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Authorised and notified according
to Article 29 of the Regulation (EU)
No 305/2011 of the European
Parliament and of the Council of 9
March 2011

MEMBER OF EOTA



European Technical Assessment ETA-25/0647 of 2026/02/24

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S

Trade name of the construction product:

Ramset ChemSet™ Reo 502 Xtrem™
Ramset ChemSet™ Epcon G5 Xtrem™

Product family to which the above construction product belongs:

Post-installed rebar connections with mortar

Manufacturer:

ITW Construction Asia Pacific (Ramset)
1 Ramset Drive
Chirside Park
VIC 3116
Australia

Manufacturing plant:

ITW Construction Asia Pacific (Ramset)
1 Ramset Drive
Chirside Park
VIC 3116
Australia

This European Technical Assessment contains:

22 pages including 17 annexes which form an integral part of the document

This European Technical Assessment is issued in accordance with Article 95(4) of Regulation (EU) 2024/3110, on the basis of:

EAD 330087-01-0601, Systems for post-installed rebar connections with mortar

This version replaces:

The ETA with the same number issued on 2025-12-11

Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and should be identified as such.

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II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

The subject of this assessment are the post-installed connections, by anchoring or overlap connection joint consisting of steel reinforcing bars (rebars) in existing structures made of normal weight concrete, using injection mortar Ramset ChemSet™ Reo 502 Xtrem™ and Ramset ChemSet™ Epcon G5 Xtrem™ for rebar in accordance with the regulations for reinforced concrete construction.

Reinforcing bars with diameters from 10 to 40 mm and Ramset ChemSet™ Reo 502 Xtrem™ and Ramset ChemSet™ Epcon G5 Xtrem™ injection mortar according to Annex A are used for the post-installed rebar connections covered by this ETA. The steel element is placed into a drilled hole previously injected with a mortar and is anchored by the bond between embedded element, injection mortar and concrete.

The characteristic material values, dimensions and tolerances of the anchors not indicated in Annexes shall correspond to the respective values laid down in the technical documentation¹ of this European Technical Assessment.

The product description is given in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document (hereinafter EAD)

The performances given in Section 3 are only valid if the rebar connection is used in compliance with the specifications and conditions given in Annex B

The provisions made in this European Technical Assessment are based on an assumed intended working life of the anchor of 50 years and 100 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

¹ The technical documentation of this European Technical Assessment is deposited at ETA-Danmark and, as far as relevant for the tasks of the Notified bodies involved in the attestation of conformity procedure, is handed over to the notified bodies.

3 Performance of the product and references to the methods used for its assessment

3.1 Characteristics of product

Mechanical resistance and stability (BWR1):

Essential characteristic	Performance
Characteristic resistance under static and quasi-static loading	See Annex C1 to C2
Characteristic resistance under seismic loading	See Annex C3 to C4

Safety in case of fire (BWR2):

Essential characteristic	Performance
Reaction to fire	Anchorage satisfy requirements for Class A1
Resistance to fire	See Annex C5

3.2 Methods of assessment

The assessment of fitness of the anchor for the intended use in relation to the requirements for mechanical resistance and stability and safety in case of fire in the sense of the Basic Requirements 1 and 2 has been made in accordance with the EAD 330087-01-0601, Systems for post-installed rebar connections with mortar.

4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

4.1 AVCP system

According to the decision 96/582/EC of the European Commission, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 1.

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking

Issued in Copenhagen on 2026-02-24 by



Thomas Bruun
Manager, ETA-Danmark

Injection mortar

Epoxy adhesive two components

Ramset ChemSet™ Reo 502 Xtrem™

Ramset ChemSet™ Epcon G5 Xtrem™



Marking

Trade name

ChemSet™ Reo 502 Xtrem™

ChemSet™ Epcon G5 Xtrem™

Identifying mark of the producer **Ramset**

Expire date

Curing and processing time

Charge code number

Static mixer

ISNE mixing nozzle



High flow mixing nozzle



RAMSET Chemset™ Reo 502 Xtrem™
RAMSET Chemset™ Epcon G5 Xtrem™

Product description

Injection system

Annex A1

Ribbed reinforcing bar (rebar):



Marking of setting depth applied on jobsite

Properties of the ribbed reinforcing bar (rebar):

- Rebar according to EN 1992-1-1 Annex C
- Bars or de-coiled rods class B or C
- Nominal diameter ϕ : 10 to 40 mm
- Rib height h in the range of $0,05 \phi \leq h \leq 0,07 \phi$
- Yield strength f_{yk} and k according to NDP or NCL of EN 1992-1-1/NA
- Ultimate strength $f_{uk} = f_{tk} = k \cdot f_{yk}$

RAMSET Chemset™ Reo 502 Xtrem™
RAMSET Chemset™ Epcon G5 Xtrem™

Product description
Specification rebar

Annex A2

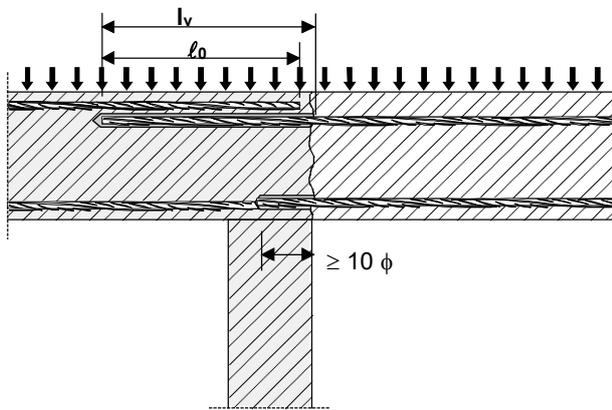


Figure A1: Overlap joint with existing reinforcement for rebar connections of slabs and beams

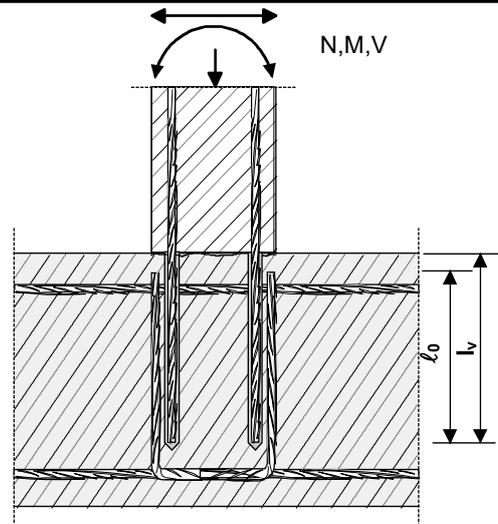


Figure A2: Overlap joint with existing reinforcement at a foundation of a column or wall where the rebars are stressed in tension

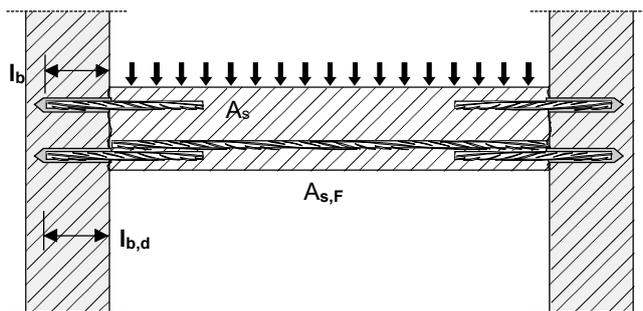


Figure A3: End anchoring of slabs or beams, designed as simply supported

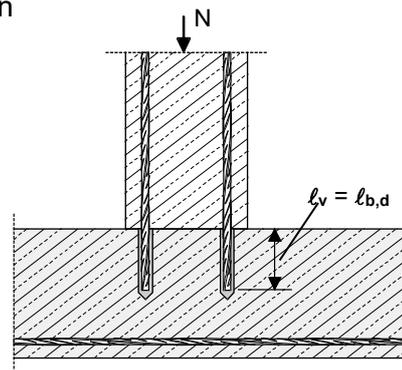


Figure A4: Rebar connection for components stressed primarily in compression. The rebars are stressed in compression

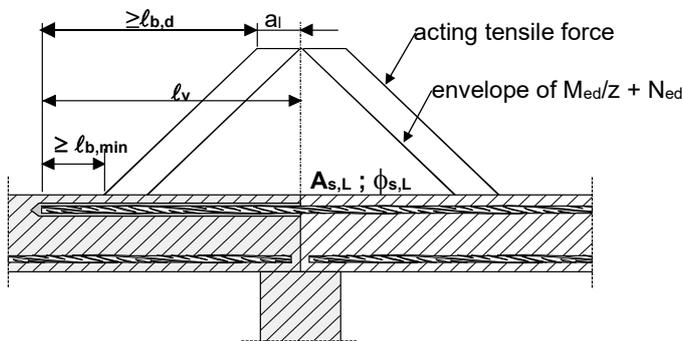


Figure A5: Anchoring of reinforcement to cover the line of acting tensile force

Note to Figure A1 to A5:

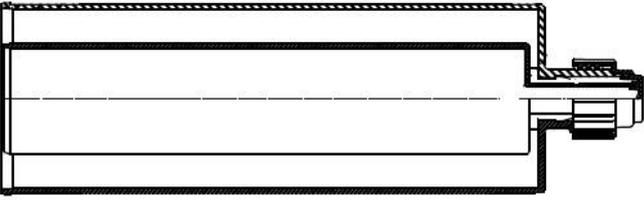
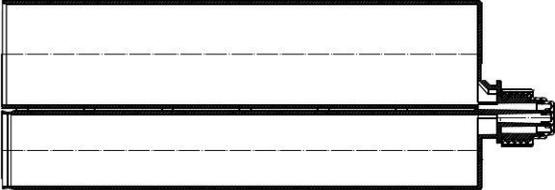
- In the Figures no transverse reinforcement is plotted, the transverse reinforcement as required by EN 1992-1-1 or EN 1998-1 shall be present.
- The shear transfer between existing and new concrete shall be designed according to EN 1992-1-1 or EN 1998-1
- Preparing of joints according to Annex B2.

RAMSET Chemset™ Reo 502 Xtrem™
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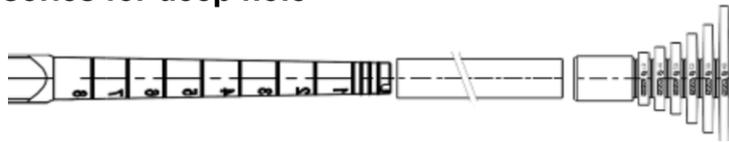
Product description
Specification rebar

Annex A3

Cartridges

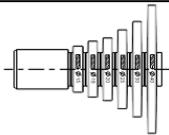
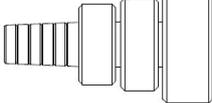
600 ml coaxial cartridge	
450ml side by side cartridge	

Injection accessories for deep hole



Plastic extension must be use for hole deeper $h_0 > 250$ mm

Piston plug must be use for hole deeper $h_0 > 350$ mm and for overhead installations

Cartridge volume	Mixing Nozzle	Extension for piston plug	Piston plug
All cartridges	ISNE mixing nozzle or High flow mixing nozzle	Ø13x1000	
			

RAMSET Chemset™ Reo 502 Xtrem™
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Product description
Cartridges
Injection accessories for deep hole

Annex A4

Specifications of intended use

Anchorage subject to:

- Static and quasi static loading : rebar Ø10 to Ø40
- Seismic loading : rebar Ø10 to Ø40
- Fire exposure : rebar Ø10 to Ø40

Base material:

- Compacted Reinforced or unreinforced normal weight concrete without fibres according to EN 206
- Strength classes C12/15 to C50/60 according to EN 206 for static and quasi static loading and under fire exposure
- Strength classes C16/20 to C50/60 according to EN 206 for seismic loading
- Maximum chloride content of 0,40 % (CL 0.40) related to the cement content according to EN 206:2013+A1:2016
- Non-carbonated concrete

Note: In case of a carbonated surface of the existing concrete structure the carbonated layer shall be removed in the area of the post-installed rebar connection with a diameter of $\phi + 60$ mm prior to the installation of the new rebar. The depth of concrete to be removed shall correspond to at least the minimum concrete cover in accordance with EN 1992-1-1. The foregoing may be neglected if building components are new and not carbonated and if building components are in dry conditions.

Temperature range:

- At installation : 0°C to +40°C
- In service : - 40°C to +75°C, max short term temperature +75°C, max long term temperature +45°C

Design:

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the forces to be transmitted.
- Design under static or quasi-static loading in accordance with EN 1992-1-1 and under seismic action in accordance with EN 1998-1 and Annex B2
- The actual position of the reinforcement in the existing structure shall be determined on the basis of the construction documentation and taken into account when designing.

Installation:

Drilling technique:

- Hammer drilling technique: sizes $\phi 10$ - $\phi 40$
- Compressed air drilling: sizes $\phi 10$ - $\phi 40$
- Diamond drilling technique: sizes $\phi 12$ - $\phi 40$

Use category:

- Dry or wet concrete (not in flooded holes) for Hammer drilling technique, compressed air drilling and diamond drilling technique
- Installation direction downwards, horizontal and overhead

▪ The installation of post-installed rebar shall be done only by suitable trained installer and under supervision on site; the conditions under which an installer may be considered as suitable trained and the conditions for supervision on site are up to the Member States in which the installation is done.

▪ Check the position of the existing rebars (if the position of existing rebars is not known, it shall be determined using a rebar detector suitable for this purpose as well as on the basis of the construction documentation and then marked on the building component for the overlap joint).

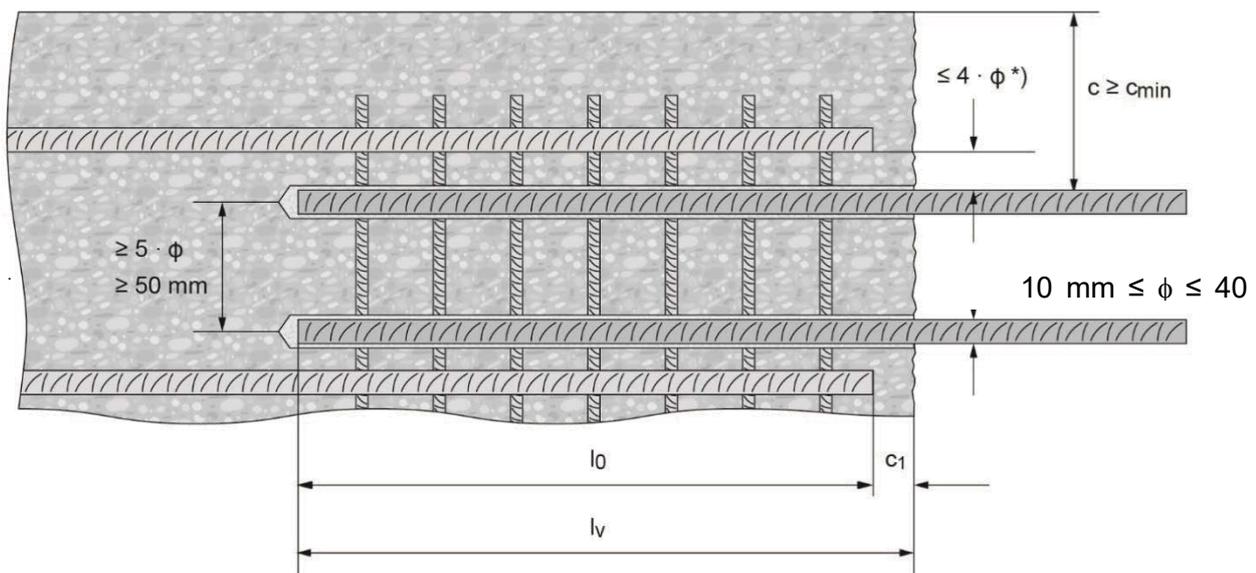
RAMSET Chemset™ Reo 502 Xtrem™
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Intended Use
Specifications

Annex B1

Figure B1: Construction rules for post-installed rebars

- Only tension forces in the axis of the rebar may be transmitted.
- The transfer of shear forces between new concrete and existing structure shall be designed additionally according to EN 1992-1-1.
- The joints for concreting must be roughened to at least such an extent that aggregate protrude.



*) If the clear distance between lapped bars exceeds $4 \cdot \phi$, then the lap length shall be increased by the difference between the clear bar distance and $4 \cdot \phi$

- c : concrete cover of post-installed rebar
- c_1 : concrete cover at end-face of existing rebar
- c_{min} : minimum concrete cover according to Table B1 and to EN 1992-1-1, Section 4.4.1.2
- ϕ : diameter of post-installed rebar
- l_0 : lap length, according to EN 1992-1-1, Section 8.7.3 for static loading, and according to EN 1998-1, Section 5.6.3 for seismic loading
- l_v : effective embedment depth $\geq l_0 + c_1$
- d_0 nominal drill bit diameter, see Annex B3
- Minimum spacing between two post-installed bars $a = 50 \text{ mm} \geq 5\phi$

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Intended used
General construction rules for post-installed rebars

Annex B2

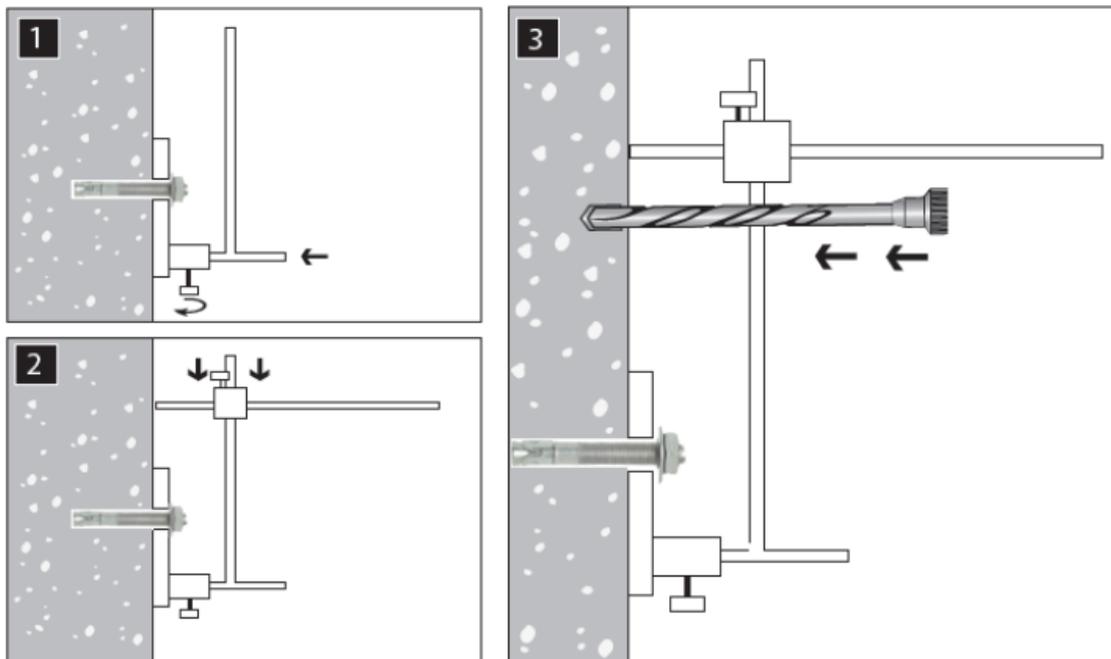
Table B1: Minimum concrete cover $c_{min}^{1)}$ of post-installed rebar

Drilling method	Bar diameter ϕ	Minimum concrete cover $c_{min}^{1)}$ [mm]	
		Without drilling aid	With drilling aid
Hammer drilling	< 25 mm	$30 + 0,06 l_v \geq 2\phi$	$30 + 0,02 l_v \geq 2\phi$
	≥ 25 mm	$40 + 0,06 l_v \geq 2\phi$	$40 + 0,02 l_v \geq 2\phi$
Compressed air drilling	< 25 mm	$50 + 0,08 l_v \geq 2\phi$	$50 + 0,02 l_v \geq 2\phi$
	≥ 25 mm	$60 + 0,08 l_v \geq 2\phi$	$60 + 0,02 l_v \geq 2\phi$
Diamond core drilling	< 25 mm	Drill stand is used as drilling aid	$30 + 0,02 l_v \geq 2\phi$
	≥ 25 mm		$40 + 0,02 l_v \geq 2\phi$

¹⁾ See Annex B2, Figure B1

Note: The minimum concrete cover as specified in EN 1992-1-1 must be observed for static, quasi-static and seismic actions.

Figure B2: Drilling aid system



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Intended used

Minimum concrete cover c_{min}

Annex B3

Table B2: Maximum embedment depth $l_{v,max}$

Rebar diameter ϕ	Maximum embedment length $l_{v,max}$ [mm]	
	Manual applicator	Pneumatic applicator
	450 ml 600 ml	450 ml 600 ml
$\phi 10$ - $\phi 40$	750	1500

**Table B3: Installation parameters
Dimensions of drill diameter and cleaning tools for reinforcing bars (rebars)**

Rebar diameter ϕ [mm]	Nominal drilling diameter d_{cut} [mm]		\emptyset Brush ¹⁾ [mm]	\emptyset Plastic extension for compressed air cleaning
	Hammer drilling	Diamond core		
$\phi 10$	12	-	13	9
$\phi 12$	15	15	16	9
$\phi 14$	18	18	20	13
$\phi 16$	20	20	22	13
$\phi 20$	25	25	26	13
$\phi 22$	28	28	30	13
$\phi 24$	30	30	32	13
$\phi 25$	30	30	32	13/20
$\phi 28$	35	35	37	13/20
$\phi 32$	40	40	42	13/20
$\phi 40$	50	50	55	13/20

¹⁾ The diameter of the round steel brush shall be checked before use. The minimum brush diameter has to be at least equal to the borehole diameter d_0 . The round steel brush shall produce natural resistance as it enters the drill hole. If this is not the case, please use a new brush or a brush with a larger diameter.

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Intended used

Maximum embedment depth $l_{v,max}$
Installation parameters

Annex B4

Table B4: Gel time and curing time

Temperature of base material	Working time	Curing time ¹⁾
5°C	75 min	30 h
10°C	45 min	22 h
15°C	35 min	14 h
20°C	22 min	7 h
25°C	14 min	5 h
30°C	8 min	4 h
35°C	6 min	3 h
40°C	4 min	2 h 45 min

¹⁾For wet concrete and diamond core drilling method, the curing time must be doubled

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Product description

Minimum curing time and maximum working time

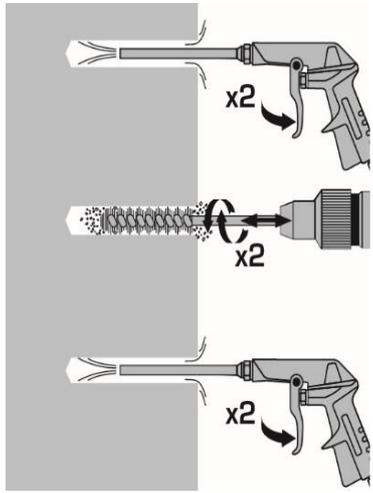
Annex B5

Drilling the hole:

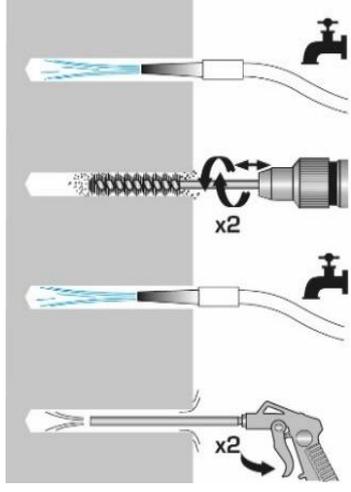
	Rotary hammer drilling or compressed air drilling
	Diamond core drilling

Cleaning the hole:

Hammer drilling technique

	<ol style="list-style-type: none"> 1. Using compress air cleaning (min 6 bars), use the appropriate plastic extension for compressed air cleaning, starting from the top of the hole blow out at least 2 times by moving downward to the bottom of the hole then moving upward to the top of the hole and until no dust is evacuated. (not less than 10s per each blowing). 2. Using the relevant brush and extension fitted on a Ramset drilling machine, starting from the top of the hole, move downward to the bottom of the hole then moving upward to the top of the hole. Repeat this operation. 3. Using compress air cleaning (min 6 bars), use the appropriate extension, starting from the top of the hole blow out at least 2 times by moving downward to the bottom of the hole then moving upward to the top of the hole and until no dust is evacuated. (not less than 10s per each blowing).
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Diamond core drilling technique

	<ol style="list-style-type: none"> 1. Clean the hole with tap water with a pipe adapted to enter in the hole. Starting from the top of the hole, move downward to the bottom of the hole then move upward to the top of the hole until water is becoming clear. 2. Using the relevant brush and extension fitted on a Ramset drilling machine, starting from the top of the hole, move downward to the bottom of the hole then moving upward to the top of the hole. Repeat this operation. 3. Clean the hole with tap water with a pipe adapted to enter in the hole. Starting from the top of the hole, move downward to the bottom of the hole then move upward to the top of the hole until water is becoming clear. 4. Using compress air cleaning (mini 6 bars), use the appropriate extension, starting from the top of the hole blow out at least 2 times by moving downward to the bottom of the hole then moving upward to the top of the hole and until no dust is evacuated. (not less than 10s per each blowing).
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RAMSET Chemset™ Reo 502 Xtrem™
 RAMSET Chemset™ Epcon G5 Xtrem™

Product description
 Installation instructions

Annex B6

Safety precaution:

The safety data sheet must be read before using the product and the safety instructions followed.

- Storage temperature of cartridge +5°C to +35 °C
- Cartridge temperature at time of installation: Must be $\geq +5^\circ\text{C}$
- Base material temperature at time of installation: Must be between 5°C and +40°C
- Check the date of expiry of the cartridge

Dispensing into the hole:

	<ol style="list-style-type: none"> 1. Put the anchorage depth mark on the rebar 2. Check the anchorage depth 3. Cut the piston plug at the relevant diameter. The volume of resin that needs to be injected in the hole must be indicated on the mixing nozzle or its extension. The marking must be placed at 0.5 times the anchorage depth 4. Dispense the first part to waste until an even colour is achieved ($\approx 20\text{cm}$). Insert the nozzle to the far end of the hole, and inject the resin, withdrawing the nozzle as the hole fills in order to avoid trapping air bubbles. Fill the hole until the mark appears. For pneumatic dispenser, the maximum pressure is 6 bars.
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Inserting the rebar:

	<ol style="list-style-type: none"> 1. Immediately insert the rebar, slowly and with a slight twisting motion. Remove excess resin from around the mouth of the hole before it sets. Control the embedment depth during the working time (See Annex B5 Table B4) which varies according to temperature of base material. 2. Leave the rebar undisturbed until the curing time has elapsed. (See Annex B5 Table B4)
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RAMSET Chemset™ Reo 502 Xtrem™
 RAMSET Chemset™ Epcon G5 Xtrem™

Product description
 Installation instructions

Annex B7

Essential characteristic under static and quasi static loading

Minimum anchorage length and minimum lap length for a working life of 50 or 100 years for hammer drilling and compressed air drilling

The minimum anchorage length $l_{b,min}$ and minimum lap length $l_{0,min}$ according to EN 1992-1-1 shall be multiplied by the relevant amplification factor $\alpha_{lb} = \alpha_{lb,100y}$ given in Table C1.

The design values of the bond strength $f_{bd,PIR}$ and $f_{bd,PIR,100y}$ are given in Table C3 considering the concrete strength classes and the rebar diameter for good bond conditions according to EN 1992-1-1. For all other bond conditions multiply the values by 0,7.

$f_{bd,PIR} = k_b \cdot f_{bd}$ with bond efficiency factor k_b according to Table C2

$f_{bd,PIR,100y} = k_{b,100y} \cdot f_{bd}$ with bond efficiency factor $k_{b,100y}$ according to Table C2

Table C1: Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$

Rebar diameter	Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$ [-]								
	Concrete strength class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
$\phi 10 - \phi 40$	1,0								

Table C2: Bond efficiency factor $k_b = k_{b,100y}$

Rebar diameter	Bond efficiency factor $k_b = k_{b,100y}$ [-]								
	Concrete strength class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
$\phi 10 - \phi 40$	1,0								

Table C3: Design values of the bond strength $f_{bd,PIR} = f_{bd,PIR,100y}$

Rebar diameter	Bond strength $f_{bd,PIR} = f_{bd,PIR,100y}$ [N/mm ²]								
	Concrete strength class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
$\phi 10 - \phi 40$	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3

RAMSET Chemset™ Reo 502 Xtrem™
RAMSET Chemset™ Epcon G5 Xtrem™

Performance

Essential characteristics under static and quasi-static loading for a working life of 50 or 100 years for hammer drilling and compressed air drilling

Annex C1

Essential characteristic under static and quasi static loading**Minimum anchorage length and minimum lap length for a working life of 50 or 100 years for diamond drilling**

The minimum anchorage length $l_{b,min}$ and minimum lap length $l_{0,min}$ according to EN 1992-1-1 shall be multiplied by the relevant amplification factor $\alpha_{lb} = \alpha_{lb,100y}$ given in Table C4.

The design values of the bond strength $f_{bd,PIR}$ and $f_{bd,PIR,100y}$ are given in Table C6 considering the concrete strength classes and the rebar diameter for good bond conditions according to EN 1992-1-1. For all other bond conditions multiply the values by 0,7.

$f_{bd,PIR} = k_b \cdot f_{bd}$ with bond efficiency factor k_b according to Table C5

$f_{bd,PIR,100y} = k_{b,100y} \cdot f_{bd}$ with bond efficiency factor $k_{b,100y}$ according to Table C5

Table C4: Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$

Rebar diameter	Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$ [-]									
	Concrete strength class									
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60	
$\phi 12-\phi 40$	1,0									

Table C5: Bond efficiency value $k_b = k_{b,100y}$

Rebar diameter	Bond efficiency factor $k_b = k_{b,100y}$ [-]									
	Concrete strength class									
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60	
$\phi 12-\phi 40$	1,0									

Table C6: Design values of the bond strength $f_{bd,PIR} = f_{bd,PIR,100y}$

Rebar diameter	Bond strength $f_{bd,PIR} = f_{bd,PIR,100y}$ [N/mm ²]									
	Concrete strength class									
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60	
$\phi 12-\phi 40$	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3	

RAMSET Chemset™ Reo 502 Xtrem™
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Performance

Essential characteristics under static and quasi-static loading
for a working life of 50 or 100 years for diamond drilling

Annex C2

Essential characteristic under seismic loading**Minimum anchorage length and minimum lap length for Hammer drilling and compressed air drilling for working life of 50 or 100 years**

The minimum anchorage length $l_{b,min}$ and minimum lap length $l_{0,min}$ according to EN 1992-1-1 shall be multiplied by the relevant amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$ given in Table C7.

The design values of the bond strength $f_{bd,PIR,seis}$ and $f_{bd,PIR,seis,100y}$ are given in Table C9 considering the concrete strength classes and the rebar diameter for good bond conditions according to EN 1992-1-1. For all other bond conditions multiply the values by 0,7.

$f_{bd,PIR,seis} = k_{b,seis} \cdot f_{bd}$ with seismic bond efficiency factor $k_{b,seis}$ according to Table C8

$f_{bd,PIR,seis,100y} = k_{b,seis,100y} \cdot f_{bd}$ with seismic bond efficiency factor $k_{b,seis,100y}$ according to Table C8

The minimum concrete cover between the value according to Table B1 and $C_{min,seis} = 2 \phi$ applies

Table C7: Amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$

Rebar diameter	Amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$ [-]							
	Concrete strength class							
	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
$\phi 10 - \phi 40$	1,0							

Table C8: Bond efficiency factor $k_{b,seis} = k_{b,seis,100y}$

Rebar diameter	Bond efficiency factor $k_{b,seis} = k_{b,seis,100y}$ [-]							
	Concrete strength class							
	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
$\phi 10 - \phi 40$	1,0							

Table C9: Design values of the bond strength $f_{bd,PIR,seis} = f_{bd,PIR,seis,100y}$

Rebar diameter	Bond strength $f_{bd,PIR,seis} = f_{bd,PIR,seis,100y}$ [N/mm ²]							
	Concrete strength class							
	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
$\phi 10 - \phi 40$	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3

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Performance
Essential characteristics under seismic loading for a working life of 50 or 100 years for hammer drilling and compressed air drilling

Annex C3

Essential characteristic under seismic loading

Minimum anchorage length and minimum lap length for diamond drilling for a working life of 50 or 100 years

The minimum anchorage length $l_{b,min}$ and minimum lap length $l_{0,min}$ according to EN 1992-1-1 shall be multiplied by the relevant amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$ given in Table C10.

The design values of the bond strength $f_{bd,PIR,seis}$ and $f_{bd,PIR,seis,100y}$ are given in Table C12 considering the concrete strength classes and the rebar diameter for good bond conditions according to EN 1992-1-1. For all other bond conditions multiply the values by 0,7.

$f_{bd,PIR,seis} = k_{b,seis} \cdot f_{bd}$ with seismic bond efficiency factor $k_{b,seis}$ according to Table C11

$f_{bd,PIR,seis,100y} = k_{b,seis,100y} \cdot f_{bd}$ with seismic bond efficiency factor $k_{b,seis,100y}$ according to Table C11

The minimum concrete cover between the value according to Table B1 and $C_{min,seis} = 2 \phi$ applies

Table C10: Amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$

Rebar diameter	Amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$ [-]							
	Concrete strength class							
	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
$\phi 12 - \phi 40$	1,0							

Table C11: Bond efficiency factor $k_{b,seis} = k_{b,seis,100y}$

Rebar diameter	Bond efficiency factor $k_{b,seis} = k_{b,seis,100y}$ [-]									
	Concrete strength class									
	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60		
$\phi 12$	1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,9		
$\phi 14$						0,9	0,9			
$\phi 16$						0,9	0,8	0,8		
$\phi 20$				0,9	0,8	0,7	0,7	0,6		
$\phi 22$				0,9	0,8	0,7	0,8	0,7		
$\phi 24$				1,0	0,9	0,8	0,9	0,8	0,8	0,71
$\phi 25$							0,9	0,8	0,76	0,71
$\phi 28$							0,9	0,82	0,84	0,79
$\phi 32$							0,91	0,92	0,86	
$\phi 40$				1,0	1,0	1,0				

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Essential characteristics under seismic loading
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Annex C5

Essential characteristic under seismic loading (Continued)**Table C12: Design values of the bond strength $f_{bd,PIR,seis} = f_{bd,PIR,seis,100y}$ in N/mm²**

Rebar diameter	Bond strength $f_{bd,PIR,seis} = f_{bd,PIR,seis,100y}$ [N/mm ²]								
	Concrete strength class								
	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60	
$\phi 12$	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,0	
$\phi 14$							3,7	3,7	
$\phi 16$						3,4	3,4		
$\phi 20$				2,7	2,7	2,7	2,7	2,7	2,7
$\phi 22$				2,7	2,7	2,7	2,7	3,0	3,0
$\phi 24$				3,0	3,0	3,0	3,0	3,0	3,0
$\phi 25$					3,0	3,0	3,0	3,0	3,0
$\phi 28$					3,0	3,0	3,4	3,4	3,4
$\phi 32$					3,4	3,4	3,7	3,7	3,7
$\phi 40$						3,7	4,0	4,3	

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Annex C5

Essential characteristics under fire exposure

Bond strength $f_{bk,fi} = f_{bk,fi,100y}$ at increased temperature for concrete strength classes C12/15 to C50/60

The bond strength $f_{bk,fi} = f_{bk,fi,100y}$ at increased temperature has to be calculated by the following equation:

$$f_{bk,fi} = f_{bk,fi,100y} = k_{fi}(\theta) \cdot f_{bd,PIR} \cdot \gamma_c / \gamma_{M,fi}$$

where

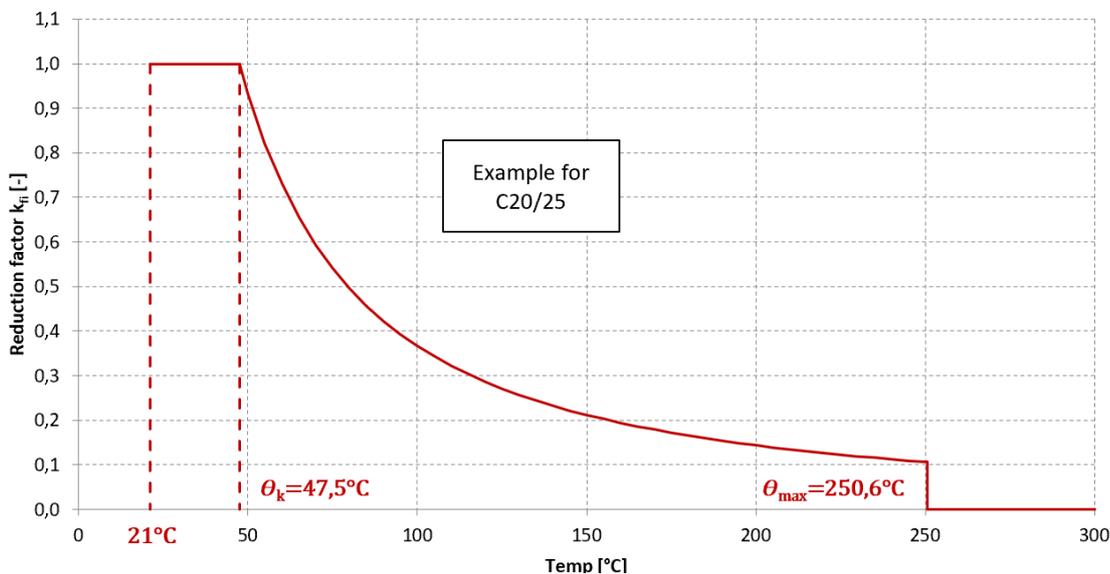
$$\theta < 250,6 \text{ } ^\circ\text{C}: \quad k_{fi}(\theta) = \min \{1,0; 1813,93651 \cdot \theta^{-1,34963} / (f_{bd,PIR} \cdot 4,3)\}$$

$$\theta > 250,6 \text{ } ^\circ\text{C}: \quad k_{fi}(\theta) = 0$$

$f_{bk,fi}$	Bond strength at increased temperature in N/mm ² for a working life of 50 years (all drilling methods)
$f_{bk,fi,100y}$	Bond strength at increased temperature in N/mm ² for a working life of 100 years (Hammer and compressed air drilling)
(θ)	Temperature in °C in the mortar layer
$k_{fi}(\theta) =$	Reduction factor at increased temperature
$k_{fi,100y}(\theta)$	
$f_{bd,PIR}$	Design values of the bonds strength in N/mm ² according to Tables C3, C6 and C9 considering the concrete classes, the rebar diameter, the drilling method and the bond condition according to EN 1992-1-1
γ_c	Partial factor according to EN 1992-1-1
$\gamma_{M,fi}$	Partial factor according to EN 1992-1-2

For evidence at increased temperature the anchorage length shall be calculated according to EN 1992-1-1, Equation 8.3 using the temperature-dependent bond strength $f_{bk,fi}$.

Figure C1: Example graph of reduction factor $k_b(\theta)$ for concrete strength class C20/25 for good bond conditions



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Bond strength at increased temperature

Annex C6