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Product Engineering Laboratory

Reid™ Product Engineering Laboratory
All testing has been performed by independent IANZ accredited testing laboratories. See below for details.

Reinforcement Technical Assessment

RTA-22/0013 of 29/04/2026

This Technical Assessment meets the testing requirements stipulated in clauses 8.7.5.2 (b), 8.9.1.3 (a), (b), 8.6.11.1,2,3 & 4 of NZS 3101:2006 A3

Trade name of the construction product

ReidBar™ Steel Components:
iPort Flange Anchors

Product family to which the construction product belongs

ReidBar™ Reinforcement System used in concrete structures sizes RB12, RBA16, RB20, RB25 & RB32

Manufacturer

Reid Construction Systems
1 Ramset Drive
Chirnside Park Victoria 3116
Australia

Manufacturing plant

Reid Construction Systems

This Technical Assessment contains:

17 pages & 13 Annexes which form an integral part of this assessment.

This Technical Assessment is in accordance with the requirements stipulated in NZS 3101:2006 A3 & NZTA Bridge Manual 3rd Edition A4

Tests performed by Holmes Solutions
Reference reports:
- 139628.00 RP 0222 [V1.0]

Tests performed by WSP
Reference reports:
- OR5144-A
- OR5144-D

Tests performed by X-Ray Laboratories Ltd
Reference reports:
- 9606B1

This Assessment replaces:

RTA-22/0013 of 13/05/2022

1. Technical description of the product

ReidBar™ iPort Flange Anchors are part of the ReidBar™ System and are used as Mechanical Anchorage.

ReidBar™ reinforcing steel is Grade 500E (Seismic) produced in accordance with AS/NZS 4671:2019.

The illustration and the description of the product are given in Annex A1 and A2.

2. Specification of intended use

The performances given in Section 3 are only valid if the anchor Reinforcement System is used in compliance with the specifications and conditions given in Annex B1. Installation guidelines are provided in Annex B2.

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

3.1 Performance Requirement of Mechanical Anchors

Criteria	Performance
Elongation at $0.7f_y$ NZS 3101:2006 A3: Cl 8.7.5.2 (b) NZTA Bridge Manual 3 rd ed. A4: Cl 4.2.1 (f) (i)	See Annex C1 & C2
High Cycle fatigue NZS 3101:2006 A3: Cl 8.7.5.2 (c), 8.9.1.3 (b) NZTA Bridge Manual 3 rd ed. A4: Cl 4.2.1 (f) (i)	See Annex C3 & C4
Alternating Large Strains NZS 3101:2006 A3: Cl 8.9.1.3 (a) NZTA Bridge Manual 3 rd ed. A4: Cl 4.2.1 (f) (i)	See Annex C5 & C6
Ultimate Tensile Strength NZS 3101:2006 A3: Cl 8.6.11.1 & 8.6.11.2 NZTA Bridge Manual 3 rd ed. A4: Cl 4.2.1 (f) (i)	See Annex C7
Mode of Failure NZS 3101:2006 A3: Cl 8.6.11.1, 8.6.11.2, 8.6.11.3 NZTA Bridge Manual 3 rd ed. A4: Cl 4.2.1 (f) (i)	See Annex C8
Resistance to Brittle Fracture NZS 3101:2006 A3: Cl 8.6.11.4 NZTA Bridge Manual 3 rd ed. A4: Cl 4.2.1 (f) (iv)	See Annex C9

3.2 Testing Methodology of Mechanical Anchors

The test program, developed with Holmes Solutions in 2022, was designed to validate the use of the new iPort Flange Anchor, alongside the ReidBar Steel Flange Nut. This new product was developed from the original design of the ReidBar Steel Flange Nut, introducing a new feature: an injection port for epoxy application.

The test program demonstrated that both the current ReidBar iPort Flange Anchor and its predecessor, the now discontinued ReidBar Steel Flange Nut, meet the performance requirements for mechanical anchors, as defined by various clauses of the New Zealand Standard 3101:2006 – Concrete Structures (Amendment 3) and the NZTA Bridge Manual SP/M/022 3rd Edition (Amendment 4).

The epoxy filler, which was used for the assembly of the components, is Ramset™ Epcon™ C8. With the launch of the new premium epoxy Ramset Chemset™ Epcon G5 Xtrem in March 2026, a new test program was specifically developed with WSP, to

complement the original program and validate the use of the new epoxy as thread filler for the ReidBar iPort Flange Anchor, in alternative to Epcon C8.

3.2.1 *Elongation at 0.7f_y - Cl 8.7.5.2 (b) NZS 3101:2006 A3 & Cl 4.2.1 (f) (i) NZTA BM 3rd Edition A4 [Holmes Solutions] [Epcon C8 epoxy filler]*

The test apparatus employed was HTM1. This multipurpose test machine has an axial static force capacity in excess of 1 MN in both compression and tension directions, and is equipped with hydraulic wedge locking jaws for mounting test specimens or fixtures

Applied force was measured using a single load cell located at the tail-stock of HTM1, specifically a PT Ltd LPCH-100 load cell with a measurement capacity of ± 1.5 MN.

The HTM1 is calibrated annually in strict accordance with the requirements of our ISO 17025 accreditation, and is deemed to be a Class-1 calibrated test machine capable of applying a given load with an accuracy of ± 1 %

A video non-contact extensometer (VNCX), an optical based strain measurement system, was used for measuring the elongation of test specimens in HTM1 without the need of physical connection to the specimen. The VNCX system uses one or more cameras to track painted markers on the test specimen, and after internal data processing it provides elongation and strain measurements as outputted values.

The VNCX system is calibrated to the required field of view prior to each testing programme in accordance with the requirements of our ISO 17025:2017 accreditation, with routine assessments completed on the calibration accuracy in accordance with our quality procedures. The camera system is deemed to be capable to provide an accuracy of ± 1 % of the reading, which is equivalent with a Class 1 accuracy in accordance with the requirements outlined in ISO 9513:2013.

Motion control and data acquisition of HTM1 was achieved using a Delta Computer Systems RMC150E motion controller and associated signal input and conditioning hardware. Data was sampled at a rate of 50 Hz.

Uniaxial tensile load was applied to the specimen with a pseudo static displacement loading rate of 3 mm/min up to 0.7f_y, where f_y is the lower characteristic yield strength in accordance with NZS 3101:1-2006 clause 8.1. f_y is equivalent to 500 MPa for Grade 500E reinforcing steel in accordance with AS/NZS4671:2019.

To calculate the maximum allowable elongation, for the coupler length L_c, the cumulative length of the structural component (ReidBar iPort Flange Anchor or Flange Nut) and of the locking nut (ReidBar Half Nut) is multiplied times 2 the theoretical elastic strain at 350MPa.

The elongation over L_c is determined from the elongation measured over the gauge length L_g, by discounting the elastic elongation of the bar outside L_c.

3.2.2 *Elongation at 0.7f_y - Cl 8.7.5.2 (b) NZS 3101:2006 A3 & Cl 4.2.1 (f) (i) NZTA BM 3rd Edition A4 [WSP] [ChemSet Epcon G5 Xtrem epoxy filler]*

NZS 3101 2006 Clause 8.7.5.2 (b) requires that:

“When tested in tension or compression, as appropriate, to the application, exhibit a change in length at a stress of 0.7f_y in the bar, measured over the length of the anchor, of less than twice that of an equal length of unspliced bar.”

Using AS/NZS 4671:2019 minimum yield stress (f_y) for grade 500E as 500MPa.

Elongation to be measured between the bearing surface of the head and a point on the bar 4 bar diameters from the anchor.

3.2.3 *High Cycle fatigue – Cl 4.2.1 (f) (i) NZTA BM 3rd Edition A4 [Holmes Solutions] [Epcon C8 epoxy filler]*

Mechanical anchors are required by NZS 3101 Cl. 8.9.1.3(b) to satisfy the requirements

of CI 5.4 of ISO 15835-1:2009. Testing must comply with CI 5.5 of ISO 15835-2:2009.

CI 5.4 of ISO 15835-1:2009 requires that mechanical splices shall sustain a fatigue loading of at least 2 megacycles with a stress range, $2\sigma_a$, of 60MPa without failure. The upper stress, σ_{max} , in the test shall be $0.6R_{eH, spec}$.

The test procedure is as per CI 5.8 of ISO 15698.2:2012 with the required stress range referenced from ISO 15835.1:2009 for Category F.

The test method specified in ISO 15835.2:2009 Cl. 5.5 requires that the frequency of load cycles shall be between 1Hz and 200Hz.

A Shimadzu RH-50 servo-hydraulic controlled universal test machine (UTM2) was used to perform high-cycle fatigue testing. The UTM2 has a load capacity of 500kN, a maximum stroke of circa 300mm, and a peak table velocity of 1000mm/min. Machine control and data acquisition is handled using an incorporated Delta Computer Systems RMC motion controller and a proportional control valve.

The UTM2 is calibrated annually in strict accordance with the requirements of our ISO 17025 accreditation, and is deemed to be a Class-1 calibrated test machine capable of applying a given load with an accuracy of $\pm 1\%$.

3.2.4 High Cycle fatigue – CI 8.9.1.3 (b) NZS 3101:2006 A3 [WSP] [ChemSet Epcon G5 Xtrem epoxy filler]

High Cycle Fatigue Testing to ISO 15835:2009 - Steels for the reinforcement of concrete – Reinforcement couplers for mechanical splices of bars – Part 2: Test Methods: Clause 5.5 – High cycle fatigue test.

Performance requirements are:

- The mechanical splices shall sustain a fatigue loading of at least 2 megacycles.
- The frequency shall be between 1Hz and 200Hz.
- The stress range shall be 60MPa.
- The upper stress shall be 0.6 of the specified characteristic (or nominal) yield strength value of the reinforcing bar, $R_{eH, spec}$.

The test pieces shall comply with the performance requirements without any failure.

The test was carried out under force control and the frequency of the load cycles was set at 30Hz for all the samples.

Samples were supplied with reference bars to determine the actual mechanical properties, as per ISO 15835:2009 - Steels for the reinforcement of concrete – Reinforcement couplers for mechanical splices of bars – Part 2: Test Methods: Clause 5.1 General.

Tensile Testing of mechanical properties to ISO 6892-1:2019 Metallic materials – Tensile testing – Method of test at room temperature, ISO 15630-1 2019 Steel for the reinforcing and prestressing of concrete – Test Methods and AS 1391:2020 Metallic materials – Tensile testing at ambient temperature, in accordance with AS/NZS 4671:2019 Steel reinforcing materials.

3.2.5 Alternating tension and compression test of large strains – CI 4.2.1 (f) (i) - NZTA Bridge Manual 3rd Edition A4 [Holmes Solutions] [Epcon C8 epoxy filler]

The performance evaluation of anchorage capacity under low-cycle elastic-plastic loading in accordance with ISO 15698:2012 is specified in NZTA SP/M/022 V3.0 A3 cl. 4.2.1(f)(i). The test method specifies subjecting cast-in concrete specimens to the loading programme below:

- Stage 1: Twenty load cycles between $0.05 R_{eH, spec}$ and $0.95 R_{eH, spec}$
- Stage 2: Four load cycles between $0.05 R_{eH, spec}$ and $2\epsilon_{y, act}$

- Stage 3: Four load cycles between $0.05 R_{eH,spec}$ and $5\epsilon_{y,act}$
- Stage 4: Loading to failure.

where, for stages 2 and 3:

$R_{eH,spec}$ = specified characteristic yield strength.

$\epsilon_{y,act}$ = actual yield strain of the reinforcing bar from control samples.

Control bars from each batch of ReidBar™ were tested in accordance with ISO 15630-1:2010. The yield strain was used to calculate the loading target for the Category S testing in stages 2 and 3.

The following requirements apply under Category S testing:

- The specimen must sustain the loading protocol from stage 1 to stage 3 without failure.
- Significant loss of stiffness, such as in concrete crushing, is deemed as failure.

A digital linear transducer was attached onto the head of the bar end, and a mechanical extensometer was attached to the protruding length of bar at a distance of at least 100 mm from where the bar exits the concrete prism. The following data channels were sampled, and logged continuously, using the Delta Computer Systems RMC150E motion controller at a rate 50 Hz:

- Applied force.
- Strain in the reinforcing bar.
- Displacement of the bar head relative to the free end of the concrete prism.

The loading sequence was controlled as described below:

- Stage 1: A tensile load was applied under force control at a rate of 20 MPa/s for cyclic loading between $0.05 R_{eH,spec}$ and $0.95 R_{eH,spec}$ for a total of 20 cycles.
- Stage 2: The specimen was loaded under strain control to twice the target yield strain at a maximum rate of 0.055 s^{-1} (this value is based on an equivalent stress rate of 20 MPa/s with an elastic modulus, E of 200 GPa), followed by loading under force control down to $0.05 R_{eH,spec}$. The cyclic loading was repeated four times.
- Stage 3: The specimen was loaded up to five times of the average yield strain under strain control with maximum speed of 0.055 s^{-1} , followed by loading under force control down to $0.05 R_{eH,spec}$. The cyclic loading was repeated four times.
- Stage 4: The specimen was loaded to failure under displacement control at a rate of 20 mm/s, at which point the mode of failure was observed.

3.2.6 *Alternating tension and compression test of large strains – Cl 8.9.1.3 (a) NZS 3101:2006 A3 [WSP] [ChemSet Epcon G5 Xtrem epoxy filler]*

For testing the performance of mechanical splices, ISO 15835-2:2009 §5.6.2 specifies the following loading programme:

- From zero strain up to twice the yield strain (strain at nominal yield strength) in tension followed by downloading to a strain corresponding to half of the stress of the nominal yield strength value of the reinforcing bar ($0.5R_{eH,spec}$) in compression, alternating four times.
- Thereafter, from zero strain up to five times the yield strain in tension, followed by downloading to a strain corresponding to the stress $0.5R_{eH,spec}$ in compression, alternating four times, followed by tensioning the test piece to failure.

Performance requirements are:

- Tensile strength: at least $R_{m,spec}$, or $R_{eH,spec} \times (R_m/R_{eH})_{spec}$

- Residual elongation: $u_4 \leq 0.3\text{mm}$, $u_8 \leq 0.6\text{mm}$

Where $R_{m,spec}$ is the nominal tensile strength value of the reinforcing bar, $R_{eH,spec}$ is the nominal yield strength value of the reinforcing bar, and $(R_m/R_{eH})_{spec}$ is the specified tensile/yield strength ratio of the reinforcing bar.

The strain/stress rates were set according to ISO 6892-1:2009 Metallic materials – Tensile testing – Part1: Method of test at ambient temperature.

For couplers, in accordance with ISO 15835-2:2009, the gauge length (L_c) should be equal to the coupler length plus eight times the diameter.

ISO 15835-2:2009 describes test methods applicable to couplers for mechanical splices of two steel reinforcing bars. The Flange Anchors are joined to only one bar. Therefore, we have considered the gauge length (L_c) should be equal to the Flange Anchor length plus four times the diameter.

3.2.7 *Ultimate Tensile Strength – Cl 8.6.11.1 & 8.6.11.2 NZS 3101:2006 A3 [Holmes Solutions]*

Mechanical anchors are required by NZS 3101 cl. 8.6.11.1 to be capable of developing the upper bound breaking strength of the reinforcing bar without damage to the concrete or overall deformation of the anchorage. No test method is specified in this clause.

The test method specified in ISO 15698.2:2012 Cl. 5.7 has been adopted which specifies monotonic loading at a rate of 10MPa/s. Specimens may be pre-loaded up to $0.9 \cdot R_{eH,spec}$ and released a number of times, in order to stabilize the head-to-concrete interaction before the specimen is exposed to static loading and head displacement is determined.

A digital linear transducer was attached onto the head of the bar end, and a mechanical extensometer was attached to the protruding length of bar at a distance of at least 100 mm from where the bar exits the concrete prism. The following data channels were sampled, and logged continuously, using the Delta Computer Systems RMC150E motion controller at a rate 50 Hz:

- Applied force
- Strain in the reinforcing bar
- Displacement of the bar head relative to the free end of the concrete prism

The loading sequence was controlled as described below:

- Stage 1: A tensile load was applied under force control at a rate of 20MPa/s for cyclic loading between $0.05 R_{eH,spec}$ and $0.9 R_{eH,spec}$ for a total of 10 cycles.
- Stage 2: The specimen was loaded under strain control to failure a maximum rate of 0.055 s^{-1} (this value is based on an equivalent stress rate of 20MPa/s with an elastic modulus, E of 200 GPa).

3.2.8 *Mode of Failure – Cl 8.6.11.1 & 8.6.11.3 NZS 3101:2006 A3 [Holmes Solutions]*

For mechanical anchors, NZS 3101 requires that the mode of failure for anchored bars is ductile yielding of the bar developing its ultimate tensile strength away from the mechanical anchorage and without thread stripping or significant distortion.

The wedge tensile testing, required by NZS 15698 to validate the robustness of the head-to-bar connection, serves this purpose very well, with a healthy degree of conservatism.

The specimens were tested against the requirements for Category B3 headed bars given in ISO 15698-1:2012 clauses 7.3.2 and ISO 15698-2:2012 clauses 6.2.

Specifically, the head shall be capable of anchoring the actual tensile strength of the reinforcing material that is being tested, by fulfilling at least one of the following.

- The failure occurs outside of the affected zone.
- The minimum specified elongation required for the bar is achieved.

- At least $0.95 R_{m,act}$ is achieved by comparison with the actual tensile strength of non-headed specimens from the same batch.

Further, for threaded heads of Category B3, according to clause 7.2.3 the wedge tensile test is required to be executed on reinforcing bars with yield strength within both the upper and lower yield strength range for which the heads are intended. The wedge tensile test was performed at a wedge angle of 4° . A tensile load was applied monotonically at a loading rate of 20 mm/min until tensile failure of the bar occurred, at which point the mode of failure was observed.

3.2.9 *Resistance to Brittle Fracture – Cl 8.6.11.4 NZS 3101:2006 A3 & Cl 4.2.1 (f) (iv) NZTA Bridge Manual 3rd Edition A4*

As per Clause 8.6.11.4 of NZS 3101 A3, mechanical couplers and anchorages shall be proven, by an appropriate test method, to possess resistance to brittle fracture at the service temperatures at which they are intended for use. However, there is no indication on what an appropriate test method would be.

The NZTA Bridge Manual, at Clause 4.2.1 (f) (iv), provides more guidance on how to demonstrate resistance to brittle fracture through testing.

In accordance with AS 1544.2, a Charpy V-notched impact resistance equal to or greater than 27 Jules shall be achieved when standard 10mmx10mm test pieces are tested at 0°C .

4 **Material Safety Data Sheet**

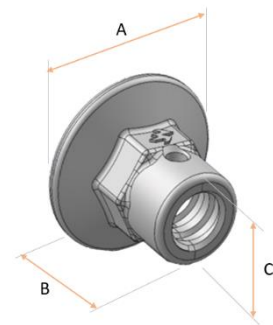
Refer to SDS ChemAlert SDS Date: 26 Apr 2022 Version No:1 (EPCON C8) for Safety Data Sheet according to New Zealand HSNO requirements.

Refer to SDS ChemAlert SDS Date: 31 Oct 2025 Version No:1.4 (CHEMSET EPCON G5 XTREM) for Safety Data Sheet according to New Zealand HSNO requirements.

ReidBar™ Steel iPort Flange Anchor
 RB12FAIPS, RBA16FAIPS, RB20FAIPS, RB25FAIPS, RB32FAIPS

Part No.	Description.	Foot Diameter (A) (mm)	Length (B) (mm)	Body Diameter (C) (mm)
RB12FAIPS	REIDBAR 12MM FLANGE ANCHOR IPORT STEEL	39	50	22
RBA16FAIPS	REIDBAR 16MM FLANGE ANCHOR IPORT STEEL	58	50	35
RB20FAIPS	REIDBAR 20MM FLANGE ANCHOR IPORT STEEL	67	50	35
RB25FAIPS	REIDBAR 25MM FLANGE ANCHOR IPORT STEEL	83	80	42
RB32FAIPS	REIDBAR 32MM FLANGE ANCHOR IPORT STEEL	92	95	55

NOTE: Hot dip galvanised finish also applicable



ReidBar™ Steel Flange Nuts & iPort Flange Anchors

Product description
 Mechanical anchorages

Annex A1

ReidBar™ Reinforcing bar RB12, RBA16, RB20, RB25, RB32

**Seismic® 500E Micro
Alloyed Reidbar™**



Commercial reinforcing (E Class - Seismic) bar to AS/NZS 4671:2019

Product Characteristics	Value
Lower Characteristic yield strength $R_{ek.L}$ (MPa)	≥ 500
Upper Characteristic yield strength $R_{ek.U}$ (MPa)	≤ 600
Characteristic Minimum Ultimate to Yield ratio - R_m/R_e	≥ 1.15
Characteristic Maximum Ultimate to Yield ratio - R_m/R_e	≤ 1.40

ReidBar™ Reinforcing Steel

Product description
Reinforcing Bars

Annex A2

Specifications of intended use

Anchorage subject to:

- Seismic, Static and quasi-static load.

Base materials

- Non-cracked and cracked concrete for reinforcing bars RB12 to RB32.
- Reinforced or unreinforced normal weight concrete for use in construction in accordance with NZS 3101:2006 A3 and NZTA Bridge Manual 3rd Edition A4.

Design:

- The Mechanical anchorages are designed in accordance with the Standards New Zealand NZS 3101:2006 A3 – Concrete Structures Standard” and the NZTA Bridge Manual 3rd Edition A4 under the responsibility of an engineer experienced in structural design and concrete work.
- Verifiable calculation notes and drawings are prepared taking into account the loads to be anchored. The position of the anchor is indicated on the design drawings.

Installation:

- Reinforcement installation carried out in accordance with ReidBar connection installation procedures (including the application of Ramset Epcon C8 or Ramset Chemset Epcon G5 Xtrem thread filler in the ReidBar fitment) by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

ReidBar™ Components	Annex B1
Intended use Specifications	

ReidBar Steel iPort Flange Anchor Installation Guidelines


Installation

ReidBar™ iPort Flange Anchor Installation Guidelines below:

1

Determine Threaded Anchor installation marking location by deducting overall product length (Column B - Page 5) from final anchor head termination position along bar.


Mark the location on the bar where the Flange Anchor needs to be positioned.



2


Thread ReidBar™ Half-Nut onto bar, ensuring pre-marked location remains visible at connection point.

ReidBar Half Nut travels past the marking.

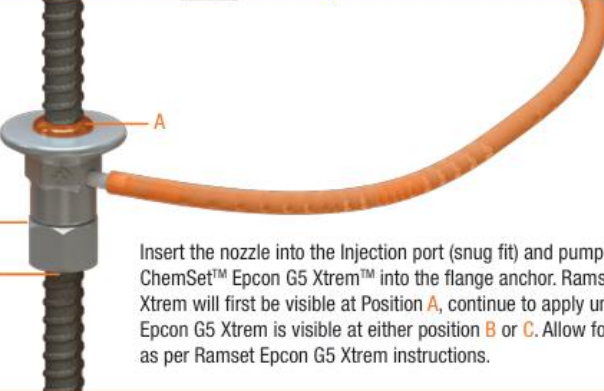


3


Thread the Flange Anchor onto the ReidBar™. Once the Flange Anchor reaches the Half Nut, use spanner to tighten the two components together. Ensure snug fit between two components prior to tightening.



4



Insert the nozzle into the Injection port (snug fit) and pump Ramset™ ChemSet™ Epcon G5 Xtrem™ into the flange anchor. Ramset Epcon G5 Xtrem will first be visible at Position A, continue to apply until Ramset Epcon G5 Xtrem is visible at either position B or C. Allow for curing time, as per Ramset Epcon G5 Xtrem instructions.



Recommended amount of Ramset Epcon G5 Xtrem injections



The ReidBar steel Flange Anchor & Half-Nut connection are to be installed utilising Ramset Epcon G5 Xtrem epoxy.

Typical specification on drawings:
 "RB_FAIPS / FAIPSG + RBNH/RBNHG
 + Ramset Chemset Epcon G5 Xtrem"

Part No.	Approx. No of Injections*	Approx. Fittings / Cartridge
RB12FAIPS / FAIPSG	2	55
RBA16FAIPS / FAIPSG	2	55
RB20FAIPS / FAIPSG	2/3	44
RB25FAIPS / FAIPSG	3	36
RB32FAIPS / FAIPSG	5	22

*recommendations are based on the use of mixing nozzle type "ISNE". Quantities based on full pumps. **Based on 110 pumps per Ramset Epcon G5 Xtrem cartridge. Refer to step 4 for application detail.

Ensure the appropriate PPE is worn when working with Ramset Epcon G5 Xtrem. Refer to www.ramset.co.nz for Ramset Epcon G5 Xtrem MSDS Sheet.

ReidBar™ Steel iPort Flange Anchor

Intended use
 Installation procedure

Annex B2

**Table C1: Elongation at 0.7f_y: CI 8.7.5.2 (b) NZS 3101:2006 A3
CI 4.2.1 (f) (i) - NZTA Bridge Manual 3rd Edition A4**

Sample	Part No.	Lg Gauge length [mm]	No. (of Sampl. Tested)	Elongat. at 0.7f _y of unspliced reference bar (using average strain of 2 reference bar test)	0.7 f _y	Elongation ratio: measured/allowed			Test report reference(s)
				[mm]		[kN]	Min. measur. / allowed ratio	Max. measur. / allowed ratio	
ReidBar Steel iPort Flange Anchors with Ramset ChemSet Epcon G5 Xtrem									
12mm iPort Flange Anchor	RB12FAIPS	112	3	0.212	39.55	0.98	1.05	2	WSP OR5144-A
20mm iPort Flange Anchor	RB20FAIPSG	148	3	0.251	109.9	1.67	1.79	2	WSP OR5144-A
32mm iPort Flange Anchor	RB32FAIPSG	255	3	0.402	281.4	1.29	1.63	2	WSP OR5144-A

**Table C2: Elongation at 0.7f_y: CI 8.7.5.2 (b) NZS 3101:2006 A3
CI 4.2.1 (f) (i) - NZTA Bridge Manual 3rd Edition A4**

Sample	Part No.	Lc* Coupler length [mm]	No. (of Sampl. Tested)	ε ₃₅₀ non-spliced ReidBar strain at 0.7f _y (theoret.)	0.7 f _y	Criteria assessed over Lc (coupler length)			Test report reference(s)
				[mm/m]		[kN]	Min Msrd displ. [mm]	Max Msrd displ. [mm]	
ReidBar Steel iPort Flange Anchors with Ramset Epcon C8									
12mm iPort Flange Anchor	RB12FAIPS	67	3	1.75	39.55	0.07	0.09	0.23	Holmes Solutions 139628.00 RP 0222 [V1.0]
16mm iPort Flange Anchor	RBA16FAIPSG	69	3	1.75	70.35	0.01	0.07	0.24	Holmes Solutions 139628.00 RP 0222 [V1.0]
20mm iPort Flange Anchor	RB20FAIPSG	72	3	1.75	109.9	0.05	0.11	0.25	Holmes Solutions 139628.00 RP 0222 [V1.0]
25mm iPort Flange Anchor	RB25FAIPSG	80	3	1.75	171.85	0.06	0.11	0.39	Holmes Solutions 139628.00 RP 0222 [V1.0]
32mm iPort Flange Anchor	RB32FAIPSG	133	3	1.75	281.4	0.16	0.26	0.47	Holmes Solutions 139628.00 RP 0222 [V1.0]

* Lc = length of Flange Anchor + length of Half Nut (samples held by the Half Nut)

ReidBar Reinforcing Bar System

Performances: Elongation at 0.7 f_y
According to NZS3101:2006 A3 & AS/NZS 4671
NZTA Bridge Manual 3rd Edition A4

Annex C1 & C2

Table C3: High Cycle Fatigue: CI 8.7.5.2 (c) & 8.9.1.3 (b) - NZS 3101:2006 A3

Sample	Part No.	No. (of Samples Tested)	In accordance with ISO 15835-1 & ISO 15835-2					Result	Test report reference(s)
			Freq.	No. of cycles	Nomin. Yield Str. f_y	Cycle upper stress	Cycle lower stress		
			[Hz]		[kN]	[kN]	[kN]		
ReidBar Steel Flange Nuts with Ramset ChemSet Epcon G5 Xtrem									
32mm iPort Flange Anchor	RB32FAIPS	3	30	2,000,000	402.0	241.3	193.0	Pass	WSP OR5144-D

Note: In accordance with ISO 15835-1:2018 CI 5.5.1, the largest diameter must be tested.

Table C4: High Cycle Fatigue: CI 4.2.1 (f) (i) - NZTA Bridge Manual 3rd Edition A4 (mechanical anchors)

Sample	Part No.	No. (of Samples Tested)	In accordance with ISO 15698-1 (Category F2) & ISO 15835-1 (Category F load cycles & stress range)					Result	Test report reference(s)
			Freq.	No. of cycles	Nomin. Yield Str. f_y	Cycle upper stress	Cycle lower stress		
			[Hz]		[kN]	[kN]	[kN]		
ReidBar Steel iPort Flange Anchors with Ramset Epcon C8									
12mm iPort Flange Anchor	RB12FAIPS	3	13	2,000,000	56.5	33.9	27.1	Pass	Holmes Solutions 139628.00 RP 0222 [V1.0]
20mm iPort Flange Anchor	RB20FAIPSG	3	12	2,000,000	157.1	94.2	75.4	Pass	Holmes Solutions 139628.00 RP 0222 [V1.0]
25mm iPort Flange Anchor	RB25FAIPSG	3	12	2,000,000	245.4	147.3	117.8	Pass	Holmes Solutions 139628.00 RP 0222 [V1.0]
32mm iPort Flange Anchor	RB32FAIPSG	3	12	2,000,000	402.1	241.3	193.0	Pass	Holmes Solutions 139628.00 RP 0222 [V1.0]

Note: In accordance with ISO 15698 CI 5.5 Table 2, the samples tested cover the geometry in the entire ReidBar range RB12 to RB32.

ReidBar Reinforcing Bar System

Performances: High Cycle Fatigue

According to NZS3101:2006 A3 & AS/NZS 4671
NZTA Bridge Manual 3rd Edition A4

Annex C3 & C4

Table C5: Large Strains: CI 8.9.1.3 (a) - NZS 3101:2006 A3

Sample	Part No.	No. (of Samples Tested)	Criteria assessed						Test report reference(s)
			ISO $u_4 \leq 0.3\text{mm}$ [mm]		ISO $u_8 \leq 0.6\text{mm}$ [mm]		UTS $\geq 575\text{MPa}$ [MPa]		
			$u_{4(\text{min})}$	$u_{4(\text{max})}$	$u_{8(\text{min})}$	$u_{8(\text{max})}$	UTS _(min)	UTS _(max)	
ReidBar Steel iPort Flange Anchors with Ramset ChemSet Epon G5 Xtrem									
12mm iPort Flange Anchor	RB12FAIPS	3	0.058	0.082	0.093	0.116	702	702	WSP OR5144-A
20mm iPort Flange Anchor	RB20FAIPS	3	0.182	0.238	0.208	0.257	681	693	WSP OR5144-A
32mm iPort Flange Anchor	RB32FAIPS	3	0.127	0.276	0.162	0.319	643	654	WSP OR5144-A

Table C6: Large Strains: CI 4.2.1 (f) (i) - NZTA Bridge Manual 3rd Edition A4 (mechanical anchors)

Sample	Part No.	No. (of Samples Tested)	$\epsilon_{y,\text{act}}$ [mm/m]	In accordance with ISO 15698.1:2012 cl.7.2.4 (Category S)				Test report reference(s)
				20x load cycles between $0.05R_{eH,\text{spec}}$ & $0.95R_{eH,\text{spec}}$	4x load cycles between $0.05R_{eH,\text{spec}}$ & $2\epsilon_{y,\text{act}}$	4x load cycles between $0.05R_{eH,\text{spec}}$ & $5\epsilon_{y,\text{act}}$	Failure mode	
ReidBar Steel iPort Flange Anchors with Ramset Epon C8								
12mm Steel iPort Flange Anchor	RB12FAIPS	3	2.4	Pass	Pass	Pass	Ductile failure outside affected zone	Holmes Solutions 139628.00 RP 0222 [V1.0]
20mm Steel iPort Flange Anchor	RB20FAIPSG	3	3.2	Pass	Pass	Pass	Ductile failure outside affected zone	Holmes Solutions 139628.00 RP 0222 [V1.0]
25mm Steel iPort Flange Anchor	RB25FAIPSG	3	3.1	Pass	Pass	Pass	Ductile failure outside affected zone	Holmes Solutions 139628.00 RP 0222 [V1.0]
32mm Steel iPort Flange Anchor	RB32FAIPSG	3	2.1	Pass	Pass	Pass	Ductile failure outside affected zone	Holmes Solutions 139628.00 RP 0222 [V1.0]

Note: In accordance with ISO 15698 CI 5.5 Table 2, the samples tested cover the geometry in the entire ReidBar range RB12 to RB32.

ReidBar Reinforcing Bar System**Annex C5 & C6****Performances: Large Strains**

According to NZS3101:2006 A3 & AS/NZS 4671
NZTA Bridge Manual 3rd Edition A4

**Table C7: Ultimate Tensile Strength – CI 8.6.11.1 & 8.6.11.2 NZS 3101:2006 A3
CI 4.2.1 (f) (i) - NZTA Bridge Manual 3rd Edition A4**

Sample	Part No.	No. (of Samples Tested)	Criteria assessed		Mode of Failure	Test report reference(s)
			UTS \geq 750MPa [MPa]			
			UTS _(min)	UTS _(max)		
ReidBar Steel iPort Flange Anchors						
12mm iPort Flange Anchor	RB12FAIPS	3	737*	873	3 heat-treated ReidBar break without incipient crushing of the concrete as defined in ISO 15698.1:2012 For one sample, the heat-treated bar failed 1.7% shy of the target load	Holmes Solutions 139628.00 RP 0222 [V1.0]
20mm iPort Flange Anchor	RB20FAIPSG	3	1053	1195	3 heat-treated ReidBar break without incipient crushing of the concrete as defined in ISO 15698.1:2012	Holmes Solutions 139628.00 RP 0222 [V1.0]
25mm iPort Flange Anchor	RB25FAIPSG	3	926	931	3 heat-treated ReidBar break without incipient crushing of the concrete as defined in ISO 15698.1:2012	Holmes Solutions 139628.00 RP 0222 [V1.0]
32mm iPort Flange Anchor	RB32FAIPSG	3	792	873	3 heat-treated ReidBar break without incipient crushing of the concrete as defined in ISO 15698.1:2012	Holmes Solutions 139628.00 RP 0222 [V1.0]

* The specimen that achieved 737MPa failed in a section of the bar away from the affected zone, in a ductile manner, and is thought to have achieved less than 750MPa due to the intrinsic variation in the heat-treatment process.

Note 1: The above Ultimate Tensile test was conducted in accordance with ISO 15698.2:2012.

Note 2: In accordance with ISO 15698.1 CI 5.5 Table 2, the samples tested cover the geometry in the entire ReidBar range RB12 to RB32.

ReidBar Reinforcing Bar System

Performances: Ultimate Tensile Strength
According to NZS3101:2006 A3 & AS/NZS 4671
NZTA Bridge Manual 3rd Edition A4

Annex C7

**Table C8: Mode of Failure – CI 8.6.11.1, 8.6.11.2, 8.6.11.3 NZS 3101:2006 A3
CI 4.2.1 (f) (i) NZTA Bridge Manual 3rd Edition A4**

Sample	Part No.	No. (of Samples Tested)	In accordance with ISO 15698-1:2012 cl. 7.3.2 (Category B3) & ISO 15698-2:2012 cl. 6.2				Mode of Failure	Test report reference(s)
			UTS [MPa]		Bar type used -&- 0.95 R _{M,act}			
			UTS _(min)	UTS _(max)				
ReidBar Steel iPort Flange Anchors								
12mm iPort Fl. Anchor	RB12FAIPS	3	646.6	651.0	Upper 50%-ile -&- 640MPa	3 ReidBar ductile failure away from affected zone	Holmes Solutions 139628.00 RP 0222 [V1.0]	
12mm iPort Fl. Anchor	RB12FAIPS	3	655.0	661.0	Lower 50%-ile -&- 630MPa	3 ReidBar ductile failure away from affected zone	Holmes Solutions 139628.00 RP 022	
16mm iPort Fl. Anchor	RBA16FAIPS	3	685.8	689.0	Upper 50%-ile -&- 648MPa	3 ReidBar ductile failure away from affected zone	Holmes Solutions 139628.00 RP 0222 [V1.0]	
16mm iPort Fl. Anchor	RBA16FAIPS	3	650.2	661.2	Lower 50%-ile -&- 622MPa	3 ReidBar ductile failure away from affected zone	Holmes Solutions 139628.00 RP 0222 [V1.0]	
20mm iPort Fl. Anchor	RB20FAIPS	3	1052.7	1209.4	Heat treated -&- 1046MPa	3 ReidBar ductile failure away from affected zone	Holmes Solutions 139628.00 RP 0222 [V1.0]	
20mm iPort Fl. Anchor	RB20FAIPS	3	657.5	660.7	Lower 50%-ile -&- 629MPa	3 ReidBar ductile failure away from affected zone	Holmes Solutions 139628.00 RP 0222 [V1.0]	
25mm iPort Fl. Anchor	RB25FAIPS	3	667.8	678.5	Upper 50%-ile -&- 645MPa	3 ReidBar ductile failure away from affected zone	Holmes Solutions 139628.00 RP 0222 [V1.0]	
25mm iPort Fl. Anchor	RB25FAIPS	3	662.1	668.9	Lower 50%-ile -&- 631MPa	3 ReidBar ductile failure away from affected zone	Holmes Solutions 139628.00 RP 0222 [V1.0]	
32mm iPort Fl. Anchor	RB32FAIPS	3	662.3	668.1	Upper 50%-ile -&- 640MPa	3 ReidBar ductile failure away from affected zone	Holmes Solutions 139628.00 RP 0222 [V1.0]	
32mm iPort Fl. Anchor	RB32FAIPS	3	660.4	669.9	Lower 50%-ile -&- 632MPa	3 ReidBar ductile failure away from affected zone	Holmes Solutions 139628.00 RP 0222 [V1.0]	

ReidBar Reinforcing Bar System

Performances: Mode of Failure
According to NZS3101:2006 A3 & AS/NZS 4671
NZTA Bridge Manual 3rd Edition A4

Annex C8

Table C9: Resistance to brittle fracture – CI 8.6.11.4 NZS 3101:2006 A3
 CI 4.2.1 (f) (iv) NZTA Bridge Manual 3rd Edition A4

Sample	Part No.	No. (of Samples Tested)	Criteria assessed		Test report reference(s)
			Energy Absorbed at 0°C (Average)	Comments	
			[J]		
ReidBar Steel Flange Nuts					
32mm Steel Flange Nuts	RB32FNSG	3	65	10x10 samples	X-Ray Lab 9606B1

ReidBar Reinforcing Bar System	Annex C9
Performances: Resistance to Brittle Fracture According to NZS3101:2006 A3 & AS/NZS 4671 NZTA Bridge Manual 3 rd Edition A4	