Make your space, a healthy place.

OUR COMMON FUTURE

MAGNUM™ BOARD – 60/60 FIRE RESISTANCE

Assessment Report

Fire Resistance of a Steel or Timber Framed Magnum Board Lined Wall

Prepared for Health Based Building

By Jason King, Fire Engineer

18 July 2014

1 Scope

This report examines the fire resistance to AS 1530.4-2005 of a steel or timber framed wall lined on each side with nominal 12 mm Magnum magnesium oxide board, and with mineral fibre insulation in the wall cavity. The required fire resistance rating (FRR) is -/60/60.

2 Background

In Southwest Research Institute (SWRI) fire endurance test No. 01.15210.01.101c a 9 foot high x 12 foot wide non-loadbearing steel framed wall was tested in accordance with ASTM E119-08a and achieved a fire resistance for integrity and insulation of 60 minutes with no failure.

The framing comprised nominal 3 ⅝ inch 20 gauge steel studs and tracks. Studs were at 24 inch centres between top and bottom tracks. A horizontal stud section was fixed 1 foot from the bottom of the wall.

The wall cavity was filled with nominal 2 pcf (32 kg/m^3) IIG MinWool Sound Attenuation Fire Batts.

The wall was lined on each face with nominal 12 mm thick Magnum board using 1 ⅝ inch screws at 8 inch centres at the perimeter of each sheet, and at 18 inch centres on the intermediate studs. All sheet joints were formed on framing members, with vertical joints offset between faces of the wall. A horizontal joint was formed on the horizontal framing member on each face of the wall with no offset between faces. The joints were stopped with jointing compound and fibreglass tape. Screw heads were stopped with jointing compound.

The test was conducted on behalf of Magnum Building Products, who have given permission for the report to be used in support of this assessment.

3 Proposed Construction

3.1 Steel Framed Walls

It is proposed to construct non-loadbearing steel framed walls lined with Magnum Board and insulated with mineral fibre insulation as follows.

Framing comprises 92 mm minimum depth x 34 mm minimum width studs and tracks of minimum nominal 1 mm base metal thickness galvanised steel. Studs are to be placed at 600 mm maximum centres between top and bottom tracks, fixed to the tracks with at least 10 gauge steel self-drilling screws. Horizontal members of the same section as the studs are to be located to correspond to horizontal joints in the linings. The horizontal members are to be fixed to the studs at each intersection using at least 10 gauge steel self-drilling screws.

The cavity is to be insulated with mineral fibre insulation of at least 40 kg/m^3 density and at least 89 mm thick, having a fibre melting point at least 1000 °C. Rockwool Rocktech S would be a suitable insulating material.

The wall is to be lined on each side with one layer of nominal 12 mm thick x 1200 mm wide Magnum Board, with the sheets placed vertically. The linings are to be fixed with 40 mm minimum length steel screws at 200 mm maximum centres at the perimeter of each board, and at 450 mm maximum centres on each intermediate stud.

Vertical sheet joints are to be offset on opposite sides of the wall by at least 600 mm. Horizontal joints may be formed on the same steel member. All sheet joints are to be stopped with fibreglass tape and jointing compound. All screw heads are to be stopped with jointing compound.

3.2 Timber Framed Walls

It is proposed to construct non-loadbearing timber framed walls lined with Magnum Board and insulated with mineral fibre insulation as follows.

Framing comprises 94 mm minimum depth x 46 mm minimum width studs and top and bottom plates. Studs are to be placed at 600 mm maximum centres between top and bottom plates. Noggings of the same section as the studs are to be located to correspond to horizontal joints in the linings.

The cavity is to be insulated with mineral fibre insulation of at least 40 kg/m^3 density and at least 89 mm thick, having a fibre melting point at least 1000 °C. Rockwool Rocktech S would be a suitable insulating material.

The wall is to be lined on each side with one layer of nominal 12 mm thick x 1200 mm wide Magnum Board, with the sheets placed vertically. The linings are to be fixed with 40 mm minimum length steel screws at 200 mm maximum centres at the perimeter of each board, and at 450 mm maximum centres on each intermediate stud.

Vertical sheet joints are to be offset on opposite sides of the wall by at least 600 mm. Horizontal joints may be formed on the same nogging. All sheet joints are to be stopped with fibreglass tape and jointing compound. All screw heads are to be stopped with jointing compound.

4 Discussion

4.1 Test Standard

The referenced fire endurance test was conducted in accordance with ASTM E119-08a. This standard differs from AS 1530.4-2005 in a number of respects. The features that differ significantly with respect to the referenced test specimen are identified as follows:

The time temperature curves differ slightly for the two standards during a 1 hour duration test, however each is within the permitted temperature variation tolerances of the other. The minor variation in temperature is not considered significant.

The method of furnace temperature measurement is significantly different, with ASTM E119 requiring fully enclosed Type K thermocouples, where AS 1530.4 requires the thermocouple measuring junction to be fully exposed to the furnace gases. This difference means that there will be a lag in the temperature measured with the enclosed thermocouple compared to the exposed thermocouple, leading to hotter temperatures in the furnace with enclosed thermocouples.

Therefore the exposure temperature of the ASTM E119 test is more severe than AS 1530.4. For the purpose of this assessment the exposure temperature is conservatively taken as being equivalent for the two standards.

The furnace pressure for ASTM E119 is not specified. For the test the pressure was set approximately equal to the laboratory pressure at the top of the specimen. This means there is a negative pressure in the furnace relative to the laboratory over the full height of the specimen. For AS 1530.4 the pressure is set equal to the laboratory pressure at 500 mm above the floor of the furnace, giving a positive relative pressure over the upper section of the specimen.

The higher pressure of AS 1530.4 is more likely to force hot gases through any gaps or openings that may form in the specimen. For this test there were no gaps or openings formed, and therefore the pressure difference is not considered likely to alter the result.

Specimen temperature is measured generally similarly for the two standards, except that for ASTM E119 the thermocouple junctions are covered by larger insulating pads than for AS 1530.4. This will tend to lead to higher temperatures being measured to ASTM E119, and it is therefore conservative to assume that the same temperatures would be recorded to AS 1530.4.

The failure criteria for integrity are similar for the two standards. For insulation ASTM E119 considers failure to occur when the average temperature of the unexposed face rises by more than 139 °C, or the maximum temperature rises by more than 180 °C. For AS 1530.4 the average and maximum limits are 140 and 180 °C respectively.

ASTM E119 requires a partition specimen to be restrained on all edges where AS 1530.4 requires the partition to be fixed at one edge and unrestrained at the other. This is intended to model a wall of unlimited length. As tested the wall was 12 ft (3.66 m) wide which exceeds the minimum 3 m required width. No adverse effects were noted as a result of the increased width. On this basis it is considered that provision of an unrestrained edge as required for AS 1530.4 compliance would not have prejudiced the result of the test at 60 minutes.

ASTM E119 requires a hose stream test to be applied. The hose stream test is not required for AS 1530.4 therefore the result of the hose stream test is not considered for this assessment.

On the basis of the above discussion it is considered that the partition tested in the referenced fire endurance test would have achieved at least equivalent performance if tested in accordance with AS 1530.4-2005.

4.2 Dimensions

The dimensions of the specimen as tested were given in imperial units. Comparisons of relevant dimensions are as follows. In all cases the tested and proposed dimensions are considered sufficiently similar that the test result would not be significantly affected.

Wall overall dimensions were 9 ft x 12 ft = 2.743 m x 3.657 m. The minimum required dimensions for AS 1530.4 are 3.0 m.

The maximum board dimensions are not stated in the test report, but are deduced to be 8 ft x 4 ft (2438 x 1219 mm). The length of the boards is not considered significant to their

performance. The proposed width of 1200 mm is slightly less than the tested board width which is not expected to be detrimental to the performance of the boards.

Steel stud and tracks as tested were of nominal 3 ⅝ inch = 92.1 mm depth. The width of the tested studs and tracks is not recorded in the test report. The difference from the proposed 92 mm minimum dimension is considered negligible. The proposed 34 mm minimum width is sufficient to allow the linings to be screwed to the stud with at least a 12 mm edge clearance, and is therefore considered acceptable.

The 20 gauge steel as tested is approximately 0.95 mm thick. The proposed 1 mm minimum thickness is considered to be equivalent or better than the tested thickness.

Stud are at 24 inch centres = 609.6 mm. The proposed 600 mm spacing is smaller, and therefore not likely to be detrimental to the performance.

Screw spacings are 8 or 18 inches = 203.2 mm or 457.2 mm. The proposed screw spacings are smaller than as tested, therefore unlikely to be detrimental to performance.

The tested screw length was 1 ⅝ inches = 41.275 mm. For fixing linings to steel once the screw thread has engaged in the steel any additional screw length provides no advantage. Therefore the proposed 40 mm screws are considered equivalent to the 1 ⅝ inch screws tested.

4.3 Timber Framing

Timber framing is expected to deform less than steel framing as tested, and therefore the lining boards will be subjected to less stress and are expected to remain in place similarly to those tested.

The mineral fibre insulation is expected to protect the sides of the framing from significant fire attack and the Magnum board will provide substantial protection to the fire side face of the timber. It is expected that the proposed 40 mm screws will retain the board in place for at least 60 minutes.

4.4 Insulation

The wall as tested was insulated with IIG MinWool Sound Attenuation Fire Batts, with a density of 40 kg/m^3 and stated melting point of at least 1093 °C.

It is proposed to replace the IIG MinWool Sound Attenuation Fire Batts with Rockwool Rocktech S mineral fibre slabs, with a density of at least 60 k g/m^3 and melting point approximately 1000 °C, or an equivalent mineral fibre insulation material. It is expected that the proposed mineral fibre, being of higher density and similar composition and thickness, with a melting point higher than the furnace temperature, will provide at least equivalent contribution to the fire resistance of the wall.

5 Opinion

It is our opinion that a steel or timber framed wall lined with nominal 12 mm Magnum board, insulated with Rockwool Rocktech S or equivalent, constructed as described in this report, would achieve a fire resistance of at least 60 minutes for Integrity and Insulation if tested in accordance with AS 1530.4-2005.

6 Limitations

This assessment report may only be quoted or reproduced in full, and is subject to the completeness and accuracy of information provided.

This assessment is issued on the basis of test data and information available at the time of issue. If test evidence contradictory to this assessment becomes available, we reserve the right to withdraw the assessment unconditionally but not retrospectively.

The opinion stated represents our assessment of likely performance, based on our experience and professional judgement in addition to the information provided. This is in line with internationally accepted practice of extrapolation from test results to increase the range of options available. It is recognised that the particular combinations of wall framing, lining and insulation assessed have not been subjected to the standard fire resistance test.

This report prepared by:

Jason King, BE, DipEngFire