APPROVAL REPORT

ZEE-LOCK AND ZEE-LOCK DOUBLE-LOCK STANDING SEAM METAL ROOF SYSTEMS

Prepared For:

BERRIDGE MANUFACTURING CO.
1720 MAURY
HOUSTON, TEXAS 77026

2Y5A1.AM
Class 4471
Date: March 10, 2000

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I INTRODUCTION

1.1 Berridge Manufacturing Company submitted their Zee-Lock and Zee-Lock Double-Lock Panel Systems to determine if they would meet the Factory Mutual Research Standard 4471 (1995) test requirements for Class 1 panel roofs.

1.2 Examination included Factory Mutual Research simulated wind uplift testing, potential for fire spread both below and above the roof panels, foot traffic testing and susceptibility to hail damage testing.

1.3 Test results show that the 24 ga. Berridge Zee-Lock and Zee-Lock Double-Lock Panel Systems meet the Factory Mutual Research Standard 4471 Approval requirements for Class 1 Panel Roofs when installed as described in the CONCLUSIONS of this report.

II MATERIALS TESTED

2.1 The Zee-Lock and Zee-Lock Double-Lock panels are the same panel utilizing two different seaming methods. Each panel is a 24 ga. (min. 0.023 in., 0.6 mm) 16 in. (406 mm) wide panel formed from ASTM A653 Grade 40 galvanized or Galvalume steel sheet with a Kynar 500 coating. The Zee-Lock and Zee-Lock Double-Lock panels are fabricated on site with a Berridge SP-21 or SP-21 X portable rolling mill.

2.2 Berridge Zee rib clips are continuous clips, running the length of the seam and fabricated from ASTM A653 Grade 40 galvanized steel sheet with a weight of 0.38 lbs/ft (0.56 kg/m). The clip is formed and it's shape matches the interface between adjacent panels. The base of the clip is secured to each min. 16 ga (0.060 in., 1.52 mm) thick steel purlin with two Construction Fasteners Inc. Dekfast #12 -1 HWH IMPAX fasteners (S/D Bond Seal) or Atlas 12-14 TCP1 hex head fasteners.

III TESTS: CRITERIA AND PROCEDURES

3.1 Tests conducted were as required by the Factory Mutual Research Standard 4471 for Class 1 Panel Roofs.

3.2 Factory Mutual Research Windstorm Classification Tests

3.2.1 Tests were conducted using the Factory Mutual Research Uplift Pressure Test Apparatus to evaluate the ability of the above deck components of the roofing system to resist a minimum simulated wind uplift pressure of 60 psf (2.9 kPa) without failure of the assemblies.

3.2.2 The simulated wind uplift pressure tests utilized a 24 ft. (7.3 m) long by 12 ft. (3.7 m) wide by 2 in. deep steel pressure vessel arranged to apply air pressure at pre-established standard rates to the underside of the test panel which formed the top of the pressure vessel. The vessel was pressurized with compressed air.

3.2.3 A net pressure of 30 psf (1.4 kPa) was applied to the test sample and maintained for 1 minute. The pressure was increased to 45 psf (2.2 kPa), then to 60 psf (2.9 kPa) and held for 1 minute at each increment. The pressure was increased in increments of 15 psf (0.7 kPa) every minute until failure occurred.

3.3 Factory Mutual Research Calorimeter Fire Test

3.3.1 The fire test from below the roof deck was conducted using the Factory Mutual Research Construction Materials Calorimeter which measures the maximum rate of fuel contribution by the sample roof, also expressed as maximum heat release rate (HRR); e.g, for a Class I rating, the assembly must exhibit a HRR no greater than 410 Btu/ft^2/min (77.6 kW/m^2) in any 3 minute time frame during the 30 minute fire exposure.

3.4 ASTM E108 Spread of Flame Tests

3.4.1 The fire tests from above the roof cover were conducted in accordance with ASTM E108 Spread of Flame Tests.

3.4.2 Sample size was 3-1/3 by 8 ft. (1.0 by 2.4 m).

3.4.3 The wind velocity over the top of the standard panel was adjusted to 12±0.5 mph (5.4±0.2 m/s).

3.4.4 Flame exposure: The flame was adjusted to 1400±50°F (760±10°C). The flame temperature was measured by a thermocouple located 1 in. (25.4 mm) above the surface of the standard panel and ½ in. (13 mm) toward the flame source from the lower edge of the standard panel. The flame was applied to each panel for 10 minutes.

3.4.5 During and after the application of the flame, each panel was observed for the distance of maximum flame spread, glowing brands and other damage.

3.5 Factory Mutual Research Resistance to Foot Traffic Test

3.5.1 The test was conducted using the Factory Mutual Research Resistance to Foot Traffic Test Apparatus to evaluate the ability of the panel roof to resist simulated foot traffic without damage. There must be no puncture of the roof panel or disengagement of the laps.

3.5.2 A 200 lb (91 kg) load which incorporates a 3 in. (76 mm) square steel plate with rounded corners was imposed on the sample. The load was placed in the approximate center of the sample (midspan) and adjacent to the side lap. The load was then removed. This cycle was repeated four additional times. The roof panels were inspected for damage after the last cycle at the steel plate interface.

3.6 Factory Mutual Research Simulated Hail Damage Test

3.6.1 A test was conducted using the Factory Mutual Research Simulated Hail Damage Test Apparatus to evaluate the ability of the roof panel to withstand a hailstorm without damage to the panel. After each drop the sample is inspected and there must be no evidence of splitting, delamination or rupture of the roof panel.

3.6.2 A 1-3/4 in. (49 mm) diameter steel ball weighing 0.78 lbs. (0.3 kg) was dropped on the test sample from a 17 ft 9-1/2 in. (5.4 m) height through a 33-3/4 in. (0.86 m) length of PVC pipe with a 2 in. (51 mm) inside diameter. This procedure was repeated several times on various sections of the sample. After each drop the sample was inspected for damage to the weatherproof membrane. Following initial testing, the sample was conditioned (weathered) for 1000 hours in the Factory Mutual Research Ultraviolet Weatherometer. The initial procedure was then repeated on the conditioned sample.

IV TEST SAMPLES

4.1 Factory Mutual Research Windstorm Classification Test Panels

Two 12 by 24 ft. (3.7 by 7.3 m) panels were constructed. The components and sequence of installation were as follows:

Sample No. 1: Berridge Zee-Lock Panel System consisting of Berridge 16 in. (406 mm) wide panels of 24 gauge Galvalume with a Kynar 500 coating. The panels were secured to Berridge 24 gauge continuous clips fastened to minimum 16 gauge purlins, spaced 5 ft. (1.5 m) o.c., with 2 - Atlas #12 x 14-14 hex head fasteners at each purlin. Adjacent panels were seamed together along side laps with a Berridge electric seaming tool resulting in the Zee-Lock Seam Assembly (90^0 to vertical).

Sample No. 2: Berridge Zee-Lock Double-Lock Panel System consisting of Berridge 16 in. (406 mm) wide panels of 24 gauge Galvalume with a Kynar 500 coating. The panels were secured to Berridge 24 gauge continuous clips fastened to minimum 16 gauge purlins, spaced 5 ft. (1.5 m) o.c., with 2 Construction Fasteners #12 -1 HWH IMPAX fasteners (S/D Bond Seal) at each purlin. Initially, adjacent panels were seamed together along side laps with a Berridge electric seaming tool resulting in the Zee-Lock Seam (90^0 to vertical). The Zee-Lock Seam is again seamed with a second Berridge electric seaming tool to produce the Zee-Lock Double-Lock seam (180^0 to vertical).

4.2 Factory Mutual Research Calorimeter Test Panel

One 4-1/2 by 5 ft. (1.4 by 1.5 m) panel was constructed. The components and sequence of installation were as follows:

6 in. (152 mm) thick vinyl backed glass fiber batt insulation.
Berridge 24 ga. Zee-Lock standing seam roof panel

4.3 ASTM E108 Spread of Flame Test Panels

Two 3-1/3 by 8 ft. (1.0 by 2.4 m) panels were constructed. The components and sequence of installation were as follows:

Sample No. 1 and 2: ½ in. (13 mm) plywood deck
6 in. (152 mm) thick glass fiber bat insulation
24 ga. Berridge Zee-Lock standing seam roof panel with Kynar 500 coating.

4.4 Factory Mutual Research Resistance to Foot Traffic Test Panel

One 4 x 10 ft. (1.2 x 3.0 m) sample was constructed as wind uplift test sample number 1 using three Berridge Zee-Lock standing seam roof panels with clips fastened to wood joists spaced 5 ft (1.5 m) o.c.

4.5 Factory Mutual Research Simulated Hail Damage Test Panel

A 16 in. by 4 ft (406 mm by 1.2 m) sample was constructed from the Zee-Lock panel.

V RESULTS

5.1 Factory Mutual Research Windstorm Classification Tests

5.1.1 Test panel No. 1 described in 4.1 above met the 60 psf (2.9 kPa) minimum Factory Mutual Research requirements for Class I-60 Windstorm Classification.

5.1.2 Test panel No. 2 described in 4.1 above met the 120 psf (5.7 kPa) minimum Factory Mutual Research requirements for Class I-120 Windstorm Classification.

5.2 Factory Mutual Research Calorimeter Fire Test

5.2.1 The calorimeter test showed the test sample to have fuel contribution rates below the maximum permissible rates for Class I construction. These rates and the Class I limits are noted below:

Maximum Average Rate of Fuel Contribution
for Various Time Intervals
Btu/ft^2/min (kW/m^2)

Time Interval	3 min	5 min	10 min	Average
Class I Standard	410(77.6)	390(73.8)	360(68.1)	285(53.0)
Sample No. 1	202(38.2)	181(34.3)	156(29.5)	112(20.8)

5.3 ASTM E108 Spread of Flame Tests

5.3.1 The results of the ASTM E108 Spread of Flame tests were as follows:

Sample No.	Slope	Max. Flame Spread	Rating
1	5"/12" (22.6°)	0 ft 0 in (0 m)	Class A
2	5"/12" (22.6°)	0 ft 0 in (0 m)	Class A

5.3.2 Deck exposure, flying brands and significant lateral flame spread were not observed during the tests.

5.4 Factory Mutual Research Resistance to Foot Traffic Test

No damage to the roof panel sample described in 4.4 above was observed during or after the test.

5.5 Factory Mutual Research Simulated Hail Damage Tests

No damage to the roof panel coating described in 4.5 above was observed after each drop of the simulated hail impactor before or after conditioning (weathering).

VI CONCLUSIONS

6.1 Test results from this program indicate that the Zee-Lock and Zee-Lock Double-Lock standing seam roof systems meet the Factory Mutual Research Standard 4471 (1995) - Class 1 Panel Roofs Approval requirements when installed over minimum 16 ga (0.060 in., 1.52 mm) steel supporting members as summarized below:

6.1.1 1-60 Windstorm Classification: Steel supporting members are max. 5 ft. (1.5 m) o.c. Berridge Zee-Lock panels, 24 ga.(min 0.023 in., 0.6 mm) and 16 in. (406 mm) wide, are secured with Berridge Zee rib clips fastened to each steel roof purlin with two Atlas 12-14 TCP1 hex head fasteners or Construction Fasteners #12 -1 HWH IMPAX fasteners (S/D Bond Seal). Adjacent panels are seamed together along side laps with a Berridge electric seaming tool resulting in the Zee-Lock Seam Assembly (90^0 to vertical).

6.1.2 1-120 Windstorm Classification: Steel supporting members are max. 5 ft. (1.5 m) o.c. Zee-Lock Double-Lock panels, 24 ga. (Min 0.023 in. 0.6 mm) and 16 in. (406 mm) wide, are secured with Berridge Zee rib clips fastened to each steel roof purlin with 2 Construction Fasteners #12 -1 HWH IMPAX fasteners (S/D Bond Seal). Adjacent panels are initially seamed together along side laps with a Berridge electric seaming tool resulting in the Zee-Lock Seam Assembly (90^0 to vertical). The seamed side laps are seamed a second time to approximately 90^0 from horizontal with a Berridge electric seaming tool resulting in the Zee-Lock Double-Lock Seam Assembly (180^0 to vertical).

6.1.3 The above constructions may also include vinyl glass fiber blanket insulation, 3 in. to 6 in. (76 mm to 152 mm) thickness, placed between the roof panels and the supporting members.

6.2 The above constructions meet the requirements for Class 1A Fire Classification when installed at a maximum slope of 5 in. per 12 in. (22.6^0).

6.3 The securement of the roof perimeter and corners shall be enhanced in accordance with FM Global Loss Prevention Data Sheet 1-31.

6.4 This examination shows that the tested roof constructions in and of themselves would not create a need for automatic sprinklers.

6.5 The tested constructions meet the Factory Mutual Research Approval criteria and when Approval is effective will be listed in the Factory Mutual Research Approval Guide.

6.6 Approval is effective when the Approval Agreement is signed and received by Factory Mutual Research.

6.8 Continued Approval will depend upon satisfactory field experience and periodic Quality Audit Inspections.

VII MARKINGS

7.1 The manufacturer shall mark each panel or packing container with the manufacturer's name and product trade name. In addition, the panel or container must be marked with the Factory Mutual Research Approval Mark and the words "Subject to the conditions of Approval as a Class 1 Panel Roof when installed as described in the current edition of the Factory Mutual Research Approval Guide".

7.2 Markings denoting Factory Mutual Research Approval shall be applied by the manufacturer only within and on the premises of manufacturing locations that are under Factory Mutual Research Facilities and Procedures Audit Program.

7.3 The manufacturer agrees that the use of the Factory Mutual Research name or Approval Mark is subject to the conditions and limitation of Factory Mutual Research Approval. Such conditions and limitations must be included in all references to Factory Mutual Research Corporation Approval.

VIII MANUFACTURERS RESPONSIBILITIES

8.1 To assure compliance with his procedures in the field, the manufacturer shall supply the roofer with necessary instructions or assistance required to produce the desired performance achieved in the tests.

8.2 The manufacturer shall notify Factory Mutual Research of any planned change in the Approved product prior to the general sale or distribution using form 797, Approved Product Revision Report.

IX QUALITY AUDIT INSPECTIONS AND RE-EXAMINATION

A re-examination and manufacturing inspection will be conducted periodically on the Approved products at the Berridge Manufacturing Company manufacturing location in Seguin, Texas to determine that the quality and uniformity of the products have been maintained and will provide the same level of performance as originally tested.

TESTS AND REPORT BY:

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REPORT REVIEWED BY:

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