



# PENETRATION SEALS

**A penetration seal is needed for any hole or gap in fire resistance rated walls and floors to maintain their fire resistance rating (FRR). Penetration seals are system-specific, so selecting the correct one may be more involved than you thought.**

By **Ed Soja**, BRANZ Fire Safety Engineer

**P**enetration seals, or 'fire stops' as defined in New Zealand Building Code Compliance Document C/AS1, are an integral part of the function of a fire resistance rated wall or floor. The purpose of penetration seals is to return any holes and gaps, made by construction features or services penetrating walls and floors, to the same fire resistance rating as the rest of the wall or floor. This includes all penetrations and sizes, anywhere a fire could create an opening through a fire resistance rated wall or floor, for example, control joints, pipes and cables (electrical and plumbing services, cable trays pipes and conduits). A 20 mm plastic pipe in a concrete wall would therefore need a proven penetration seal.

Only sealing methods tested or assessed by a competent authority can be guaranteed to provide the appropriate fire resistance rating. Penetration seals themselves have no fire resistance rating, just as a steel stud in a fire resistance rated wall has no fire resistance in its own right. However, the penetration seal used with a particular penetrating service in a particular building element will maintain the fire resistance of that building element.

## Many forms of penetration seals

Penetration seals apply to a specific system, so a penetration seal intended for a concrete or masonry wall may not be suitable in a framed plasterboard lined wall. Equally, they may only suit steel-framed walls or only timber-framed.

There are several forms of penetration seals that may be used.

### MASTICS – INTUMESCENT OR NON-INTUMESCENT

Intumescent mastics swell on heating and fill any holes or spaces around the penetration in a fire. They are used where materials may degrade, such as plastic pipes, or where the heat can cause differential movement between

the building element and penetration. They are commonly used as linear gap seals in movement joints in concrete or masonry walls.

Non-intumescent mastics are used where only small gaps occur, for example, around wall edges, and stop flaming on the non-fire side.

### PILLOWS

Pillows are fabric covered and filled with non-combustible aggregate such as powders and gravel. They are resilient enough to be positioned without leaving gaps and may be used with a mastic to seal around the penetration.



An example of inappropriate packing of the aperture.

### INTUMESCENT STRIPS

These are flexible strips of materials that expand when heated and can be wound round pipes (called wraps) or other services. They have no framework and must be inserted into the thickness of a wall or floor. Another form is used as linear gap seals and may incorporate a flexible foam material that compresses into the gap.

### COLLARS AND FLOOR WASTE SEALS

Collars are steel casings into which intumescent strips are inserted. These are like intumescent strips but allow the seal to be used on the surface of a floor or wall and retain the intumescent material in position. They can also be

precast within the wall where the steel casing acts as shuttering (boxing). Some collars have additional features such as metal vanes or spring-activated closures that enable most positive or faster closing.

Floor waste seals are a special application of the collar, with no pipe extension above the floor. This can make a significant difference in performance.

### BOARDS AND BATTS

These are either solid boards of materials such as calcium silicate or vermiculite, or mineral fibre blankets – sometimes with a fire-retardant coating. They fill in large areas of opening and are used in conjunction with mastics, wraps and collars.

### MORTARS

Special fire mortars are available to fill large areas. Sometimes, ordinary concrete is not suitable to make good an aperture, as shrinkage may cause gaps and cause failure. Fire mortars are designed to provide minimal shrinkage, are lighter than normal concrete and are used with other forms of seal on the penetrating service.

## Service outlets need protection

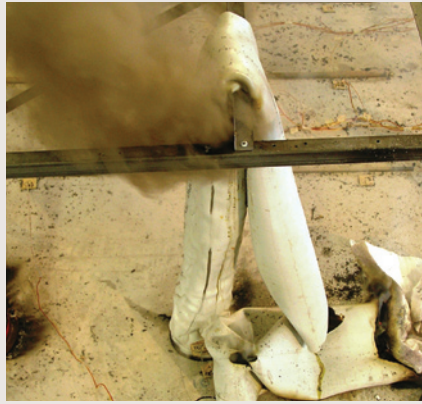
Service outlets, such as electrical sockets and switches, can form a weakness in a fire resistance rated building element and need to be protected with fire resistant materials proven in the specific application. An example is pieces of intumescent material, very like the intumescent strips and wraps discussed above, but cut into small rectangles and inserted at the back of the outlet box. The outlet box needs to be constructed from steel. Inserting materials such as mineral or ceramic wool is no guarantee of performance.

## Building Code requirements

For compliance with the New Zealand Building Code Clause C *Fire safety*, the Acceptable Solution is given in C/AS1 paragraph 6.17 Fire



Waste pipe with no seal.



Pipe collapse during a test, with some cable penetrations visible.

stopping, which specifies the test method in paragraph C7/1 of Appendix C.

Paragraph 6.17 gives a valuable summary of the testing and installation requirements for penetration seals, which includes:

- fire stops and methods of installation shall be identical with those of the prototype used in tests to establish their FRR
- the material selected shall be approved as appropriate for the type and size of the gap or penetration, and for type of material and construction used in the fire separation.

It covers hollow construction and service outlets but, in the end, a test result or assessment based on testing is required to validate the contribution the penetration seal makes in maintaining the fire resistance of the building element.

### Test standards and methods

The appropriate standards for compliance of penetration seals with C/AS1 are AS 4072.1-1992 and AS 1530.4-1997. AS 4072.1-1992 *Components for the protection of openings in fire-resistant separating elements* gives advice on design requirements, testing and assessment of test results and permissible variation to the tested specimen. It is an important document in defining the testing of electrical services. AS 4072.1-1992 is used in conjunction with AS 1530.4-1997 *Methods for fire tests on building materials, components and structures – Fire-resistance tests of elements of building construction*. This defines the heating conditions and failure criteria. The criteria are:

- integrity – being able to see through any part after the test is considered a failure
- insulation – temperature rise on the non-fire exposed face of no more than 180°C above

the temperature at the start of the test. Use of other standards constitute an Alternative Solution. Standards such as BS 476:Part 20 do not apply to penetration seals. Any test using it is an ad hoc test, as it does not give guidance on how to test penetration seals – what to test, where to install thermocouples to determine the insulation rating, lengths of pipe to use and range of cables and pipe diameters.

### Correct installation essential

The correct penetration seal must be selected for the service and type of fire rated wall or floor and installed according to the manufacturer's instructions.

These are some common mistakes and design restrictions to be aware of:

- Avoid oversize holes beyond the seal capability – seal separately, do not fill with inappropriate materials.
- Choose the correct product in framed construction.
- Intumescent wraps are designed to close off a plastic pipe – always use with a casing or they will expand into the cavity and be ineffective.
- Collars, wraps and mastics are designed to be installed either on one side of a service penetration, on both sides or in the centre – read the manufacturer's data for the correct application.
- Linear gap seals may require special backing materials such as a polyethylene rod.
- Mastics are designed to work within a certain thickness range – always install them to the correct depth and within the gap width specified.
- Ensure fixings used on collars are the type and number specified by the manufacturer. ◀

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