

Likely performance of a TVC40 Maxi doorset incorporating laminate facings and fire seals

Assessment Report

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Executive summary

Based on the test data and other factors discussed in this report, it is the opinion of this Division that the Firecore TVC40 doorset incorporating a 1.0-mm thick laminate door shield (also known as Pyroex HPL Laminate, Duropal HPL Laminate, Decorative HPL Laminate and Lamco HPL Laminate) as detailed in CSIRO test reports FSV 1642 and FSV 1643, incorporating either rebated or retro-fit perimeter door seal as described in the table below, would achieve fire-resistance levels (FRL) of -/240/30 if tested in accordance with AS 1530.4-2005 or BS 476 parts 20 & 22.

Seal Manufacturer	Seal model	Type
Kilargo	KG4004 (HP4002), KG4002TF (HP4002TF)	Retro-fit intumescent perimeter seal
Kilargo	KP2004 (LP2004), KP2004AS (LP2004AS), KP2004DS (LP2004DS)	Rebated intumescent perimeter seal
Lorient	LDPU	Retro-fit intumescent perimeter upgrade seal
Lorient	LP2004, LP2004AS and LP2004DS	Rebated intumescent perimeter seal
Trafalgar	PUS37	Retro-fit intumescent perimeter seal

Likely performance of a TVC40 Maxi doorset incorporating laminate facings and fire seals

1 Introduction

This report provides the assessment of this Division on the likely performance of a Firecore TVC40 Maxi single leaf doorset incorporating a laminate facing and fitted with perimeter seals, if tested in accordance with AS1530.4-2005 and BS476 Parts 20 & 22-1987.

This Division has conducted several tests on TVC40 and TVC30 doorsets. The data from those tests is used to support the variations covered in this assessment report.

2 Supporting Data

Several fire-resistance and fire tests have been conducted on TVC40 and TVC 30 doorsets. These reports are described in Appendix A.

3 Proposal

You have proposed to incorporate perimeter fire door seals (both retro-fitted or rebated seals) with your tested TVC40 Maxi doorset faced with a laminate door shield as reported in CSIRO test reports FSV 1642 and FSV 1643, to achieve FRL -/240/30 if tested in accordance with AS 1530.4-2005 or BS 476 Parts 20 and 22-1987.

4 Analysis

The fire performance of a TVC40 Maxi single leaf side hung doorset faced with a laminate door shield has been reported in CSIRO test reports FSV 1642 (AS 1530.4-2005) and FSV 1643 (BS 476 Parts 20 & 22).

The tested door measured nominally 2100-mm high x 900-mm wide x 48-mm thick and comprised internally of a nominally 39-mm thick TVC40 core panel faced on both sides, firstly with nominally 3.6-mm thick untreated plywood bonded to the core with PVA adhesive. The door leaf was then faced on both sides with a 1.0-mm thick Laminate Door Shield,. The external facing was bonded to the plywood with contact adhesive.

Test observations revealed that a red glow was visible at the top lock stile edge of the door leaf after 68 minutes of testing. At 69 minutes a cotton pad test was applied over the red glow and the integrity of the doorset was reported as failed at this time due to flaming of the cotton pad.

The doorset failed the insulation criterion after 70 minutes when the average temperature rise on the unexposed face of the door leaf exceeded 140K (Insulation lost at 69 minutes in terms of BS476.20-1987).

The laminate external facing was observed to delaminate from the door leaf after 90 minutes and had fallen from the unexposed face of the door leaf after 102 minutes of testing. No other instances of integrity loss due to excessive gaps or sustained flaming were observed in relation the door leaf for the 241 minute duration of the test.

Fire-resistance testing of TVC30 and TVC40 doorsets incorporating either rebated intumescent perimeter fire seals fitted to the door leaf or frame, or alternately, retro-fitted intumescent perimeter fire seals adhered to the door frame have been conducted by this Division (Appendix A).

The installation of perimeter fire seals has demonstrated the integrity performance of these seals for periods of up to 240 minutes, as shown in table 1 below.

Seal Manufacturer	Seal model	Type	FRL	Report reference
Kilargo	KG4004 (HP4002), KG4002TF (HP4002TF)	Retro-fit intumescent perimeter upgrade seal	-/240/30	FSV 1354, FCO-2960 and FSP 1192
Kilargo	KP2004 (LP2004), KP2004AS (LP2004AS), KP2004DS (LP2004DS)	Rebated intumescent perimeter seal	-/240/30	FSP 1350, FSV 1194 and FCO-2960
Lorient	LDPU	Retro-fit intumescent perimeter upgrade seal	-/240/30	FSV 1630
Lorient	LP2004, LP2004AS and LP2004DS	Rebated intumescent perimeter seal	-/240/30	FSV 1630
Trafalgar	PUS37	Retro-fit intumescent perimeter upgrade seal	-/240/30	FSP 1403

Table 1: Perimeter fire seals tested on TVC30 and TVC40 doorsets.

During the fire-resistance test reported in CSIRO test report FSV 1642, a gap was observed between the door leaf and frame after a period of 68 minutes, with the integrity of the doorset being assessed by the application of a cotton pad at 69 minutes. The cotton pad used to assess the integrity of the doorset is applied over any small gaps which may be fluing hot gases between the edge of the door leaf and the door frame. The test standards prevent the use of the cotton pad for uninsulated elements as radiant heat from the specimen may contribute to unpiloted ignition of the cotton pad.

Full scale and pilot scale fire testing of TVC 30 and TVC 40 doorsets incorporating intumescent perimeter seals (Appendix A) have demonstrated that no observable gaps formed between the door leaf and the door frame for these duration of the tests. These doorsets incorporated intumescent perimeter seals either rebated in the door edge or door frame, or were retro-fitted to the door frame. As no gaps were observed to form between the door leaf and the door frame, the integrity of the doorset was maintained and therefore application of the cotton pad was not applicable.

It is expected that the inclusion of either rebated perimeter fire seals or retro-fitted fire seals as shown in table 1, fitted to the prototype doorset reported in CSIRO test reports FSV 1642 (AS 1530.4-2005) and FSV 1643 (BS 476 Parts 20 & 22) would achieve fire resistance levels of (FRL) of -/240/30.

5 Conclusion

Based on the test data and other factors discussed in this report, it is the opinion of this Division that the Firecore TVC40 doorset incorporating a 1.0-mm thick laminate door shield (also known as Pyroex HPL Laminate, Duropal HPL Laminate, Decorative HPL Laminate and Lamco HPL Laminate) as detailed in CSIRO test reports FSV 1642 and FSV 1643, incorporating either rebated or retro-fit perimeter door seals as described in the table below, would achieve fire-resistance levels (FRL) of -/240/30 if tested in accordance with AS 1530.4-2005 or BS 476 parts 20 & 22.

Seal Manufacturer	Seal model	Type
Kilargo	KG4004 (HP4002), KG4002TF (HP4002TF)	Retro-fit intumescent perimeter seal
Kilargo	KP2004 (LP2004), KP2004AS (LP2004AS), KP2004DS (LP2004DS)	Rebated intumescent perimeter seal
Lorient	LDPU	Retro-fit intumescent perimeter upgrade seal
Lorient	LP2004, LP2004AS and LP2004DS	Rebated intumescent perimeter seal
Trafalgar	PUS37	Retro-fit intumescent perimeter seal

6 Term of validity

This assessment report will lapse on 31 October 2019. 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.

Appendix A - Supporting Data

A.1 CSIRO reports numbered FSV1642 and 1643

On 29 April 2014 this Division conducted a fire-resistance test on two single leaf TVC40 side hung doorsets installed in a 230-mm thick masonry wall in accordance with AS1530.4-2005 and BS476:1987. Test data relating to doorset A only is used as supporting data for this assessment.

The door frame was fabricated from 1.4-mm thick zincanneal steel with double 50-mm x 25-mm rebates, a 38-mm architrave and a 112-mm opening for brickwork. The door frame was prepared with three 100-mm x 75-mm x 2.5-mm loose pin zincanneal steel bolt hinges which were slotted through the architrave face and welded to the back of the frame behind the door seat rebate. The door frame had an overall reveal height of 2110-mm and a reveal width of 904-mm. The door frame was built into the brickwork, with wire ties at nominal 400-mm centres and back filled with mortar.

Both door leaves measured nominally 2100-mm high x 900-mm wide x 48-mm thick, comprised internally a nominally 39-mm thick TVC40-core panel faced on both sides firstly with nominally 3.6-mm thick untreated plywood followed by an external facing. The plywood was bonded to the core with PVA adhesive.

The door core was reinforced at hardware fixing points with 0.6-mm perforated steel channel reinforcing plates, however at the lockset position, 0.6-mm thick perforated aluminium channel reinforcing plate was used. Additional steel strips, 300-mm x 28-mm x 1.2-mm thick were fitted between the hinge reinforcing channels and the core edge. Timber edge strips nominally 10-mm thick, were glued to perimeter edges of the core leaf with contact adhesive.

Doorset A was faced on both sides with 1.0-mm thick Laminate Door Shield, also known as Pyroex HPL Laminate, Duropal HPL Laminate, Decorative HPL Laminate and Lamco HPL Laminate. The external facing was bonded to the plywood with contact adhesive.

Test observations revealed that a red glow was visible at the top lock stile edge of Door A after 68 minutes. At 69 minutes a cotton pad test was applied over the red glow and integrity of the doorset was reported as failed at is time due to flaming of the cotton pad. Doorset A failed the insulation criterion after 70 minutes when the average temperature rise on the unexposed face of the door leaf exceeded 140K (Insulation lost at 69 minutes in terms of BS476.20-1987).

The laminate external facing on doorset A was observed to delaminate after 90 minutes, and had fallen from the unexposed face of the door leaf after 102 minutes of testing. No other instances of integrity loss due to gaps or sustained flaming were observed for the 241 minute duration of the test.

A.2 CSIRO reports numbered FSV1354 and FSV1355

On 27 April 2009 this Division conducted a fire-resistance test on TVC40 plywood faced, double-leaf, double-acting doorset fitted into a steel frame and mounted into a 230-mm thick masonry wall in accordance with AS1530.4-2005 and BS476:1987.

The door leaves, each measured nominally 2100-mm high x 895-mm wide x 49-mm thick, comprised internally a nominally 39-mm thick TVC40-core panel faced on both sides with a nominally 3.6-mm thick flame-retardant treated plywood. The plywood skins were bonded to the cores with PVA adhesive. Each core, along the top and bottom, at the pivot and floor spring positions, was routed to accommodate 300-mm long x 15-mm wide x 40-mm high timber reinforcing strips. High density (nominally 900 kg/m³) TVC-Core strips, nominally 35-mm wide x 39-mm high were glued to the top and bottom of each of the door cores. The cores were reinforced at hardware fixing points with

0.6-mm perforated steel channel reinforcing plates. Edge strips nominally 10-mm thick, were glued to the side edges of the core leaves with contact adhesive.

Lorient FDMS-BB bullnose aluminium meeting stiles incorporating intumescent seals (LP3004AS) were fitted to both side edges of each of the door leaves. Lorient LP3004AS intumescent seals were recessed centrally into a 30-mm wide x 4-mm deep groove along the top of each of the door leaves.

The door frame was fabricated from 1.4-mm thick zincanneal steel. The frame section had a flat face along the head, and a concave face along the stiles, with a 40-mm architrave and a 112-mm throat opening for brickwork. The head of the door frame incorporated two cut-outs to accommodate top pivot assemblies. The door frame had an overall reveal height of 2113-mm and a reveal width of 1804-mm. The door frame was built into double-leaf brickwork, with wire ties at nominal 400-mm centre and back filled with mortar. The two floor spring closer assemblies were recessed and grouted with mortar into a masonry sill.

Lorient HP4002 intumescent seals, nominally 38-mm wide x 1.6-mm thick, were self-adhered along the centre of the head and both stiles of the frame.

The system, as tested, failed integrity at 57 minutes due to sustained flaming longer than 10 seconds from one of the spring closers. Insulation was lost at 61 minutes due the average temperature rise limit of 140 K being exceeded (Insulation lost at 57 minutes in terms of BS476.20-1987).

A.3 CSIRO assessment report numbered FCO-2757

This Division concluded in FCO-2757 that the TVC40 Maxi double-leaf double-action fire doorset as tested on 27 April 2009 and reported in FSV1534 & FSV1535 incorporating Lockwood 8840 Series top pivot and floor spring closer or incorporating an alternative closer that has previously or subsequently been approved for use with the doorset would be capable of achieving fire-resistance levels of -/240/60 if tested in accordance with AS 1530.4-2005, and integrity of 240 minutes and insulation of 61 minutes if tested in accordance with BS476:22-1987.

A.4 CSIRO assessment report numbered FCO-2960

This Division concluded in FCO-2960 that TVC 30 and TVC 40 doorsets when incorporating various Kilargo seals achieve fire-resistance levels (FRL) of -120/30 when fitted to TVC30 mini doorsets and -/240/30 when fitted to TVC40 Maxi doorsets.

A.5 CSIRO report numbered FSV 1194

On 2 May 2006 this Division conducted a fire-resistance test on a TVC40 core single leaf plywood faced door in a timber frame (doorset A) and a TVC30 core single leaf moulded MDF faced door in a steel frame (doorset B) in accordance with AS1530.4-2005. Test data relating to doorset A is used as supporting data for this assessment.

Door leaf A measured nominally 2058-mm high x 821-mm wide x 47-mm thick. The leaf comprised a nominally 39-mm thick TVC40 core panel faced on both sides with a 3.6-mm thick plywood facing. The plywood facings were bonded to the TVC40 core with PVA adhesive. The TVC40 core was reinforced at the hinge, closer and lockset fixing points with 0.6-mm thick perforated steel channel plates. Additional 1.2-mm thick x 300-mm long x 38-mm wide hinge backing plates were located at the hinge positions.

Door leaf A was hung in a timber door frame constructed using 120-mm wide x 30-mm thick hardwood timber stiles and head sections retrofitted using 10-mm diameter x 100-mm long countersunk head masonry anchors at 300-mm centres inside an opening in the 230-mm thick brick wall. A hardwood timber section 70-mm deep x 30-mm wide was used to form a door stop providing

a single rebate 30-mm wide x 50-mm deep as shown on drawing FC8823/3, dated 2 May 2006, by Firecore Pty Ltd. The timber door frame provided an overall reveal height of 2070-mm and reveal width of 825-mm. The door frame was fitted with 60-mm wide x 12-mm thick hardwood timber architraves fitted to the unexposed face of the timber frame. A 20-mm wide x 4-mm deep rebate housed Lorient LP2004AS fire and smoke seals on both jambs and the head of the door frame. The door frame was fitted with three 100-mm x 100-mm x 2.5-mm loose pin steel butt hinges rebated and screw fixed into the door frame hinge stile.

Doorset A failed the insulation criterion after 60 minutes of testing due to the average temperature rise on the unexposed face of the door leaf exceeding 140 K and failed the integrity criterion after a period of 70 minutes when sustained flaming in excess of 10 seconds was observed due to closer oil at the bottom of the door leaf.

A.6 CSIRO report numbered FSP 1192

On 9 February 2006 this Division conducted a fire test on a 39-mm thick TVC40 refractory core panel, of similar construction to the fire-rated doorset described in our Sponsored Investigation Report FSV 0939. The specimen incorporated a Kilargo HP4002 perimeter upgrade seal, fixed to the door frame stop on the exposed hinge stile and half the width of the head using self adhesive tape backing. The seal measured 40-mm in width x 1.6-mm in thickness, and was made from intumescent material housed in a PVC top hat section. The gap between the hinge stile, head and the door frame was stated to be 8-mm. A Lorient HP4002TF perimeter upgrade seal (High Performance Intumescent) was fixed to the door frame stop on the exposed lock stile and half the width of the head using self adhesive tape backing. The seal measured 40-mm in width x 1.6-mm in thickness, and was made from intumescent material housed in a PVC top hat section, and included two smoke fins. The gap between the hinge stile, head and the door frame was stated to be 8-mm.

A.7 CSIRO report numbered FSV 1630

The specimens consisted of four single-leaf side-hung pilot sized doorsets built into a masonry wall. The doorsets were tested opening into the furnace with the door closers fitted to the unexposed faces of the leaves. Test data relating to doorset specimen 2 is used to support this assessment.

The door frame was fabricated from 1.1-mm thick zincanneal steel. The frame section had double 40-mm x 25-mm rebates, a 38mm architrave and a 230-mm opening for brickwork. prepared with two (2-off) 100-mm x 75-mm x 2.5-mm loose pin zincanneal steel butt hinges which were slotted through the architrave face and welded to the back of the frames behind the door seat rebate. The door frames had an overall reveal height of 844-mm and a reveal width of 824-mm. The door frames were built into the brickwork, with wire ties at nominal 400-mm centre and back filled with mortar.

The door leaves, approximately 831-mm high x 818-mm wide x 37-mm thick, comprised a 29.5-mm (nominal) thick TVC30-core panel faced on both sides with 3.6-mm thick plywood. The plywood was bonded to the core with PVA adhesive. The core was reinforced at the lock fixing point with a 0.6-mm perforated aluminium channel lock reinforcing plate and at the closer & hinges fixing points with 0.6-mm perforated steel channel closer & hinges reinforcing plates. Additional steel strips, 300-mm x 28-mm x 1.2-mm thick were fitted between the hinge reinforcing channels and the core edge. Edge strips nominally 10-mm thick, were glued to perimeter edges of the core leaves with contact adhesive.

The door leaves were hung on two 100-mm x 75-mm x 2.5-mm loose pin zincanneal steel butt hinges, one side welded to the frame, the other side fixed to the door leaves' edge through two 300-mm long x 75-mm wide x 0.6-mm thick perforated steel channel hinge reinforcing plates and two 300-mm x 28-mm x 1.2-mm thick hinge backing steel strips with four 50-mm x 10-mm gauge counter sunk Phillips lead screws per hinge.

The specimen incorporated Lorient a LDPU perimeter seal measuring 40-mm x 2-mm self adhered into the corner of the door frame rebate protecting an oversized clearance of 7-mm between the edge of the door and the frame on the lock stile and half length along the head. A Lorient LP2004DS seal measuring 20-mm x 4-mm was recessed into the edge strip of the door leaf on the hinge stile and along the remaining half length of the head.

The performance of the perimeter seals was reported by this Division in assessment FCO-3064. The LP2004DS rebated door seal and the LDPU seal was reported to maintain the FRL -/240/30 of the TVC40 doorset. The LDPU seal was tested protecting a 7-mm gap between the door frame and the door leaf.

A.8 CSIRO report numbered FSP 1403

On 19 April 2010 this Division conducted a fire test on a 29.5-mm thick TVC30 refractory core panel, of similar construction to the fire-rated doorsets described in our Sponsored Investigation Report FSV 1382. The door leaf was hung in a metal door frame fabricated from 1.1-mm thick zincanneal steel with a reveal size 844-mm high x 824-mm wide. The frame section incorporated double 40-mm x 25-mm rebates, a 38-mm architrave and a 230-mm wide throat and bricked into a specimen containing frame. The door leaf was fitted to the door frame with oversized clearances of 5-mm, along the head and both stiles.

The door was fitted with Trafalgar PUS37 perimeter upgrade seals measuring 37-mm in width x 2-mm thickness; self adhered to the door frame rebates along the head and both stiles. The seal consisted of an intumescent material encased in a PVC extruded protective covering for adhesion to the door frame rebate. The PU37 perimeter upgrade seal was reported to maintain the FRL -/240/30 of the doorset.

References

The following informative documents are referred to in this Report:

AS

1530.4-2005 Methods for fire tests on building materials, components and structures Part 4: Fire-resistance tests of elements of building construction.

BS

476:Part 22:1987 Fire tests on building materials and structures Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction.

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FSV 1642 & FSV1643 Full-scale fire-resistance test on a single leaf side hung TVC40 core doorset.

FSV 1354 & 1355 Full-scale fire-resistance test on a double leaf double acting doorset.

FSV 1194 Full-scale fire-resistance test on tow single leaf doorsets.

FSV 1192 Pilot-scale fire-resistance test for alternative hardware.

FSV 1630 Pilot-scale fire-resistance test for alternative hardware.

FSP 1403 Pilot-scale fire-resistance test for alternative hardware.

FCO-2757 Assessment report TVC40 doorset installed incorporating alternative hardware.

FCO-2960 Fire performance of doorsets incorporating various Kilargo seals.

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