



Project number: 12CA37234

24th August 2012

ASSESSMENT REPORT

Assessment to determine the anticipated fire resistance performance of currently UL classified DFR2 product, if subject to testing in accordance with BS 476: Part 20 (methodology) and EN 1366-4.

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1. Introduction

This report presents an assessment to determine the anticipated fire resistance performance of currently UL classified DFR2 product, if subject to testing in accordance with BS 476: Part 20 (methodology) and EN 1366-4.

The DFR2 joint products are UL Listed – File no R26111, for use in Joint System Nos. FF-D-0075, FF-D-1086, FW-D-0052 and FW-D-1073. The basic standard used to investigate these types of joint systems is ANSI/UL 2079, "Tests for Fire Resistance of Building Joint Systems."

- The respective EN standard is EN 1366-4:2006+A1:2010 Fire resistance tests for service installations. Linear joint seals
- To date there have been no standardized methods within the UK, under national British Standards, for evaluating the contribution of fire stopping and/or penetration sealing systems either via test or assessment. They have therefore been tested by analogy with methods for other separating elements such as the walls and floors within which they are intended to be used. As a result existing test and assessment data is based on ad hoc fire test conditions and is difficult to compare, there being inevitable differences in methodology. The BS 476 series of tests is being withdrawn for use in relation to the EC Construction Products Directive / Regulation, but is still valid for use in other countries which wish to retain the previous data base. Interim rules for acceptance and field of application of this ad-hoc test data are available in the Association for Specialist Fire Protection publication: Fire stopping: Linear joint seals, penetration seals & small cavity barriers.

2. Assumptions

This report provides anticipated performances to the test standards detailed in the conclusion of this report only. Validation is not made of performance to other standards that may be mentioned in other sections of this report, including product descriptions.

The conclusions of this report relate to UL Joint System Nos. FF-D-0075, FF-D-1086, FW-D-0052 and FW-D-1073 as on the date of this report. Subsequent changes to either the product or the UL Joint System details are not covered by this report and shall be subject to additional review.

UL Joint System Nos. FF-D-0075, FF-D-1086, FW-D-0052 and FW-D-1073 as on the date of this report are shown in Appendix 2.

3. Assessment Procedure

This assessment has been conducted following the guidance of the Passive Fire Protection Association (PFPF) Guide to Undertaking Assessment in Lieu of Fire Tests.

4. Evaluation

The DFR2 joint products are UL listed – File no R26111, for use in Joint System Nos. FF-D-0075, FF-D-1086, FW-D-0052 and FW-D-1073. The basic standard used to investigate these joint systems is ANSI/UL 2079, "Tests for Fire Resistance of Building Joint Systems."

The anticipated performance of the assemblies DFR2 product should they be tested in accordance with EN 1366-4:2006+A1:2010 Fire resistance tests for service installations. Linear joint seals.

Performance is to be determined for the currently certificated/listed DFR2 joint product against the requirements of EN 1366-4:2006+A1:2010 Fire resistance tests for service installations. Linear joint seals. The submitted test data (listed in Appendix 1) details testing conducted in accordance ANSI/UL 2079, "Tests for Fire Resistance of Building Joint Systems."

For the purposes of this assessment, each report provided as evidence has been reviewed individually, considering the behavior of the tested specimen during testing and the following aspects of each test standard:

- Pre-test conditioning
- Test conditions
- Test specimen design and construction, including supporting constructions
- Type and application of instrumentation
- Performance criteria – fire, movement
- Results
- Field of application

Review Summary - UL File R26111, Test Record 20090306

The fire endurance test was conducted with the ANSI/UL 2079, Fourth Edition, Tests for Fire Resistance of Building Joint Systems, , dated October 21, 2004 with revision dated June 30, 2008, on product designated as "EMSEAL Fire-rated foam expansion joint DFR2". The product was tested as a Floor-to-Floor joint.

This review concludes that the test methodologies are similar, but with a number of significant variations. The key variations that may significantly affect the anticipated EN 1366-4 performance and the field of application are detailed below:

Test Requirement	UL 2079: Fourth Edition and as tested.	EN 1366-4+A1: 2010	Comments
Pressure conditions	3.7 Pa, 300mm below principle horizontal surface of the test specimen.	Horizontal furnace - 20 Pa, 100mm below lowest point of test construction.	EN more onerous UL 2079 pressure approximates to 5.4 Pa. Further evidence required - see Review Summary Test Record 20090528
Test specimen: Size, No. Splices Orientation	914mm or 10 x joint width. One specimen required. Floor to Floor Tested 64" in length, nominal 4" wide joint (3" min, 5" max.)	Min 900mm and 10:1 ratio. Installed in configuration no. 3 - seal at top of joint (EN1366-4, figure 3). Testing in TYPE A (linear joint in a horizontal test construction) orientation covers for TYPE E (horizontal floor joint abutting a wall)	Installed in configuration no. 3 - seal at top of joint (EN1366-4, figure 3). Limited to this use. TYPE B (similar to Floor-to-Wall) allowed from testing of TYPE A (similar to Floor-to-Floor) configuration.

Test Requirement	UL 2079: Fourth Edition and as tested.	EN 1366-4+A1: 2010	Comments
Movement	100 cycles at 30cpm plus 400 at 10cpm, 3" to 5" (+/- 25%)	Optional. Not required for movement up to 7.5%. 1 - prior to test. Fire test to be conducted on a seal at full movement extent. 2-movement during test	UL test conducted at full extent (5") during fire. Allow +/- 25%.

The floor-to-floor systems constructed as described in the report met the Conditions of Acceptance in the Standard as follows:

1. The joint systems withstood the fire endurance tests for the rating period without permitting the passage of flame through openings, or the occurrence of flaming, on any elements on the unexposed surface of the test assembly.
2. The transmission of heat through the joint system did not raise the temperature of any individual thermocouple on the unexposed surface of the joint system more than 325°F (181°C) above its initial temperature during the rating period. Initial average temperature of the unexposed surface of the sample was 19°C. Therefore, the limiting maximum temperature was 200°C.

The maximum temperature rise recorded on the unexposed face of the joint was 98°C.

Review Summary - UL File R26111, Test Record 20090528

The fire endurance test was conducted with the ANSI/UL 2079, Fourth Edition, Tests for Fire Resistance of Building Joint Systems, , dated October 21, 2004 with revision dated June 30, 2008, on product designated as "EMSEAL Fire-rated foam expansion joint WFR2". The product was tested as a Wall-to-Wall joint.

This review is conducted to provide additional evidence for consideration of the effect of reduced furnace pressure highlighted in the review of Test Record 20090306. Consideration of the anticipated performance of this product against the requirements of alternative test standards has not been conducted.

The WFR2 system is similar in construction to the DFR2 system, other than the intumescent layer is applied of both exposed faces, whereas only the underside face of the DFR2 is coated with intumescent, the upper face being coated with a layer of silicone.

Test Requirement	UL 2079: Fourth Edition and as tested.	EN 1366-4+A1: 2010	Comments
Pressure conditions	>2.5 Pa mid-height of the joint.- required by standard.	Horizontal furnace - 20 Pa, 100mm below lowest point of test construction.	EN more onerous UL 2079 pressure estimated as >9.7 Pa., 100mm below top of specimen
Movement	100 cycles at 30cpm plus 400 at 10cpm, 4.5" to 7.5" (+/- 25%)	Optional. Not required for movement up to 7.5%. 1 - prior to test. Fire test to be conducted on a seal at full movement extent. 2-movement during test	UL test conducted at full extent (7.5")during fire.
Hose stream	210 kPa(30 Psi) hose stream for 150 s, conducted on a duplicate sample after 60 mins fire endurance exposure.	Not required.	UL more onerous.

The wall-to-wall systems constructed as described in the Report met the Conditions of Acceptance in the Standard as follows:

1. The joint systems withstood the fire endurance tests for the rating period without permitting the passage of flame through openings, or the occurrence of flaming, on any elements on the unexposed surface of the test assembly.
2. The transmission of heat through the joint system did not raise the temperature of any individual thermocouple on the unexposed surface of the joint system more than 325 °F (181 °C) above its initial temperature during the rating period. Initial average temperature of the unexposed surface of the sample was 19 °C. Therefore, the limiting maximum temperature was 200 °C.
3. The joint system described in this report maintained its integrity through and after the application of the 210 kPa (30 psi) hose stream

The maximum temperature rise recorded on the unexposed face of the joint was 89°C.

Discussion

The review of UL File R26111, Test Record 20090306 highlighted the following aspects of the testing that may significantly affect the anticipated EN 1366-4 performance.

Pressure conditions:

The pressure within the fire test furnace, with respect to the non-fire side of the barrier element, will determine the direction of leakage through the barrier. Thus, if the test furnace is maintained as an area of relative low pressure, any leakage through the test assembly will be from its non-fire side into the furnace. Conversely, if the furnace is operated at a positive pressure differential, any leakage will occur from the furnace to the non-fire side of the test assembly. This simple relationship can have a substantial impact on the measured fire resistance of joints which develop cracks or other through openings upon exposure to fire.

Both UL 2079 and EN 1366-4 specify positive furnace pressure. The UL 2079 pressure is lower than the EN 1366-4 pressure and it is the anticipated effect of this increased pressure that is discussed here.

Test Record 20090306 specifies the pressure to have been approximately 5.4 Pa at the location that EN 1366-4 would have required a pressure of 20 Pa. Both pressures are positive and would have directed hot gases from the furnace to the non-fire side. Test observations and post-test images show that no cracks or other openings (including discolouration from the passage of hot gases) appeared during the fire test, no shrinkage was observed and that a depth of at least 1" (25%) of the seal foam remained uncharred at the end of the 120 minute fire endurance test. Thermocouples located over the non-fire side of the joint showed a maximum temperature rise of 98°C, indicative of thermal conductivity rather than the passage of hot furnace gases. Based on these observations of the product behaviour and temperature measurements, an increase in furnace pressure from approximately 5.4 Pa to 20 Pa, when subjected to the referenced test methods, would not be considered to significantly affect the performance of this particular joint system.

Additional evidence taken from Test Record 20090306 shows a very similar joint tested at an increased pressure (approx. 10 Pa). Similar behavior of the joint was observed. An actual reduction of the temperature of the non-fire side surface of the joint was recorded (89°C). This joint was tested with a greater width, considered to be more onerous by EN 1366-4. This evidence indicates that minor increased in positive pressure do not significantly reduce the fire resistance performance.

Test Record 20090306 also describes the application of the 'Hose Stream' test. This test was applied to a duplicate joint following 60 minutes fire endurance. The joint system described maintained its integrity through and after the application of the 210 kPa (30 psi) hose stream.

To conclude, an increase in furnace pressure from UL 2079 to EN 1366-4 is not considered to be enough to significantly reduce the fire resistance performance of the particular joint system under review.

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Test specimen Size, No. Splices Orientation:

Test Record 20090306 details a joint installed in what is considered to be configuration no. 3 – seal at top of joint (EN1366-4, figure 3). The scope of EN 1366-4 limits the application of the joint to this configuration.

Movement:

Both UL 2079 and EN 1366-4 specify methods for determining movement characteristics. Movement under EN 1366-4 is not mandatory and joints may be tested without movement for claims less than +/- 7.5%.

If movement greater than +/- 7.5% is required, EN 1366-4 specifies either the fire test to be:

- conducted on a joint cycled prior to the fire test, and fire tested at full extension, or
- cycled during a fire test.

The testing conducted in Test Record 20090306 was cycled prior to testing, and the fire endurance test was conducted with the joint at maximum expansion.

The declared movement capability of the joint under the scope of EN 1366-4 is, therefore +/- 25%.

The anticipated performance of the assemblies DFR2 product should they be tested following the methodology of BS 476: Part 20: 1987 - Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles).

To date there have been no standardized methods within the UK, under British Standards, for evaluating the contribution of fire stopping and/or penetration sealing systems either via test or assessment. They have therefore been tested by analogy with methods for other separating elements such as the walls and floors within which they are intended to be used. As a result existing test and assessment data is based on ad hoc fire test conditions and is difficult to compare, there being inevitable differences in methodology. The BS 476 series of tests is being withdrawn for use in relation to the EC Construction Products Directive / Regulation, but is still valid for use in other countries which wish to retain the previous data base. Interim rules for acceptance and field of application of this ad-hoc test data are available in the Association for Specialist Fire Protection publication: Fire stopping: Linear joint seals, penetration seals & small cavity barriers.

Based on the content of the Association for Specialist Fire Protection publication: Fire stopping: Linear joint seals, penetration seals & small cavity barriers, the testing of joints configured as per EN 1366-4, but exposed to the furnace conditions of BS 476: Part 20, would be deemed compliant.

5. Conclusions

The table below shows the anticipated performance of the joint systems described in UL System Nos.

FF-D-0075, FF-D-1086, FW-D-0052 and FW-D-1073 (detailed in Appendix 2 of this report) subject to assumptions made in this report, should they be subjected to testing in accordance with EN 1366-4:2006+A1:2010 or testing following the methodology of BS 476: Part 20: 1987 (following the guidance of the Association for Specialist Fire Protection publication: Fire stopping: Linear joint seals, penetration seals & small cavity barriers):

Criteria	Performance
Insulation	120 minutes
Integrity	120 minutes
Movement	+/- 25% maximum

6. Validity

This assessment is issued on the basis of test data and information available at the time of issue.

If contradictory evidence becomes available to Underwriters Laboratories (UK) Ltd the assessment will be unconditionally withdrawn and Emseal LLC will be notified in writing. Similarly the assessment is invalidated if the assessed construction is subsequently tested because actual test data is deemed to take precedence over an expressed opinion.

The assessment is valid initially for a period of five years i.e. after which time it is recommended that it be returned for re-appraisal.

The appraisal is only valid provided that no other modifications are made to the tested construction other than those described in this report.

7. Declaration by Emseal LLC

We confirm that the component or element of structure, which is the subject of this assessment, has not to our knowledge been subjected to a fire test to the Standard against which the assessment is being made.

We agree to withdraw this assessment from circulation should the component or element of structure be the subject of a fire test to the Standard against which this assessment is being made.

We are not aware of any information that could adversely affect the conclusions of this assessment.

If we subsequently become aware of any such information we agree to cease using the assessment and ask Underwriters Laboratories (UK) Ltd to withdraw the assessment.

Signed:

For and on behalf of:

8. Signatories

Report by:



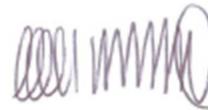
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Senior Project Engineer
Building Materials and Life Safety

For and on behalf of Underwriters Laboratories (UK) Ltd.

REPORT ISSUED: 24th August 2012

Reviewed by:



C. W. Miles

Business Development Manager
Building Materials and Life Safety

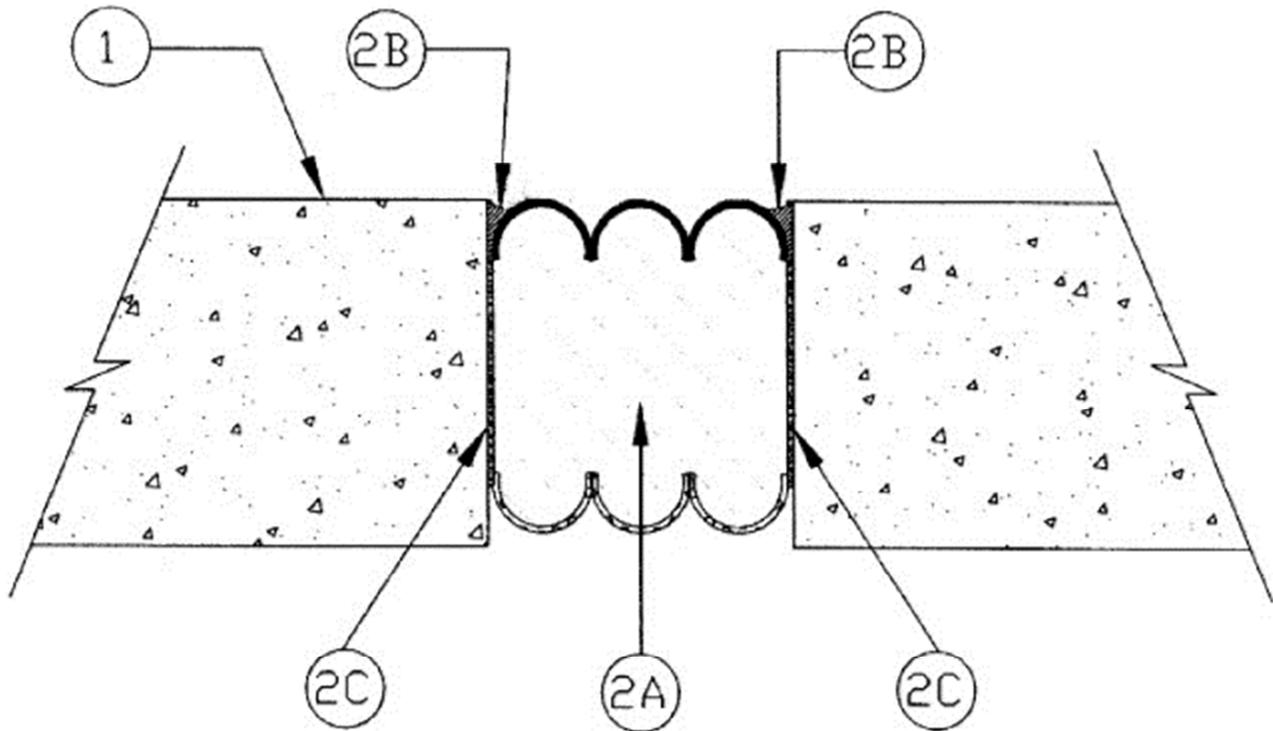


Appendix 1: Summary of Primary Supporting Evidence

Underwriters Laboratories (UL) File Reference R26111, Volume 1.1 dated 2009-03-06 and Volume 1.2 dated 2009-05-28.

Appendix 2: UL System Designs

System No. FF-D-0075



1. **Floor Assembly** — Min 4-1/2 in. (114 mm) thick reinforced normal weight 150 pcf, (2400 kg/cu meter), structural concrete.

2. **Joint System** — Nominal width of joint is 1/2 to 2 in. (13 to 50 mm). The joint system is designed to accommodate a max 25 percent compression or extension from its installed width. The joint system shall consist of the following:

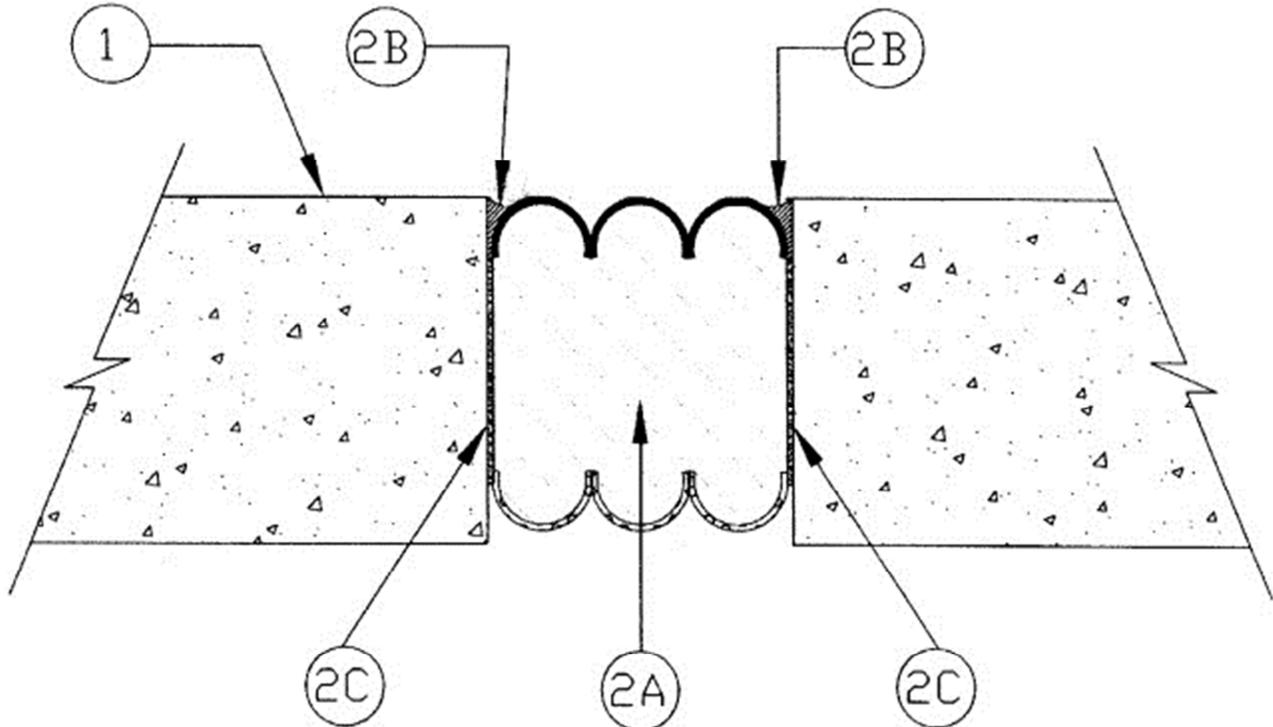
A. **Forming Material*** — Compressed, fire-retardant impregnated, 3 3/4 in. (95 mm) deep foam. Topside of foam is coated with Silicone and underside is coated with intumescent. As an option, one additional layer of Silicone may be applied over the underside layer of intumescent. Foam is installed in joint opening as a permanent form.

EMSEAL L L C — DFR2 Mechanical joint system.

B. **Sealant Band** — (Optional) — Watertight 3/4 in. (19 mm) deep silicone sealant band and corner bead supplied by joint system manufacturer, and installed in accordance with installation instruction.



C. Epoxy adhesive — Consists of two parts; part A (base), and part B (hardener). The epoxy is supplied by joint system manufacturer, and installed in accordance with installation instructions.

System No. FF-D-1086

1. **Floor Assembly** – Min 4-1/2 in. (114 mm) thick reinforced normal weight 150 pcf, (2400 kg/cu meter), structural concrete.

2. **Joint System** – Nominal width of joint is 2-1/4 to 4 in. (55 to 100 mm). The joint system is designed to accommodate a max 25 percent compression or extension from its installed width. The joint system shall consist of the following:

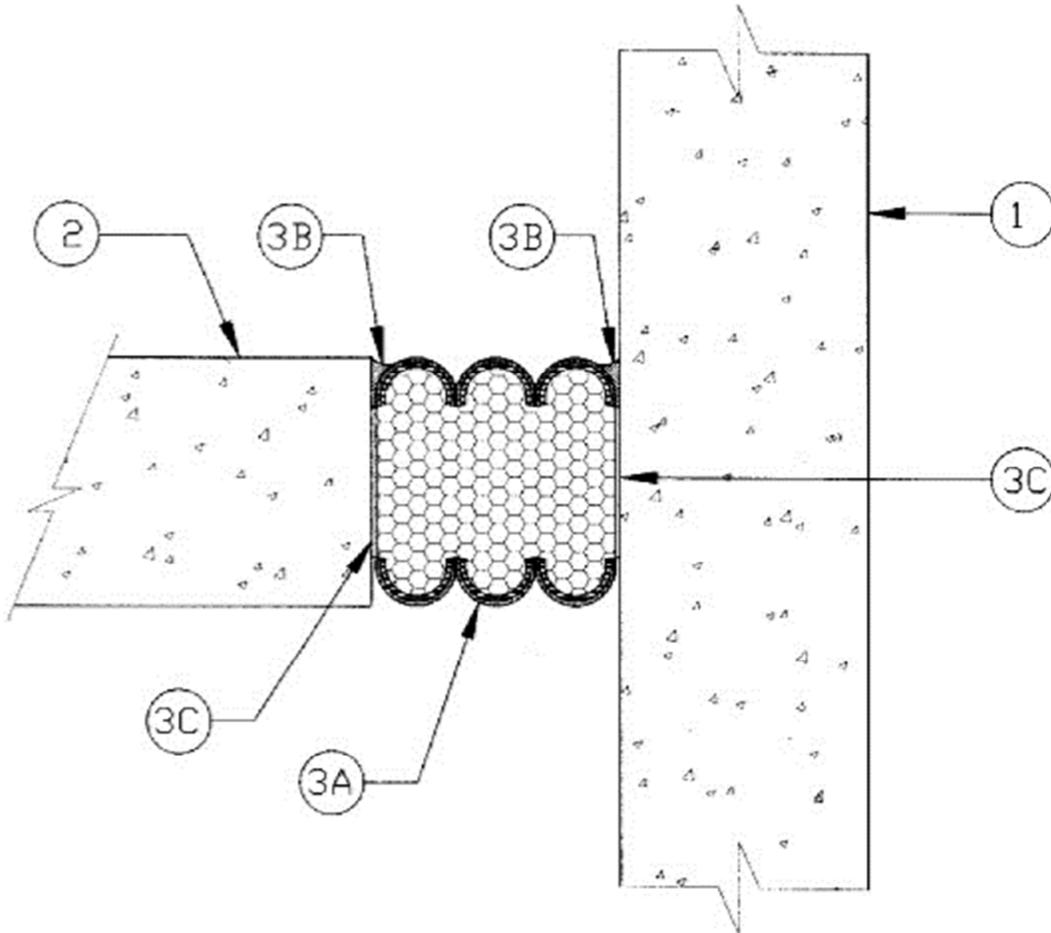
A. **Forming Material*** – Compressed, fire-retardant impregnated, 3 ¼ in. (95 mm) deep foam. Topside of foam is coated with Silicone and underside is coated with intumescent. As an option, one additional layer of Silicone may be applied over the underside layer of intumescent. Foam is installed in joint opening as a permanent form.

EMSEAL L L C — DFR2 Mechanical joint system.

B. **Sealant Band** – (Optional) – Watertight ¾ in. (19 mm) deep silicone sealant band and corner bead supplied by joint system manufacturer, and installed in accordance with installation instruction.

C. **Epoxy adhesive** – Consists of two parts; part A (base), and part B (hardener). The epoxy is supplied by joint system manufacturer, and installed in accordance with installation instructions.

System No. FW-D-0052



1. **Wall Assembly** – Min 4-1/2 in. (114 mm) thick reinforced normal weight 150 pcf, (2400 kg/cu meter) structural concrete. Wall may also be constructed of any UL Classified **Concrete Blocks***.

See **Concrete Blocks (CAZT)** category in the Fire Resistance Directory for names of manufacturers.

2. **Floor Assembly** – Min 4-1/2 in. (114 mm) thick reinforced normal weight 150 pcf, (2400 kg/cu meter), structural concrete.

3. **Joint System** – Nominal width of joint is ½ to 2 in. (13 to 50 mm). The joint system is designed to accommodate a max 25 percent compression or extension from its installed width. The joint system shall consist of the following:

A. **Forming Material*** – Compressed, fire-retardant impregnated, 3 ¾ in. (95 mm) deep foam. Topside of foam is coated with Silicone and underside is coated with intumescent. As an option, one additional layer of Silicone may be applied over the underside

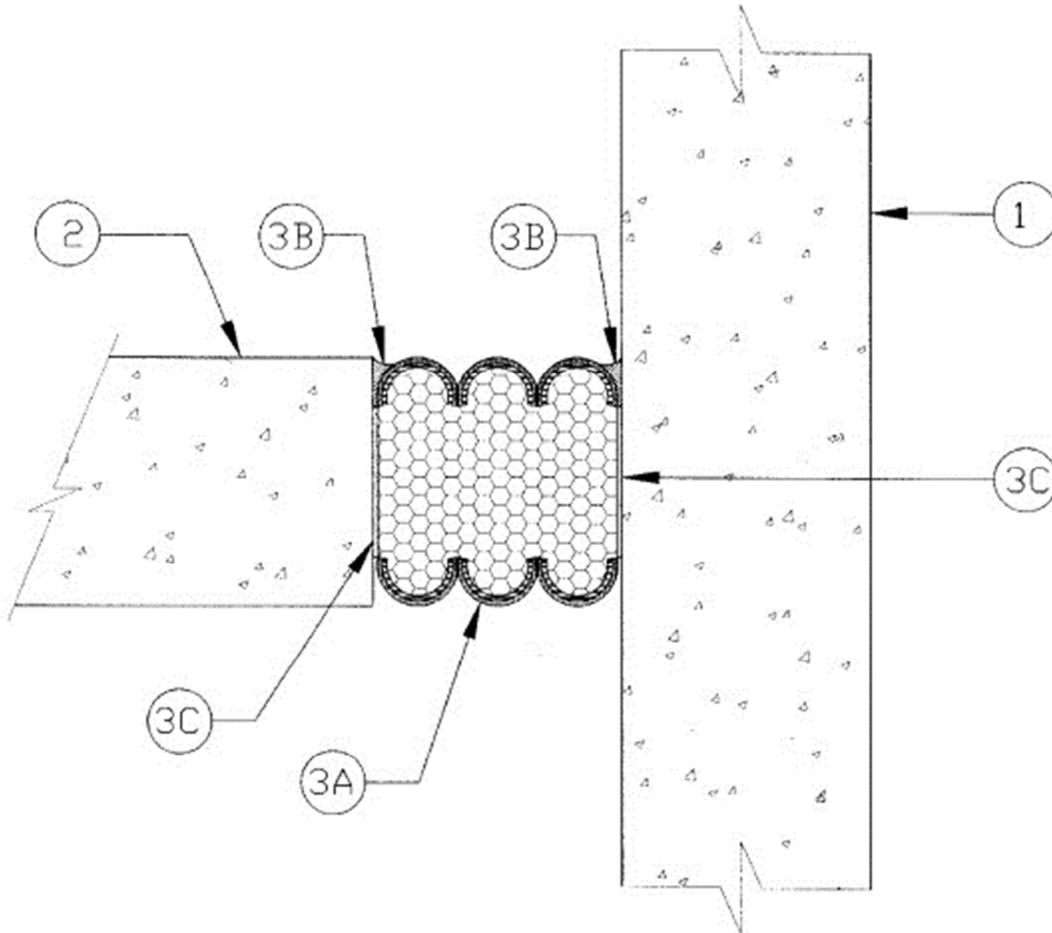
layer of intumescent. Foam is installed in joint opening as a permanent form.

EMSEAL L L C — DFR2 Mechanical joint system.

B. **Sealant Band** — (Optional) — Watertight $\frac{3}{4}$ in. (19mm) deep silicone sealant band and corner bead supplied by joint system manufacturer, and installed in accordance with installation instruction.

C. **Epoxy adhesive** — Consists of two parts; part A (base), and part B (hardener). The epoxy is supplied by joint system manufacturer, and installed in accordance with installation instructions.

System No. FW-D-1073



1. **Wall Assembly** – Min 4-1/2 in. (114 mm) thick reinforced normal weight 150 pcf, (2400 kg/cu meter) structural concrete. Wall may also be constructed of any UL Classified **Concrete Blocks***.

See **Concrete Blocks (CAZT)** category in the Fire Resistance Directory for names of manufacturers.

2. **Floor Assembly** – Min 4-1/2 in. (114 mm) thick reinforced normal weight 150 pcf, (2400 kg/cu meter), structural concrete.

3. **Joint System** – Nominal width of joint is 2-1/4 to 4 in. (55 to 100 mm). The joint system is designed to accommodate a max 25 percent compression or extension from its installed width. The joint system shall consist of the following:

A. **Forming Material*** – Compressed, fire-retardant impregnated, 3 3/4 in. (95 mm) deep foam. Topside of foam is coated with Silicone and underside is coated with intumescent. As an option, one additional layer of Silicone may be applied over the underside

layer of intumescent. Foam is installed in joint opening as a permanent form.

EMSEAL L L C — DFR2 Mechanical joint system.

B. **Sealant Band** — (Optional) — Watertight $\frac{3}{4}$ in. (19 mm) deep silicone sealant band and corner bead supplied by joint system manufacturer, and installed in accordance with installation instruction.

C. **Epoxy adhesive** — Consists of two parts; part A (base), and part B (hardener). The epoxy is supplied by joint system manufacturer, and installed in accordance with installation instructions.