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## Legacy report on the BOCA® *National Building Code/1999*

**DIVISION: 02—SITWORK**  
**Section: 02620—Subdrainage**

### REPORT HOLDER:

**B-DRY® SYSTEM, INC.**  
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### EVALUATION SUBJECT:

**B-DRY® THERMO-FLO® AND B-DRY® PIPE AND GRAVEL DRAINAGE SYSTEMS**

### EVALUATION SCOPE:

**Compliance with the following code:**

- BOCA® *National Building Code/1999*
  - Section 803.2 Classification
  - Section 803.3.2 Smoke development
  - Section 803.4 Required flame spread index
  - Section 1710.1 Preconstruction load test - General

### 1.0 DESCRIPTION OF EVALUATION

This report evaluates B-Dry® Thermo-Flo® and B-Dry® Pipe and Gravel Drainage Systems for use as subsurface drainage systems for draining ground water or storm water through a review of data submitted.

### 2.0 DESCRIPTION AND USE OF PRODUCT

#### 2.1 GENERAL DESCRIPTION

The B-Dry® Drainage Systems are intended for use in new and existing construction. The systems are located below the interior concrete slab of the below grade story or basement floor beside the footing of the foundation wall. There are two types of B-Dry® Drainage Systems, both of which are intended for use with foundation walls of either concrete masonry unit or poured concrete construction.

The B-Dry® Thermo-Flo® System consists of a two-piece or 1-piece poly vinyl chloride (PVC) drain channel, 0.004 to 0.006-inch-thick (0.102 to 0.152 mm) polyethylene film, B-Dry® Rigid Sealer®, minimum 1 inch (25.4 mm) crushed stone, a poly vinyl chloride (PVC) plastic angle, and thermoplastic rivets. See Figure 1 of this report for an illustration of the Thermo-Flo® Drainage System when used with a concrete masonry unit foundation wall and Figure 2

of this report for an illustration of the Thermo-Flo® Drainage System when used with a poured concrete foundation wall.

The B-Dry® Pipe and Gravel System consists of a 3-inch-diameter (76.2 mm) polyethylene plastic drain pipe, 0.004 to 0.006-inch-thick (0.102 to 0.152 mm) polyethylene film, B-Dry® Rigid Sealer®, minimum 1/4 inch (6.4 mm) to maximum 1 inch (25.4 mm) crushed stone, and thermoplastic rivets. See Figure 3 of this report for an illustration of the Pipe and Gravel Drainage System when used with a concrete masonry unit foundation wall and Figure 4 of this report for an illustration of the Pipe and Gravel Drainage System when used with a poured concrete foundation wall.

#### 2.2 USE OF PRODUCT

When used with concrete masonry unit foundations, both systems function by draining water or moisture permeating through the wall assembly or through weep holes placed on the inside face of concrete masonry units. The water passes through gravel or crushed stone before entering the channel or pipe. The water is then discharged from the structure by gravity or mechanical means. The gravel or crushed stone is intended to filter debris from the water. A layer of 0.004 to 0.006-inch-thick (0.102 to 0.152 mm) polyethylene film and B-Dry® Rigid Sealer® are applied to the inside face of the exterior wall to direct moisture below the floor level and into the drainage channel or pipe.

When used with a poured concrete foundation wall, both drainage systems are to be supplementary to a foundation drain installed in accordance with Section 1813.0 of the BOCA® *National Building Code/1999*. In the instances where water does permeate through the poured concrete foundation wall, the drainage systems are intended to discharge the water as described above for concrete masonry unit foundation walls.

#### 2.3 COMPONENTS

Sections 2.3.1 through 2.3.5 of this report describe the components of the B-Dry® Thermo-Flo® Pipe and Gravel Drainage Systems, and 1 piece Free Flo System.

See Figures 1, 2, 3, and 4 of this report for additional information regarding the configuration of the two drainage systems and their components.

##### 2.3.1 Drain Channels or Pipes

The B-Dry® Thermo-Flo® Drainage System drain channel component is a two-piece or one-piece construction of extruded, solid poly vinyl chloride (PVC) compound which are 0.1-inch-thick (2.54 mm). The top piece is a flat plate

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5-inch-wide (127 mm) and 10-foot-long (3048 mm) and snaps onto the bottom U-shaped drain channel. Drainage holes, 1-inch-diameter (25.4 mm) and 3 inches (76 mm) on center, are located on each side of the base of the U-shaped channel. The component cross section is a 3-by-6-inch (76 × 152 mm) rectangle with a 2-inch (51 mm) flange on top. The flange is attached to the foundation wall with a poly vinyl chloride (PVC) plastic angle and thermoplastic rivets.

The B-Dry® Pipe and Gravel Drainage System incorporates a drainage pipe component that is a 3-inch-diameter (76 mm) polyethylene plastic pipe with 0.1-inch-thick (2.54 mm) walls. The drainage pipe components are installed in 1 foot (305 mm) sections which are placed  $\frac{1}{4}$  inch (6.4 mm) apart to allow moisture or water to drain through the pipes and away from the structure.

### 2.3.2 B-Dry® Rigid Sealer®

Polyethylene film [0.004 to 0.006-inch-thick (0.102 to 0.152 mm)] is temporarily attached to the foundation walls with tape. Following attachment of the film to the wall, B-Dry® Rigid Sealer® is applied at the intersection of the wall and the floor. Thermoplastic rivets spaced 18 to 22 inches (457 × 559 mm) are then used to permanently attach the film and the Rigid Sealer® to the foundation wall. The Rigid Sealer® is 0.080-inch-thick (2.03 mm) polyethylene plastic with a density of 72 lb/ft<sup>3</sup> (1153 kg/m<sup>3</sup>) and is available in 4-by-8-foot (1219 × 2438 mm) sheets.

### 2.3.3 Crushed Stone

One layer of stone is used for the B-Dry® Thermo-Flo® Drainage Systems. A minimum 6 inch (152 mm) layer of minimum 1 inch (25.4 mm) crushed stone shall be placed on one side of the drain channel with the side facing the footing left free of stone to allow an air space to exist between the footing and channel.

Three layers of stone are used for the B-Dry® Pipe and Gravel Drainage Systems. A minimum 1-inch-thick (25.4 mm) layer of minimum  $\frac{1}{4}$  inch (6.4 mm) to maximum  $\frac{1}{2}$  inch (12.7 mm) crushed stone shall be placed at the bottom of the trench. A minimum 3 inch (76.2 mm) layer of minimum  $\frac{3}{4}$  inch (19.1 mm) to maximum 1 inch (25.4 mm) crushed stone shall be placed around the drain pipe. A minimum  $\frac{1}{2}$ -inch-thick layer (12.7 mm) of minimum  $\frac{1}{4}$  inch (6.4 mm) to maximum  $\frac{1}{2}$  inch (12.7 mm) crushed stone shall then be placed on top.

### 2.3.4 Plastic Angle

The plastic angle component of the Thermo-Flo® Drainage System is a one-piece construction of extruded, solid poly vinyl chloride (PVC) compound which is 0.1-inch-thick (2.54 mm). Both legs of the angle are 1.030-inch-long (26.2 mm).

### 2.3.5 Thermoplastic Rivets

Thermoplastic rivets are used to fasten the Rigid Sealer® and the plastic angle to the wall. The rivets are available in a maximum length of 0.75 inch (19.1 mm), with a head dimension of 0.63 inch (16 mm) and a grip range of 0.50 to 0.60 inch (12.7 to 15.2 mm).

## 2.4 USE AND APPLICATION

### 2.4.1 Thermo-Flo® Drainage System

Figures 1 and 2 of this report show a schematic illustration of the B-Dry® Thermo-Flo Drainage System with concrete masonry unit and poured concrete foundation walls.

**2.4.1.1** The below grade story or basement floor, if existing, shall be removed and the soil and underlying fill excavated for a distance of 8 to 12 inches (203 to 305

mm) from the wall to permit a trench to be installed adjacent to the footing (See Limitation 4.6 of this report).

**2.4.1.2** A trench shall be excavated alongside the footing, but not below the footing, at a depth of at least  $\frac{2}{3}$  the depth of the footing. For example, if the footing depth is 12 inches (305 mm), then the trench shall be dug to a depth of 8 inches (203 mm) minimum (See Limitation 4.2 of this report).

**2.4.1.3** The bottom U-shaped channel of the Thermo-Flo® Drainage System is placed in the trench. The top piece is then snapped onto the U-shaped channel or one-piece pipe. The 2-inch (51 mm) flange is supported by a piece of poly vinyl chloride (PVC) angled plastic attached to the wall with thermoplastic rivets spaced 8 inches (203 mm) on center.

**2.4.1.4** In concrete masonry unit foundation walls,  $\frac{3}{4}$ -inch-diameter (19.1 mm) holes shall be drilled in each core of every block in the bottom course of blocks. The holes allow moisture running down the inside of the block to be expelled from the wall and into the drain channel.

**2.4.1.5** A minimum 6-inch-thick (152 mm) layer of minimum 1 inch (25.4 mm) crushed stone shall be placed on one side of the drain channel with the side adjacent to the footing left free of stone to allow an air space to exist between the footing and channel.

**2.4.1.6** Polyethylene film [0.004 to 0.006-inch-thick (0.102 to 0.152 mm)] is temporarily attached to the foundation walls with tape. Following attachment of the film, B-Dry® Rigid Sealer® is applied to the wall. This allows moisture condensing on the inside face of the exterior wall to be channeled into the Thermo-Flo® Drainage System. The 4-by-8-foot (1219 × 2438 mm) B-Dry® Rigid Sealer® sheets are cut at the job site to extend from the top of the weep holes to a minimum of 1 foot (305 mm) above the finished below-grade story or basement floor. The polyethylene film and Rigid Sealer® are fastened to the wall using thermoplastic rivets spaced 18 to 22 inches (457 × 559 mm).

**2.4.1.7** The floor shall be resurfaced with concrete meeting the minimum requirements as set forth in Sections 1905.0, 1906.0, 1907.0, and 1908.0 of the BOCA® *National Building Code*/1999.

### 2.4.2 Pipe and Gravel Drainage System

Figures 3 and 4 of this report show a schematic illustration of the B-Dry® Pipe and Gravel Drainage System with concrete masonry unit and poured concrete foundation walls.

**2.4.2.1** The below-grade story or basement floor is removed in the same manner as in Section 2.4.1.1 of this report.

**2.4.2.2** A trench shall be excavated alongside the footing in the same manner as in Section 2.4.1.2 of this report.

**2.4.2.3** A minimum 1-inch-thick (25.4 mm) layer of minimum  $\frac{1}{4}$  inch (6.4 mm) to maximum  $\frac{1}{2}$  inch (12.7 mm) crushed stone shall be placed at the bottom of the trench before installing the drain pipe.

**2.4.2.4** The drain pipes are then placed in the trench. The drains are 1 foot (305 mm) lengths of PVC pipe which are placed approximately  $\frac{1}{4}$  inch (6.4 mm) apart to allow water to pass through as shown in Figures 3 and 4 of this report. A minimum 3 inch (76.2 mm) layer of minimum  $\frac{3}{4}$  inch (19.1 mm) to maximum 1 inch (25.4 mm) crushed stone shall be placed around the drain pipe. A minimum  $\frac{1}{2}$  inch layer (12.7 mm) of minimum  $\frac{1}{4}$  inch (6.4 mm) to maximum  $\frac{1}{2}$  inch (12.7 mm) crushed stone shall then be placed on top as indicated in Figures 3 and 4 of this report.

**2.4.2.5** Where the Pipe and Gravel System is installed with a concrete masonry unit foundation wall, weep holes  $\frac{3}{4}$ -inch-diameter (19.1 mm) shall be drilled in each core of every concrete block at the base of the foundation wall. Note that only those blocks on the bottom tier are to be drilled and that the number of weep holes to be drilled will depend on the number of interior cavities within the blocks.

**2.4.2.6** After covering the inside of the foundation wall with a layer of 0.004 to 0.006-inch-thick (0.102 to 0.152 mm) polyethylene film, Rigid Sealer<sup>®</sup> is applied to the wall to channel moisture below the floor and into the drainage pipe. The polyethylene film and B-Dry<sup>®</sup> Rigid Sealer<sup>®</sup> are installed in the same manner as in Section 2.4.1.6 of this report.

**2.4.2.7** The floor shall be resurfaced with concrete meeting the minimum requirements as set forth in Section 2.4.1.7 of this report.

### 3.0 INFORMATION SUBMITTED

**3.1** United States Testing Company, Inc., Test Report No. 93110, dated April 23, 1986, was submitted as evidence that B-Dry<sup>®</sup> Rigid Sealer<sup>®</sup> has a smoke-developed index of less than 450 and a flame spread index between 76 and 200 (Class III).

**3.2** Tensile Testing Metallurgical Laboratory, Job No. 98-015-927, dated January 16, 1998, was submitted as evidence of physical testing performed on the B-Dry<sup>®</sup> Pipe and Gravel Drainage System in accordance with Section 1710.3 of the BOCA<sup>®</sup> *National Building Code/1999*.

**3.3** Test data from BF Goodrich Company, dated June 13, 1986, was submitted as evidence of physical testing performed on the Thermo-Flo<sup>®</sup> Drainage System in accordance with Section 1710.3 of the BOCA<sup>®</sup> *National Building Code/1999*.

**3.4** Certification letter sealed and signed by a Professional Engineer, dated September 26, 1984, was submitted as evidence of structural testing performed on concrete masonry units with drainage holes.

### 4.0 CONDITIONS OF USE

This report is limited to the applications and products as stated in this report. The ICC-ES Subcommittee on National Codes intends that the report be used by the code official to determine that the report subject complies with the code requirements specifically addressed, provided that this product is installed in accordance with the following limitations:

#### Limitations

**4.1** The B-Dry<sup>®</sup> Thermo-Flo<sup>®</sup> and Pipe and Gravel Drainage Systems shall be installed as described in this report.

**4.2** The footing shall not be undermined under any circumstances during the excavation of the trench required for the installation of the B-Dry<sup>®</sup> Thermo-Flo<sup>®</sup> and Pipe and Gravel Drainage Systems.

**4.3** B-Dry<sup>®</sup> Rigid Sealer<sup>®</sup> meets the requirements for a Class III interior finish material as defined by Section 803.0 of the BOCA<sup>®</sup> *National Building Code/1999*, and is limited for use in areas where a Class III Interior Finish is permitted.

**4.4** B-Dry<sup>®</sup> Thermo-Flo<sup>®</sup> and Pipe and Gravel Drainage Systems shall not be installed where the load capacity

of the wall is not adequate or is jeopardized by the excavation and/or installation.

**4.5** B-Dry<sup>®</sup> Thermo-Flo<sup>®</sup> and Pipe and Gravel Drainage Systems shall not be installed in such a manner as to reduce the lateral load-resisting capabilities of the below-grade story or basement foundation walls.

**4.6** Where the load capacity of the wall or footing is not adequate or is jeopardized by the excavation and/or installation, construction of the system shall cease. Methods required to enhance the capacity or stability of the foundation system, including modifications and repairs of structural cracks in existing foundation walls, shall be determined by a registered design professional and are outside the scope of this report.

**4.7** Water which drains into this drainage system shall be collected and disposed of in an approved manner in accordance with the *1997 International Plumbing Code<sup>®</sup>*. The collection and disposal system shall be installed in accordance with the *1997 International Plumbing Code<sup>®</sup>*, the design of which is outside the scope of this evaluation.

**4.8** Evaluation of the Thermo-Flo<sup>®</sup> and Pipe and Gravel Drainage Systems when utilized with a poured concrete foundation wall is limited to installations that comply with Section 1813.5.2 of the BOCA<sup>®</sup> *National Building Code/1999*.

**4.9** The B-Dry<sup>®</sup> System, Inc., Thermo Flo<sup>®</sup> and Pipe and Gravel Drainage Systems are limited to applications where the ground water table investigation determines that a subsoil drainage system is required.

**4.10** This report is subject to periodic re-examination. For information on the current status of this report, contact the ICC-ES.

### 5.0 INFORMATION REQUIRED ON CONSTRUCTION DOCUMENTS

To aid in the use of this report, the following represents the minimum level of information to be reflected on construction documents in order to determine compliance with this research report.

**5.1** The language "See ICC-ES Legacy Report No. 97-66."

**5.2** The type of drainage system intended for use.

**5.3** The type of foundation wall construction.

**5.4** Method for disposal of water from the system.

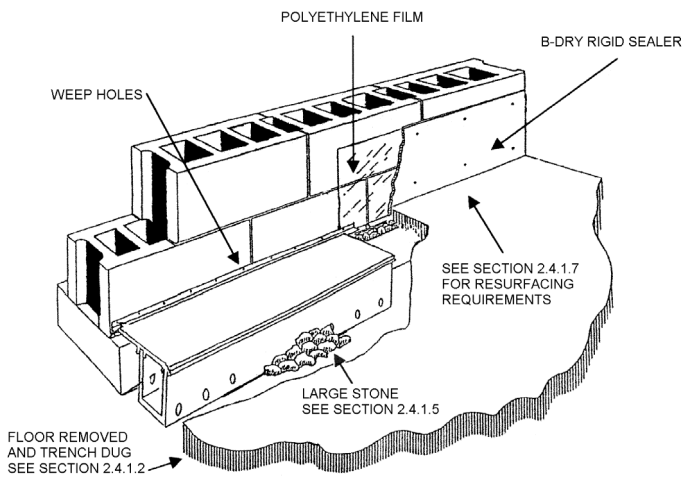
**5.5** Instructions regarding investigations of the load carrying capacity of the wall to determine adequacy.

**5.6** Specifications for all destructive operations.

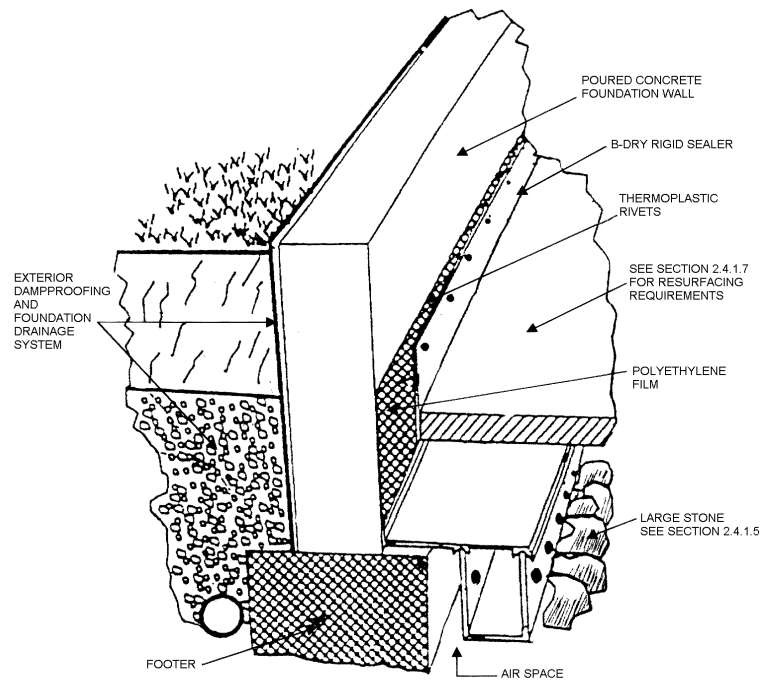
**5.7** Specifications for location and size of weep holes in concrete masonry unit foundations.

### 6.0 PRODUCT IDENTIFICATION

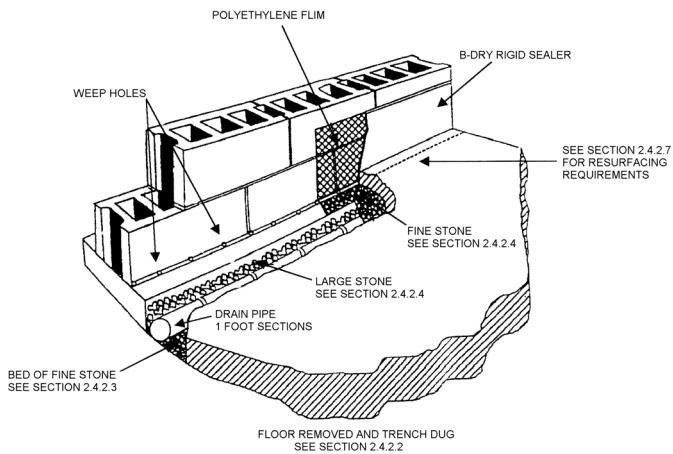
All packaging of B-Dry<sup>®</sup> Thermo-Flo<sup>®</sup> and Pipe and Gravel Drainage Systems manufactured in accordance with this research report shall be marked at the plant with the manufacturer's name and model number, along with the identifying language "See ICC-ES Legacy Report No. 97-66."



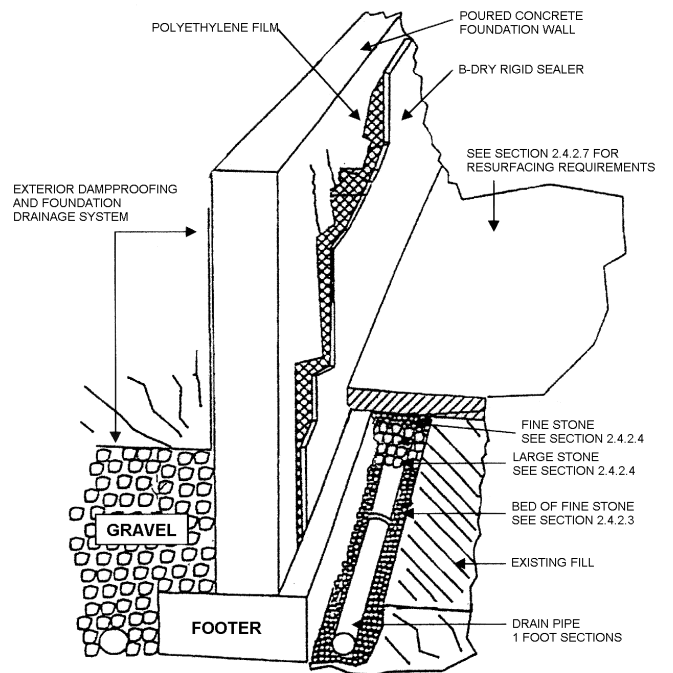
**FIGURE 1\*—THERMO-FLO® DRAINAGE SYSTEM CONCRETE MASONRY UNIT FOUNDATION WALL**



**FIGURE 2\*—THERMO-FLO® DRAINAGE SYSTEM POURED CONCRETE FOUNDATION WALL**



**FIGURE 3\*—PIPE AND GRAVEL DRAINAGE SYSTEM CONCRETE MASONRY UNIT FOUNDATION WALL**



**FIGURE 4\*—PIPE AND GRAVEL DRAINAGE SYSTEM POURED CONCRETE FOUNDATION WALL**

\*THESE DRAWINGS ARE FOR ILLUSTRATION PURPOSES ONLY. THEY ARE NOT INTENDED FOR USE AS CONSTRUCTION DOCUMENTS FOR THE PURPOSE OF DESIGN, FABRICATION OR ERECTION.