) Ltd.
YTL Westwood	Starter bar	YTL Construction (S) Pte. Ltd.
River Isle	Starter bar	NQC
A Treasure Trove	Starter bar	Sim Lian Construction Co. Pte. Ltd.
West Shore Residences	Starter bar	Ang Cheng Guan Construction Pte. Ltd.

PROJECT	APPLICATION	CONTRACTOR
	FACTORIES	
JTC Factory 161 Kallang Way		Interpo
Light Industrial Factory @ Jalan Kilang	Starter bar - CBP wall	V3 Construction
Micron (MSA 1.5 Project)		Sato Kogyo (S)
Project Eureka		Kajima Overseas Asia
Pan Tech Industrial Building		Win Kiong Engineering Service
Biopolis	Bracket fixing	InnoVision Façade
BTR Singapore	Adhesive for Anchor Bolts	Hiap Seng Engineering Ltd
Silo Plant at Jurong Port Road		YTL Construction (S) Pte. Ltd.
	COMMERCIAL OR MIXED DEVELOPMENT	
South Beach Mixed Development	Starter bar - beams	Hyundai E & C
		Doo Song Construction Co Ltd
Marina Bay Sands Integrated Resorts	Starter bar - CBP Wall/Slabs/Beams	Sato Kogyo (S)
		Sembawang E&C
		Shanghai Tunnel
		L & M Foundation
OG Complex A & A	Starter bars	Wing Tuck
One Raffles Quay	Starter bar – slabs / beams	Obayashi Corporation
		Gammon Skanska
Hilton Hotel	Temporary works	Hock Keng Heng
HSBC	Threaded studs for Temporary Works	Hock Keng Heng
Mercedes Showroom	Starter bar – beams / slabs	Gammon Skanska
Ginza Plaza A&A	Starter bar	Vigcon Construction
Somerset UOL Building	CBP Wall	Kajima Overseas Asia
Scotts Square		Shimizu Corporation
Paya Lebar Square	Starter bars	Low Kheng Huat (S)
UOB Centre	A & A	Gennal Industries
		TET Engineering & Metal Works
Bugis Junction	A & A	TET Engineering & Metal Works

PROJECT	APPLICATION	CONTRACTOR
	MARINE WORKS	
PSA Tanjong Pagar Reefer Wharf		Eng Lee Engineering
PSA Tanjong Pagar Slab Upgrading	Starter bar – slabs	United Specialist
PSA Brani Terminal	Starter bar – beams	United Specialist
Loyang Marine Base	Starter bar	DGS
Jurong Shipyard	Starter bar	Jurong Engineering
PSA Beam Strengthening	Starter bar – beams	Muhibbah Engineering (S'pore)
	OTHERS	
Sports Hub	Starter bar - slabs / beams	Dragages
Gardens by the Bay	Starter bar	
Pasir Ris Sports Hub	Starter bar - beams	Quek Hock Seng
Ng Teng Fong Hospital	Starter bar - beams	Penta Ocean
Merlion Park		Antara Koh
Mohd. Sultan Road Art Centre		Building Structural Inspection
Buddha Tooth Temple	Starter bar – CBP wall / beams	Sato Kogyo (S)
Singapore Flyers	Starter bar	Takenaka
Sentosa Cove Bus Terminal	Road kerb	Gammon
Art & Science Museum	Starter bar	Penta Ocean Corporation
SP Power Grid EW3		Nishimatsu Construction & KTC JV