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Fire resistance of FIRECRUNCH X-FIRE-10 wall system when tested in accordance with AS 1530.4-2014

Assessment Report

Author: Keith Nicholls

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Client: FireCrunch Australasia Pty Ltd

Inquiries should be addressed to:

Fire Testing and Assessments	Author	The Client
NATA Registered Laboratory 14 Julius Avenue North Ryde, NSW 2113	Infrastructure Technologies 14 Julius Avenue North Ryde, NSW 2113 Telephone +61 2 9490 5450	FireCrunch Australasia Pty Ltd Suite 19, Level 44, MLC Centre 19 Martin Place, Sydney NSW 2000 Telephone +61 1300 795 774

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Keith Nicholls	Jing Xu	Keith Nicholls
		
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Contents

1 Introduction

This report is an assessment of fire resistance of FIRECRUNCH X-FIRE-10 wall system when tested in accordance with AS 1530.4-2014.

This report is prepared for meeting the evidence of suitability requirements of NCC 2022 Volume 1 Clauses S1C2 (b) and (c) and NCC 2019 Volume 1 Amdt 1 Schedule 5 clause 2 (b) and (c) as appropriate for FRL.

This report reviews and confirms the extent to which the reference fire resistance tests listed in section 2 meet the requirements of the standard fire test standards listed in section 4 of the report. The proposed variations to the tested construction presented in section 3 are subject to an analysis in Appendix B and the conclusions are presented in Section 5 of this report.

The field of applicability of the results of this assessment report is presented in Section 6 and subject to the requirements, validity and limitations of Sections 7, 8 and 9.

2 Supporting Data

This assessment report refers to various test reports to support the analysis and conclusions of this report. They are listed below in Table 1.

Table 1 – Referenced Tests

Report Reference	Test Standard	Outline of Test Specimen
FSV 2122	AS 1530.4 -2014	Fire resistance test on a load bearing framed wall system without horizontal butt joint.

The test report FSV 2122 was undertaken by CSIRO North Ryde and sponsored by FireCrunch Australasia Pty Ltd.

The test identified above is confirmed by this Accredited Testing Laboratory to be equivalent or more severe than a Standard Fire Test in accordance with the test standard specified in Section 4 of this report when applied to the specimen as identified above.

3 Proposed Variations

The proposed construction comprises the framed wall system as tested in FSV 2122 when tested in accordance with AS 1530.4 -2014 section 3 and with the following variations

- The replacement of the tested two layers of Fletcher Insulation MW 450 mineral wool insulation slabs with a stated density of 64 kg/m^3 with two layers of mineral wool insulation slabs with density of at least 75 kg/m^3.
- The wall cavity insulation is installed as a single piece to completely fill the cavity in wall studs without through joints or gaps between the mineral wool insulation slabs.
- Increase vertical joint from tested 3mm width to 3mm - 6mm width as per Figure 1
  - Sheet joints backed with stud and fixed to stud with 8g x 25mm bugle head drywall screws at max. 200mm centres, and 15mm from sheet edges
  - Gap filled to full depth with Promaseal A Acrylic sealant, taped and set using setting compound as the tested vertical joints
- Inclusion of 3mm - 6mm horizontal butt joint as per Figure 1
  - Sheet joints backed with stud and fixed to stud with 8g x 25mm bugle head drywall screws at max. 200mm centres, and 15mm from sheet edges
    Gap filled to full depth with Promaseal A Acrylic sealant, taped and set using setting compound as the tested vertical joints

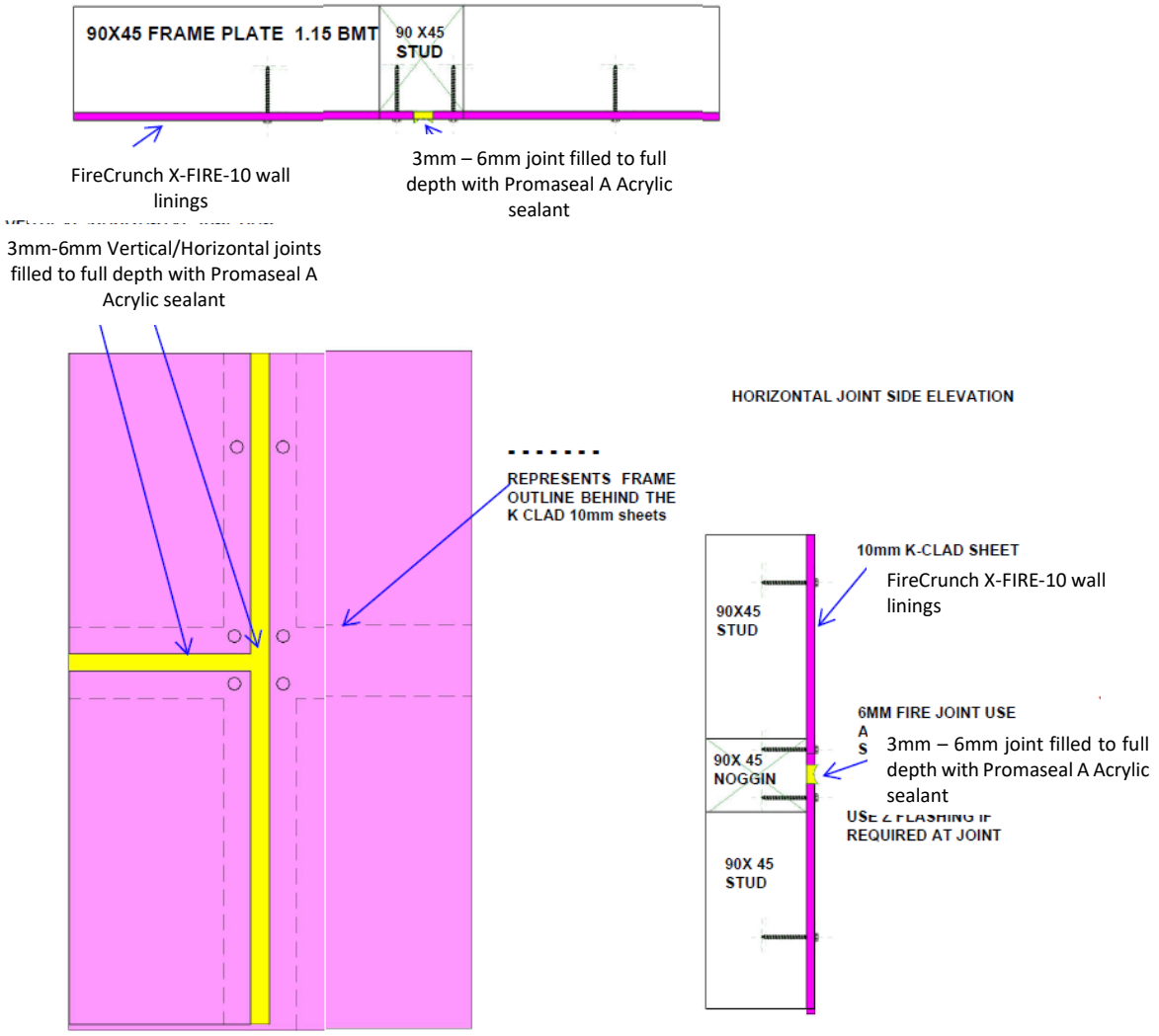

Figure 1: Board joint detail (FireCrunch X-FIRE-10 wall lining on the other side of stud not shown for clarify)

4 Referenced Standards

Standards:

AS 1530.4-2014	Methods for fire tests on building materials, components, and structures Part 3: Fire resistance tests of elements of building construction. As appropriate for load bearing wall elements.

5 Conclusion

On the basis of the analysis presented in this report, it is the opinion of this Accredited Testing Laboratory that the tested prototypes described in Section 2 when varied as described in Section 3 will achieve the Fire Resistance stated below when submitted to a standard fire test in accordance with the test methods referenced in Section 4 and subject to the requirements of section 7, the validity of section 8 and limitation of section 9.

90/90/90 (Load on wall ≤ 18.3 kN/m)

6 Direct Field of Application of Results

The results of this assessment apply to walls exposed to fire from each side.

7 Requirements

Any variations with respect to size, constructional details, loads, stresses, edge or end conditions that are other than those identified in this report, may invalidate the conclusions drawn in this report.

8 Term of Validity

This assessment report will lapse on 31st May 2029. Should you wish us to re-examine this report with a view to the possible extension of its term of validity, would you please apply to us three to four months before the date of expiry. This Division reserves the right at any time to amend or withdraw this assessment in the light of new knowledge.

9 Limitations

The conclusions of this assessment report may be used to directly assess the fire resistance performance under such conditions, but it should be recognised that a single test method will not provide a full assessment of the fire hazard under all fire conditions.

Because of the nature of fire resistance testing, and the consequent difficulty in quantifying the uncertainty of measurement, it is not possible to provide a stated degree of accuracy. The inherent variability in test procedures, materials and methods of construction, and installation may lead to variations in performance between elements of similar construction.

This assessment report does not provide an endorsement by CSIRO of the actual products supplied to industry. The referenced assessment can therefore only relate to the actual prototype test specimens, testing conditions and methodology described in the supporting data, and does not imply any performance abilities of construction of subsequent manufacture.

This assessment is based on information and experience available at the time of preparation. The published procedures for the conduct of tests and the assessment of test results are the subject of constant review and improvement and it is recommended that this report is reviewed on or, before, the stated expiry date.

The information contained in this assessment report shall not be used for the assessment of variations other than those stated in the conclusions above. The assessment is valid provided no modifications are made to the systems detailed in this report. All details of construction should be consistent with the requirements stated in the relevant test reports and all referenced documents.

Appendix A Supporting Test Data

A.1. CSIRO REPORT FSV 2122

On the 21 September 2015 this Division conducted a full-scale fire-resistance test on load-bearing steel-framed wall system, lined on both sides with one layer of 10mm thick product stated by the manufacturer to be identical to FireCrunch X-FIRE-10. The specimen comprised a load-bearing framed wall system with overall nominal dimensions measuring 3000mm high x 3000mm wide x 110mm thick.

The steel wall frame comprised eleven (11) 90mm x 45mm x 1.0mm BMT steel studs fixed into top and bottom steel tracks with nominal dimensions of 90mm x 45mm x 1.0mm BMT steel. The steel studs were spaced at nominal 300mm centres, with two back to back (double) studs used at 600mm centres to correspond with each of the FireCrunch MBE-10 board product stated by the manufacturer to be identical to FireCrunch X-FIRE-10 joints, as shown in drawing numbered 2, undated, by FireCrunch Australia Pty Limited.

Steel noggings, with nom. dimensions 90mm x 45mm x 1.0mm BMT were screw fixed between the wall studs at 1000mm vertical centres. The back to back (double) studs were first sealed at the joining faces using PROMASEAL A acrylic sealant prior to being screw fixed together using 12-14 x 20mm long hex head Tek screws at 400mm centres. The remainder of the steel wall framing was screwed together using 10 gauge x 25mm long steel screws.

The steel wall framing was lined on each face with a single layer of 10mm thick product stated by the manufacturer to be identical to FireCrunch X-FIRE-10 orientated vertically. The sheets measured nominally 1200mm wide x 3000mm long x 10mm thick, with stated density of 950 kg/m3.

Prior to the wall boards being screw fixed to the wall studs, a nom. 10mm wide x 3mm deep bead of PROMASEAL A acrylic sealant was applied to the flanges of the tracks and studs and left to cure overnight. The FireCrunch MBE-10 boards (Product stated by the manufacturer to be identical to X-FIRE-10) were then screwed to the wall studs using 8-gauge x 25mm long bugle head drywall screws at 200mm centres, through pre-drilled holes 15mm from the board edges. All board joints were offset by 600mm. A nominal 3mm gap was left between all board joints which were later sealed to the full board depth using PROMASEAL A acrylic sealant, and then taped and set using a setting compound.

The wall cavity was filled with two layers of Fletcher Insulation mineral wool insulation batts. The batts had a stated density of 64 kg/m3 and measured 1200mm in length x 900mm in width. One layer of 50mm thick batts was laid against the exposed boards while the 40mm thick batts were laid against the unexposed boards. Insulation strips were cut to fit within the metal studs.

A total load of 55 kN was applied to the specimen for the duration of the test.

The wall system failed with respect to insulation when the maximum temperature rise criterion of 180K was exceeded at 89 minutes on the unexposed face of the wall lining over a wall stud. The wall system maintained structural adequacy and integrity for 98 minutes at which time the test was terminated.

Figure A1: Unexposed face of test specimen detailing external face thermocouple locations

A.2. RELEVANCE OF TEST DATA TO AS 1530.4-2014

General

The fire resistance tests FSV 2122 was conducted in accordance with AS 1530.4-2005. This standard differs from AS 1530.4-2014 and the significance of these differences relevant to Section 3 for wall is discussed below.

Temperature regime

The furnace heating regime and the parameters outlining the accuracy of control of the furnace temperature in AS 1530.4-2005 is the same as of that in AS 1530.4-2014.

Furnace pressure

The furnace pressure conditions for in AS 1530.4-2005 and AS 1530.4-2014 are the same.

Specimen mounting

Both AS 1530.4-2005 and AS 1530.4-2014 requires framed wall systems

> "Where sheets are vertically installed, there shall be at least two vertical joints and one horizontal joint in the specimen, if these are intended to be used in practice."

With reference to the wall specimen in FSV 2122, it was confirmed that the linings of the framed wall system wall vertically installed with two vertical joints, but it did not include a horizontal joint as required by both AS 1530.4-2005 and AS 1530.4-2014 standards. Therefore, the tested system is only applicable to walls without any horizontal joints.

Specimen thermocouple arrangements

The specimen thermocouple arrangements for the referenced tests are not appreciably different between AS 1530.4-2005 and AS 1530.4-2014.

Criteria for failure

The criteria for the referenced tests are not appreciably different between AS 1530.4-2005 and AS 1530.4-2014.

Conclusion

Based on the above discussion, the test identified above is confirmed by this Accredited Testing Laboratory to be equivalent or more severe than a Standard Fire Test in accordance with the test standard specified in Section 4 of this report when applied to the specimen identified above without horizontal joints in sheeting.

Appendix B Analysis of Variations

B.1 Variations to wall construction

The proposed construction comprises the framed wall system as tested in FSV 2122 when tested in accordance with AS 1530.4 -2014 section 3 and with the following variations

- The replacement of the tested two layers of Fletcher Insulation MW 450 mineral wool insulation slabs with a stated density of 64 kg/m^3 with two layers of mineral wool insulation slabs with density of at least 75 kg/m^3.
- The wall cavity insulation is installed as a single piece to completely fill the cavity in wall studs without through joints or gaps between the mineral wool insulation slabs.
- Increase vertical joint from tested 3mm width to 3mm - 6mm width as per Figure 1
    - Sheet joints backed with stud and fixed to stud with 8g x 25mm bugle head drywall screws at max. 200mm centres, and 15mm from sheet edges
    - Gap filled to full depth with Promaseal A Acrylic sealant, taped and set using setting compound as the tested vertical joints
- Inclusion of 3mm - 6mm horizontal butt joint as per Figure 1
    - Sheet joints backed with stud and fixed to stud with 8g x 25mm bugle head drywall screws at max. 200mm centres, and 15mm from sheet edges
    - Gap filled to full depth with Promaseal A Acrylic sealant, taped and set using setting compound as the tested vertical joints

Variation to mineral wool density and installation

The proposed construction comprises the framed wall system as tested in FSV 2122 with the following variations:

- The replacement of the tested two layers of Fletcher Insulation MW 450 mineral wool insulation slabs with a stated density of 64 kg/m^3 with two layers of mineral wool insulation slabs with density of at least 75 kg/m^3.
- The wall cavity insulation is installed as a single piece to completely fill the cavity in wall studs without through joints or gaps between the mineral wool insulation slabs.

With reference to FSV 2122, the tested prototype wall system comprised steel stud and noggin wall framing (90mm x 45mm x 1.0mm BMT steel studs at 300mm centres) lined with 10mm thick product stated by the manufacturer to be identical to FireCrunch X-FIRE-10 wall linings. The wall system incorporated Fletcher Insulation (MW 450) mineral wool slabs with a density of 64 kg/m^3 within the wall cavity.

The fire performance of the full scale loadbearing wall system has been reported in FSV 2122 , where the tested system maintained structural adequacy and integrity for the 98 minute duration of the test. The maximum temperature rise insulation failure criterion of 180K was exceeded at 89 minutes on the unexposed face of the specimen.

The insulation failure at this time was isolated to a single thermocouple (T/C 24 – Appendix A Figure A1) positioned on the unexposed face of the wall lining over a wall stud which exceeded 203^{o}C at 89 minutes. The ambient temperature on the day of the test was 21^{o}C. After 95 minutes of testing a maximum temperature of 202^{o}C was recorded adjacent to a board joint on the unexposed face of the wall system (T/C 21 - Figure A1), 6 minutes after the first recorded failure.

The average temperature recorded on the unexposed face of the FireCrunch X-FIRE-10 wall lining at the time of insulation failure measured 97^{o}C and the maximum temperature measured at the head of the specimen was 146^{o}C. Both of these recorded temperatures are below the average and maximum temperature rise failure criterion.

During construction of the test specimen the mineral wool slabs were installed in two layers, a 50mm thick slab layer and a 40mm thick slab layer installed back to back, used to fill the 90mm deep wall cavity. An additional strip of 90mm thick insulation material was cut to size and used to infill the steel stud frame sections (Figure B1).

The insulation installation method resulted in a through vertical joint between the mineral wool slabs at the intersection of the insulation strip used within the stud profile and insulation slabs (40mm and 50mm thick slabs) installed within the wall cavity (Figure B2).

Figure B1 – 90mm thick strip of mineral wool insulation inserted within stud profile.

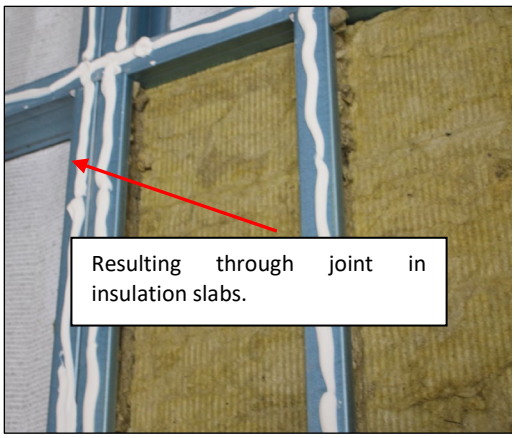

Figure B2 – Vertical through joint in insulation slabs at intersection of 90mm thick insulation strip in wall studs and 40mm/50mm slabs used in wall cavity.

The fire performance of the wall system is dependent on the exposed wall linings as well as the wall cavity insulation, which both contribute to delay the temperature rise of the wall framing and therefore the subsequent rise in temperature on the unexposed face of the specimen.

The presence of any through gap in the wall cavity insulation will allow the flow of hot furnace gases into the wall cavity when the exposed wall lining boards crack or the exposed board joints open up due to shrinkage and/or wall deflections.

It is expected that when the insulation slabs are installed as a single piece without through joints, the hot furnace gas will be hindered. It is also expected that an increase in the density of mineral insulation used within the wall cavity will also provide additional insulation which will provide further protection to the wall cavity, allowing the unexposed side of the wall to maintain insulation performance for at least one minute greater than that tested,

Based on the above, it is expected that the proposed construction will be able to maintain structural adequacy, integrity and insulation for up to 90 minutes when tested in accordance with AS 1530.3 – 2014.

Variations to joints and inclusion of horizontal butt Joints

The proposed construction comprises the framed wall system as tested in FSV 2122 with the following variations:

- Increase vertical joint from tested 3mm width to 3mm - 6mm width as per Figure 1
  - Sheet joints backed with stud and fixed to stud with 8g x 25mm bugle head drywall screws at max. 200mm centres, and 15mm from sheet edges
  - Gap filled to full depth with Promaseal A Acrylic sealant, taped and set using setting compound as the tested vertical joints
- Inclusion of 3mm - 6mm horizontal butt joint as per Figure 1
  - Sheet joints backed with stud and fixed to stud with 8g x 25mm bugle head drywall screws at max. 200mm centres, and 15mm from sheet edges
  - Gap filled to full depth with Promaseal A Acrylic sealant, taped and set using setting compound as the tested vertical joints

With reference to FSV 2122, the tested prototype wall system comprised steel stud and noggin wall framing (90mm x 45mm x 1.0mm BMT steel studs at 300mm centres) lined with 10mm thick product stated by the manufacturer to be identical to FireCrunch X-FIRE-10 wall linings. The frame was faced on each side of the studs with one layer of 10mm thick X-FIRE-10 orientated vertically. The sheets were nominally 1200mm wide x 3000mm long x 10mm thick, with stated density of 950 kg/m^3.

Before the boards were fixed onto the frame, a 3mm x 10mm bead of PROMASEAL A acrylic sealant was applied to the flanges of both tracks and studs and allowed to set overnight. The boards were then secured to the studs with 8-gauge x 25mm long bugle head drywall screws at 200mm centres, through pre-drilled holes, 15mm from the board edges. The board joints were offset by 600mm.

During the test it was observed that the cracks had developed in the plaster along both board joints at 44 minutes into the test which opened to approximately 4mm wide gap at 82 minutes. This joint however did not show any signs of integrity failure for at the 98 minutes duration of the test.

The proposed construction comprises increase in width of vertical joint ranging from 3mm to 6mm. The minor increase in joint size will have increase amount of sealant in the joint and will be backed by stud which will provide a physical barrier to prevent forming of gap or flaming at this location. With 8 minutes margin in integrity performance at the joint, it is expected the proposed joint will maintain integrity for up to 90 minutes.

The proposed construction also comprises inclusion of 3mm to 6mm horizontal butt joints being treated with the same method as vertical joints with the same stud backing, same screw fixing and fixing centres as well as the same sealant width and depth. Therefore, a similar behaviour is expected for the proposed horizontal joint. It is considered this method of fixing and reinforcing of the horizontal joint will not introduce an integrity or insulation weakness before 90 minutes

Based on the above, it is expected that the proposed construction will be able to maintain structural adequacy, integrity, and insulation for up to 90 minutes when tested in accordance with AS 1530.4 – 2014.

CONTACT US

t 1300 363 400
+61 3 9545 2176
e enquiries@csiro.au
w www.csiro.au

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FOR FURTHER INFORMATION

Infrastructure Technologies
Keith Nicholls
Group Leader, Fire Testing and Assessments
t +61 2 94905450
e keith.nicholls@csiro.au
w https://research.csiro.au/infratech/fire-safety/fire-testing/

Infrastructure Technologies
Jing Xu
Senior Consultant, Fire Assessments
t +61 2 9490 8041
e jing.xu@csiro.au
w https://research.csiro.au/infratech/fire-safety/fire-testing/