

The fire resistance of Hilti CP 648-E Firestop Wraps protecting plastic pipes in a slab in accordance with AS 1530.4 – 2014 and AS 4072.1 – 2005 Amdt. 1

Assessment Report

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1 Introduction

This report is an assessment of the fire resistance of Hilti CP 648-E Firestop Wraps protecting plastic pipes in a slab in accordance with AS 1530.4 – 2014 and AS 4072.1 – 2005 Amdt. 1.

This report supersedes previous versions.

This report is prepared for the purpose of meeting the requirements of NCC Volume 1 Schedule 5 Clause 2(c) as appropriate for FRL.

This report reviews and confirms the extent to which the reference tests listed in Section 2 meet the requirements of the 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 Section 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;

Report Reference	Test Standard	Outline of Test Specimen
FSH 1028	AS 1530.4 -1997	Fire resistance test of various penetrations in slab protected with Hilti products.

The test FSH 1028 was undertaken by CSIRO North Ryde and sponsored by Hilti (Aust.) Pty Ltd. Permission has been given for the use of these reports for this assessment.

3 Proposed Variations

The proposed construction comprises pipes tested in FSH 1028 and subjected to the following variation

- Confirm the performance of CP 648 E Firestop wrap as tested in FSH 1028 in accordance with AS 1530.4 - 2014
- The inclusion of 50mm PVC pipe with 1 layer of CP 648 E Firestop wrap
- The inclusion of min.150mm and 165mm thick slab
- The inclusion of CP 636 mortar and standard sand and cement mortar as fillings for gaps between pipe and slab
- The proposed construction is as shown in Tables 1 and 2, and Figures 1-3

Table 1: Proposed pipe construction in slab

Nominal Pipe Diameter (mm)	Nominal Pipe Wall Thickness (mm)	Diameter of Opening in Slab (Do) (mm)	Figure
40	2.0	62	1
50	2.2	77	1
65	2.7	87	1
80	2.9	112	2
100 PVC Sandwich type construction	3.2	152	2
150	4.5	225	3

Table 2: Table of components

Component number	Name	Detail
1	Concrete slab	<p>For 180 minutes application</p> <p>Minimum 150mm slab that has been tested, assessed or designed to achieve the required FRL</p> <p>For 240 minutes application</p> <p>Minimum 165mm slab that has been tested, assessed or designed to achieve the required FRL</p>
2	PVC pipe	See Table 1
3	CP 648-E	As tested in FSH 1028
4	Mortar	CP 636 mortar or standard sand and cement mortar

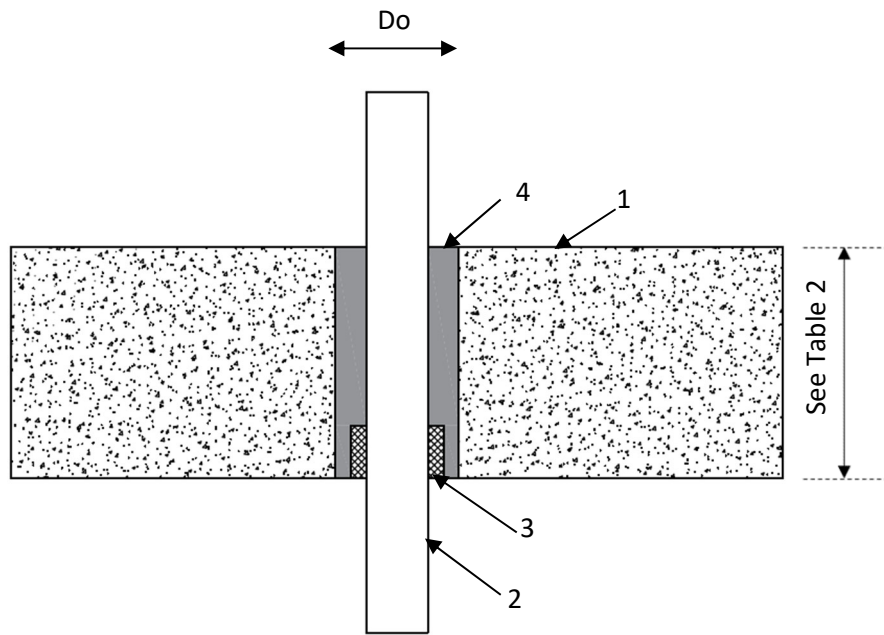


Figure 1: 40, 50 and 65mm pipe with 1 layer of CP 648-E wrap

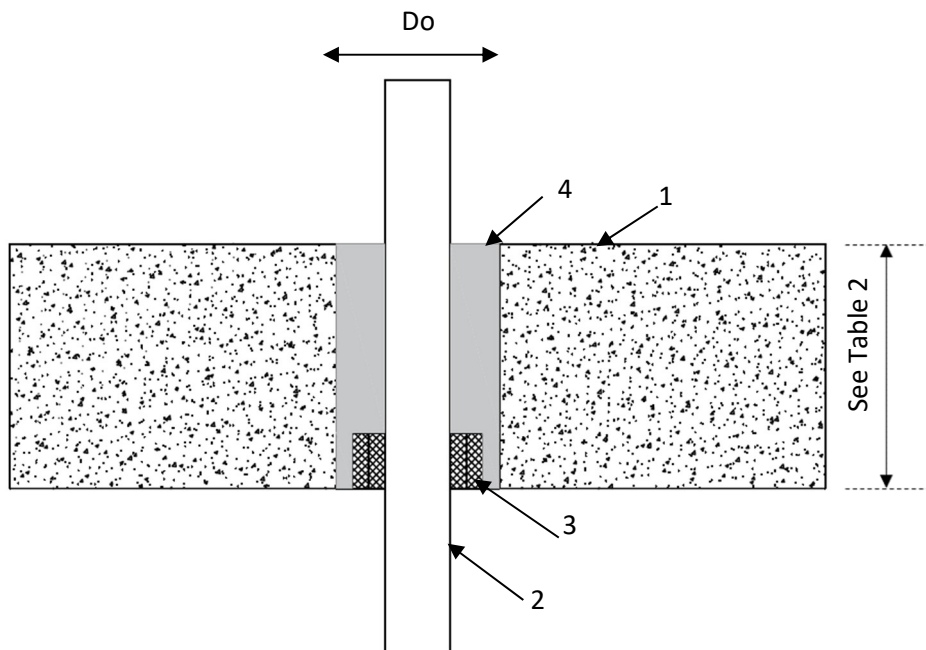


Figure 2: 80 and 100mm pipe with 2 layers of CP 648-E wrap

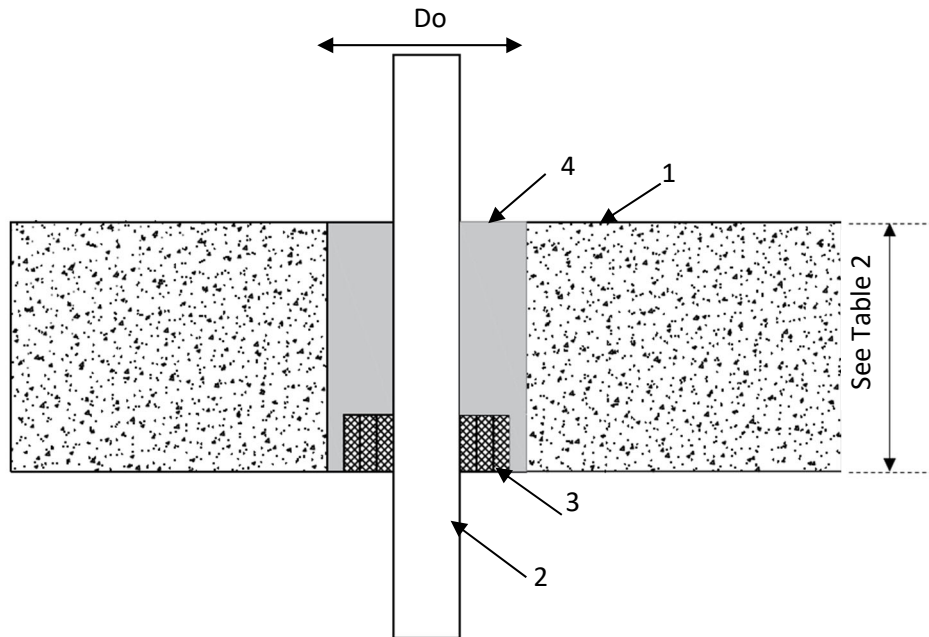


Figure 3: 150mm pipe with 3 layers of CP 648-E wrap

4 Referenced Standards

Standards:

AS 1530.4 – 2014

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

AS 4072.1 – 2005 Amdt. 1

Components for the protection of openings in fire-resistant separating elements, Part 1: Service penetrations and control joints.

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 performance below when submitted to a 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.

Table 2: FRL of PVC pipes penetrating a Min. 165mm thick concrete slab

Nominal Pipe Diameter (mm)	Figure and Table	FRL
40	Figure 1 Table 2 and 3	-/240/240
50		-/240/240
65		-/240/240
80	Figure 2 Table 2 and 3	-/240/240
100 PVC Sandwich type construction	Table 2 and 3	-/120/120
150	Figure 3 Table 2 and 3	-/90/90

Table 3: FRL of PVC pipes penetrating a Min. 150mm thick concrete slab

Nominal Pipe Diameter (mm)	Figure and Table	FRL
40	Figure 1 Table 2 and 3	-/180/180
50		-/180/180
65		-/180/180
80	Figure 2 Table 2 and 3	-/180/180
100 PVC Sandwich type construction		-/120/120
150	Figure 3 Table 2 and 3	-/90/90

6 Direct Field of Application of Results

The results of this assessment apply to penetrations in floors when exposed to fire from below.

7 Requirements

It is required the systems described above be fitted to a floor construction that has been tested, assessed or designed to achieve the required FRL.

Any variations concerning 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 March 2026. 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 the 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 constructions 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 Sponsored Investigation report numbered FSV 1028

On 10 January 2004, this Division conducted a full-scale fire-resistance test in accordance with AS 1530.4-1997 and AS 4072.1-1992 on a 150-mm thick concrete slab system incorporating twenty-six pipe penetrations. Only specimens 18-22 are relevant for this assessment report.

All of the pipes extended into the furnace by 100 mm and extended out by at least 2000 mm on the unexposed face of the slab. The pipes were supported at points 500 mm and 1500 mm from the unexposed face of the slab.

Table A1: Specimens 18-22 construction and performance

Specimen designation	Pipe Material	Pipe Diameter (mm)	Pipe Wall Thickness (mm)	Slab Width (mm)	Protection	The mortar between pipe and slab	Integrity (minutes)	Insulation (minutes)
18	PVC	40	2.0	150	CP 648-E (1 layer)	CP 636 mortar	240 (NF)	240 (NF)
19	PVC	65	2.7	150	CP 648-E (1 layer)	Standard grade mortar	240 (NF)	240 (NF)
20	PVC	80	2.9	150	CP 648-E (2 layers)	CP 636 mortar	240 (NF)	240 (NF)
21	PVC Sandwich type construction	100	3.2	150	CP 648-E (2 layers)	Standard grade mortar	162	162
22	PVC	150	4.5	150	CP 648-E (3 layers)	CP 636 mortar	93	92

A.2 Applicability of AS 1530.4 – 1997 test data to AS 1530.4 -2014

The referenced fire resistance test FSV 1028 was conducted in accordance with AS 1530.4– 1997, which differs from AS 1530.4–2014. These variations and their potential effect on the fire resistance performance of the referenced test specimen are discussed below.

Furnace Temperature Regime

The specified specimen heating rate in AS 1530.4–1997 is given by:

$$T_t - T_0 = 345 \log(8t + 1)$$

Where;

T_t = Furnace temperature at time t , in degrees Celsius.

T_0 = Initial furnace temperature, in degrees Celsius, not less than 10°C nor more than 40°C.

t = Time into the test, measured from the ignition of the furnace, in minutes.

The furnace heating regime in fire resistance tests conducted in accordance with AS 1530.4–2014 follows the same trend as that in AS 1530.4–1997.

Furnace Thermocouples

The furnace thermocouples specified in AS 1530.4-2014 are type K, mineral insulated metal sheathed (MIMS) with a stainless steel sheath having a wire diameter less than 1.0mm and an overall diameter of 3mm. The measuring junction protrudes a minimum of 25mm from the supporting heat resistant tube.

The furnace thermocouple specified in AS 1530.4–1997 is the same as that of AS 1530.4-2014.

Furnace Pressure

It is a requirement of AS 1530.4-2014 that for horizontal elements, the furnace shall be operated such that a pressure of 20Pa is established at a position 100 mm below the underside of the test specimen above that of the laboratory atmosphere. It is a requirement of AS 1530.4-1997 is the same.

Specimen mounting

The mounting of specimens differs slightly between AS 1530.4-2014 and AS 1530.4-1997.

AS 1530.4-1997 requires PVC pipe penetration to be mounted such that it protrudes no less than 2000mm away from the furnace and no less than 100mm into the furnace.

AS 1530.4-2014 requires penetration services to be installed so that it projects a minimum of 500 mm on the fireside, of which at least 200 mm shall extend beyond the extremities of the penetration sealing system. The non-fire side pipe length shall be a minimum of 2000mm.

The specimens 18-22 in FSV 1028 protruded 2000mm away from the furnace and 100mm into the furnace and had 100mm specimen extended beyond the extremities of the penetration sealing system on the fireside.

Even though the pipe was shorter than the prescribed length of pipe for protruding into the furnace, it is expected that the PVC plastic pipe's low melting point would result in the pipe melting off early in the test such that the length of protrusion would have minimal impact on the specimen performance.

Specimen Thermocouples

The Specimen Thermocouples positions differ slightly between AS 1530.4-2014 and AS 1530.4-1997. The difference would not have affected the outcome of the test if tested in accordance with AS 1530.4-2014.

Integrity Criteria

The integrity criteria differ slightly between AS 1530.4-2014 and AS 1530.4-1997. For AS 1530.4-2014 the penetration shall be deemed to have failed the integrity when;

- a) Flaming occurs or
- b) when a 6mm x 150mm gap gauge can pass through the specimen.
- c) Failed cotton pad

The integrity criteria for AS 1530.4-1997 deems a penetration to have failed integrity if a crack or fissure opens during the test that allows the passage of hot gases or flames.

In FSH 1028, specimen 18, 19 and 20 did not form any cracks or fissures at the penetration seal, the differences in these criteria are therefore not significant.

In FSH 1028, specimens 21 and 22 failed integrity with vision into the furnace at 162 minutes and 93 minutes. The criteria of vision into the furnace is a more onerous criterion than that of cotton pad ignition. Therefore it is expected that specimens 21 and 22 would have maintained integrity for at least 120 and 90 minutes even when a cotton pad is available.

Insulation Criteria

The insulation criteria differ slightly between AS 1530.4-2014 and AS 1530.4-1997. For AS 1530.4-2014, the penetration shall be deemed to have failed the insulation when the thermocouple located on the specimen or the separating element exceeds the initial temperature by more than 180° K.

The insulation criteria specified in AS 1530.4-1997 is the same as that of AS 1530.4-2014.

Application of Test Data

Based on the discussion above, it is concluded that the results obtained from the referenced fire resistance tests conducted in accordance with AS 1530.4-1997 can be applied to an assessment of the integrity performance of the PVC pipe penetrations tested in FSH 1028 if tested in accordance with AS 1530.4-2014.

Appendix B Analysis of Variations

B.1 Variation to pipe and mortar

The proposed construction comprises pipes tested in FSH 1028 and subjected to the following variation

- The inclusion of 50mm PVC pipe with CP 648 E Firestop wrap
 - The inclusion of 150mm and 165mm thick slab
 - The inclusion of CP 636 mortar and standard mortar as fillings for gaps between pipe and slab
- The proposed construction is as shown in Tables 1 and 2, and Figures 1-3

It is required the systems described above be fitted to a floor construction that has been tested, assessed or designed to achieve the required FRL.

With reference to FSH 1028, the 150mm thick slab was penetrated by 40, 65, 80 and 150mm PVC pipes and 100mm PVC sandwich type construction and protected with one, two or three layers of CP 648-E wrap. The construction and performance of these specimens are as shown in Table A1.

The proposed variation comprises a 50mm diameter PVC pipe with a wall thickness of 2.2mm protected with 1 layer of CP 648-E wrap.

It is observed that 1 layer of CP 648-E wrap was sufficient to close the 40mm and the 65mm pipe in a 150mm thick slab such that the pipes maintained insulation and integrity for up to 240 minutes without signs of failure. The 40mm pipe was closed by the wrap at 5 minutes while the 65mm pipe was closed by the wrap at 9 minutes. It is expected that the 50mm pipe, with a wall thickness between that of the 40mm pipe and the 65mm pipe, would be closed off by the wrap between 5 -9 minutes and also be able to insulation and integrity for up to 240 minutes.

The proposed variation comprises the application of CP 636 mortar and standard mortar between the pipe as fillings for gaps between pipe and slab.

It is observed in FSH 1028 specimen 19-22 that integrity and insulation failure, when occurred, were not associated with the mortar used in the specimen. Specimen 18, 19 and 20 also demonstrated that both mortar types were able to maintain integrity and insulation for up to 240 minutes without failure.

The proposed variation comprises the increase of the slab thickness from 150mm to 165mm. It is expected that this increase in the slab thickness would not detrimentally affect the performance of the pipe since the CP 648-E is exposed to fire on the fireside and so be exposed to the same furnace severity as when installed in a 150mm slab.

Confidence in the ability of concrete slab to perform for the required FRL is offered by reference to NZS 3101.1-2006 Section 4, where the required slab thicknesses by that standard are the same as those proposed for the given FRL.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation as shown in Table B2 and B3 when tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1 -2005 Amdt. 1.

Table B2: FRL of PVC pipes penetrating a Min. 165mm thick concrete slab

Nominal Pipe Diameter (mm)	Figure and Table	FRL
40	Figure 1 Table 2 and 3	-/240/240
50		-/240/240
65		-/240/240
80	Figure 2	-/240/240
100 PVC Sandwich type construction	Table 2 and 3	-/120/120
150	Figure 3 Table 2 and 3	-/90/90

Table B3: FRL of PVC pipes penetrating a Min. 150mm thick concrete slab

Nominal Pipe Diameter (mm)	Figure and Table	FRL
40	Figure 1 Table 2 and 3	-/180/180
50		-/180/180
65		-/180/180
80	Figure 2 Table 2 and 3	-/180/180
100 PVC Sandwich type construction		-/120/120
150	Figure 3 Table 2 and 3	-/90/90

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