PENETRATIONS IN FIRE-RATED PLASTERBOARD

Building services often pass through gypsum plasterboard-lined walls or floor/ceiling assemblies. Current poor practices in the design and construction of these are reducing the fire safety of some buildings.

By Hans Gerlich, Technical Manager Building Systems, Winstone Wallboards Limited

In 2008 the Fire Protection Association of New Zealand (FPANZ), funded by the Building Research Levy, surveyed a group of buildings to assess passive fire protection in practice. This survey identified areas for improvement to the design, installation, inspection and maintenance of passive fire protection in buildings.

Specify fire-rated penetrations in the design

When fire rated penetrations aren't specified in the design, they often become an unfortunate and undesirable afterthought. Walls are constructed and lined, then penetrations need to be formed through them. Alternatively, cable trays, ducts or pipes may have been installed, and walls need to be constructed around them.

Building services subcontractors obviously find it frustrating when fire-rated elements have not been planned for. Conscientious contractors might stop, consult and resolve, while others are likely to just charge ahead and penetrate the offending obstruction.

Resolving and specifying fire-rated penetrations in the design office, not on site, significantly improves results. A good solution is to combine services as much as possible in service shafts. These shafts can be fire rated, eliminating the need for many different and individual penetrations.

Ensure fitness for purpose

A penetration seal must have been tested in the construction type it is to be installed in. Fire test results for penetration seals, such as plastic pipe collars that have been tested in concrete, can not be simply tranferred to other types of construction, such as framed cavity construction lined with gypsum plasterboard.

This sounds obvious and simple, but it's often abused. Although problems associated with transferring results from concrete to plasterboard construction are generally well understood, there is also a more subtle trap that many users and suppliers overlook – plasterboard's loss of strength in a fire.

Plasterboard linings lose strength in fire

Gypsum plasterboard dehydrates when exposed to fire – the technical term is 'calcination'. This is used in the plasterboard manufacturing process by removing water from the crystal structure of mined gypsum to transform it into powdery plaster of Paris. Gypsum plasterboard is then manufactured by rehydrating plaster and casting the slurry between sheets of cardboard paper. Gypsum crystals form, set and bond with the face papers, resulting in a solid composite sheet material. Optional additives give gypsum plasterboard desired properties such as water or fire resistance.

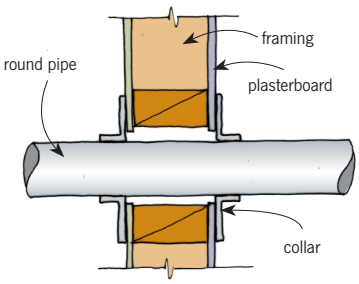
During fire exposure, gypsum alters its chemical composition again and changes from a solid to a powdery consistency. Strength is lost and so is the ability to support items directly fixed to it.

Penetration seal FRR and wall FRR

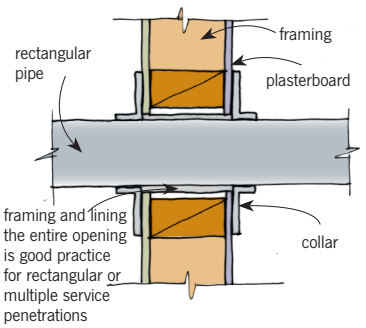
It is essential to check test reports and manufacturers' information carefully to see if penetration seals have been tested in the construction they are being installed in.

Many suppliers of penetration seals in New Zealand rely on overseas or local test data →

Round pipe



Rectangular pipe with entire opening lined



3D view of pipe penetrations and collar

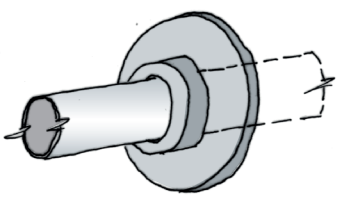


Figure 1: Penetration seal supported by framing.

carried out on gypsum plasterboard assemblies with significantly *greater* fire resistance than that claimed for the penetration seal. For example, a PVC pipe collar may have been directly fixed to and tested in a double- layer gypsum plasterboard assembly with an inherent fire resistance rating (FRR) of, for example, 2 hours. If the PVC pipe collar fails at 30 or 60 minutes, this FRR is then claimed for the penetration seal.

However, when the collar is directly fixed to a gypsum plasterboard assembly with the same FRR as claimed for the penetration, and not to a wall with a much higher fire resistance as tested, premature failure can be expected because the wall lining will be unable to support the weight of the penetration seal for the claimed time of fire resistance.

In other words, the weight of a 30-minute penetration seal directly supported by linings is likely to cause premature failure of a 30-minute gypsum plasterboard assembly.

Support penetrations and seals

Neither the penetrating item or the penetration seal product must rely on the plasterboard linings for support.

Support penetration seals with framing around the aperture (see Figure 1) and not directly by the gypsum plasterboard linings. Installation of additional framing members is often required.

The same philosophy applies to penetrations such as cable trays, bundles of wiring, electrical outlets, ducts, hatches and any plasterboard patches placed around the penetration opening. Always fix to framing or provide independent support immediately adjacent to the fire-rated element, such as metal rod hangers to support a duct and damper from the floor above.

KEY POINTS

1. Specify fire-rated penetrations in the design office, not on site.
2. Combine services in fire-rated service shafts.
3. Check test reports and manufacturers' information carefully – have penetration seals been tested in the construction they are being installed in?
4. Support penetration seals by framing around the aperture. Include a support such as metal rod hangers adjacent to penetrations.
5. Train services site staff to recognise a fire-rated wall.