American Safe Room

Explosion Resistant
Pre-hung
Blast Door

Drawing number: ASR-50-BD
Revision: K4
December 30, 2016

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Description

ASR-50-BD Blast Door is a pre-hung, explosion resistant blast door that offers excellent protection from extremely high pressure blast waves like those produced by a large conventional or nuclear device detonated in relatively close proximity. This door is rated to withstand high pressure events up to 7,200 pounds per square foot — that is 50 pounds per square inch (PSI). The step over threshold options (page 8 and 9) offers a compression seal between the door and the frame allowing for the use of a positive pressure NBC filtration system inside the shelter.

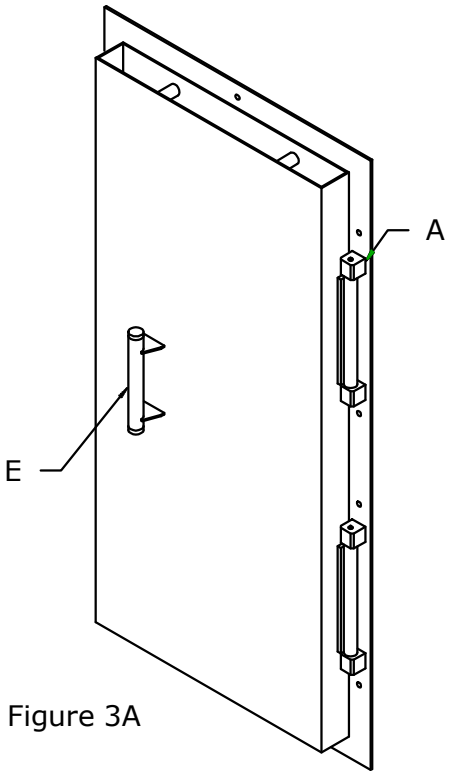


Figure 3A

Hinges (A)
The two vault style 1½ inch diameter steel hinge pins are machined from alloy steel (1), rotating in lubricated 60-60 bronze hat bushings (2) that are embedded in steel bearing blocks (3) with standard grease fittings (4).

This robust assembly allows for both high strength and precise closure to insure the proper alignment and compression of the gas seal.

Door frame (B)
The heavy steel bolt on frame is constructed from 5 by 3 inch by ¼-inch thick steel L-shaped angle with the 3 inch leg serving as the centering guide for hanging the door. The 5 inch leg is predrilled for the included concrete anchoring studs, and serves as a drilling template for locating the drill holes. The pour in place frame adds another flange on the inside wall to make it even stronger.

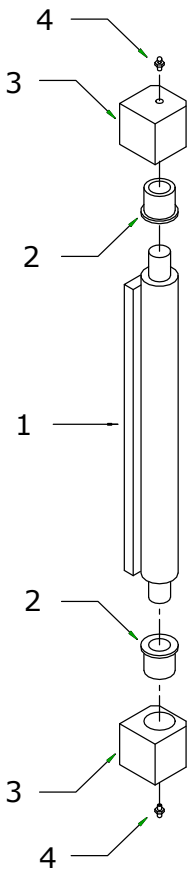


Figure 3B

Inside cam latches (D)
The two inside cam latches draw closed the door as the rotate, compressing the gas seal.

Heavy duty pull handles (E)
Large two handed grip heavy duty pull handles constructed from steel tube and plate are located on both the inside and outside of the door.

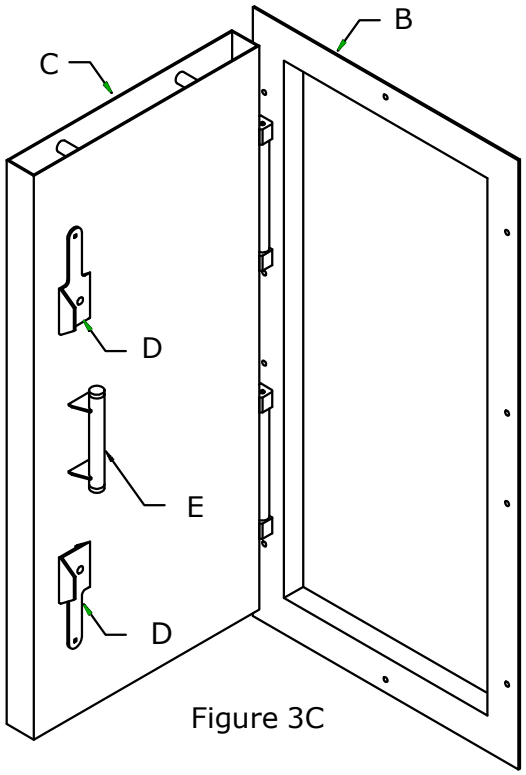


Figure 3C

Strength

The ASR blast door features a stronger door leaf design that is a full 5 sided envelope fabricated from $^{3}/_{16}$ inch steel plate and is filled with concrete *after* the door is installed. This outer skin envelope design (A, B, C, D) affords a greater strength to weight ratio than does early style rebar reinforced poured in place doors of the 1950's. The reason is that the outer skin of the envelope becomes the reinforcement steel, this is the element that stiffens the door against failure due to crumbling and buckling.

Example:
An ASR blast door leaf that is 36 x 80 inches is constructed from 1,200 cubic inches of steel, having a pre-fill weight of 340 pounds of steel.

A standard 36 x 80 inch 1950's style rebar reinforced door that is imported from Europe has as it's structure two courses of ½ inch rebar placed on 6 inch centers (5 vertical and 13 horizontally) for 145 feet of total length of rebar which yields a steel weight of weight of 85 pounds. There is no outer skins on this style of door.

The 1950's door will take about 2,000 pounds of concrete fill, add this to the rebar weight of 85 pounds for a total leaf weight of approximately 2,085 pounds. The ASR door will take about 1000 pounds of concrete fill, add this to the envelop weight of 340 pounds yielding a total leaf weight of approximately 1,340 pounds — the same strength at almost half the weight.

In short, the ASR blast door features more steel, less concrete, and equal or better strength. This less weight means less stress on the hinges, latches and walls. Add to that the ease of installation - no need to pour the bolt on frame in place or make your own plywood forms for the door leaf.

For more information on how this door resists the effects of nearby detonations, see the blast load certification introduction on page 22.

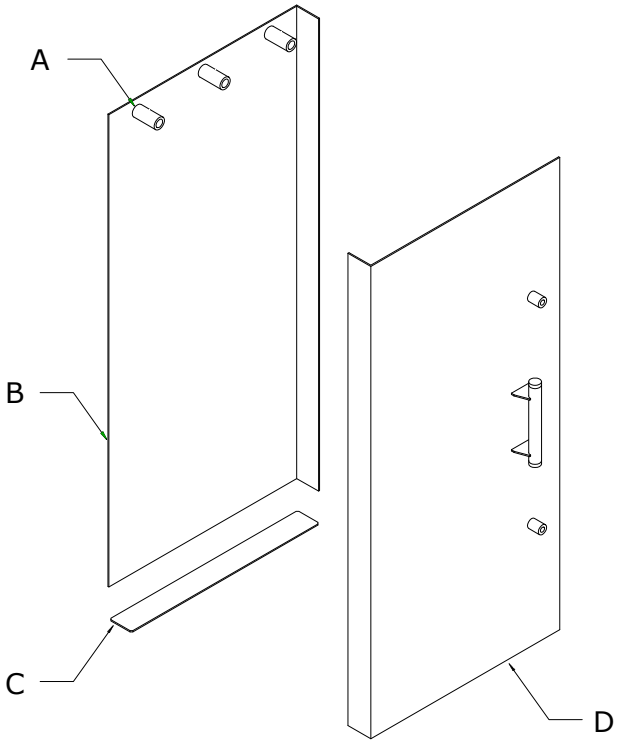


Figure 4

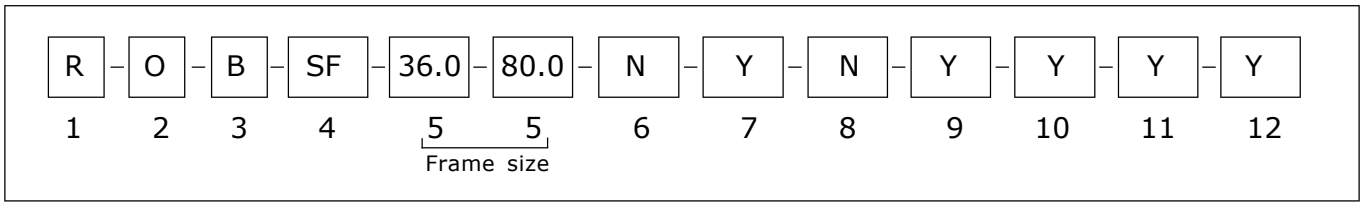
Door construction

A	Lifting point spacers
B	Inside door skin
C	Door floor
D	Outside door skin

Part number

The first step to ordering a blast door is to determine which options are required and create a part number. Every option is explained in this manual on the page numbers references below.

The part number example shown below represents right hand outward swinging bolt-on door, with step over frame threshold, a 36 inch wide by 80 inch high frame size, without outside operators, with assault resistant security latches, without outside deadbolt assembly, with the inset deadbolt assembly, with a viewer, without a differential pressure gauge, and with an additional fire rated door seal. You can fill out the part number block at the left to show the exact blast door you require.



Hand, frame, threshold and size

1. Right or left hand opening, (R or L), see page 6
2. Outward or inward swinging (O or I), see page 6
3. Frame type, bolt-on or pour-in-place (B or P), see page 7
   Note: Please include the dimension inside to inside of the frame flanges with the part number. See page 7 for more information
4. Threshold type: stepover 3” (S3), stepover 5” (S5), flat (FT), or stepover frame (SF), see page 8
5. Frame size in inches, width (##.##) x height (##.##), see page 9, 10, and 11
   32.00 x 72.00 inches and 36.00 x 80.00 inches are the standard door sizes
   Note: nonstandard sized door sizes may cost extra
   We have built many custom doors and will build to fit your existing opening

Latches and locks

6. Outside operators, (Y or N), see page 12
7. Assault resistant security latches and wall capture brackets, (Y or N), see page 13
8. Outside deadbolt lock assembly, (Y or N), see page 14
9. Inset deadbolt lock assembly (Y or N), see page 15
   Note: Items (6 and 7) and (8 and 9) are not normally ordered together on the same door

Options

10. Wide angle viewer, (Y or N), see page 16
11. Differential pressure gauge, (Y or N), see page 16
12. Additional fire rated door seal (Y or N), see page 16

To quote price and availability on a blast door, we need to know this part number, the complete delivery address, whether it is a commercial or residential address, and if you can off-load it with forklift or need a drop gate truck to deliver it on the ground. You will need to have turn around room where the door will be delivered.

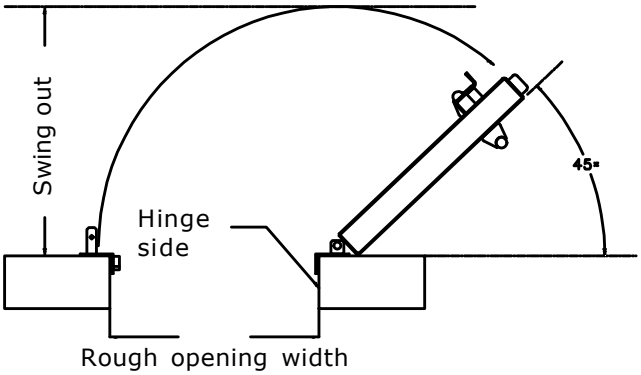
Please e-mail this information to sales@AmericanSafeRoom.com or FAX it to 503-212-6695

Opening direction

These blast doors are designed to open outward, but can be installed to swing inward. On an outward swinging door, the extreme forces produced in a high energy explosion will be taken in the seated condition — transmitted directly from the door leaf to the door frame and wall — not through the hinges and latches to the door frame. See the blasts load certification introduction on page 22 for more information on how forces are transferred through a blast door.

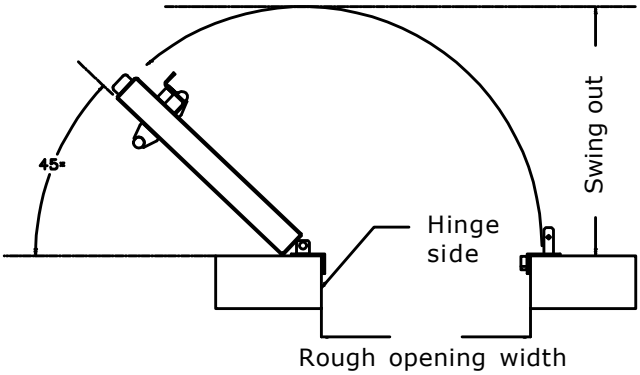
To determine which opening direction is suitable for your needs, picture yourself standing inside the door frame with one foot inside and one foot outside of the shelter — with your back to the hinges. If the door swings to your right it is a right hand door, if the door swings to your left it is a left hand door.

Enter an "L" for a left hand opening door or a "R" for a right hand opening door in box 1 on page 5.



Right hand door shown from top

Figure 6A



Left hand door shown from top

Figure 6B

Note:

- Swing out is always 6" greater than the door width. Example: a 36 inch door width will have a swing out of 42 inches.
- Free opening (inside to inside of door frame) is always ¾ of an inch less than frame size.

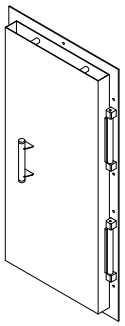
Inward or outward swinging

You can install the doors so they swing inward, but the rated blast pressure protection goes down from 50 PSI to 14.5 PSI.

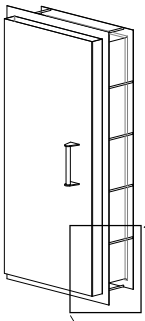
On an inward swinging door, the hinges are behind the wall where they cannot be cut with a torch and if debris falls against the door, you can still open it.

The opening direction of an inward swinging door is determined the same way as an outward swinging door.

Bolt on or pour in place frame



Bolt on
The bolt on doors feature an easy installation and if you are on a tight schedule, it allows you to pour your shelter walls first, then install the door after the wall cures. See page 18 for this installation.



Pour in place
The pour in place doors are the most secure installation. They feature a channel section frame that is the form for the door opening. The wall pour concrete flows into this channel, locking it in place.

Pour in place installation
To install a pour in place door, you need to connect the frame flanges to the wall forms. We don't provide specific installation instructions on how to do this, but here are three installation methods that our customers have used:

Butt up the wall form boards to the frame flanges.

Overlap the wall form boards to the frame flanges.

Insert ICF blocks part way inside the frame flanges.

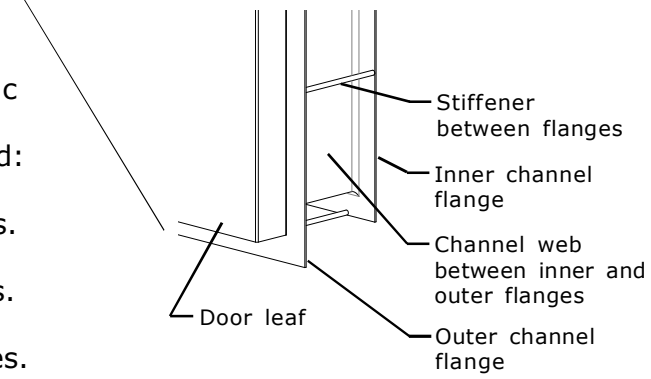


Figure 7A
Pour in place frame detail

Whatever method you use, be sure that there is sufficient contact between the poured concrete and the frame: at least the bottom parts of both flanges and the web should be in contact with the concrete. In other words, do not insert the form material (plywood or ICF block) all the way to the web of the frame channel. This will float the blast door on the form material instead of having a concrete to steel connection on the frame.

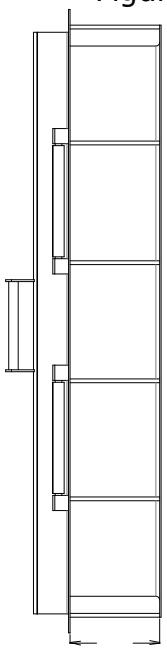
For pour in place doors, we need to know the inside to inside flange dimension you want. Please provide this with the part number. See figure 7B for this dimension.

If you are going to butt up the form boards to the frame flanges, the inside to inside dimension should be the exact thickness of the concrete wall.

If you are going to overlap the form boards to the frame flanges, the inside to inside dimension should be the thickness of the wall, minus ½ inch because the frame flanges are each ¼ inch thick.

If you are going to insert ICF blocks part way into the frame, the inside to inside dimension should be the concrete thickness of your wall plus double the ICF block thickness.

Figure 7B



Inside to inside of the frame flanges

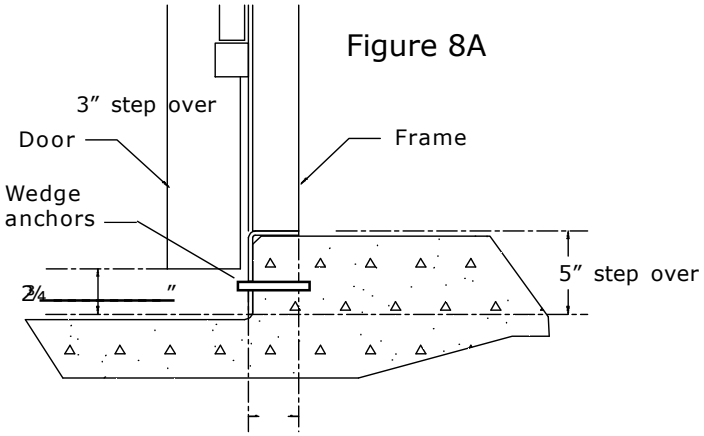
After the walls have cured, the door leaf needs to be filled with concrete. See page 20 for instructions on filling it.

Frame styles

There are four styles of frames to choose from. See the side elevations below and the door size drawings on the next three pages.

Note that in order to have a door that seals you must have mating surfaces on the door leaf and the frame that compress the seal around all four edges of the door leaf. Because of this, the flat threshold will not completely seal — the bottom has a ¾ inch gap.

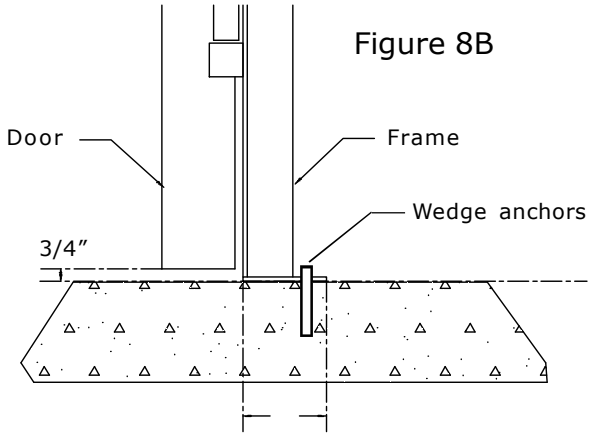
Figure 8A



S5: Step over threshold - 5 inch height

- Complete seal all around the door leaf
- Bottom anchor studs inserted into the wall and through the face of the frame
- 2¾ inch door/floor clearance

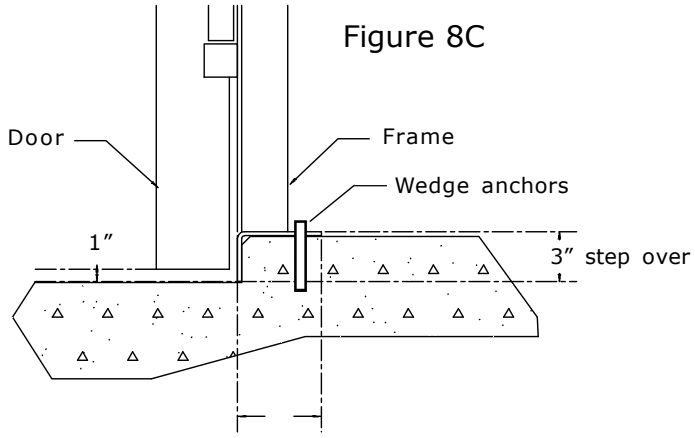
Figure 8B



FT: Flat threshold

- Seal on three sides — the bottom has a ¾ inch open gap that does not seal
- Bottom anchor inserted into the floor and up through the lip of frame
- ¾ inch door/floor clearance

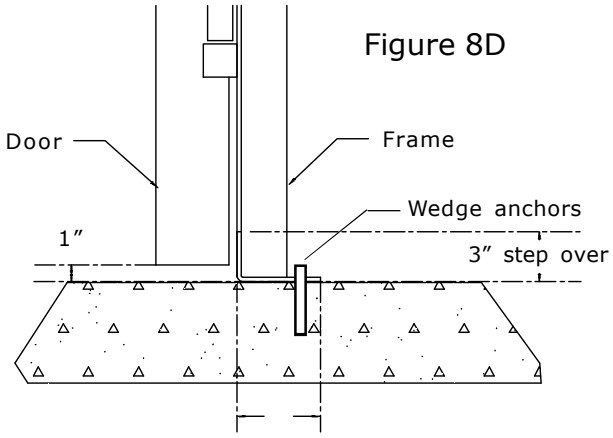
Figure 8C



S3: Step over threshold - 3 inch height

- Complete seal all around the door leaf
- Bottom anchor studs inserted into the threshold (the bottom of the rough opening) and up through the lip of the frame
- One inch door/floor clearance

Figure 8D



SF: Step over frame

- Complete seal around door leaf
- Bottom anchor inserted into the floor and up through the lip of frame
- One inch door/floor clearance

Door size — step over threshold

FRAME STYLE (S)

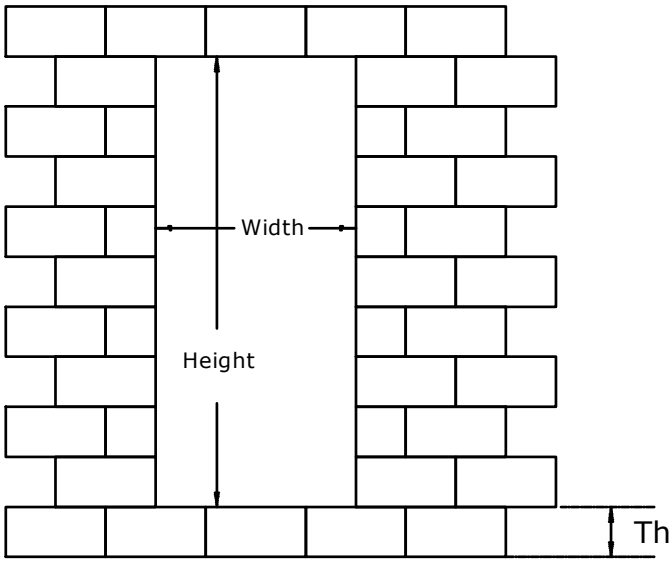


Figure 9A

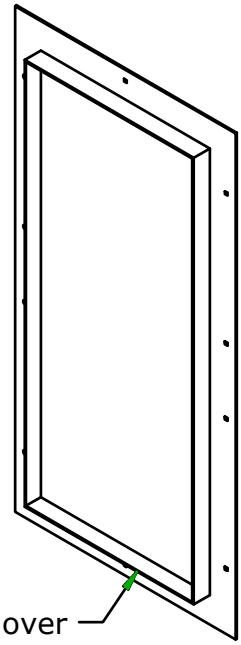


Figure 9B

Step over threshold, 3 inch — frame style "S3"
The step over threshold must have a curb at least 3¼ inches high as shown above.
Enter style code "S5" in box 4 of the part number form on page 5.
Enter the size (in inches decimal) in box 5 of the part number form.

Step over threshold, 5 inch — frame style "S5"
The step over threshold must have a curb at least 5¼ inches high as shown above.
Enter style code "S5" in box 4 of the part number form on page 5.
Enter the size (in inches decimal) in box 5 of the part number form.

Standard door sizes

- 32 inches wide by 72 inches high
- 36 inches wide by 80 inches high

Wall opening size
On bolt on doors, the outside of the door frame lip (that fits into the wall opening) is made to the exact size of the door ordered. To insure a proper fit the rough opening in the wall should be made at least ½ inch wider and taller than the frame lip. Example: a 32 x 72 inch door should have an opening of at least 32½ x 72½ inches. On pour in place door sizes, the order size is the free opening.

Free opening
The free opening is the maximum opening dimension of the frame. It will determine what can fit through the door after it is installed. For bolt on doors, the free opening width and height of a door is ¾ of an inch less than the size ordered. Example: a 32 x 72 inch door will have a free opening of at least 31¼ x 71¼ inches. On pour in place door sizes, the order size is the free opening.

Door size — step over frame

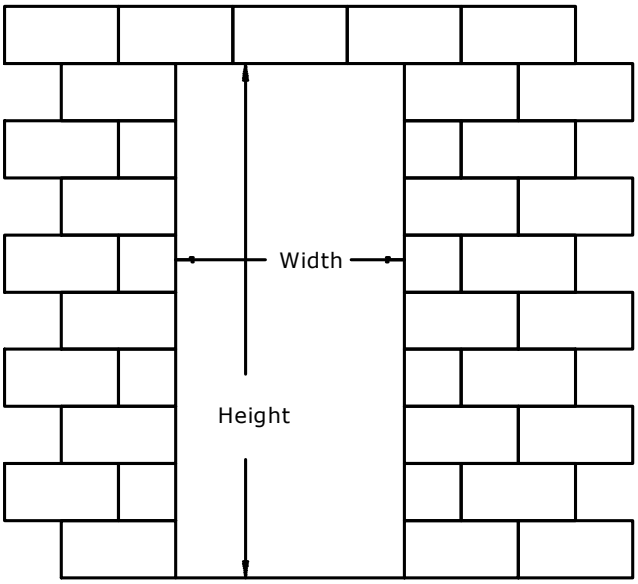


Figure 10A

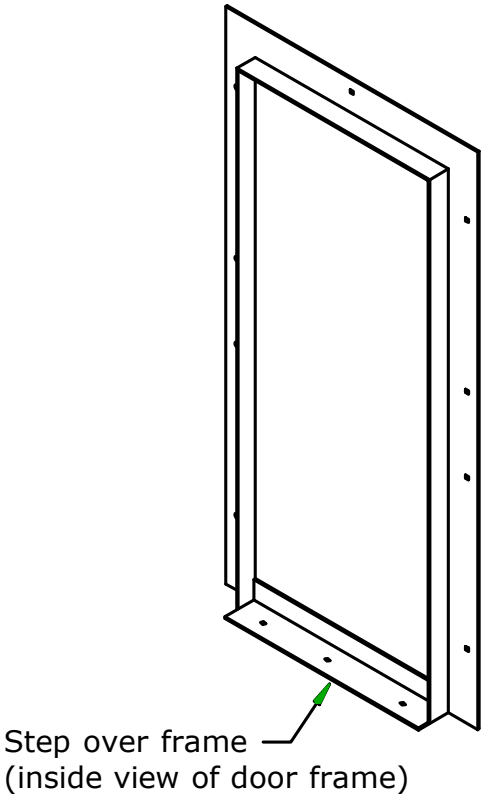


Figure 10B

Flat threshold — frame style "SF"
The flat threshold sits directly on the floor.

Enter style code "SF" in box 4 of the part number form on page 5.

Enter the size (in inches decimal) in box 5 of the part number form.

Standard door sizes

- 32 inches wide by 72 inches high
- 36 inches wide by 80 inches high

Wall opening size
On bolt on doors, the outside of the door frame lip (that fits into the wall opening) is made to the exact size of the door ordered. To insure a proper fit the rough opening in the wall should be made at least ½ inch wider and taller than the frame lip. Example: a 32 x 72 inch door should have an opening of at least 32½ x 72½ inches. On pour in place door sizes, the order size is the free opening.

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Door size — flat threshold

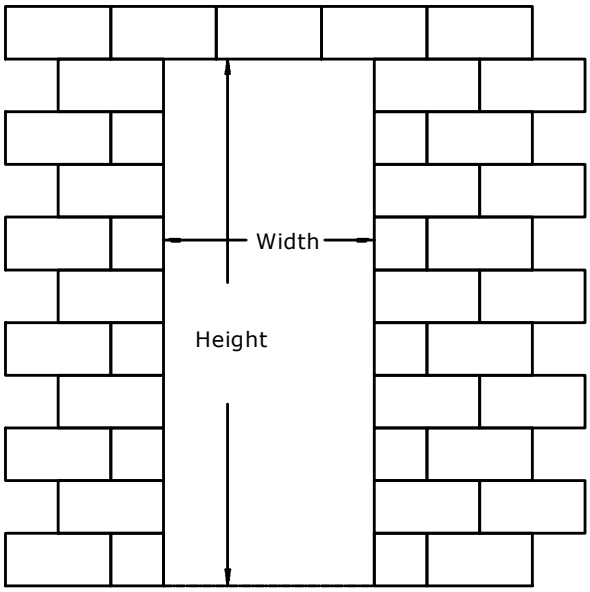

Figure 11A

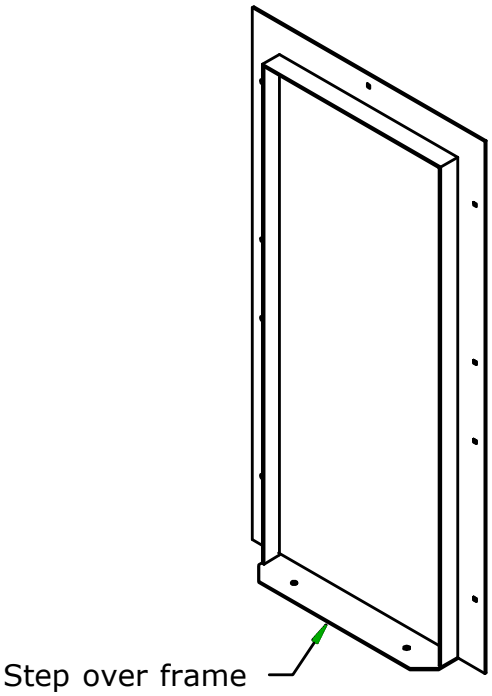

Figure 11B

Flat threshold — frame style "FT"
The flat threshold sits directly on the floor.

Enter style code "FT" in box 4 of the part number form on page 5.

Enter the size (in inches decimal) in box 5 of the part number form.

Note that this frame style does not provide a gas tight seal because there are no mating surfaces at the bottom to compress a door seal.

Standard door sizes

- 32 inches wide by 72 inches high
- 36 inches wide by 80 inches high

Wall opening size
On bolt on doors, the outside of the door frame lip (that fits into the wall opening) is made to the exact size of the door ordered. To insure a proper fit the rough opening in the wall should be made at least ½ inch wider and taller than the frame lip. Example: a 32 x 72 inch door should have an opening of at least 32½ x 72½ inches. On pour in place door sizes, the order size is the free opening.

Free opening
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Outside operators

Outside operators are latch handles on the outside of the door that rotate with the inside latches. There is a shaft that goes through the door leaf linking the inside and outside handles. This shaft is inside a thick machined steel pipe with a grease fitting on the inside of the door. It rotates on two bronze bushings

This option allows you to latch and unlatch the blast door from both the inside and outside. Interior blast doors and industrial applications are the most common installations that require the occupants to open and close the door from either side. It is not suitable for a blast door on the outside wall of a shelter where security is a concern. Outside operators and assault resistant security latches are not normally ordered on the same door. They tend to cancel each other out.

The outside operator (number 1, figure 12B) works in unison with the inside latch (number 2, figure 12A). If you rotate the outside operator, it will rotate the inside cam latch — they are on a common shaft.

To add this option, enter "Y" in box 6 of the part number form on page 5.

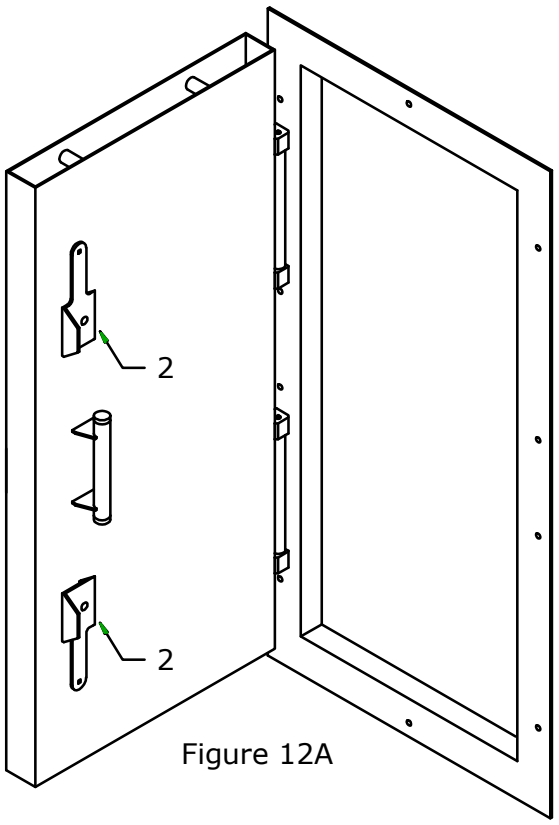


Figure 12A

Note: the outside operator handles (A) are shipped separately and must be installed when the door is installed.

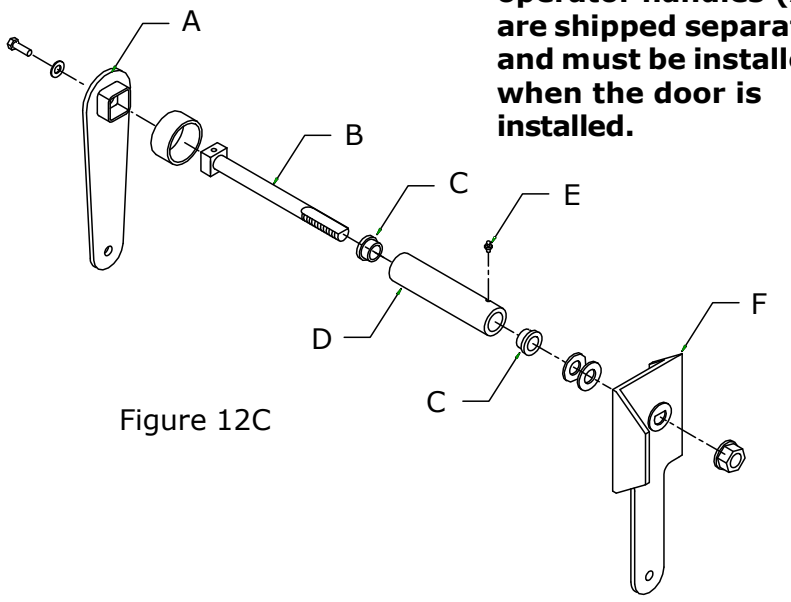


Figure 12C

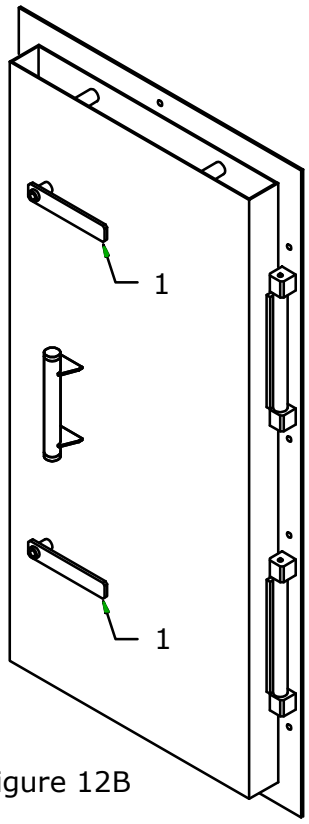


Figure 12B

The outside operator handles (A) may be removed when outside access is not desired.
The assembly transmits outside rotational force directly to the internal cam latch (F) by means of a ¾ inch alloy steel shaft (B) carried by two 60-60 bronze bushings (C) housed inside of the air tight lubrication sleeve (D) with re-grease able fitting (E).

Assault resistant security latches and wall capture brackets

The assault resistant security latches are two additional cam latches on the hinge side of the door (letter A, figure 13A, below) and an anti-slip bracket (letter B) that keeps the door from slipping downward if the hinges are cut. It's purpose is to hold the door in place even if the outside hinges are attacked by a malicious person trying to gain entrance to your shelter. All of the latches are on the inside behind four inches of concrete that a torch cannot burn through.

These are used on an outward swinging door only. On an inward swinging door, the hinges are on the inside where they cannot be attacked directly.

The wall capture brackets are steel angles that go from the door frame lip to the inside of the wall on a bolt-on door. They need to be cut to length and welded onto the frame lip and fastened to the inside wall after the door is installed. They fit walls from 6 to 12½ inches thick. See page 20 for installation instructions.

Wall capture brackets are used on bolt on frames only. The pour in place frame wraps around the back of the wall just like these brackets.

With this option, the blast door is highly resistant to being defeated from the outside. The door itself is resistant to cutting with a torch due to being filled with concrete. The hinges can be cut off with a torch, but the door will stay in place. The frame fasteners can be removed or cut off with a torch - and the frame will stay in place.

To add this option, enter "Y", in box 7 of the part number form on page 5.

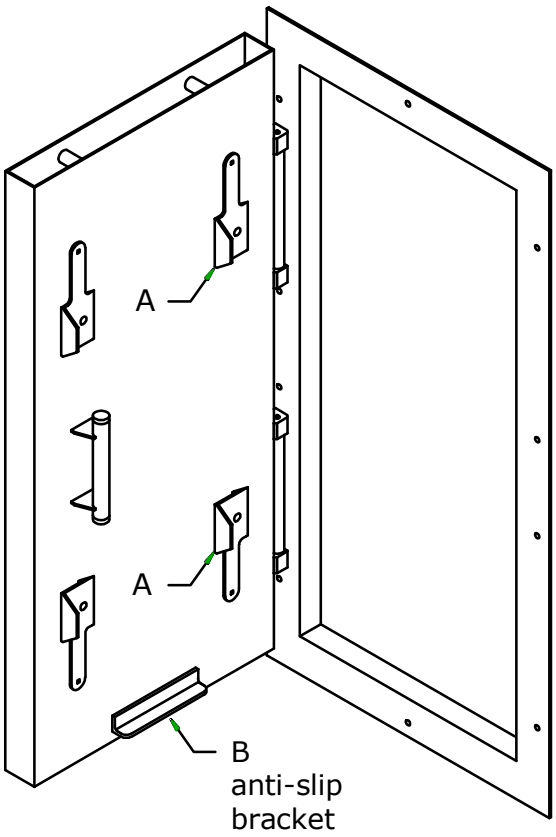


Figure 13A
Door viewed from the outside
A - assault resistant cam latches

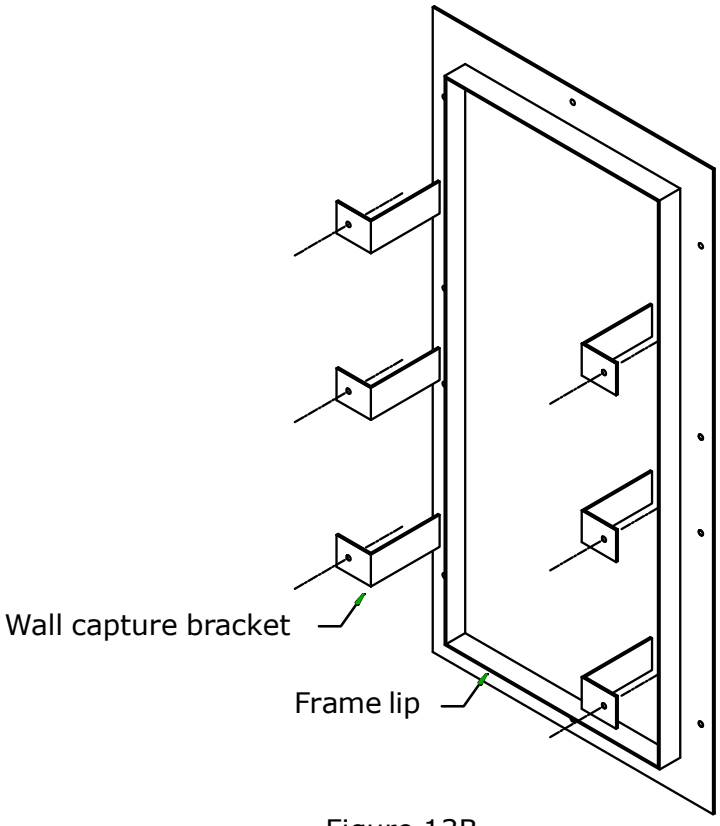


Figure 13B
Door frame viewed from the inside

Outside deadbolt lock assembly

The optional outside deadbolt assembly is used for access control when you are not in your shelter. It consists of a steel box with an industrial grade deadbolt welded to the outside of the door leaf and a corresponding latch plate welded onto the outside of the frame. Two original keys are provided — **they are shipped attached to the rings of the manual binder inside the bucket.**

On most hasp assemblies, there are two holes that line up. These holes could allow a malicious person to easily lock the occupants of a shelter inside by sliding a rod through the holes. This deadbolt assembly does have two holes that line up, but when the deadbolt is locked in the retracted position, it fills up the hole in the lock box, preventing a rod from being inserted.

Note: this deadbolt assembly cannot be operated from inside the shelter. See page 15 for the inset deadbolt assembly that can. Outside and inset deadbolt assemblies are not normally ordered on the same door. They do the same thing.

To add this option, enter “Y”, in box 8 of the part number form on page 5.

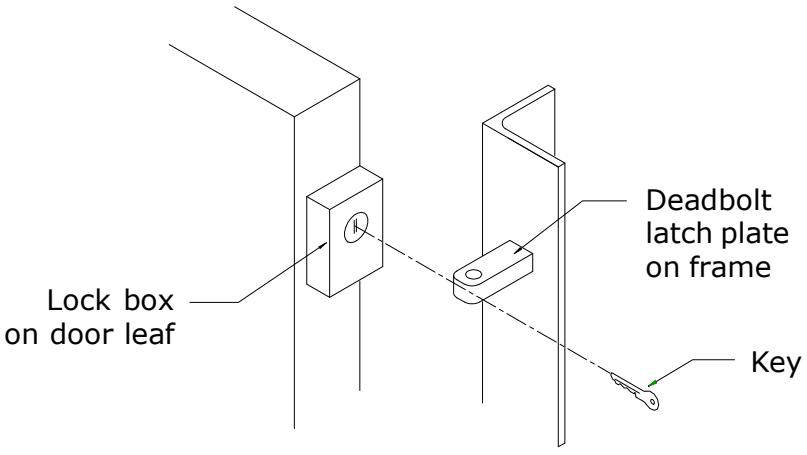


Figure 14A
Deadbolt lock detail

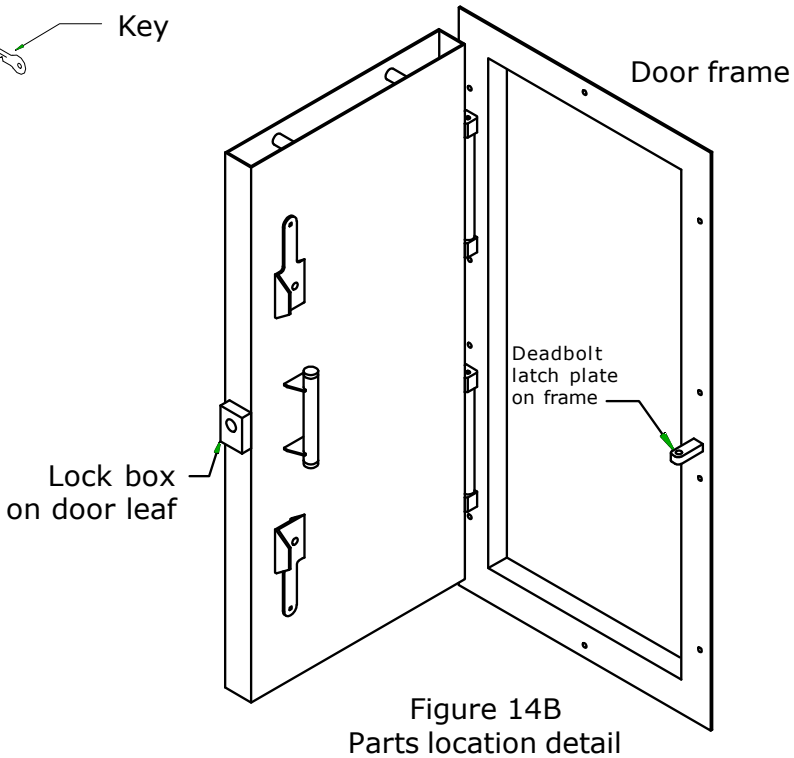


Figure 14B
Parts location detail

Inset deadbolt lock assembly

The optional inset deadbolt assembly is used for access control when you are not in your shelter. It consists of a steel box with an industrial grade deadbolt that is welded to the inside of the door leaf and a "tunnel" of pipe going through the door leaf so the key can be inserted from the outside. The back of this box (inside the shelter) has a lever that operates the deadbolt without a key.

This arrangement insets the lock about three inches from the outer face of the door leaf where it is difficult to attack or use traditional lock picking tools. Two original keys are provided — **they are shipped attached to the rings of the manual binder inside the bucket.**

Outside and inset deadbolt assemblies are not normally ordered on the same door. They do the same thing.

To add this option, enter "Y", in box 9 of the part number form on page 5.

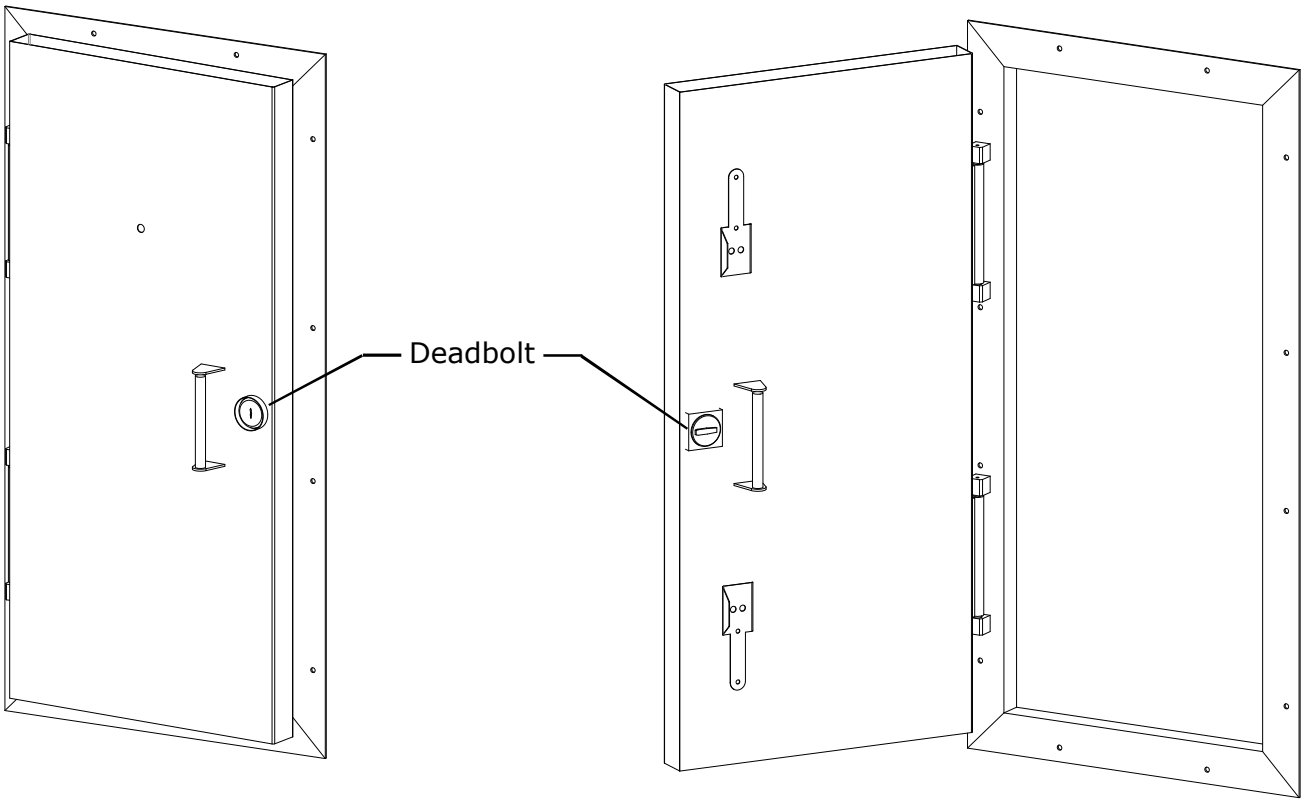


Figure 15A
Outside of door

Figure 15B
Inside of door

Security viewer

The security viewer allows you to see what is happening outside the shelter from the inside. It carries a 90 minute fire rating from UL and a has a panoramic view that gives you a wide field of view. Item A in figures 16A and 16B.

To add this option, enter "Y" in box 10 of the part number form on page 5.

Differential pressure gauge

The differential pressure gauge takes a constant sampling of the air pressure both inside and outside the shelter and displays the difference in air pressure in inches of water column (1 pound per square inch is 27.68 inches of water column). The door is a great place to mount the gauge because we install a sampling tube through the door when we manufacture it. You do not have to install a sampling tube through the wall or ceiling of your shelter. Item B in figure 16A is the shroud on the outside and item B in figure 16B is the gauge on the inside.

Important: ensure that there are four 10-24 machine screws in the threaded holes on the inside of the door before filling it with concrete. Remove these screws after the concrete has cured and mount the pressure gauge.

For more detail see the differential pressure monitor, see the installation manual available at www.AmericanBombShelter.com.

To add this option, enter "Y" in box 11 of the part number form on page 5.

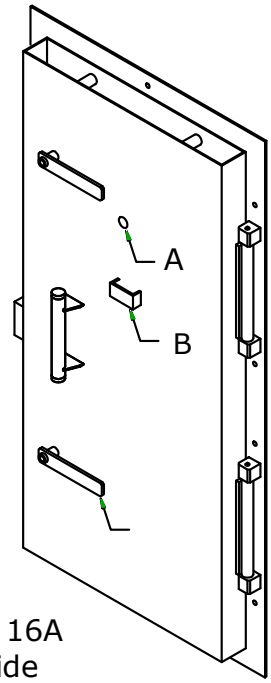


Figure 16A
Outside

Additional fire rated door seal

This seal is applied outside of the regular EPDM door seal. It is a ½ inch wide bulb seal that would have to fail before the main seal is compromised by a thermal event.

Tested in accordance with NFPA (National Fire Protection Association) standards 105 and 252, this seal also meet ASTM E283, E90, and E413. UL classified for use on hollow metal and steel-covered composite-style fire doors rated up to and including three hours. Meets UL 10B, UL 10C, and UL 1784.

To add this option, enter "Y" in box 12 of the part number form on page 5.

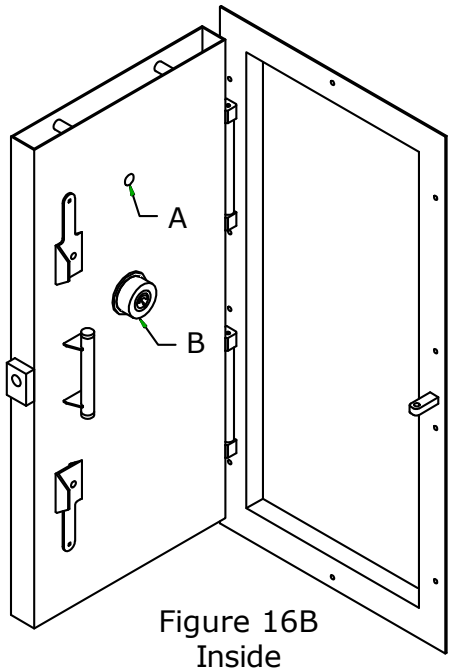


Figure 16B
Inside

Lock and latch operation

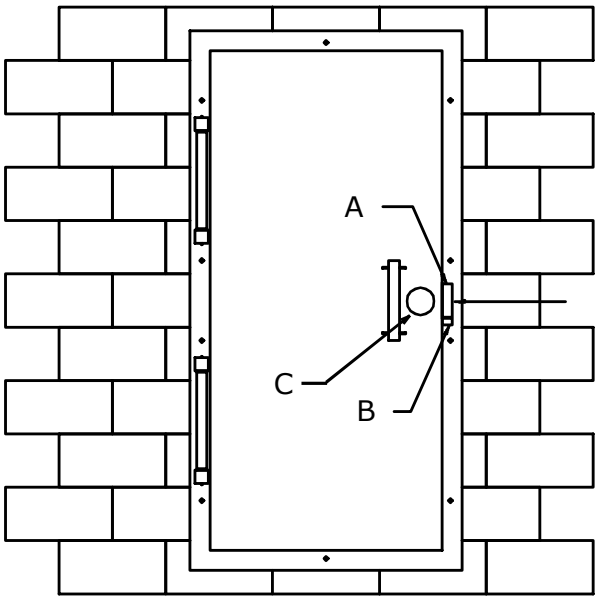


Figure 17A

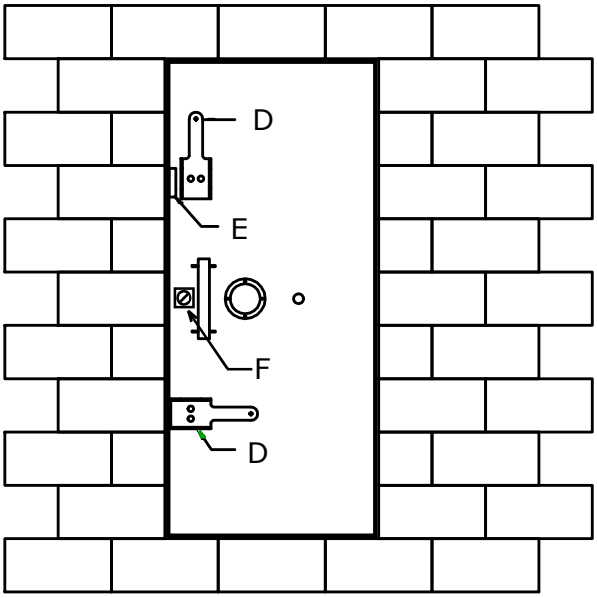


Figure 17B

Note: figures 17A and 17B show both the outside deadbolt assembly and the inset deadbolt assembly for illustration purposes. These two assemblies are not usually found on the same door because they do the same thing — give you access control when you are not in your shelter.

Outside view - outside deadbolt
The outside deadbolt assembly is a steel box with a deadbolt lock welded to the door envelope (A), and latch plate welded to the frame (B). The bolt may be locked in either the locked or open condition from the outside, with a key. It cannot be operated from inside the shelter.

Outside view - inset deadbolt
The inset deadbolt assembly is a steel pipe welded through the door leaf with a deadbolt lock welded to the inside end of it (C). The bolt inserts into a hole in the frame when in the locked position. The bolt may be locked in either the locked or open condition from the outside with a key, or the inside without a key — it has a rotating handle on the inside.

Note: if you have either of the deadbolt options, it is critical that you not warp the frame when tightening the concrete wedge anchors. You can get the hole in the strike out of alignment with the deadbolt.

Inside view
The two cam lock levers (D) draw the door tight to the gas seal by means of tightening against the cam plate (E). In the open position the lever ends point up and down or away from each other. In the closed or locked position the lever ends are parallel pointing across the door to the hinged side. They rotate in opposite directions to latch in case the door is subject to extreme vibrations in a blast — if one latch is loosened, the other will tighten.

Figure 17B shows the top lever in the open or unlatched position, and the bottom lever in the closed or latched position.

Item F is the inside of the inset deadbolt assembly. It has a handle the operates the bolt without the key.

Installation — bolt on frame

Hanging the door

The pre-hung blast door is constructed with two lifting points inside the door envelope. Use only lifting equipment and hardware approved for overhead lifting for this task.

Lift the door into place

Lift door frame assembly into the wall opening and push the door so that the frame lip is fully captured inside the boundaries of the opening. Brace or otherwise secure the door frame assembly so that it can not fall out of the opening.

Be sure to lift the door with a strap or chain using the pick points inside the door leaf as shown in figure 18.

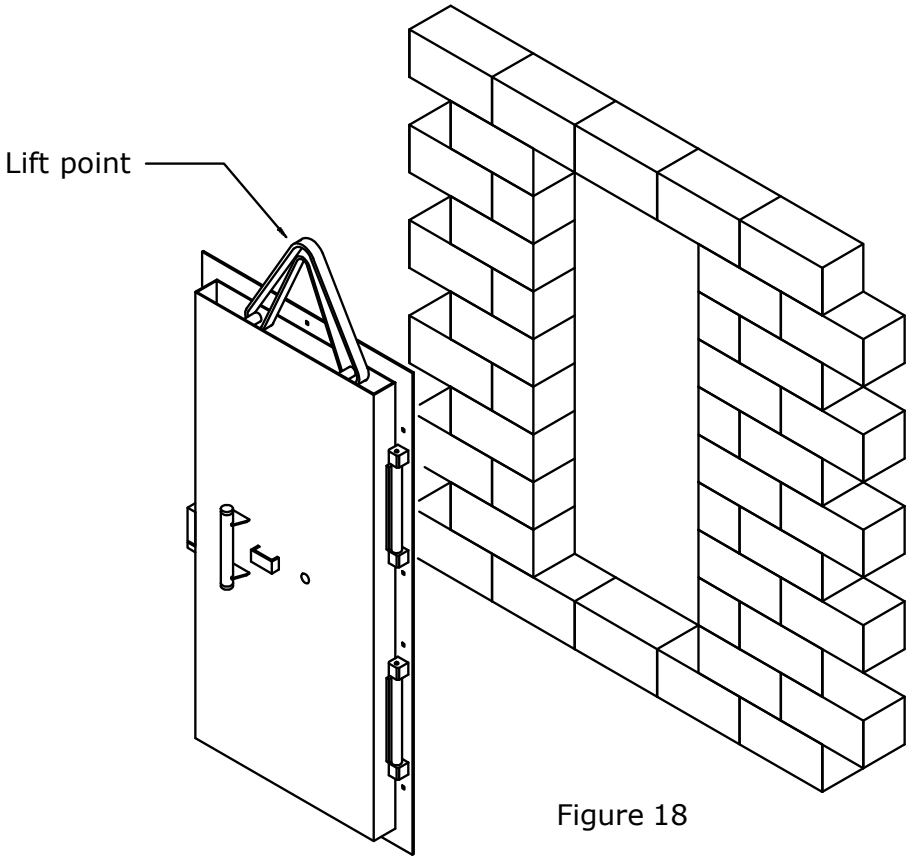


Figure 18

Caution

Take care to not pinch body parts between the door and any obstructions. When swinging the door closed use only the provided door handles. Read and understand these instructions thoroughly before attempting to hang this blast door. American Safe Room strongly recommends that this door be installed by a qualified installer with the proper tools and equipment. A licenced general contractor should be able to follow these directions and complete the installation properly.

Installation — bolt on frame (continued)

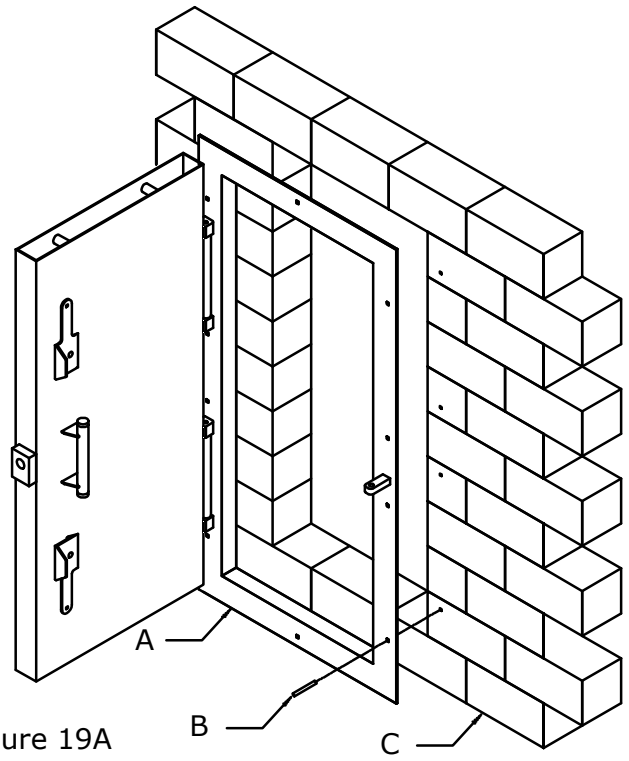


Figure 19A

Grouting the door frame
In order for the door to close, latch, and seal correctly it is necessary for the outer door frame flange (A) to nest flat against the wall surface (C).

If the wall is not perfectly straight, the door frame will bend when the nuts are tightened on the wedge anchor studs, so it is imperative that the wall be grouted to the frame. Do not tighten the frame to an uneven wall. It will warp the frame and the door will not seal.

In cases where the wall is not square or flat with the door frame it will be necessary to use cement grouting to create a flat surface between the frame and well. This is accomplished by creating a ½ inch wide void between the door frame and wall surface and filling it with wet cement grout.

Using the door frame and wall surface as a vice evenly clamp a number of ½ inch thick shims or spacers between the door frame and wall surface by lightly tightening the anchor bolts.

When the cement grout is dry remove the shims and tighten the anchor bolts to full torque, this will provide the door frame with a flat mounting surface.

Installing the anchors
Using the included ½-inch masonry bit, drill the mounting anchor stud holes using the predrilled holes in frame (A) as a template.

Caution: If the some of the nuts on the anchors are tightened more than the others, the door frame can warp. Ensure that the frame stays straight as you tightened the nuts.

They are Concrete Wedge Anchor "Thunder Studs©" that are ½-inch diameter by 4¼ inch length (B).

See page 21 for the technical information and **hole depth** for this fastener system.

Concrete Fasting Systems
Wedge Anchor, Thunder Stud©
1231 E. 26th Street
Cleveland, Ohio 44114

Phone 888-498-5747
www.confast.com

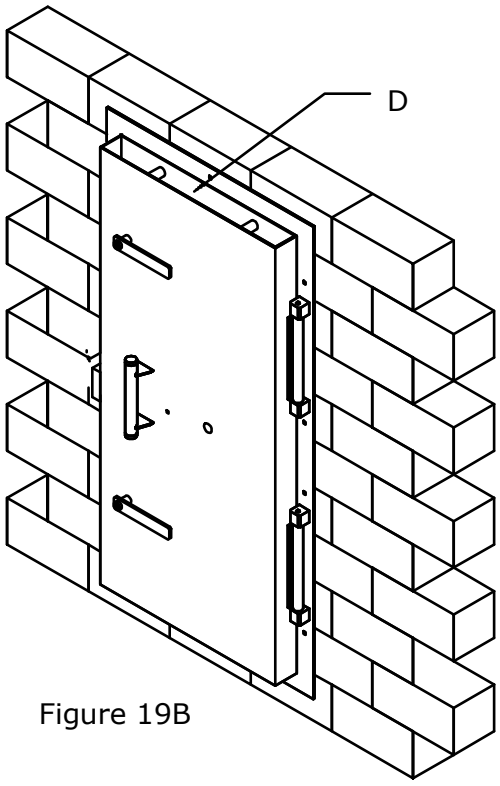


Figure 19B

Installation — bolt on frame (continued)

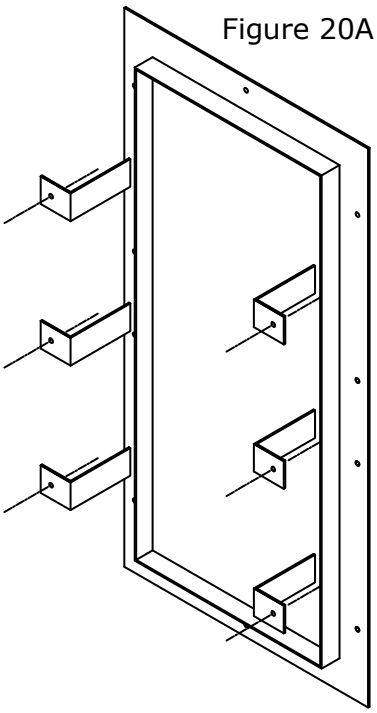
Wall capture brackets
The wall capture brackets are designed to provide extra security and strength to door loads in the unseating condition. They also keep the door frame in place if a malicious person removes the nuts on the outside wedge anchors. Smaller doors will have four brackets, not six, as shown. Wall capture brackets are not necessary on pour in place frames.

Position angle bracket as shown and cut off the long leg leaving a 1/8 inch weld gap between the frame leg and the angle bracket.

Locate the angle brackets between the door frame anchor studs to avoid interferences of the anchors, and install the provided anchor studs as described on page 21.

Make a full length ¼ inch vertical fillet weld the across the 4 inch wide strap and the door frame.

Figure 20A



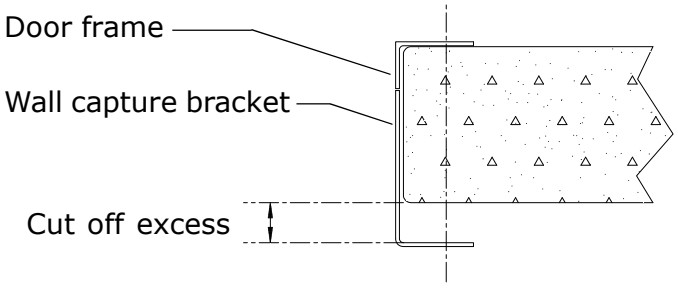


Figure 20B

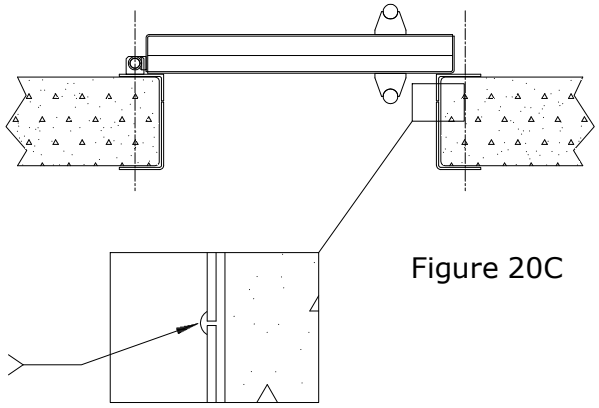


Figure 20C

Sealing the inside door frame lip
After the cement grout is dry and the door frame anchor bolts have been tightened apply a liberal amount of silicon caulking between the inner door frame lip and the sill area.

Filling the door cavity with concrete

After the frame is attached to the wall, the door envelope (item D on Figure 19B on page 19) is filled with concrete. The door must be shut while the concrete cures. It should not be opened for at least four days.

Caution
Do not use a vibrating tamper or tamp down the concrete with a lot of force. The door leaf will bow outward due to hydraulic pressure from the tamping.

Warning
The door is shipped with the latches secured to keep the door leaf and frame together during shipping. If the door is installed with the inside latches secured in an unoccupied shelter, the door and frame must be removed to gain access - you will be locked out of your shelter. This door is designed to deny entry to people outside the shelter.

Pour in place frames
The walls must be poured and have time to get their initial cure. Waiting at least seven days after they are poured to fill the door cavity is recommended.

Outward swinging door
If there is another door or hatch into the shelter, securely latch the door leaf closed prior to filling it. You may swing the door open to make filling easier, but close and latch it as soon as the cavity is filled. Leave the shelter through the other door or hatch and wait four days before opening the door.

If there is no other entrance into the shelter and the latches cannot be used to hold the door closed, brace the door from the outside with boards so that it will not move until the concrete has cured.

Inward swinging door
If there is another door or hatch into the shelter, securely latch the door leaf closed prior to filling it. You may swing the door open to make filling easier, but close and latch it as soon as the cavity is filled. Leave the shelter through the other door or hatch and wait four days before opening the door.

If there is no other entrance into the shelter and the latches cannot be used to hold the door closed, fill the door leaf with concrete inside the shelter, temporarily close the door and operate the latches to ensure the door is working properly, then open the door, go outside and use a cum-a-long or a ratcheting tie down strap to hold the door shut so that it will not move until the concrete has cured. Attach it to the outside pull handle. Tighten it so the door leaf is held securely against the frame.

Concrete
4,000 PSI concrete is recommended. The amount of concrete required will depend on the door size ordered. The formula for calculating the needed fill amount of concrete in cubic feet is the height of the door in inches times the width of the door in inches times the thickness of the door in inches divided by 1,728 (one cubic foot in inches). Four inches is added to the order height and width to allow for the overlap of the door leaf on the frame.

Example: 36 x 80 inch door with a four inch concrete fill thickness.

36 + 4 = 40
80 x 4 = 84
40 x 84 = 3,360
3,360 x 13,440 cubic inches
13,440 / 1,728 = 7.8 cubic feet of concrete

Concrete wedge anchor - technical information

The ThunderStud® wedge anchor consists of two pieces, permanently pre-assembled into a single unit. The carbon steel rod is threaded for a portion of its length. The extreme end of the threaded portion is rounded to protect the threads from damage while the anchor is being driven into the hole drilled in the concrete. The other end of the rod has a necked down diameter, which runs for a short distance, at the end of which it tapers outwardly to the full diameter of the rod. A precision formed universal clip made of carbon steel is permanently assembled around the necked down diameter to complete the anchor. Each package contains the correct number of nuts and washers.

Concrete Wedge Anchor - Approvals
Listed by Underwriters Laboratories (UL), International Conference of Building Officials (ICBO) carbon steel only, Board of Standards and Appeals (BSA), City of L.A. Meets or exceeds U.S. Government G.S.A. Specifications FF-S-325 Group 11, Type 4, Class

Concrete Wedge Anchor - Applications
Medium to heavy duty into concrete.

Concrete Wedge Anchor - Installation
(1) Drill hole into concrete with a carbide tipped masonry drill bit conforming to ANSI B94, 12-77, the same size as the ThunderStud® wedge anchor. If the fixture being fastened is in place and being used as a template to locate the ThunderStud® anchor, the mounting hole in the fixture should afford clearance for the universal wedge clip on the stud. (2) Clean hole, place the ThunderStud® wedge anchor through the hole in the fixture or directly into the concrete and hammer it in to the drilled hole until the threads are below the surface of the fixture/concrete. (3) Turn the nut by hand until the unit is snugged up. Tighten the nut with a wrench, approximately three or four full turns, to complete the fastening.

Concrete Wedge Anchor - hole depth
Minimum embedment, plus fixture, plus nut and washer. The ThunderStud® wedge anchor requires no maximum hole depth. The depth of the hole in the concrete should be the length of the wedge anchor minus the thickness of the material being fastened. This will result in some extra depth to accommodate a minor amount of concrete cutting which may not be able to be cleaned out of hole.

The above information is from the wedge anchor manufacturer. Here is information specific to our blast doors:

> Standard size doors have a frame thickness of ¼ inch. The wedge anchors we supply are 4¼ inches long so the hole should be 4 inches deep.
>
> Large, custom sized doors may have a 5/16” frame thickness. The wedge anchor hole depth on these should be $3\,^{7}/_{8}$ inches deep.

Blast and rebound loads

Mass
Blast doors are designed to have a lot of mass to provide radiation protection. Another reason is because they cannot fail until they deflect and they cannot deflect until they start to move. An object at rest will remain at rest unless acted on by an unbalanced force and all objects resist changes to their state of motion. The greater the mass, the greater the force it takes to overcome it's static (lack of) inertia. *The blast load has very high energy, but a very short duration.* It must get the door moving, move it enough to fail, then have energy left to damage what is inside the shelter — all in under a second.

This is true of all blast doors with a lot of mass, but the American Safe Room blast resistant door also utilizes it's steel envelope to resist deflection. When the blast pressure hits the door leaf, the force is transmitted from the outer skin to the concrete fill to the inner skin. The outer skin (and the entire steel envelope) keeps the concrete in place. The concrete is under compression, and the inner skin is under tension. *These are exactly the loads that steel and concrete are optimized to resist.*

Pressure events
When a nearby detonation occurs, the first wave to hit your location is high pressure. You have the incident (direct) pressure wave, the reflected wave, and the mach stem (combined incident and reflected).

On an outward swinging blast door, the pressure wave will compress the door leaf against the frame (the seated condition). The door leaf acts as a bridge and the force is transferred directly from the leaf to the frame.

Vacuum event
The second event is "negative" pressure (less than atmospheric). This is because the blast blows the atmosphere outward from the point of detonation and result is less pressure than normal atmospheric pressure — down to a vacuum. Since a vacuum is the absence of atmosphere, you cannot go lower than negative 14.5 PSI (the air pressure at sea level).

In this phase, an outward swinging door will be sucked out, away from the frame (the unseated condition). The force travels from the door leaf through the hinges and latches to the frame. Since the latches will fail before the massive hinges, the latch load rating is shown in the last two drawings.

Professional engineer certification
This door engineer certified for 7,200 pounds per square foot (50 pounds per square inch) in the seated condition and 2,088 pounds per square foot (14.5 pounds per square inch) in the unseated condition. The unseated condition is sometimes referred to as a "rebound load."

This certification is available online at www.AmericanSafeRoom.com