U.S. DEPARTMENT OF HOMELAND SECURITY
Federal Emergency Management Agency
National Flood Insurance Program

OMB No. 1660-0008
Expiration Date: November 30, 2018

# ELEVATION CERTIFICATE
Important: Follow the instructions on pages 1–9.

Copy all pages of this Elevation Certificate and all attachments for (1) community official, (2) insurance agent/company, and (3) building owner.

| SECTION A – PROPERTY INFORMATION | FOR INSURANCE COMPANY USE |
|---|---|
| A1. Building Owner's Name<br>TODD SMITH | Policy Number: |
| A2. Building Street Address (including Apt., Unit, Suite, and/or Bldg. No.) or P.O. Route and Box No.<br>10808 WATERSIDE DRIVE | Company NAIC Number: |

| City<br>GULFPORT | State<br>Mississippi | ZIP Code<br>39503 |
|---|---|---|

A3. Property Description (Lot and Block Numbers, Tax Parcel Number, Legal Description, etc.)
PARCEL NO. 10090-02-005.002     LOT 46, WATERSIDE SUBDIVISION

A4. Building Use (e.g., Residential, Non-Residential, Addition, Accessory, etc.)     RESIDENTIAL

A5. Latitude/Longitude:  Lat. 30 24'48.1"     Long. -089 01'02.2"     Horizontal Datum: ☐ NAD 1927  ☒ NAD 1983

A6. Attach at least 2 photographs of the building if the Certificate is being used to obtain flood insurance.

A7. Building Diagram Number     1B

A8. For a building with a crawlspace or enclosure(s):

  a) Square footage of crawlspace or enclosure(s)     0     sq ft

  b) Number of permanent flood openings in the crawlspace or enclosure(s) within 1.0 foot above adjacent grade     0

  c) Total net area of flood openings in A8.b     0     sq in

  d) Engineered flood openings?  ☐ Yes  ☒ No

A9. For a building with an attached garage:

  a) Square footage of attached garage     944     sq ft

  b) Number of permanent flood openings in the attached garage within 1.0 foot above adjacent grade     3

  c) Total net area of flood openings in A9.b     995     sq in

  d) Engineered flood openings?  ☒ Yes  ☐ No

| SECTION B – FLOOD INSURANCE RATE MAP (FIRM) INFORMATION |||
|---|---|---|
| B1. NFIP Community Name & Community Number<br>CITY OF GULFPORT, 285253 | B2. County Name<br>HARRISON | B3. State<br>Mississippi |

| B4. Map/Panel Number | B5. Suffix | B6. FIRM Index Date | B7. FIRM Panel Effective/ Revised Date | B8. Flood Zone(s) | B9. Base Flood Elevation(s) (Zone AO, use Base Flood Depth) |
|---|---|---|---|---|---|
| 28047C0267 | G | 12/21/2017 | 06/16/2009 | AE | 16 |

B10. Indicate the source of the Base Flood Elevation (BFE) data or base flood depth entered in Item B9:
☐ FIS Profile  ☒ FIRM  ☐ Community Determined  ☐ Other/Source: _____

B11. Indicate elevation datum used for BFE in Item B9: ☐ NGVD 1929  ☒ NAVD 1988  ☐ Other/Source: _____

B12. Is the building located in a Coastal Barrier Resources System (CBRS) area or Otherwise Protected Area (OPA)? ☐ Yes ☒ No

  Designation Date: _____  ☐ CBRS  ☐ OPA

# ELEVATION CERTIFICATE

OMB No. 1660-0008
Expiration Date: November 30, 2018

**IMPORTANT: In these spaces, copy the corresponding information from Section A.**

**FOR INSURANCE COMPANY USE**

Building Street Address (including Apt., Unit, Suite, and/or Bldg. No.) or P.O. Route and Box No.
10808 WATERSIDE DRIVE

Policy Number:

| City | State | ZIP Code | Company NAIC Number |
|------|-------|----------|---------------------|
| GULFPORT | Mississippi | 39503 | |

## SECTION C – BUILDING ELEVATION INFORMATION (SURVEY REQUIRED)

C1. Building elevations are based on: ☐ Construction Drawings* ☐ Building Under Construction* ☒ Finished Construction
*A new Elevation Certificate will be required when construction of the building is complete.

C2. Elevations – Zones A1–A30, AE, AH, A (with BFE), VE, V1–V30, V (with BFE), AR, AR/A, AR/AE, AR/A1–A30, AR/AH, AR/AO. Complete Items C2.a–h below according to the building diagram specified in Item A7. In Puerto Rico only, enter meters.
Benchmark Utilized: GPS RTK NETWORK        Vertical Datum: NAVD88, GEOID 2009

Indicate elevation datum used for the elevations in items a) through h) below.

☐ NGVD 1929  ☒ NAVD 1988  ☐ Other/Source: _____

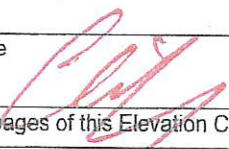Datum used for building elevations must be the same as that used for the BFE.

Check the measurement used.

| | | | |
|---|---|---|---|
| a) Top of bottom floor (including basement, crawlspace, or enclosure floor) | 17.0 | ☒ feet | ☐ meters |
| b) Top of the next higher floor | N/A | ☒ feet | ☐ meters |
| c) Bottom of the lowest horizontal structural member (V Zones only) | N/A | ☒ feet | ☐ meters |
| d) Attached garage (top of slab) | 14.8 | ☒ feet | ☐ meters |
| e) Lowest elevation of machinery or equipment servicing the building (Describe type of equipment and location in Comments) | 17.0 | ☒ feet | ☐ meters |
| f) Lowest adjacent (finished) grade next to building (LAG) | 12.8 | ☒ feet | ☐ meters |
| g) Highest adjacent (finished) grade next to building (HAG) | 14.3 | ☒ feet | ☐ meters |
| h) Lowest adjacent grade at lowest elevation of deck or stairs, including structural support | 13.0 | ☒ feet | ☐ meters |

## SECTION D – SURVEYOR, ENGINEER, OR ARCHITECT CERTIFICATION

This certification is to be signed and sealed by a land surveyor, engineer, or architect authorized by law to certify elevation information. *I certify that the information on this Certificate represents my best efforts to interpret the data available. I understand that any false statement may be punishable by fine or imprisonment under 18 U.S. Code, Section 1001.*

Were latitude and longitude in Section A provided by a licensed land surveyor? ☒ Yes ☐ No      ☐ Check here if attachments.

| Certifier's Name CLIFFORD A. CROSBY, P.L.S. | License Number MS 2539 | |
|---|---|---|
| Title OWNER | | |
| Company Name CROSBY SURVEYING | | Place Seal Here |
| Address 716 LIVE OAK DRIVE | | |
| City BILOXI | State Mississippi | ZIP Code 39532 |
| Signature | Date 02/11/2020 | Telephone (228) 234-1649 |

Copy all pages of this Elevation Certificate and all attachments for (1) community official, (2) insurance agent/company, and (3) building owner.

Comments (including type of equipment and location, per C2(e), if applicable)
LOWEST MACHINERY IS THE BOTTOM OF THE AIR CONDITIONING UNIT ON RAISED PLATFORM.

# ELEVATION CERTIFICATE

| IMPORTANT: In these spaces, copy the corresponding information from Section A. | | | FOR INSURANCE COMPANY USE |
|---|---|---|---|
| Building Street Address (including Apt., Unit, Suite, and/or Bldg. No.) or P.O. Route and Box No. 10808 WATERSIDE DRIVE | | | Policy Number: |
| City GULFPORT | State Mississippi | ZIP Code 39503 | Company NAIC Number |

## SECTION E – BUILDING ELEVATION INFORMATION (SURVEY NOT REQUIRED)
## FOR ZONE AO AND ZONE A (WITHOUT BFE)

For Zones AO and A (without BFE), complete Items E1–E5. If the Certificate is intended to support a LOMA or LOMR-F request, complete Sections A, B, and C. For Items E1–E4, use natural grade, if available. Check the measurement used. In Puerto Rico only, enter meters.

E1. Provide elevation information for the following and check the appropriate boxes to show whether the elevation is above or below the highest adjacent grade (HAG) and the lowest adjacent grade (LAG).

   a) Top of bottom floor (including basement, crawlspace, or enclosure) is    \_\_\_\_\_ . \_\_\_\_\_ ☐ feet ☐ meters ☐ above or ☐ below the HAG.

   b) Top of bottom floor (including basement, crawlspace, or enclosure) is    \_\_\_\_\_ . \_\_\_\_\_ ☐ feet ☐ meters ☐ above or ☐ below the LAG.

E2. For Building Diagrams 6–9 with permanent flood openings provided in Section A Items 8 and/or 9 (see pages 1–2 of Instructions), the next higher floor (elevation C2.b in the diagrams) of the building is    \_\_\_\_\_ . \_\_\_\_\_ ☐ feet ☐ meters ☐ above or ☐ below the HAG.

E3. Attached garage (top of slab) is    \_\_\_\_\_ . \_\_\_\_\_ ☐ feet ☐ meters ☐ above or ☐ below the HAG.

E4. Top of platform of machinery and/or equipment servicing the building is    \_\_\_\_\_ . \_\_\_\_\_ ☐ feet ☐ meters ☐ above or ☐ below the HAG.

E5. Zone AO only: If no flood depth number is available, is the top of the bottom floor elevated in accordance with the community's floodplain management ordinance? ☐ Yes ☐ No ☐ Unknown. The local official must certify this information in Section G.

## SECTION F – PROPERTY OWNER (OR OWNER'S REPRESENTATIVE) CERTIFICATION

The property owner or owner's authorized representative who completes Sections A, B, and E for Zone A (without a FEMA-issued or community-issued BFE) or Zone AO must sign here. The statements in Sections A, B, and E are correct to the best of my knowledge.

Property Owner or Owner's Authorized Representative's Name

| Address | City | State | ZIP Code |
|---|---|---|---|
| | | | |

| Signature | Date | Telephone |
|---|---|---|
| | | |

Comments

☐ Check here if attachments.

# ELEVATION CERTIFICATE

| IMPORTANT: In these spaces, copy the corresponding information from Section A. | FOR INSURANCE COMPANY USE |
|---|---|
| Building Street Address (including Apt., Unit, Suite, and/or Bldg. No.) or P.O. Route and Box No.<br>10808 WATERSIDE DRIVE | Policy Number: |

| City<br>GULFPORT | State<br>Mississippi | ZIP Code<br>39503 | Company NAIC Number |
|---|---|---|---|

## SECTION G – COMMUNITY INFORMATION (OPTIONAL)

The local official who is authorized by law or ordinance to administer the community's floodplain management ordinance can complete Sections A, B, C (or E), and G of this Elevation Certificate. Complete the applicable item(s) and sign below. Check the measurement used in Items G8–G10. In Puerto Rico only, enter meters.

G1. ☐ The information in Section C was taken from other documentation that has been signed and sealed by a licensed surveyor, engineer, or architect who is authorized by law to certify elevation information. (Indicate the source and date of the elevation data in the Comments area below.)

G2. ☐ A community official completed Section E for a building located in Zone A (without a FEMA-issued or community-issued BFE) or Zone AO.

G3. ☐ The following information (Items G4–G10) is provided for community floodplain management purposes.

| G4. Permit Number | G5. Date Permit Issued | G6. Date Certificate of Compliance/Occupancy Issued |
|---|---|---|
| | | |

G7. This permit has been issued for: ☐ New Construction ☐ Substantial Improvement

G8. Elevation of as-built lowest floor (including basement) of the building: _____ ☐ feet ☐ meters Datum _____

G9. BFE or (in Zone AO) depth of flooding at the building site: _____ ☐ feet ☐ meters Datum _____

G10. Community's design flood elevation: _____ ☐ feet ☐ meters Datum _____

| Local Official's Name | Title |
|---|---|
| | |

| Community Name | Telephone |
|---|---|
| | |

| Signature | Date |
|---|---|
| | |

Comments (including type of equipment and location, per C2(e), if applicable)

☐ Check here if attachments.

**IMPORTANT: In these spaces, copy the corresponding information from Section A.**

Building Street Address (including Apt., Unit, Suite, and/or Bldg. No.) or P.O. Route and Box No.
10808 WATERSIDE DRIVE

| City | State | ZIP Code |
|---|---|---|
| GULFPORT | Mississippi | 39503 |

**FOR INSURANCE COMPANY USE**

Policy Number:

Company NAIC Number

If using the Elevation Certificate to obtain NFIP flood insurance, affix at least 2 building photographs below according to the instructions for Item A6. Identify all photographs with date taken; "Front View" and "Rear View"; and, if required, "Right Side View" and "Left Side View." When applicable, photographs must show the foundation with representative examples of the flood openings or vents, as indicated in Section A8. If submitting more photographs than will fit on this page, use the Continuation Page.



Photo One

Photo One Caption FRONT VIEW 2/11/2020



Photo Two

Photo Two Caption REAR VIEW 2/11/2020

| IMPORTANT: In these spaces, copy the corresponding information from Section A. | | | FOR INSURANCE COMPANY USE |
|---|---|---|---|
| Building Street Address (including Apt., Unit, Suite, and/or Bldg. No.) or P.O. Route and Box No. 10808 WATERSIDE DRIVE | | | Policy Number: |
| City GULFPORT | State Mississippi | ZIP Code 39503 | Company NAIC Number |

If submitting more photographs than will fit on the preceding page, affix the additional photographs below. Identify all photographs with: date taken; "Front View" and "Rear View"; and, if required, "Right Side View" and "Left Side View." When applicable, photographs must show the foundation with representative examples of the flood openings or vents, as indicated in Section A8.



Photo One

Photo One Caption  RIGHT SIDE VIEW 2/11/2020



Photo Two

Photo Two Caption  LEFT SIDE VIEW 2/11/2020

# Certification of Engineered Flood Openings
## In accordance with the Code of Federal Regulations for the National Flood Insurance Program

I hereby certify that the **Crawl Space Door Systems** flood vents **816CS, 1220CS, 1232CS, 1616CS, 1624CS, 1632CS, 2032CS, 2424CS, and 2436CS** are designed are designed in accordance with the requirements of the Code of Federal Regulations for the National Flood Insurance Program (NFIP) to provide automatic equalization of hydrostatic flood forces by allowing for the entry and exit of floodwaters, when properly installed and sized as set forth below. Vent opening measurements were measured and certified by Mr. Christopher Mark Loney, Virginia P.E. NO. 029000. Detailed calculations were prepared as outlined in "Review of certification of Engineered Flood Openings," prepared by Dr. Georg Reichard, Associate Professor of Building Construction, Virginia Tech (available upon request from Crawl Space Door Systems, Inc. billy@crawlspacedoors.com)

## Design Characteristics

Section 2.6.2.2 of ASCE/SEI 24-05 provides an equation to determine the required <u>net area</u> of engineered openings ($A_o$) for a given <u>enclosed area</u> ($A_e$). This equation is based on the hydraulic formula for the flow rate across sharp edged orifices. I have utilized this equation to calculate 1) the restricted flow rate through the main frame opening in case the louver is blown out during a flood event; 2) the flow rate through the individual openings between louver blades; and 3) the flow rate through projected openings between louver blades following hydraulic short-tube theory. The maximum total enclosed area ($A_e$) that can be serviced by a single vent has then been determined by utilizing the lowest flow rate of the three assessed scenarios for each vent and is listed in Table 1. These values are based on the following assumptions:

- In absence of reliable data, the rates of rise and fall have been assumed at a minimum rate of 5 feet/hour;
- The (maximum) difference between the exterior and interior floodwater levels shall not exceed 1 foot during base flood conditions;
- A factor of safety of 5 has been assumed, which is consistent with design practices related to protection of life and property;
- The net area of openings ($A_o$) as provided by the manufacturer.

| (*) | Model | H x W [in] | $A_o$ [in$^2$] | $A_e$ [ft$^2$] |
|---|---|---|---|---|
| ☑ | 816CS | 8 x 16 | 105 | 205 |
| ☐ | 1220CS | 12 x 20 | 235 | 500 |
| ☐ | 1232CS | 12 x 32 | 305 | 645 |
| ☐ | 1616CS | 16 x 16 | 180 | 395 |
| ☐ | 1624CS | 16 x 24 | 310 | 670 |
| ☐ | 1632CS | 16 x 32 | 405 | 835 |
| ☐ | 2032CS | 20 x 32 | 630 | 1240 |
| ☐ | 2424CS | 24 x 24 | 570 | 1230 |
| ☐ | 2436CS | 24 x 36 | 850 | 1765 |

**Table 1** Maximum total <u>enclosed area</u> ($A_e$) that can be serviced by each individual model based on the given <u>net area</u> of engineered openings ($A_o$)
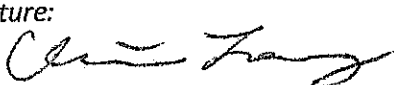
## Installation Requirements and Limitations

This certification will be voided if the following installation requirements and limitations are not enforced:

- There shall be a minimum of two openings on different sides of each enclosed area subject to flooding;
- The bottom of all openings shall be no higher than one foot above the higher of the interior or exterior grade that is immediately under each opening;
- No temporary (e.g. during cold weather) or permanent solid cover may be placed into or over the flood vent that would block the automatic entry or exit of floodwaters at any time;
- Where data or analyses indicate more rapid rates of rise and fall, the required number of openings shall be increased to account for those different conditions. The number or size of the openings may be decreased if data or analyses indicate rates of rise and fall are less than 5 feet per hour.

## Certifying Design Professional

| | | | |
|---|---|---|---|
| *Name* | Christopher Mark Loney | *Title* | Mechanical Engineer |
| *Company* | Innovation Products Company | | |
| *Address* | 1675 Meredith Road, Virginia Beach, VA 23455 | | |
| *License* | Professional Engineer | *License No.* | 0402029000 |

*Signature:*

*Date:* 11/12/17

*[Seal: COMMONWEALTH OF VIRGINIA — CHRISTOPHER M. LONEY No. 029000 — PROFESSIONAL ENGINEER]*

## Identification of the Building and Installed Flood Vents (By Others)

The flood vent models marked in Table 1*) are being installed at the following building:

*Building Address*

*10808 Waterside*

# Certification of Engineered Flood Openings

## In accordance with the Code of Federal Regulations for the National Flood Insurance Program

I hereby certify that the **Crawl Space Door Systems flood vents 816CS, 1220CS, 1232CS, 1616CS, 1624CS, 1632CS, 2032CS, 2424CS, and 2436CS** are designed are designed in accordance with the requirements of the Code of Federal Regulations for the National Flood Insurance Program (NFIP) to provide automatic equalization of hydrostatic flood forces by allowing for the entry and exit of floodwaters, when properly installed and sized as set forth below. Vent opening measurements were measured and certified by Mr. Christopher Mark Loney, Virginia P.E. NO. 029000. Detailed calculations were prepared as outlined in "Review of certification of Engineered Flood Openings," prepared by Dr. Georg Reichard, Associate Professor of Building Construction, Virginia Tech (available upon request from Crawl Space Door Systems, Inc. billy@crawlspacedoors.com)

## Design Characteristics

Section 2.6.2.2 of ASCE/SEI 24-05 provides an equation to determine the required <u>net area</u> of engineered openings ($A_o$) for a given <u>enclosed area</u> ($A_e$). This equation is based on the hydraulic formula for the flow rate across sharp edged orifices. I have utilized this equation to calculate 1) the restricted flow rate through the main frame opening in case the louver is blown out during a flood event; 2) the flow rate through the individual openings between louver blades; and 3) the flow rate through projected openings between louver blades following hydraulic short-tube theory. The maximum total enclosed area ($A_e$) that can be serviced by a single vent has then been determined by utilizing the lowest flow rate of the three assessed scenarios for each vent and is listed in Table 1. These values are based on the following assumptions:

- In absence of reliable data, the rates of rise and fall have been assumed at a minimum rate of 5 feet/hour;
- The (maximum) difference between the exterior and interior floodwater levels shall not exceed 1 foot during base flood conditions;
- A factor of safety of 5 has been assumed, which is consistent with design practices related to protection of life and property;
- The net area of openings ($A_o$) as provided by the manufacturer.

| *) | Model | H x W [in] | $A_o$ [in$^2$] | $A_e$ [ft$^2$] |
|----|-------|------------|----------------|----------------|
| ☐ | 816CS | 8 x 16 | 105 | **205** |
| ☐ | 1220CS | 12 x 20 | 235 | **500** |
| ☐ | 1232CS | 12 x 32 | 305 | **645** |
| ☑ | 1616CS | 16 x 16 | 180 | **395** |
| ☐ | 1624CS | 16 x 24 | 310 | **670** |
| ☐ | 1632CS | 16 x 32 | 405 | **835** |
| ☐ | 2032CS | 20 x 32 | 630 | **1240** |
| ☐ | 2424CS | 24 x 24 | 570 | **1230** |
| ☐ | 2436CS | 24 x 36 | 850 | **1765** |

**Table 1** Maximum total <u>enclosed area</u> ($A_e$) that can be serviced by each individual model based on the given <u>net area</u> of engineered openings ($A_o$)
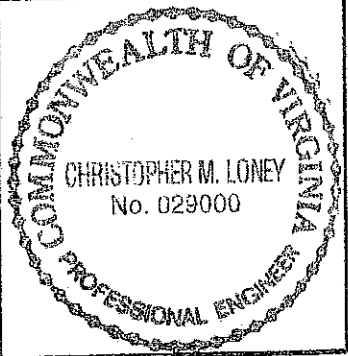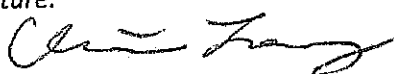
## Installation Requirements and Limitations

This certification will be voided if the following installation requirements and limitations are not enforced:

- There shall be a minimum of two openings on different sides of each enclosed area subject to flooding;
- The bottom of all openings shall be no higher than one foot above the higher of the interior or exterior grade that is immediately under each opening;
- No temporary (e.g. during cold weather) or permanent solid cover may be placed into or over the flood vent that would block the automatic entry or exit of floodwaters at any time;
- Where data or analyses indicate more rapid rates of rise and fall, the required number of openings shall be increased to account for those different conditions. The number or size of the openings may be decreased if data or analyses indicate rates of rise and fall are less than 5 feet per hour.

## Certifying Design Professional

| | | | |
|---|---|---|---|
| *Name* | **Christopher Mark Loney** | *Title* | **Mechanical Engineer** |
| *Company* | **Innovation Products Company** | | |
| *Address* | **1675 Meredith Road, Virginia Beach, VA 23455** | | |
| *License* | **Professional Engineer** | *License No.* | **0402029000** |

*Signature:*

*Date:* 11/12/17

COMMONWEALTH OF VIRGINIA
CHRISTOPHER M. LONEY
No. 029000
PROFESSIONAL ENGINEER

## Identification of the Building and Installed Flood Vents (By Others)

The flood vent models marked in Table 1*) are being installed at the following building:

*Building Address*

# Certification of Engineered Flood Openings

## In accordance with the Code of Federal Regulations for the National Flood Insurance Program

I hereby certify that the **Crawl Space Door Systems flood vents 816CS, 1220CS, 1232CS, 1616CS, 1624CS, 1632CS, 2032CS, 2424CS, and 2436CS** are designed are designed in accordance with the requirements of the Code of Federal Regulations for the National Flood Insurance Program (NFIP) to provide automatic equalization of hydrostatic flood forces by allowing for the entry and exit of floodwaters, when properly installed and sized as set forth below. Vent opening measurements were measured and certified by Mr. Christopher Mark Loney, Virginia P.E. NO. 029000. Detailed calculations were prepared as outlined in "Review of certification of Engineered Flood Openings," prepared by Dr. Georg Reichard, Associate Professor of Building Construction, Virginia Tech (available upon request from Crawl Space Door Systems, Inc. billy@crawlspacedoors.com)

## Design Characteristics

Section 2.6.2.2 of ASCE/SEI 24-05 provides an equation to determine the required <u>net area</u> of engineered openings ($A_o$) for a given <u>enclosed area</u> ($A_e$). This equation is based on the hydraulic formula for the flow rate across sharp edged orifices. I have utilized this equation to calculate 1) the restricted flow rate through the main frame opening in case the louver is blown out during a flood event; 2) the flow rate through the individual openings between louver blades; and 3) the flow rate through projected openings between louver blades following hydraulic short-tube theory. The maximum total enclosed area ($A_e$) that can be serviced by a single vent has then been determined by utilizing the lowest flow rate of the three assessed scenarios for each vent and is listed in Table 1. These values are based on the following assumptions:

- In absence of reliable data, the rates of rise and fall have been assumed at a minimum rate of 5 feet/hour;
- The (maximum) difference between the exterior and interior floodwater levels shall not exceed 1 foot during base flood conditions;
- A factor of safety of 5 has been assumed, which is consistent with design practices related to protection of life and property;
- The net area of openings ($A_o$) as provided by the manufacturer.

| *) | Model | H x W [in] | $A_o$ [in²] | $A_e$ [ft²] |
|---|---|---|---|---|
| ☐ | 816CS | 8 x 16 | 105 | 205 |
| ☐ | 1220CS | 12 x 20 | 235 | 500 |
| ☐ | 1232CS | 12 x 32 | 305 | 645 |
| ☑ | 1616CS | 16 x 16 | 180 | 395 |
| ☐ | 1624CS | 16 x 24 | 310 | 670 |
| ☐ | 1632CS | 16 x 32 | 405 | 835 |
| ☐ | 2032CS | 20 x 32 | 630 | 1240 |
| ☐ | 2424CS | 24 x 24 | 570 | 1230 |
| ☐ | 2436CS | 24 x 36 | 850 | 1765 |

Table 1 Maximum total <u>enclosed area</u> ($A_e$) that can be serviced by each individual model based on the given <u>net area</u> of engineered openings ($A_o$)
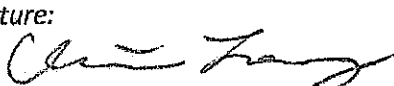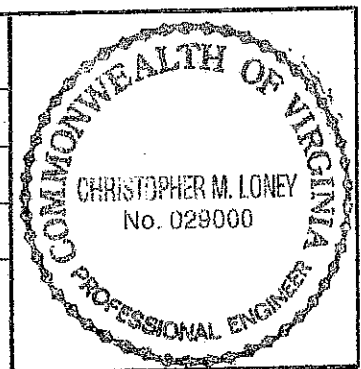
## Installation Requirements and Limitations

This certification will be voided if the following installation requirements and limitations are not enforced:

- There shall be a minimum of two openings on different sides of each enclosed area subject to flooding;
- The bottom of all openings shall be no higher than one foot above the higher of the interior or exterior grade that is immediately under each opening;
- No temporary (e.g. during cold weather) or permanent solid cover may be placed into or over the flood vent that would block the automatic entry or exit of floodwaters at any time;
- Where data or analyses indicate more rapid rates of rise and fall, the required number of openings shall be increased to account for those different conditions. The number or size of the openings may be decreased if data or analyses indicate rates of rise and fall are less than 5 feet per hour.

## Certifying Design Professional

| | | | |
|---|---|---|---|
| *Name* | **Christopher Mark Loney** | *Title* | **Mechanical Engineer** |
| *Company* | **Innovation Products Company** | | |
| *Address* | **1675 Meredith Road, Virginia Beach, VA 23455** | | |
| *License* | **Professional Engineer** | *License No.* | **0402029000** |
| *Signature:* | | *Date:* | 11/12/17 |

*Seal: COMMONWEALTH OF VIRGINIA — CHRISTOPHER M. LONEY No. 029000 — PROFESSIONAL ENGINEER*

## Identification of the Building and Installed Flood Vents (By Others)

The flood vent models marked in Table 1*) are being installed at the following building:

*Building Address*

# Certification of Engineered Flood Openings

## In accordance with the Code of Federal Regulations for the National Flood Insurance Program

I hereby certify that the Crawl Space Door Systems flood vents 816CS, 1220CS, 1232CS, 1616CS, 1624CS, 1632CS, 2032CS, 2424CS, and 2436CS are designed are designed in accordance with the requirements of the Code of Federal Regulations for the National Flood Insurance Program (NFIP) to provide automatic equalization of hydrostatic flood forces by allowing for the entry and exit of floodwaters, when properly installed and sized as set forth below. Vent opening measurements were measured and certified by Mr. Christopher Mark Loney, Virginia P.E. NO. 029000. Detailed calculations were prepared as outlined in "Review of certification of Engineered Flood Openings," prepared by Dr. Georg Reichard, Associate Professor of Building Construction, Virginia Tech (available upon request from Crawl Space Door Systems, Inc. billy@crawlspacedoors.com)

## Design Characteristics

Section 2.6.2.2 of ASCE/SEI 24-05 provides an equation to determine the required <u>net area</u> of engineered openings ($A_o$) for a given <u>enclosed area</u> ($A_e$). This equation is based on the hydraulic formula for the flow rate across sharp edged orifices. I have utilized this equation to calculate 1) the restricted flow rate through the main frame opening in case the louver is blown out during a flood event; 2) the flow rate through the individual openings between louver blades; and 3) the flow rate through projected openings between louver blades following hydraulic short-tube theory. The maximum total enclosed area ($A_e$) that can be serviced by a single vent has then been determined by utilizing the lowest flow rate of the three assessed scenarios for each vent and is listed in Table 1. These values are based on the following assumptions:

- In absence of reliable data, the rates of rise and fall have been assumed at a minimum rate of 5 feet/hour;
- The (maximum) difference between the exterior and interior floodwater levels shall not exceed 1 foot during base flood conditions;
- A factor of safety of 5 has been assumed, which is consistent with design practices related to protection of life and property;
- The net area of openings ($A_o$) as provided by the manufacturer.

| *) | Model | H x W [in] | $A_o$ [in$^2$] | $A_e$ [ft$^2$] |
|----|-------|-----------|----------------|----------------|
| ☑ | 816CS | 8 x 16 | 105 | 205 |
| ☐ | 1220CS | 12 x 20 | 235 | 500 |
| ☐ | 1232CS | 12 x 32 | 305 | 645 |
| ☐ | 1616CS | 16 x 16 | 180 | 395 |
| ☐ | 1624CS | 16 x 24 | 310 | 670 |
| ☐ | 1632CS | 16 x 32 | 405 | 835 |
| ☐ | 2032CS | 20 x 32 | 630 | 1240 |
| ☐ | 2424CS | 24 x 24 | 570 | 1230 |
| ☐ | 2436CS | 24 x 36 | 850 | 1765 |

Table 1 Maximum total <u>enclosed area</u> ($A_e$) that can be serviced by each individual model based on the given <u>net area</u> of engineered openings ($A_o$)
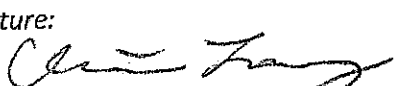
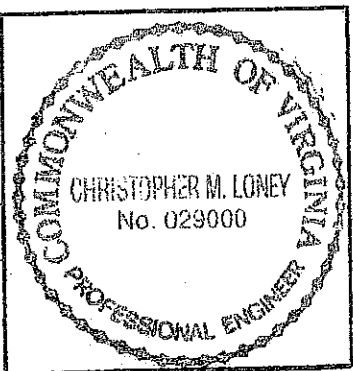## Installation Requirements and Limitations

This certification will be voided if the following installation requirements and limitations are not enforced:

- There shall be a minimum of two openings on different sides of each enclosed area subject to flooding;
- The bottom of all openings shall be no higher than one foot above the higher of the interior or exterior grade that is immediately under each opening;
- No temporary (e.g. during cold weather) or permanent solid cover may be placed into or over the flood vent that would block the automatic entry or exit of floodwaters at any time;
- Where data or analyses indicate more rapid rates of rise and fall, the required number of openings shall be increased to account for those different conditions. The number or size of the openings may be decreased if data or analyses indicate rates of rise and fall are less than 5 feet per hour.

## Certifying Design Professional

| | | | |
|---|---|---|---|
| Name | Christopher Mark Loney | Title | Mechanical Engineer |
| Company | Innovation Products Company | | |
| Address | 1675 Meredith Road, Virginia Beach, VA 23455 | | |
| License | Professional Engineer | License No. | 0402029000 |

Signature: _[signature]_

Date: 11/12/17

_[Seal: COMMONWEALTH OF VIRGINIA — CHRISTOPHER M. LONEY No. 029000 — PROFESSIONAL ENGINEER]_

## Identification of the Building and Installed Flood Vents (By Others)

The flood vent models marked in Table 1*) are being installed at the following building:

Building Address

_10808 Waterside_

# Certification of Engineered Flood Openings

## In accordance with the Code of Federal Regulations for the National Flood Insurance Program

I hereby certify that the Crawl Space Door Systems flood vents 816CS, 1220CS, 1232CS, 1616CS, 1624CS, 1632CS, 2032CS, 2424CS, and 2436CS are designed are designed in accordance with the requirements of the Code of Federal Regulations for the National Flood Insurance Program (NFIP) to provide automatic equalization of hydrostatic flood forces by allowing for the entry and exit of floodwaters, when properly installed and sized as set forth below. Vent opening measurements were measured and certified by Mr. Christopher Mark Loney, Virginia P.E. NO. 029000. Detailed calculations were prepared as outlined in "Review of certification of Engineered Flood Openings," prepared by Dr. Georg Reichard, Associate Professor of Building Construction, Virginia Tech (available upon request from Crawl Space Door Systems, Inc. billy@crawlspacedoors.com)

## Design Characteristics

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- The net area of openings ($A_o$) as provided by the manufacturer.

| *) | Model | H x W [in] | $A_o$ [in²] | $A_e$ [ft²] |
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| ☐ | 1632CS | 16 x 32 | 405 | 835 |
| ☐ | 2032CS | 20 x 32 | 630 | 1240 |
| ☐ | 2424CS | 24 x 24 | 570 | 1230 |
| ☐ | 2436CS | 24 x 36 | 850 | 1765 |

Table 1 Maximum total enclosed area ($A_e$) that can be serviced by each individual model based on the given net area of engineered openings ($A_o$)
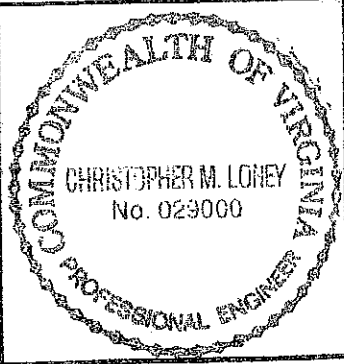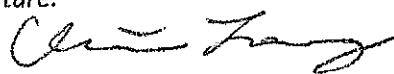
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## Certifying Design Professional

| | |
|---|---|
| Name | **Christopher Mark Loney** |
| Company | **Innovation Products Company** |
| Address | **1675 Meredith Road, Virginia Beach, VA 23455** |
| License | **Professional Engineer** |

Title **Mechanical Engineer**

License No. **0402029000**

Signature:

Date: **11/12/17**

## Identification of the Building and Installed Flood Vents (By Others)

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# Certification of Engineered Flood Openings

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| ☐ | 2424CS | 24 x 24 | 570 | 1230 |
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**Table 1** Maximum total <u>enclosed area</u> ($A_e$) that can be serviced by each individual model based on the given <u>net area</u> of engineered openings ($A_o$)

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| | | | |
|---|---|---|---|
| *Name* | **Christopher Mark Loney** | *Title* | **Mechanical Engineer** |
| *Company* | **Innovation Products Company** | | |
| *Address* | **1675 Meredith Road, Virginia Beach, VA 23455** | | |
| *License* | **Professional Engineer** | *License No.* | **0402029000** |

*Signature:*

*Date:* 11/12/17

COMMONWEALTH OF VIRGINIA
CHRISTOPHER M. LONEY
No. 029000
PROFESSIONAL ENGINEER

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*Building Address*