



Tighe&Bond

10 Central Street
Manchester-by-the-Sea Massachusetts

Flood Mitigation Alternatives for Critical Town Facilities

Prepared For:

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Section 1 Introduction

1.1 Project Overview and Goals

Manchester-by-the-Sea would like to take advantage of the upcoming Hazard Mitigation Grant Program (HMGP) to address current and future flood risk to critical community assets with proposed upgrades to the Town's Emergency Management Facilities (Town Hall/Police Station) and the Wastewater Treatment Plant (WWTP). These two locations are within the 100-year flood plain and have sustained damages in the past from both coastal and inland flooding. The frequency of flooding at these locations is only expected to increase as Manchester-by-the-Sea experiences the impacts of sea level rise (SLR) and increased storm surge. Tides for Manchester Harbor are similar to those in Boston Harbor and are expected to experience impacts of SLR. Tide gauge data for Boston has been collected over the past 100 years and suggests a linear sea level rise trend of approximately 2 mm/year for sites and structures not subjected to soft soils and land subsidence. The project area is located above marine clay, and likely is subject to additional land subsidence. A map of the FEMA flood zones for a portion of Manchester-by-the-Sea is shown in Figure 1, below.

A recent review of SLR projections for Manchester included the recommendation that new facilities subject to coastal flooding be designed with an allowance for 1.7-feet of future sea level rise by 2070 plus wave action, if applicable. If a site is subject to wave action, it is expected the 100-year flood, plus sea level rise, plus wave action is likely to exceed the 100-year flood plus 3 feet, for both breaking and non-breaking waves. The WWTP and Town Hall facilities are within the FEMA AE Zone with a base flood elevation of 10 feet-NAVD88 but are not subject to wave action.

This memo evaluates flood mitigation options for both the Town Hall/Police Station and WWTP and provides a discussion of the pro's and con's relative to approximate cost, permitting, deployment and useful life of each option. Flood mitigation options are designed to elevation 12.5-feet NAVD88, the 500-year floodplain water surface elevation, which is 2.5-feet higher than the FEMA 100-year base flood elevation for this location, providing a 0.8-foot margin of safety over the recommended 1.7-feet allowance for SLR to account for potential land subsidence.

Earlier evaluations of the WWTP recommended a sea-wall enclosing the entire waterfront around 10 Central Street. This option would be very expensive and difficult to permit.

Section 2 and 3 discuss options for the WWTP and Town Hall/Police Station. Section 4 summarizes recommendations for the most cost-effective approach at each location.

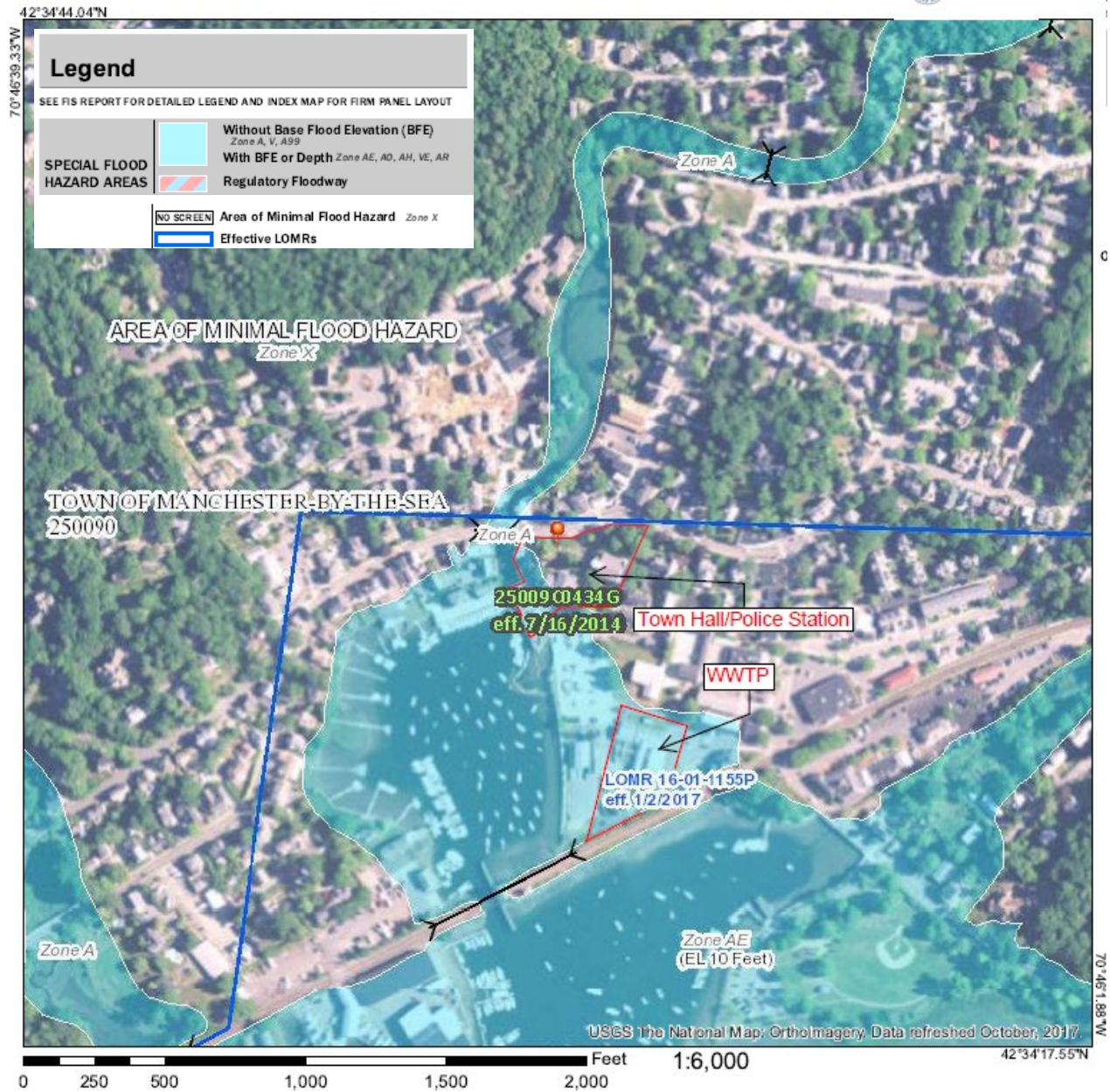


Figure 1: Flood Zone Map (adapted from FEMA Flood Map Service Center)

Section 2 Wastewater Treatment Plant Flood Mitigation Alternatives

The Manchester Wastewater Treatment Plant (WWTP) is designed for an average daily flow of 1.2 MGD, a maximum daily flow of 3.0 MGD and an instantaneous maximum flow of 5.0 MGD. It was constructed in 1998 and includes: influent pumping, influent sewage grinding with a manual bar rack, grit removal equipment, aeration tanks and blowers, chlorine disinfection and sludge thickening. The WWTP is located on Manchester Harbor and discharges to an outfall 8,900 feet outside the Harbor near Misery Island.

The WWTP is located entirely within the 100-year and 500-year FEMA floodplains. The Headworks Building has the highest risk of flooding on the site. Non-submersible influent and effluent pumps are located below grade within the Headworks Building and would be rendered inoperable if flood waters were to enter the building which would result in the entire WWTP being inoperable. Chemical storage is also located at grade within the Headworks Building in open cabinets. The WWTP parking lot has flooded previously during king tides and storm surges (with notable flooding as recently as March 2018). The flooding resulted in damage to meters and electrical conduits in service manholes, and flooding of the Odor Control Building. High groundwater seeps into the basement in the Headworks Building. Flooding is exacerbated when the storm drainage system overflows during extreme rain events, or back surges out of catch basins during extreme high tides.

Figure 2, below, depicts the extent of flood hazard areas at the WWTP, including the current 100-year base flood elevation and future flooding hazards for storm surge and sea level rise. Exposure vulnerability is represented based on probability of occurrence from 1% (very unlikely) to 99% (extremely likely). This graphic does not account for the location of underground utilities that may be impacted by coastal flooding, or stormwater flooding from extreme precipitation.

Table 1 provides structure elevations for key elements of the WWTP and summarizes impacts of the 100-year storm (base flood elevation is 10 feet NAVD88). For multi-story buildings the elevation of the first story is provided.

TABLE 1
Elevations of Key WWTP Elements and Flood Impacts

Structure	Elevation (feet) ¹	Impact
100 Year Storm	10.0	
Facility Grounds	7.19– 10.19	Currently flood during extreme flood conditions.
Operations Building	10.19	Basement may flood at future 100-year flood elevations.
Headworks Building	10.19	Lower levels may flood at future 100-year flood elevations.

Aeration Tanks (Top of Wall)	18.86	Potential for flooding is low.
Clarifiers (Top of Wall)	16.29	Potential for flooding is low.
Flash Mix Tank	10.19	Likely to flood at 100-year flood elevations.
Chlorine Feed/Storage	9.19	Potential to flood at 100-year flood elevations.
Odor Control	9.19	Currently floods during high tides. Likely to flood at future 100-year flood elevations.
Generator	10.19	Potential to flood at future 100-year flood elevations.

¹ In NAVD88. Elevations were taken from 1996 *Manchester By the Sea WWTF Upgrading Contract Drawings*, which was NGVD29. Converted to NAVD88 by subtracting 0.8061 feet.

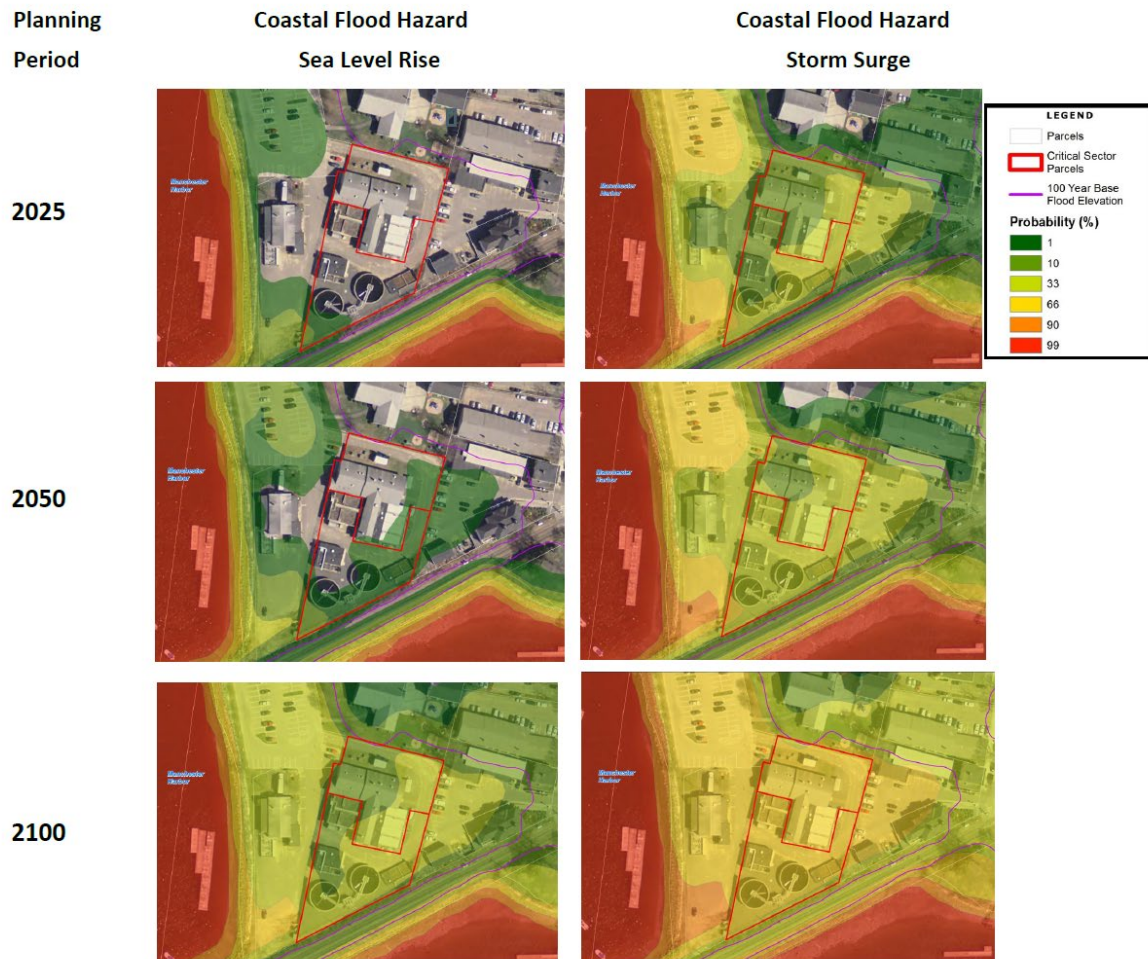


Figure 2: WWTP Flood Hazard Areas (Vulnerability and Risk Assessment)

The following alternatives were identified as potential flood mitigation options for the WWTP and are evaluated in the following sections:

- Moveable Flood Wall System
- Chemical Storage Locks
- Elevate Generators
- Stormwater Outfall Check Valves

Addition flood mitigation options for the WWTP were discussed with the Town but were not included for evaluation in this memo including sump and mobile pumps, dry flood proofing the WWTP building, and waterproofing electrical manholes in the parking area.

2.1 Moveable Flood Wall System

2.1.1 Overview

Moveable flood wall systems are rapidly deployable connected sections that create a flexible flood barrier of any length. These systems are suitable for use on roads, pavements, pathways and level areas of grass or soil. The system can be assembled by two people and is deployed before a storm event which could cause flood conditions. The barrier is made of a lightweight plastic material which is filled with water to create a seal between the barrier and the ground. The barrier holds back flood waters to a few inches below the top of its height. In addition to the flood barrier, portable pumps may also be deployed behind the flood barrier enclosure to drain any excess stormwater accumulating behind the barrier.

If desired, the flood wall may remain in place for the winter months and be removed during tourist season to allow for increased parking capacity. When in place, the flood barrier will need to allow for vehicle access in and out of the parking lot, so it will be necessary to remove portions of the barrier intermittently.

Flood wall systems can range from 2-feet to 8-feet in height and come in sections approximately 2-3 feet wide and 1-2 feet deep. Barriers can also connect directly to in-situ objects such as walls and buildings. Two types of systems were evaluated, Floodstop and Muscle Wall. Photos showing the units are included in Attachment B.

2.1.2 Installation Process

Figure 3 shows the conceptual alignment of the flood wall deployed before a flood event to prevent flood water from entering the WWTP and protect areas at high risk of flooding. The barrier would be deployed as necessary and the units could be stored in an easily accessible location when not in use.

Vehicular access would not be anticipated while the flood barriers were fully deployed as flooding conditions would be occurring or be eminent outside of the barriers. Each barrier and interconnecting pin can be removed and the sections of barrier along the WWTF fence gate could be removed should vehicular access be required during deployment.



Figure 3: Flood Barrier Alignment at WWTP

2.1.3 Costs

As part of this project, vendors were contacted for an estimate of probable construction cost for a moveable flood barrier system. The FloodStop barrier fills with rising flood waters, which combined with weight of the unit ensures the barrier holds back flood waters. The cost for 925 feet of a 3-foot FloodStop barrier by Barrier Solutions is estimated to be approximately \$167,000. This price includes the flood stop barriers and an interlocking key that creates a seal between the units. This price does not include deployment of the flood barrier system during flood events or storage of the units when not in use. Installation of the FloodStop barrier can be carried out by operations staff in a fairly short period of time.

A second flood wall product, Muscle Wall, is also available and comes in 4-feet and 6-feet height options. The cost for 925 feet of a 4-foot high Muscle Wall flood barriers is approximately \$134,000. This price includes the units and a liner which renders the barrier impenetrable. A downside of the Muscle Wall is that it requires deployment of sandbags and polyethylene liner, greatly increasing the level of effort to install the units, whereas the FloodStop barrier only requires deployment of the walls and pins.

Since Town staff will deploy the flood barrier system during flood events and store the units when not in use, the FloodStop barrier by Barrier Solutions would be recommended based on the time savings in installation.

All preliminary costs can be found in Attachment A.

2.2 Chemical Storage Locks

2.2.1 Overview

Chemicals are stored in the laboratory of the WWTP, located within the Operations Building. The chemicals are often stored on lab benches and open shelving units as shown in Figure 4. The first-floor elevation of the Operations Building is 10.19 feet, just above the 100-year base flood elevation.

Other flood mitigation options described in this Memo, would prevent water from entering the Operations Building during the 500-year flood conditions and prevent lab chemicals from mingling with flood waters. However, should the WWTF not be protected from flooding, the chemicals should be stored above the flood elevation. The storage area should be made watertight. It is recommended that chemicals be stored in an elevated locking wall mounted chemical storage cabinet.



Figure 4: Chemical and Sample Storage at WWTP Laboratory

2.2.2 Costs

The cost for a 20-gallon wall mounted locking chemical storage cabinet is approximately \$1,100. The dimensions of each storage cabinet are 43-inches wide by 12-inches deep by 43-inches high. Cabinets could be mounted by operations staff on the laboratory wall. The Town may wish to purchase three wall-mounted chemical storage cabinets to contain all possible liquid hazards, which have a capital cost of approximately \$3,300.

2.3 Elevate generator

2.3.1 Overview

The WWTP is equipped with a 500 KW standby generator that can provide power to the Facility for about 10 days at 40% capacity. The generator is located on the north side of the Operations Building and is situated on a 5-inch concrete pad. The fuel tank is located below the generator and is at an elevation of approximately 9.8 feet. To elevate the generator to 12.5 feet, the bottom of the fuel tank will need to be elevated an additional 2.7 feet above the existing concrete pad. Stairs would likely be needed to access the fuel tank and generator.

2.3.2 Installation

A new concrete pad 4-feet tall, approximately 11-feet wide and 20-feet long will be placed adjacent to the existing concrete pad. Once the new pad has been poured and set, the generator will be disconnected and moved to the adjacent pad with the use of a crane. The generator will then be reconnected; depending on the distance between the existing and new concrete pads, wires and fuel piping may need to be extended to reach the generator's new location.

2.3.3 Costs

To pour a new concrete pad, transfer the generator from the existing pad and reconnect is estimated for a construction crew to take approximately 5 days of labor plus down time. The estimated cost is \$170,000. A breakdown of approximate costs is included in Attachment A.

2.4 Stormwater outfall check valves

2.4.1 Overview

There are two stormwater outfalls in close proximity to the WWTP and the Town Hall/Police Station, as shown in Figure 5, below. These outfalls discharge to Manchester Harbor. When the surface elevation of this water is high due to tidal conditions, water can flow backward through the outfall pipe and back up the storm drain system causing localized flooding near the Town Hall and WWTP. To prevent backward flow through these outfall pipes, check valves may be installed. This duckbill valve is installed at the end of the outfall piping. It is normally closed and when water pushes through, that pressure opens the pipe discharge. A check valve is a one-way valve that allows fluid to flow in only one direction, in this case- out of the stormwater outfall pipe into the receiving waterbody. Additionally, in-line check valve options can be installed in the drain pipes near outfalls and catch basins.



Figure 5: Locations of Stormwater Outfalls near WWTP and Town Hall

2.4.2 Installation Process

The outfall nearest to the Town Hall which discharges on the north side of the boat ramp is non-pressure rated 12-inch PVC and the outfall nearest the WWTP which discharge north of the railroad tracks is 15-inch. There are several different check valve options that may

be installed at these outfalls. The 12-inch Checkmate In-Line check valve may be installed on the inside of both the 12-inch and 15-inch outfall pipes. Twelve-inch and 15-inch Tide Flex check valves may be installed on the outside of the 12-inch and 15-inch outfall pipes, respectively. Manufacturer specifications for each of the check valves are included in Attachment B. These check valves have had success in allowing one-directional flow, however if debris is caught in the flapper, the valve may stay open. Therefore, the valves should be inspected frequently. To prevent surcharge from the rest of the stormwater drainage area into WWTP's catch basins, it is also recommended that in-line check valves be installed in the catch basins on the discharge pipe to allow easy access for maintenance.

2.4.3 Costs

Costs for each of the check valve options are included in the table below. The Town DPW staff should be able to install the check valves themselves without issue within a few hours as a cost saving measure. For budgetary purposes, however, contractor installed costs for the check valve are presented. Installation options are for duck bill and in-line check valves at the discharge end of the pipe, and for in-line check valves to be installed in the catch basins' discharge pipe.

TABLE 2:

Check Valve Cost Estimates

Check Valve Type	Estimated Installation Costs
In-Line Check Valves at Catch Basins & Outfall	\$12,600
In-Line Check Valves at Catch Basins & Duck Bill Type Valve at Outfall Pipes	\$15,000

Section 3 Town Hall/Police Station

The Town Hall is home to the Police Headquarters, the Town's Emergency Operations Center, and multiple Town offices. At its closest point, the building sits approximately 20 yards from where Sawmill Brook meets Manchester Harbor. The building's emergency generator is located on the west side of the building, closest to the Harbor. There is a boat ramp within the parking lot behind the building and adjacent to the Harbor. Flood waters often enter the parking lot via the boat ramp and have risen as high as the building lower level entrance on multiple occasions. The basement (or ground floor) contains the holding cell, marine rescue equipment, the Harbor Masters office, as well as police vehicles, offices, and storage areas. The elevation of the basement is at approximately elevation 8 feet. The Emergency Operations as well as mechanical and electrical systems for the entire building are located on the first floor. The elevation of the first floor is at approximately elevation 12 feet. The 100-year base flood elevation is 10 feet NAVD88.

Figure 6, below, depicts the extent of flood hazard areas at the Town Hall/Police Station, including the current 100-year base flood elevation and future flooding hazards for storm surge and sea level rise. Exposure vulnerability is represented based on probability of occurrence from 1% (very unlikely) to 99% (extremely likely). The base flood elevation is 10 feet (NAVD 88). This graphic does not account for the location of underground utilities that may be impacted by coastal flooding.

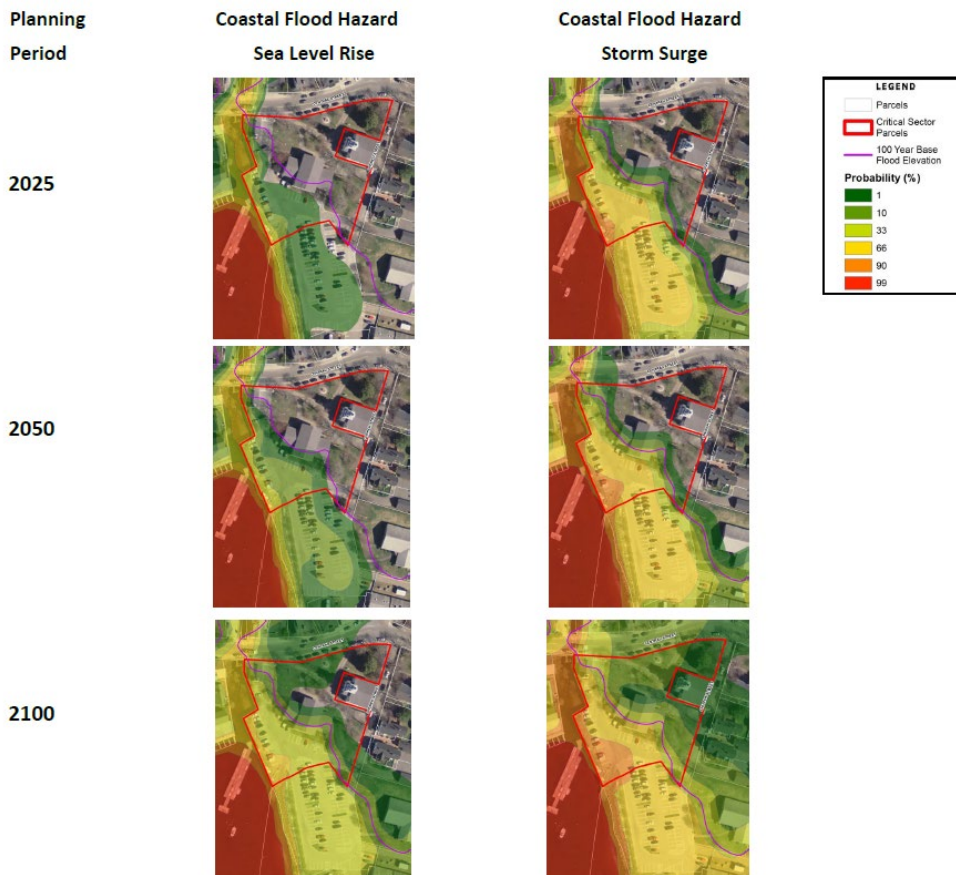


Figure 6: Town Hall/Police Station Flood Hazard Areas (Vulnerability and Risk Assessment)
The following alternatives were identified as potential flood mitigation options for the Town Hall/Police Station and are evaluated in the following sections:

- Moveable Flood Wall System
- Dry Flood Proof Building
- Elevate Generator
- Elevate or Seal Electrical Conduits
- Flood Proof Elevator Shaft (Sump)

Fixed sump pumps were discussed as an alternative to include, however we did not have enough information on the building to proceed with any substantial evaluation. Sump pumps range from several hundred to several thousand dollars depending on the size and backup power supply. Our approach assumed residual flood water inside the building would flow to the lowest elevation inside of the building, the elevator shaft. A sump pump proposed for the elevator shaft is further described in Section 3.6.

3.1 Moveable Flood Wall System

3.1.1 Overview

As described in Section 2.1, moveable flood wall systems are rapidly deployable connected sections that create a flood barrier of any length. These systems are suitable for use on roads, pavements, pathways and level areas of grass or soil. The system can be assembled by two people and is deployed before a storm event which could cause flood conditions. The barrier holds back flood waters to a few inches below the top of its height.

Flood wall systems can range from 2-feet to 8-feet in height and come in sections approximately 2-3 feet wide and 1-2 feet deep. Barriers can also connect directly to in-situ objects such as walls and buildings. Because the flood barriers at Town Hall would need to provide approximately 4.5-feet of protection, an additional berm with a 36-inch wall, or a 60-inch high flood barrier without a berm would be recommended. The main access to the building is provided on the north side at an elevation of 15.6 feet, well above the 100-year base flood elevation. The lower level is connected to the upper level by an elevator and stairs so there are no issues with entrapment on the lower level should a barrier system be recommended.

3.1.2 Installation Process

Figure 7 below shows the conceptual alignment of the flood wall deployed during a flood event to prevent from flood water from entering the Town Hall and Police Station. The barrier would be deployed only as necessary and the units would be stored in an easily accessible location when not in use. Police vehicles would need to be moved out of the garage before the flooding events, but other equipment located in the lower level could be accessed by the stairs or elevator. This flood barrier can be installed in 1-2 hours by operations staff.

3.1.3 Costs

As part of this project, multiple vendors were contacted and provided cost estimates for a moveable flood barrier system. The cost for 300 feet of a 36-inch FloodStop barrier by Barrier Solutions is approximately \$54,000. FloodStop units fill with rising flood waters

which combined with weight of the unit ensures the barrier holds back flood waters. This price includes the flood stop barriers and an interlocking key that creates a seal between the units. This price does not include deployment of the flood barrier system during flood events or storage of the units when not in use.

Note that the 36-inch FloodStop barriers would only provide protection up to elevation 11.5-feet when the 500-year storm is at elevation 12.5-feet. A one-foot berm could be constructed around the perimeter of the building to make up the difference in elevation. This option would require some modifications to the building access when the walls were not deployed. Cost for the berm will range considerably depending on the materials used.



Figure 7: Flood Barrier Alignment at Town Hall/Police Station

One option might be to repurpose the granite blocks from Central Pond retaining wall, creating an attractive sitting wall that is wide and tall enough to deploy the flood barrier units. For budgeting purposes, we have included a \$20,000 allowance for the berm and related landscaping improvements.

The cost for 300 feet of a 6-foot high Muscle Wall flood barriers is approximately \$79,000. This price includes the units and a liner which renders the barrier impenetrable. Note that the Muscle Wall type flood wall would also require the deployment of sand bags and a polyethylene liner. This price does not include deployment of the flood barrier system during flood events or storage of the units when not in use. The height required for this unit and level of effort to deploy the Muscle Wall suggest that a combined berm and Floodstop might be a better alternative for this location.

All preliminary costs can be found in Attachment A.

3.2 Dry Floodproof a Building

3.2.1 Overview

Dry floodproofing a building entails making a structure watertight below the level that flood waters are expected to reach to prevent water from entering. To do so, all windows, doors, louvers and other openings that are below the 500-year floodplain elevation (12.5 feet) must be equipped with flood protection to prevent water from entering. Once dry flood proofing is implemented, alternative access must be maintained. In this case stairs to the upper level should be kept clear for easy exit. For this location dry flood proofing may include the use of flood planks – planks that sit between brackets that are attached to the outer wall of the structure or flood doors, permanent doors that are flood proof and flood proofing electrical conduit (discussed in Section 3.5). If dry floodproofing is chosen as an alternative, additional review of the structure will be needed to document feasibility. Our initial recommendations include a combination of permanent flood proof doors and deployable flood planks for the windows with openings at a higher elevation.

3.2.2 Installation Process

There are eight windows (sill elevation 10.7 feet), three doors (sill elevation 8.7 feet) and one garage door (sill elevation 8.0 feet) at the Town Hall and Police Station that are located below the 500-year floodplain elevation. A combination of flood doors and flood planks are recommended to floodproof the building and prevent flood waters from entering through these openings. Flood doors are always permanently installed and in use. Flood plank brackets are permanently installed; however, the flood planks themselves must be placed between the brackets before a flood event is expected to occur.

3.2.3 Costs

The total cost estimate for dry flood proofing the Town Hall and Police Station using flood planks is approximately \$53,700. This includes installation and design of Flood Risk America's EZ Panel Flood Barrier's in front of the garage door, five windows, and three basement doors.

In lieu of using flood panels in front of the three doors, flood proof doors could be installed. The total cost to flood proof the Town Hall by using flood planks on the windows and garage door and flood doors on the three basement doors would be \$105,700, which includes installation and design.

Preliminary costs estimates can be found in Attachment A.

3.3 Elevate Generator

3.3.1 Overview

The Town Hall and Police Station are equipped with a generator which is located on the west side of the building and is situated on a 7-inch concrete pad. The bottom of the generator is at an elevation of approximately 8.8 feet. To elevate the generator above the 12.5 foot 500-year flood plain elevation, the bottom of the generator will need to be elevated an additional 4-feet above the existing concrete pad. Additionally, stairs would need to be provided for access to the generator and fuel tank. If this project is chosen as an option, the pad and access can be researched in more detail.

3.3.2 Installation Process

The generator will be disconnected and removed from the concrete pad and stored in a safe and dry area while construction is underway. An additional four feet of concrete will be poured onto the existing concrete pad. Once the concrete has been poured and set, the generator will be moved back to the pad with the use of a crane. The generator will then be reconnected; depending on the distance between the existing and new concrete pads, wires and fuel piping may need to be extended to reach the generator's new elevation.

3.3.3 Costs

To retrofit the existing concrete pad, disconnect and reconnect the generator, including approximately 3 days of labor, is estimated to cost \$47,000. A breakdown of approximate costs is included in Attachment A.

3.4 Elevate or Seal Electrical Conduits

3.4.1 Overview

With the use of a moveable flood wall around the Town Hall and Police Station, outdoor electrical conduits, outlets and the electric vehicle charging stations should all be protected under flood conditions. However, if the Town opts to dry flood proof the building itself instead of using the flood wall, the electrical conduits and connected boxes must be elevated or sealed to isolate them from potential flood water.

3.4.2 Installation Process

Electrical conduits and connection boxes can be water proofed by utilizing watertight service entrance connectors.

3.4.3 Costs

Town could install watertight Service Entrance Connectors such as those manufactured by O-Z/Gedney. These devices would be used for securing and sealing service entrance and UF cables entering the building, and electrical enclosure or conduit hub. The malleable iron body and PVC grommet design makes them suitable for use in wet locations. The Town's electrician could install the devices. The opinion of probable construction cost for this option including installation and design is \$10,300.

3.5 Floodproof Elevator Shaft

3.5.1 Overview

The elevator shaft of the Town Hall and Police Station is located below grade (the bottom of the shaft elevation is unknown but likely at or below sea level) and has flooded in recent history. The use of a moveable flood barrier would prevent flood waters from reaching the building and consequently flooding the elevator shaft. However, water may be entering the elevator shaft via cracks in the foundation and rising groundwater. To manage groundwater or floodwaters that may enter the elevator shaft, a fixed sump pump with a battery backup is recommended to remove any water that enters the shaft.

3.5.2 Installation Process

The sump pump will be permanently fixed in place at the bottom of the elevator shaft to not interfere with normal operation of the elevator. The pump will discharge to a pipe connected directly to the storm drain system. The pump will automatically turn on and begin pumping when water is detected.

3.5.3 Costs

The cost of the pump depends on size and back-up power options. The cost of the pump, labor for installation of the pump and connection to the storm drain system is approximately \$7,000, depending on any other structural modifications required to accommodate the pump.

Section 4 Recommendations

4.1 WWTP

Advantages and disadvantages of the proposed flood mitigation elements are listed in Table 4A and 4B, below. Flood mitigation recommendations for the WWTP suggest the flood barrier as the best alternative because it will protect the entire facility and is readily deployable. In lieu of the flood wall, the alternative would be to elevate the wall-mounted cabinets and the generator, but this is not a feasible alternate as the WWTP will still be at risk from flooding. For either alternative, in-line check valves should be installed in the stormwater outfall pipes to prevent catch basins flooding due to back surging. This is especially critical because catch basins are located within the diked area. While not included as an alternative in this memo, we recommend that the DPW floodproof the manhole in the parking lot where there are vulnerable electrical connections. Installing a floodproof manhole cover is one inexpensive option.

The total cost for recommended projects for the WWTP is \$187,000 for the flood wall and stormwater check valve, including installation costs.

TABLE 4A:

Advantages and Disadvantages of WWTP Option #1

Alternative	Advantages	Disadvantages
Moveable Flood Wall <u>Estimated Cost:</u> \$167,000	Provides flood protection to entire WWTP	- Requires large storage space when not in use - Will require gates to be partially open when deployed - Requires time to deploy before flood occurs
Stormwater outfall check valves <u>Estimated Cost:</u> \$28,000	- Prevent flooding from backup in storm drain system - DPW can install	- Need to excavate to access stormwater outfalls - Permits for this work may be require

Table 4B:

Advantages and Disadvantages of WWTP Option #2

Alternative	Advantages	Disadvantages
Wall-Mounted Chemical Storage Cabinets <u>Estimated Cost:</u> \$3,300	- Secondary form of preventing flood waters mingling with chemicals - Operations staff can install	Unnecessary if flood protection has already been provided for Operations Building
Elevate Generator <u>Estimated Cost:</u> \$182,000	Provides protection for backup energy source	If moving the generator pad to a new location, wetlands permitting is required

4.2 Town Hall and Police Station

Advantages and disadvantages of each alternative are listed in Tables 4C and 4D, below. Flood mitigation recommendations for the Town Hall and Police Station is presented as 2 options. Option #1 includes the flood barrier, a berm and floodproofing the elevator shaft for a total cost of \$81,000. Option #2 includes elevating the generator and dry floodproofing of the doors, windows and electrical service connections and installing the elevator sump pump for a total cost of \$181,000. A summary of the 2 options are provided in Tables 4 and 5.

TABLE 4C:

Advantages and Disadvantages of Town Hall and Police Station Option #1

Alternative	Advantages	Disadvantages
Moveable Flood Wall <u>Estimated Cost:</u> \$54,000	Provides flood protection to first flood	- Requires large storage space when not in use - Wall height is extreme unless additional berm constructed
Construct Berm <u>Estimated Cost:</u> \$20,000	- Improve aesthetics - Reduce cost on required wall height	Additional landscaping work will be needed to elevate walkways to provide handicap access
Floodproof Elevator Shaft <u>Estimated Cost:</u> \$7,000	Automatically begins pumping to remove water from building when it enters	- May not be able to handle large amounts of water over a sustained period - May overload storm drain

Option #1 Subtotal

\$81,000

TABLE 4D:

Advantages and Disadvantages of Town Hall and Police Station Alternative #2

Alternative	Advantages	Disadvantages
Dry Floodproof Building <u>Estimated Cost:</u> \$105,700	Prevents water from entering through openings in building	- Requires time to deploy before flood occurs - Requires structural analysis - Block windows
Elevate Generator <u>Estimated Cost:</u> \$58,000	- Provides protection for backup energy source - Critical project for emergency operations	Temporary disruption of emergency power during installation
Seal Electrical Conduits <u>Estimated Cost:</u> \$10,300	Provides protection for electrical conduits entering building	Unnecessary if flood barrier is in use

Floodproof Elevator ShaftEstimated Cost:

\$7,000

- Automatically begins pumping to remove water from building when it enters

- May not be able to handle large amounts of water over a sustained period of time
- May overload storm drain

Alternative #2 Subtotal

\$181,000

4.3 Total Cost Estimates for Recommended Projects and Grant Breakdown

The total cost for flood mitigation projects for the Hazard Mitigation Grant using Alternative 1 for Town Hall plus the recommended improvements at the WWTP is \$268,000. The 25% Town match for the project would be \$67,000 and the grant ask would be 75% of the total project costs or \$201,000. We anticipate that up to \$20,000 of the Town match could be contributed in-kind labor (based on DPW installing the check valves and assisting with berm construction) with the remaining \$47,000 as a cash match.

The total cost for flood mitigation projects for the Hazard Mitigation Grant using Alternative 2 for Town Hall plus the recommended improvements at the WWTP is \$368,000. The 25% Town match for the project would be \$92,000 and the grant ask would be 75% of the total project costs or \$276,000. We anticipate that up to \$20,000 of the Town match could be contributed in-kind labor (based on DPW installing the check valves and electrical bushings) with the remaining \$72,000 as a cash match.



Attachment A
Preliminary Costs

ENGINEER'S OPINION OF PROBABLE COST - PREFERRED PROJECT

**Town Hall Option 1 Flood Barrier, Berm, Elevator Sump
Manchester by the Sea**

Prepared By: DOR
Date Prepared: 3/12/2019
T&B Project No.: 221476-013

Conceptual	<u>X</u>	Construction	<u> </u>
Preliminary (w/o plans)	<u> </u>	Change Order	<u> </u>
Design Development @	<u>0</u>	% Complete	<u> </u>

ITEM NO.	ITEM DESCRIPTION	QUANTITIES	UNITS	UNIT COST	TOTAL COST ²
Construction					
1	Flood Stop Flood Barrier	1	LS	\$54,000	\$54,000
2	Construct Berm	1	LS	\$20,000	\$20,000
3	Elevator Shaft Sump Pump	1	EA	\$7,000	\$7,000
4					
Subtotal					\$81,000
Total Project Costs					\$81,000

ENGINEER'S OPINION OF PROBABLE COST - PREFERRED PROJECT

**Town Hall Option 2 Dry-Proofing Building
Manchester by the Sea**

Prepared By: DOR
Date Prepared: 3/12/2019
T&B Project No.: 221476-013

Conceptual	X	Construction	
Preliminary (w/o plans)		Change Order	
Design Development @	0	% Complete	

ITEM NO.	ITEM DESCRIPTION	QUANTITIES	UNITS	UNIT COST	TOTAL COST ²
Construction					
1	Flood Planks Windows & Garage Door	1	LS	\$105,700	\$105,700
2	Raise Generator	1	LS	\$58,000	\$58,000
3	Seal Electrical Conduits	1	LS	\$10,300	\$10,300
4	Elevator Shaft Sump Pump	1	EA	\$7,000	\$7,000
Subtotal					\$181,000
Total Project Costs					\$181,000

*Includes, Engineering, Installation, Contractor OH&P, 5% Contingency

WWTP	\$	187,000
Opt 1 total	\$	368,000
FEMA share	\$	276,000.00
Town Share	\$	92,000.00

ENGINEER'S OPINION OF PROBABLE COST - PREFERRED PROJECT

**Town Hall Dry-Proof via Flood Doors
Manchester by the Sea**

Prepared By: DOR
Date Prepared: 3/12/2019
T&B Project No.: 221476-013

Conceptual	X	Construction	
Preliminary (w/o plans)		Change Order	
Design Development @	0	% Complete	

ITEM NO.	ITEM DESCRIPTION	QUANTITIES	UNITS	UNIT COST	TOTAL COST ²
Construction					
1	General Conditions (10%)	1	LS	\$3,800	\$3,800
2	Flood Planks Windows & All Doors	1	LS	\$32,000	\$32,000
6	Labor	2	Days w/ 3 Workers	\$3,000	\$6,000
Subtotal					\$41,800
Overhead & Profit (15%)					\$6,300
Total Construction Cost					\$48,100
Engineering					
	Design				\$1,200
	Construction Phase Services				\$1,800
Total Engineering Cost					\$3,000
Total Capital Cost					\$51,100
Contingency (5%)					\$2,600
Total Capital Cost with Contingency					\$53,700
TOTAL PROJECT COST, SAY					\$53,700

ENGINEER'S OPINION OF PROBABLE COST - PREFERRED PROJECT

**Town Hall Dry-Proof via Flood Planks and Doors
Manchester by the Sea**

Prepared By: DOR
Date Prepared: 3/12/2019
T&B Project No.: 221476-013

Conceptual	X	Construction	
Preliminary (w/o plans)		Change Order	
Design Development @	0	% Complete	

ITEM NO.	ITEM DESCRIPTION	QUANTITIES	UNITS	UNIT COST	TOTAL COST ²
Construction					
1	General Conditions (10%)	1	LS	\$7,600	\$7,600
2	Flood Planks Windows & Garage Door	1	LS	\$24,000	\$24,000
3	Flood Doors (Qty 3)	1	LS	\$43,000	\$43,000
6	Labor	3	Days w/ 3 Workers	\$3,000	\$9,000
Subtotal					\$83,600
Overhead & Profit (15%)					\$12,500
Total Construction Cost					\$96,100
Engineering					
	Design				\$1,800
	Construction Phase Services				\$2,700
Total Engineering Cost					\$4,500
Total Capital Cost					\$100,600
Contingency (5%)					\$5,100
Total Capital Cost with Contingency					\$105,700
TOTAL PROJECT COST, SAY					\$105,700

ENGINEER'S OPINION OF PROBABLE COST - PREFERRED PROJECT

**Elevate Town Hall Generator
Manchester by the Sea**

Prepared By: COB
Date Prepared: 3/12/2019
T&B Project No.: 221476-013

Conceptual	X	Construction	
Preliminary (w/o plans)		Change Order	
Design Development @	0	% Complete	

ITEM NO.	ITEM DESCRIPTION	QUANTITIES	UNITS	UNIT COST	TOTAL COST ²
Construction					
1	General Conditions (10%)	1	LS	\$4,000	\$4,000
2	Conduit & wiring associated with generator	1	LS	\$5,000	\$5,000
3	Pour new Concrete Slab				\$12,000
4	Labor	3	Days with 2 workers	\$2,000	\$6,000
5	Transport Generator from old slab to new Slab	1	LS	\$5,000	\$5,000
6	Stairs	1	LS	\$8,000	\$8,000
Subtotal					\$40,000
Overhead & Profit (15%)					\$6,000
Total Construction Cost					\$46,000
Engineering					
	Design				\$4,600
	Construction Phase Services				\$4,600
Total Engineering Cost					\$9,200
Total Capital Cost					\$55,200
Contingency (5%)					\$2,800
Total Capital Cost with Contingency					\$58,000
TOTAL PROJECT COST, SAY					\$58,000

ENGINEER'S OPINION OF PROBABLE COST - PREFERRED PROJECT

**Town Hall Watertight Electrical Service Connections
Manchester by the Sea**

Prepared By: DOR
Date Prepared: 3/12/2019
T&B Project No.: 221476-013

Conceptual	X	Construction	
Preliminary (w/o plans)		Change Order	
Design Development @	0	% Complete	

ITEM NO.	ITEM DESCRIPTION	QUANTITIES	UNITS	UNIT COST	TOTAL COST ²
Construction					
1	General Conditions (10%)	1	LS	\$600	\$600
2	Watertight Electric Conduit Bushing	40	EA	\$8	\$320
6	Labor	3	Days w/ 2 Workers	\$2,000	\$6,000
Subtotal					\$6,920
Overhead & Profit (15%)					\$1,000
Total Construction Cost					\$7,920
Engineering					
	Design				\$900
	Construction Phase Services				\$900
Total Engineering Cost					\$1,800
Total Capital Cost					\$9,720
Contingency (5%)					\$500
Total Capital Cost with Contingency					\$10,220
TOTAL PROJECT COST, SAY					\$10,300

ENGINEER'S OPINION OF PROBABLE COST - PREFERRED PROJECT

**Elevate WWTP Generator
Manchester by the Sea**

Prepared By: COB
Date Prepared: 3/12/2019
T&B Project No.: 221476-013

Conceptual	X	Construction	
Preliminary (w/o plans)		Change Order	
Design Development @	0	% Complete	

ITEM NO.	ITEM DESCRIPTION	QUANTITIES	UNITS	UNIT COST	TOTAL COST ²
Construction					
1	General Conditions (10%)	1	LS	\$17,900	\$17,900
2	Conduit & wiring associated with generator	1	LS	\$5,000	\$5,000
3	Pour new Concrete Slab				\$79,500
4	Labor	5	Days with 2 workers	\$2,000	\$10,000
5	Transport Generator from old slab to new Slab	1	LS	\$5,000	\$5,000
6	Access Stairs	1	LS	\$8,000	\$8,000
Subtotal					\$125,400
Overhead & Profit (15%)					\$18,800
Total Construction Cost					\$144,200
Engineering					
	Design				\$14,500
	Survey				
	Construction Phase Services				\$14,500
Total Engineering Cost					\$29,000
Total Capital Cost					\$173,200
Contingency (5%)					\$8,700
Total Capital Cost with Contingency					\$181,900
TOTAL PROJECT COST, SAY					\$182,000

ENGINEER'S OPINION OF PROBABLE COST - PREFERRED PROJECT

Catch Basin & Outfall Pipe In-Line Check Valves

Manchester by the Sea

Prepared By: DOR
Date Prepared: 3/12/2019
T&B Project No.: 221476-013

Conceptual	<u>X</u>	Construction	<u> </u>
Preliminary (w/o plans)	<u> </u>	Change Order	<u> </u>
Design Development @	<u>0</u>	% Complete	<u> </u>

ITEM NO.	ITEM DESCRIPTION	QUANTITIES	UNITS	UNIT COST	TOTAL COST ²
Construction					
1	General Conditions (10%)	1	LS	\$800	\$800
2	12-Inch In-Line Check Valve	2	EA	\$1,600	\$3,200
3	15-Inch In-Line Check Valve	2	EA	\$1,600	\$3,200
4	Labor	1	Days w/ 2 Workers	\$2,000	\$2,000
Subtotal					\$9,200
Overhead & Profit (15%)					\$1,400
Total Construction Cost					\$10,600
Engineering					
	Design				\$450
	Construction Phase Services				\$900
Total Engineering Cost					\$1,350
Total Capital Cost					\$11,950
Contingency (5%)					\$600
Total Capital Cost with Contingency					\$12,550
TOTAL PROJECT COST, SAY					\$12,600

ENGINEER'S OPINION OF PROBABLE COST - PREFERRED PROJECT

**In-Line Check Valves at Catch Basins & Duck Bill Type Valve at Outfall Pipes
Manchester by the Sea**

Prepared By: DOR
Date Prepared: 3/12/2019
T&B Project No.: 221476-013

Conceptual	X	Construction	
Preliminary (w/o plans)		Change Order	
Design Development @	0	% Complete	

ITEM NO.	ITEM DESCRIPTION	QUANTITIES	UNITS	UNIT COST	TOTAL COST ²
Construction					
1	General Conditions (10%)	1	LS	\$1,000	\$1,000
2	Catch Basin In-Line Check Valve	1	EA	\$1,600	\$1,600
3	Catch Basin In-Line Check Valve	1	EA	\$1,600	\$1,600
4	12- Duck Bill Check Valve	1	EA	\$1,700	\$1,700
5	15-Inch Duck Bill Check Valve	1	EA	\$3,200	\$3,200
6	Labor	1	Days w/ 2 Workers	\$2,000	\$2,000
Subtotal					\$11,100
Overhead & Profit (15%)					\$1,700
Total Construction Cost					\$12,800
Engineering					
	Design				\$450
	Construction Phase Services				\$900
Total Engineering Cost					\$1,350
Total Capital Cost					\$14,150
Contingency (5%)					\$800
Total Capital Cost with Contingency					\$14,950
TOTAL PROJECT COST, SAY					\$15,000

Attachment B
Manufacturer Specifications

Flood Barrier

36" HIGH FLOODSTOP COMPONENT DETAILS



36" high Modular Unit

- 40" long self-filling or pre-filled flood barrier units
- Standard modular unit dimensions: Approx 40" (L) x 36" (H) x 30" (D)
- Modular Unit Weight: 60lbs
- Any colour can be requested. The colours red and white is standard



36" High Multi-hub

- Allowing wall connection or acute cornering.
- Standard unit dimensions: Approx 29" (L) x 36" (H) x 17" (D)
- Modular Unit Weight: 20lbs
- Any colour can be requested. The colour white is standard



36" High Universal Key

- Interlocking key that creates a seal and applied ballast between Modular and Multi-hub units.
- This component is made up of two easily manageable parts, an Upper Key (approx 50lbs) and Lower Key (approx 55lbs).



phone 201.746.0921 fax 201.664.1054 web orangefloodcontrol.com

address 48 Bi-State Plaza Ste. 256 Old Tappan, NJ 07675



THE ENGINEERED SOLUTION FOR FLUID
PROTECTION AND CONTAINMENT



Muscle Wall is a flood control product that replaces thousands, if not hundreds of thousands of sandbags all while being quick, easy, reusable, reliable, and customizable. All traits that are essential for flood fighting solutions, yet hard to find in other competing products.

APPLICATIONS

Asset
Containment



Floodwater
Diversion



Erosion Control



Stormwater
Management



468 SANDBAGS REPLACED BY 1 MUSCLE WALL



TIME IS MONEY AND MUSCLE WALL SAVES BOTH

Filling and stacking sandbags is a messy, time-consuming, and labor-intensive process. The true expense of sandbags, once the cleanup, transportation, and other costs are factored, is \$2.50 to \$5.00 per bag. Most sandbags can't be reused because they are contaminated with gas, oils, and raw sewage.

To protect homes, businesses, and communities from the threat of floodwater sandbags can be used, but it requires the efforts of many people. When the threat is gone, home-owners and businesses are faced with the costly hassle of disposing of the heavy, contaminated sandbags. Muscle Wall can be set up quickly and easily by only a few of people, are reusable, and effective.

MUSCLE WALL



EFFECTIVE SAND BAG ALTERNATIVE

The speed and ease of the Muscle Wall system can save thousands, if not hundreds of thousands of dollars in repairs after a flood. A crew of only four people can set up 100 feet of Muscle Wall in about 30 minutes. If flooding has already started, Muscle Wall can be floated into place, filled with the very water you need to protect against, and sunk to create the essential barrier.



OUR JOB DOESN'T END WITH A SALE

We train our customers on the most effective way to set up and utilize Muscle Wall. Even though floods can pose a greater threat to a community than fires, often municipalities don't have people on staff who have flood-fighting expertise. We can coach you to success, even when it appears the odds are stacked against you. Together we can develop a customized solution to fit your needs.



PROTECTING BUSINESS CONTINUITY

Big expenses during a flooding event come from the loss of business continuity. Businesses must remain shut down while repairs are made or flood protection methods are removed. Muscle Wall, in one instance, was used to protect an office building from floodwater, and as a result the office was able to be back up and running the very next day. Other buildings in the vicinity were out of commission for months, costing thousands of dollars in lost revenue.

Check Valves

Series TF-1

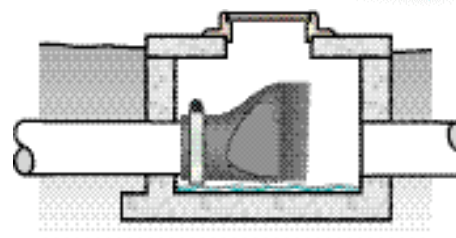
- ▶ Ideal for manhole installations
- ▶ Minimal bottom clearance required
- ▶ Lightweight, all-elastomer design
- ▶ Seals around small solids
- ▶ Available in slip-on or flanged design

Materials of Construction

Neoprene, Hypalon®, Buna-N, EPDM, Viton®.

Mounting Bands

304 or 316 Stainless steel.



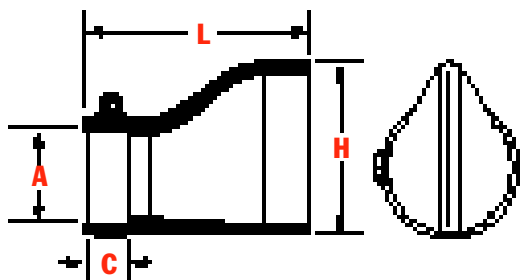
The TF-1 is designed for installation in existing structures such as interceptors, manholes and vaults where the invert of the pipe is close to the floor. The flat-bottom and offset-bill design of the TF-1 allows it to be installed without any modifications to the structure.

The TF-1 offers low cracking pressure to reduce the potential for standing water and very low headloss which is not affected by rust, corrosion or lack of lubrication.

The TF-1 is ideal for sewer systems because it will seal around small debris.

The TF-1 design is available with a slip-on or flanged pipe connection.

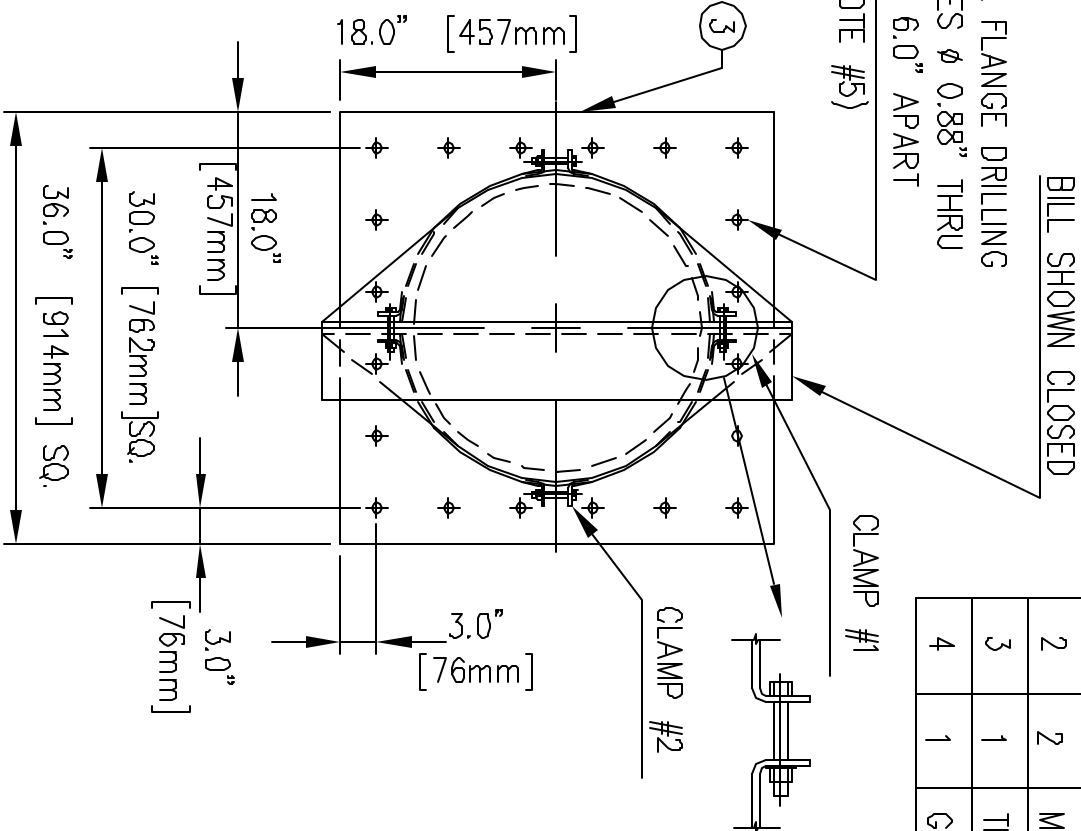
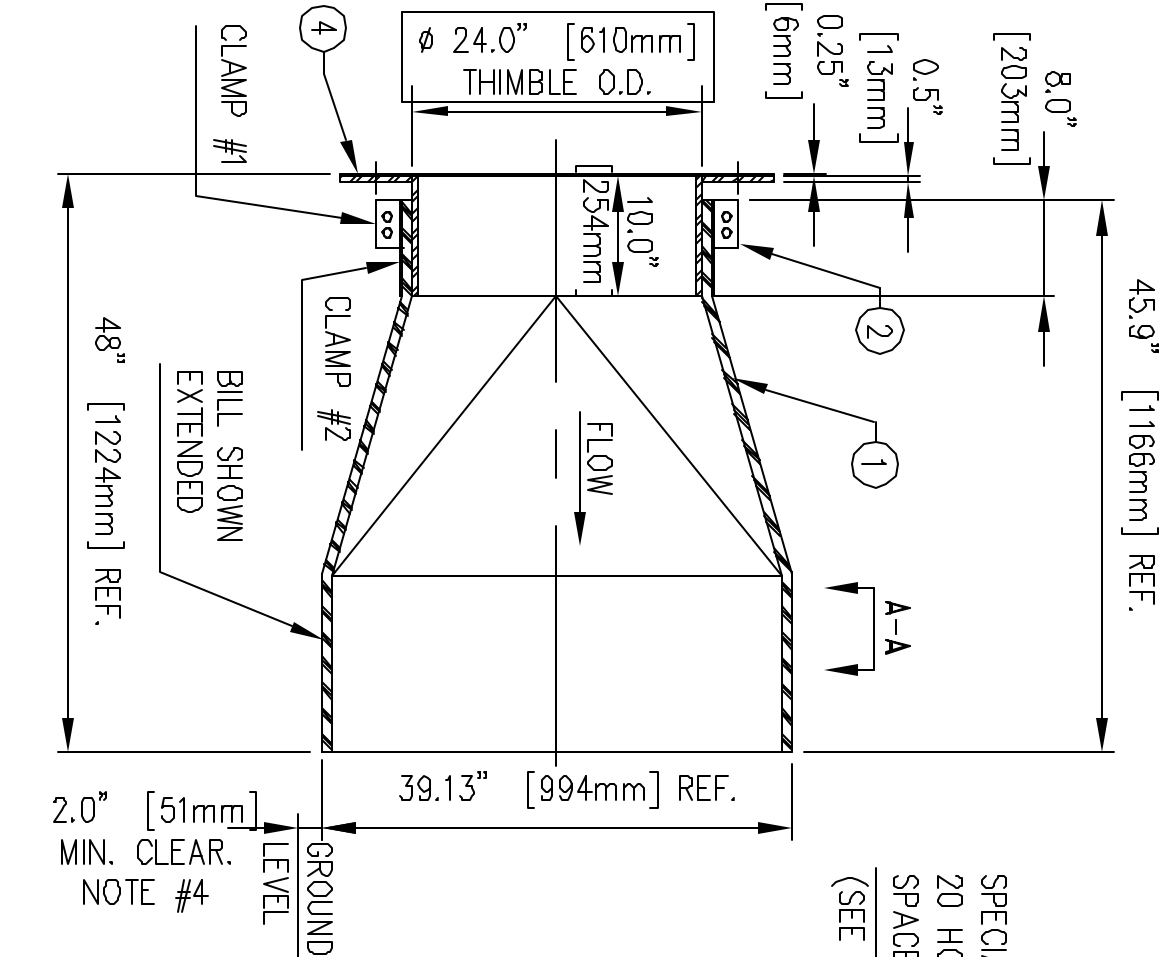
Tideflex® TF-1 valves are constructed with a curved bill as standard.



Pipe O.D. (A)	Length (L)	Bill Height (H)	Cuff Length (C)
4	10	8	1 1/2
5	10	8	1 1/2
6	16	12	2
8	18	16	2
10	23	19	3
12	27	23	4
14	27	23	4
16	35	30	5
18	36	34	6
20	44	37	8
22	44	37	8
24	48	43	8
26	48	43	8
28	48	43	8
30	56	55	9
32	56	55	9
36	67	69	10
38	67	69	10
40	67	69	10
42	61	71	10
44	61	71	10
48	66	78	10
50	66	78	10
54	66	78	10
58	66	78	10
60	73	91	14
68	73	91	14
72	96	115	16

Numbers indicate maximum dimensions in inches.

ITEM QTY.		DESCRIPTION	MAT'L
1	1	CHECK VALVE SLEEVE	NEOPRENE/NEOPRENE COVER
2	2	MOUNTING CLAMP	304 S/STEEL
3	1	THIMBLE PLATE	304 S/STEEL
4	1	GASKET	NEOPRENE

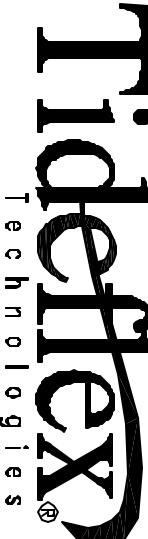


NOTES:

1. MAXIMUM BACK PRESSURE - [MUST BE SUPPLIED] LINE PRESSURE - [MUST BE SUPPLIED]
2. TIDEFLEX IS TO BE MOUNTED WITH THE OUTLET IN THE VERTICAL POSITION.
3. TIDEFLEX TO FIT ON A [24.0"] O.D. THIMBLE PLATE
4. BECAUSE OF SAND, ROCK AND OTHER DEBRIS ACCUMULATION BY BACKFLOW OF WATER THE SUGGESTED BOTTOM CLEARANCE SHOULD BE PROVIDED.
5. THIMBLE PLATE DIMENSIONS ARE FOR REFERENCE ONLY. ENGINEER IS TO DETERMINE ADEQUATE PLATE DIMENSIONS NUMBER OF HOLES, DIAMETER OF HOLES AND SPACING. THIS PLATE CONFIGURATION WILL BE SUPPLIED WITH APPROVED DRAWING UNLESS REVISED DIMENSIONS ARE SUPPLIED.
6. CUSTOMER TO SHOW DIRECTION OF PREDOMINANT CURRENT FLOW WITH ARROW IN VIEW 'A-A'. (IF NO CURRENT CUSTOMER TO WRITE NO IN BOX.)

PRELIMINARY DRAWING
NOT FOR APPROVAL PURPOSES

SALES ORDER N^o:TXX-XXXX



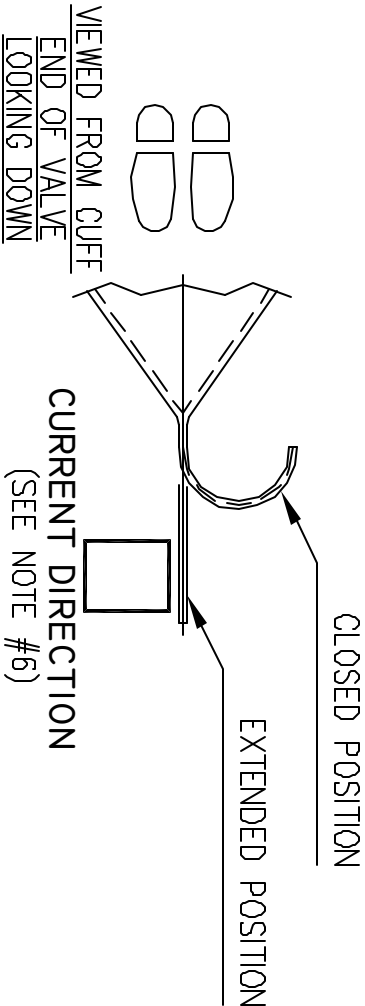
Tideflex[®]
Technologies

300 BILMAR DR.
PITTSBURGH, PA.
15205
412-919-0919

TT Product: 24" TF-2 TIDEFLEX W/THIMBLE PLATE
TT PART N^o: TF-240-APPROVAL

DR. BY: MVH	DATE: 7-22-05	CHKD. BY:	DATE:	REV
CAD SCALE: FULL				
PLOT SCALE: .0625		DWG N ^o : TTS-DWG		

VIEW A-A
NOT TO SCALE



VIEWED FROM CUFF
END OF VALVE
LOOKING DOWN

CUSTOMER: XXX

ORDER No: XXX

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF TIDEFLEX TECHNOLOGIES, INC. IT IS LOANED BY TIDEFLEX TECHNOLOGIES, INC. SUBJECT TO THE CONDITIONS THAT IT AND THE INFORMATION EMBODIED THEREIN SHALL BE USED ONLY FOR RECORD AND REFERENCE PURPOSES. IT SHALL NOT BE USED OR CAUSED TO BE USED IN ANY WAY PREJUDICIAL TO THE INTERESTS OF TIDEFLEX TECHNOLOGIES, INC. IT SHALL NOT BE REPRODUCED OR COPIED IN WHOLE OR PART, OR DISCLOSED TO ANYONE WITHOUT THE DIRECT WRITTEN PERMISSION OF TIDEFLEX TECHNOLOGIES, INC. AND SHALL BE RETURNED UPON REQUEST.

Sump Pump

3/12/2019

5-ASP Cellar floor pump - 505300

Manufacturer:

Little Giant

Series (10 Models):

Floor Sump Pump Little Giant 5

Product Name:

5-ASP Cellar floor pump

Model Number:

505300

Gallons Per Hour: 1200 (20 GPM)

Voltage: 115

Horsepower: 0.17

115v Automatic

26% Off

~~\$335.00~~

\$248.00

Email to a Friend

1

ADD TO CART

Compare

Wishlist

Description	Product Details	Supporting Docs
Model Number	505300	
Series	Floor Sump Pump Little Giant 5	
Warranty (YRS.)	1	
Max Flow (GPM.)	20	
Max Flow GPH	1200	
TDH Maximum (Ft)	26	
TDH Maximum (PSI)	11	
Horsepower	0.17	
Watts	380	
Outlet Connection Type	FNPT	
Outlet (In.)	1	
Wetted Materials	Epoxy coated	
Elastomers / O-ring	Buna-Nitrile	
Voltage (V)	115	
Phase (Ø)	Single(1)	
Motor Frequency	60	
Motor	Hermetically Sealed	
Speed (RPM.)	1725	
Max Operating Temperature (F)	120	

Viscosity	Water 1.00 cp 31.00 ssu
Mechanical Seal	VITON LIP SEAL
Motor Bearings	Bronze
Applications	Contractor, Coolant, Dewatering, Fountain, Irrigation, Pond, Portable, Submersible, Sump
Other	120F max. intermittent liquid temp. Thermal overload protected. sacrificial anode available.
Approvals	CSA
Impeller Material	Plastic, semi-open
Cord Length (Ft.)	10
Duty	Continuous
Country of Manufacture	United States
Weight (Lbs)	9
Time to Ship (DAYS)	1 day

Dry Floodproofing



DOOR FLOOD SHIELD



MADE IN USA

FLOOD SHIELD

Protect door openings & building contents
from flood water

Drop in and Go!

- Stainless steel springs provide constant seal compression.
- 1/4" Marine grade aluminum shield with handle cutouts.
- Closed cell neoprene rubber gaskets installed on bottom and sides of shield.

Available Now

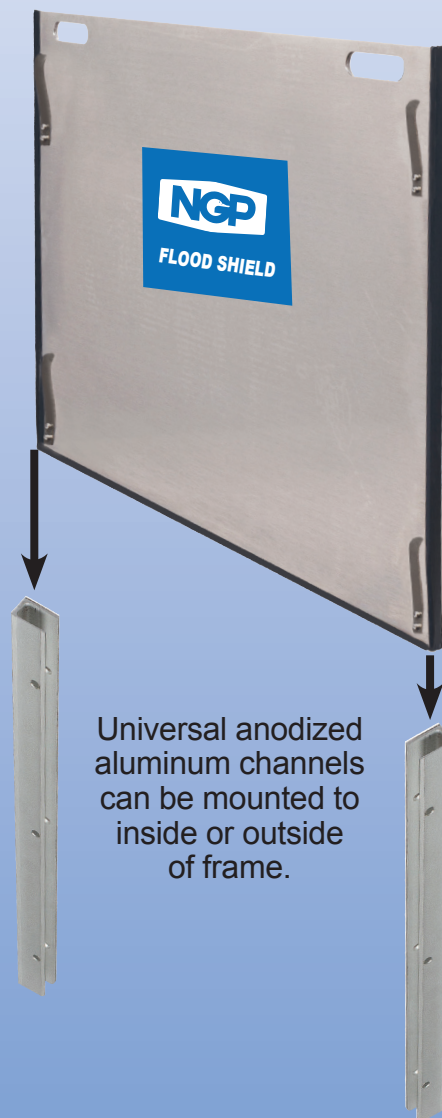
FS10 . . . 10" high

FS22 . . . 22" high

FS34 . . . 34" high

* Up to 96" wide

* Over 50" support post recommended.



Universal anodized
aluminum channels
can be mounted to
inside or outside
of frame.

* Complies with guidelines of the
Federal Emergency Management Agency (FEMA) and
Federal Insurance and Mitigation Administration (FIMA)
for use on doors in flood prone areas.

**National
Guard
Products**

4985 East Raines Road

Memphis, TN 38118

Phone: (800) 647-7874

Fax: (800) 255-7874

www.ngp.com

Flood Shield

Flood Shield is designed to help protect door openings and building contents from flood water. This unique product features a spring mechanism that maintains constant tension against the gasketing to create a solid flood barrier.

- 1/4" Marine grade aluminum shield with handle cutouts.
- Closed cell neoprene rubber gaskets installed on bottom and sides of shield.
- Anodized aluminum mounting channels.
- Universal channels can install inside or outside mount.
- Dark bronze mounting channels available (specify).
- Stainless steel springs provide seal compression.
- #10 x 1-1/2" stainless steel sheet metal screws.

Complies with guidelines of the Federal Emergency Management Agency (FEMA) and Federal Insurance and Mitigation Administration (FIMA) for use on doors in flood prone areas.

Lengths up to 96" available.

Over 50" a center support post is recommended.

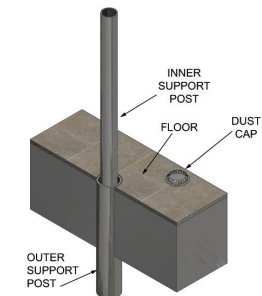
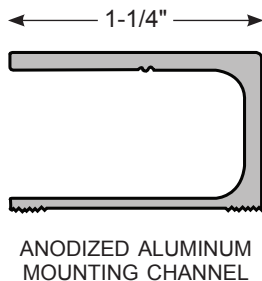
A threshold is recommended if sill is not smooth and clean.

Orders for this product are non-changeable and non-cancellable.



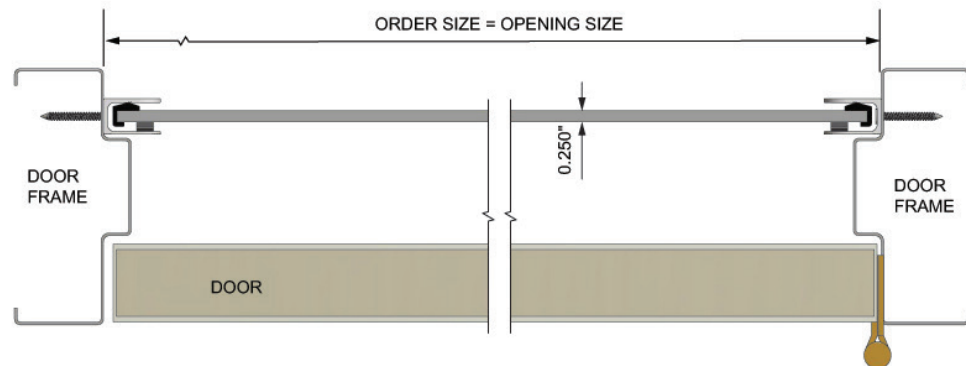
Universal anodized aluminum channels can be mounted to inside or outside of frame.

FS10 10" High
FS22 22" High
FS34 34" High

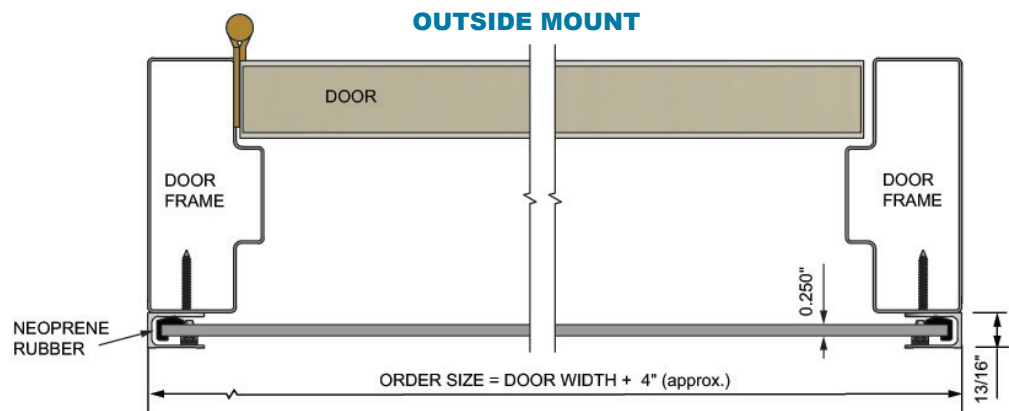


FSSP Optional Center Support & Cap

INSIDE MOUNT



OUTSIDE MOUNT



Model: PD-520



Pedestrian Flood Doors

PS DOORS Flood Protection Solutions

The PD-520 is a pedestrian door designed specifically to handle flooding conditions. Pedestrian Flood Doors are always in place, giving you constant flood protection while still allowing access to your facility.

This door comes ready to install and can be fitted with standard panic hardware, an electronic key pad or card reader for accessing the door.

Windows and other options are available depending on your needs and water protection heights.

Standard Features:

- Compression seal—requires no compressed air for activation.
- Mild steel or stainless steel.
- Utilizes standard panic door hardware.

Application Use:

- Walk door—normal use
- Freight doors
- Emergency exit openings
- Lift stations

Benefits:

- Always in place
- No human intervention required
- Door used as a normal pedestrian door

Available in single or paired configuration.

Also certified by:



NATIONAL FLOOD BARRIER
TESTING & CERTIFICATION PROGRAM

ISO9001:2008
CERTIFIED
QUALITY MANAGEMENT SYSTEM



Professionally Distributed by:



Made in USA.

Orange Flood Control, LLC

48 Bi-State Plaza, Suite 256
Old Tappan, NJ 07675
201.746.0921 (office)
201.664.1054 (fax)

www.orange-flood-control.com

Model: PD-520



Pedestrian Flood Doors

PS DOORS Flood Protection Solutions

The PD-520 is a normal use pedestrian walk door that also acts as a flood protection door. As long as the door is closed and latched, your door is FM Approved to protect from water flooding up to 36 inches.

Choosing the right flood barrier or door is important to your overall flood protection plan and affects your flood response time. PS DOORS will work with you or your flood protection team to make significant improvements in both flood protection and response time.



Made in USA.

Professionally Distributed by:



Orange Flood Control, LLC

48 Bi-State Plaza, Suite 256

Old Tappan, NJ 07675

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201.664.1054 (fax)

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The EZ Flood Panel is the **ONLY** flood panel that is certified to provide you **flood insurance credits!**

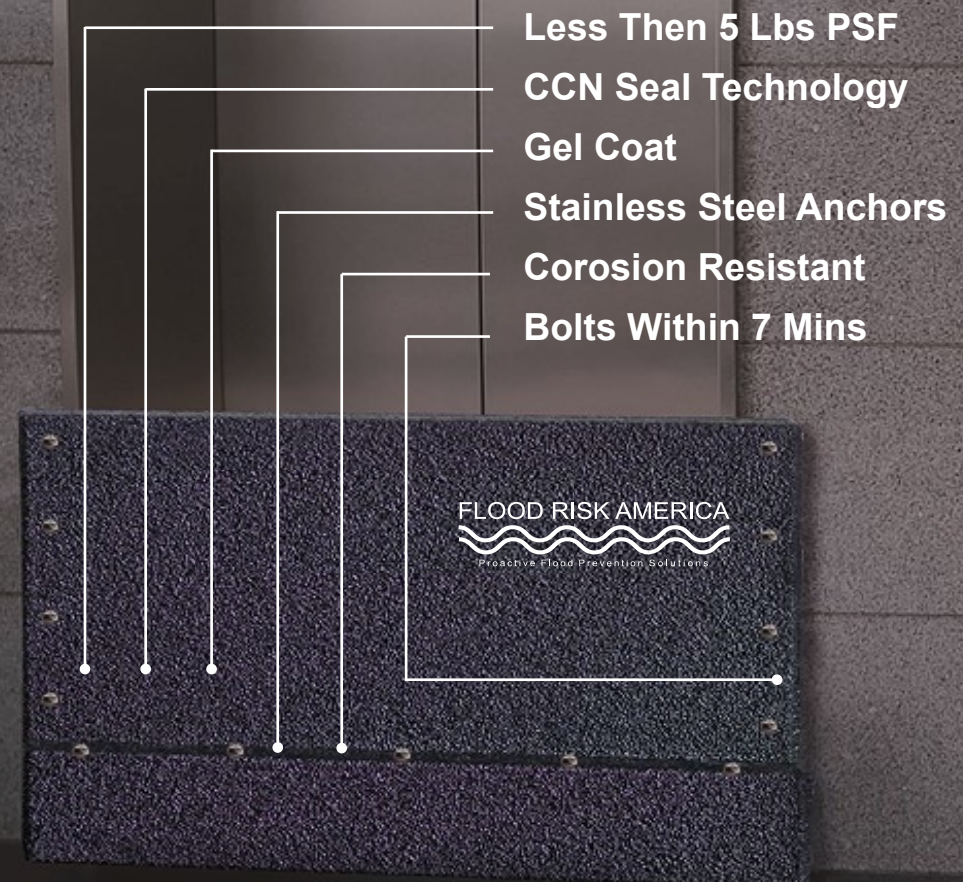


The EZ Flood Panel uses our patented, sustainable flood-seal technology to protect elevators and control room doors against rising floodwater. This device creates a sealed barrier around the elevator doors, preventing water from entering. Each panel is designed specifically for a customized fabrication to meet individual installation requirements and custom shaping and contouring to meet job-specific demands. It is both easy to install and remove, taking only a few minutes.

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- ISO Certified
- Insurance Industry Certified
- Lower Insurance Premiums
- Lower Insurance Deductibles
- Better Coverage Limits
- Cost-Effective
- Federal Grant Assistance
- No Business Interruption
- Installation Available

EZ Flood Panel

for Elevators and Control Rooms



EZ Flood Panel | Technical Features



Robert Adamo

201.746.0921

radamo@orangefloodcontrol.com

FINISH
PANEL MATERIAL
INSTALLATION
WARRANTY
HARDWARE
SEAL
WEIGHT
SIZE
APPLICATIONS

GEL coat, corrosion-resistant
WTR layer composite
~ 7 minutes per person
Lifetime warranty
Stainless steel anchors
CCN seal technology
Less than 5 pounds PSF
Customized fabrication, shaping, and contouring for any design or size needed
New construction or existing structures, and can be applied on: elevators, windows, doorways, walkways, essential equipment, and control rooms

The EZ Flood Panel is durable, lightweight, corrosion-resistant, cost-effective, and designed to withstand more than 12,000 PSI. It has been scientifically developed to withstand harsh saltwater environments with technology utilized in both aerospace and vessels from the United States Navy and Air Force. The EZ Flood Panel will work on new construction site properties or existing structures. It has been rigorously tested and suitable for exterior or interior doors, windows, mechanical rooms, driveways, store fronts, and loading docks.

Elevators



Windows



Control Room Doors



Electric Room Doors



Features & Benefits

- Light weight
- Durable
- Cost-effective
- Corrosion-resistant
- Withstands more than 12,000 PSI
- Easy to install and remove
- Environmentally friendly
- Made in the USA

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Watertight Service Connectors

Cable Terminators

General Information

Purpose:

Cable Terminators and Sealing Fittings are used on conduit ends and cable ends to effectively seal the cable and conduit.

Where Installed:

- Wherever the jacket or sheath is removed from multi-conductor cable.
- Wherever it is desirable that the ends of conduit and cables be sealed against the entrance of water, damp or corrosive atmospheres, hot or cold air or dust.
- Wherever it is desirable to seal the entrance of exposed cable into cabinets, switchboards or terminal boxes.

Types:

Four basic types are offered as described below:

Figure 1: The **Terminator** body is deep enough to provide an ample compound chamber for use indoors or outdoors. A Canvas Bakelite Cover, either with or without taping cones, is provided to space and protect the cables. Instead of a cover, a female thread can be furnished for use with a short nipple or a flexible conduit adapter. The Terminator is recommended for sealing the ends of multi-conductor cables and for sealing the ends of conduit, and cables.

Figure 2: The **Compound Bushing** is more compact than the Terminator. Its compound chamber is not as deep. No cover or top thread is provided. It is for use in protected locations where space is limited.

Figure 3: The **Sealing Bushing** is similar to the compound Bushing except that a compound chamber is not provided. This fitting therefore is not recommended as a cable sealing device for use at the ends of multi-conductor cable. However, the conduit end is effectively sealed around the cable by neoprene gaskets for rubber type insulations. It is widely used to seal the ends of conduit against moisture, dust, corrosive atmospheres and objectionable gases. It is also used to seal conduit against the entrance of warm humid air which would otherwise condense inside the conduit.

Figure 4: These **Conduit Sealing Bushings** are used for sealing ends of conduit where cables emerge in applications involving higher fluid or gas pressures than can be handled by standard sealing bushings. These Conduit Sealing Bushings are compact and require only as much space inside a cabinet as an ordinary conduit bushing.

All of these illustrations show the Terminators and Sealing Fittings used with cable run in conduit. Each type is available for use with exposed cable. Terminators for many combinations of cable and conduit sealing devices other than those shown in the catalog can be made from standard parts. Information regarding such combinations to meet special job requirements will be gladly given on receipt of your request.

Water and Raintightness:

Terminators, Compound Bushings and Sealing fittings for cables having rubber types of insulations and jackets provide a watertight seal around the cables and at conduit ends, but the degree of seal at cabinet entrances depends on the type of cable entrance used. We invite inquiry regarding special sealing problems not covered in this catalog.

Voltage Ratings:

Since the insulation on the individual conductor is not disturbed in the terminator, it is not subject to a voltage rating any more than the conduit on which it is used. Furthermore, the DOZSEAL Insulating Compounds which are recommended for use in these devices have high dielectric strength. (See Page RA15 for listing of compounds.) Their use improves the insulation of the cable within the terminator and eliminates the possibility of any air or moisture being in contact with the cable insulation at this point.

Termination made with O-Z/Gedney Terminators are suitable for use at the voltage rating of the cable being used provided terminating kits are used where required.

Other Terminators:

- See Catalog Sections TA and TB for Armored Cable and Metal Clad Cable Terminators.
- See Catalog Section BC for Hazardous Location Metal Clad Cable Terminators.
- See Catalog Section QA for Cable Support Products.

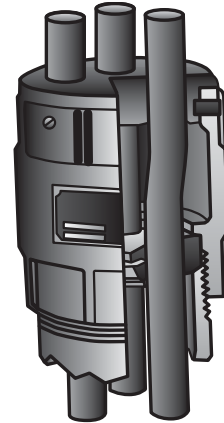


Figure 1

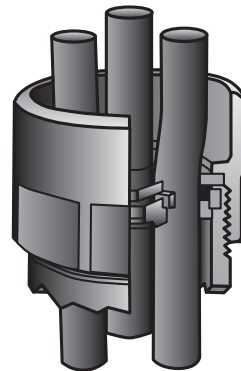


Figure 2

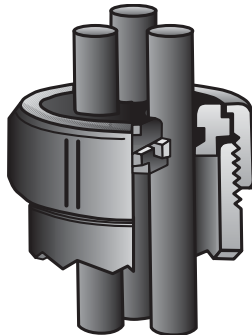


Figure 3

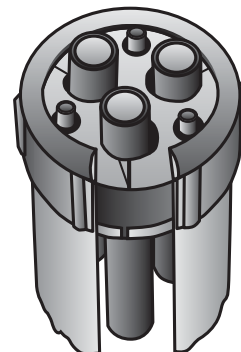


Figure 4

Cable Terminators

Assembly Procedure

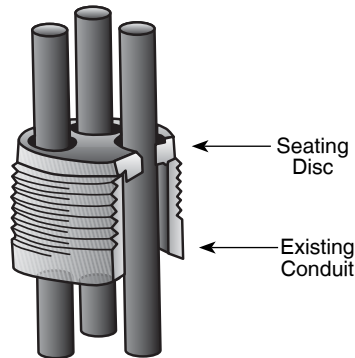
Blank Sealing Bushings and Terminators Containing Discs:

There are many types of fittings containing Bakelite discs and O-rings which can be safely drilled in the field by following our detailed instructions. "These fittings will perform satisfactorily only when properly machined to the actual dimensions for the specific O.D. of cable used. Detailed instruction sheets containing layout data and special assembly procedures are supplied with blank fittings. Failure to comply may result in compound leakage and/or loss of seal around cable. O-Z/Gedney is not responsible for any field machined or modified fittings."

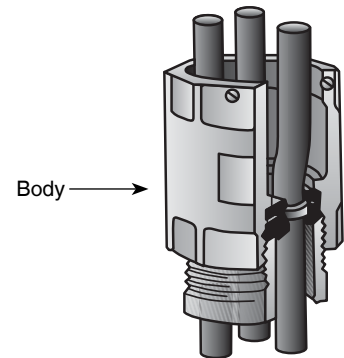
Other Terminators:

- See Catalog Sections TA and TB for Armored Cable and Metal Clad Cable Terminators.
- See Catalog Section BC for Hazardous Location Metal Clad Cable Terminators.
- See Catalog Section QA for Cable Support Products.

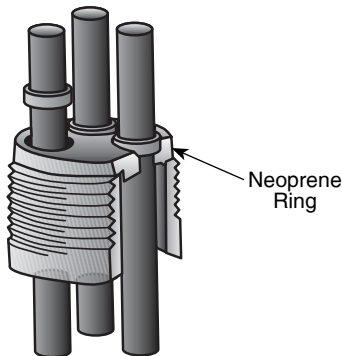
The basic principles used throughout the line of O-Z/Gedney Terminators covering their use with Rubber Covered Cables are clearly illustrated in this assembly.



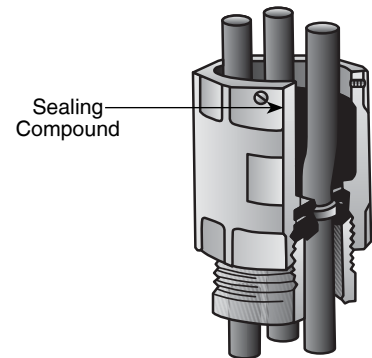
1 After cables are prepared, Bakelite seating disc with properly drilled holes is slipped over cables and set into the conduit.



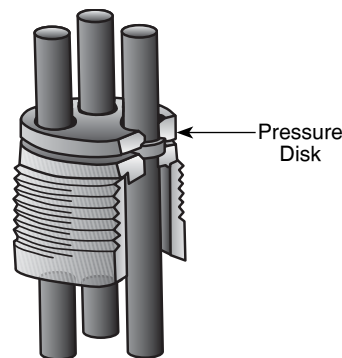
4 The body is then screwed directly on the conduit, clamping the discs and applying pressure to the neoprene rings.



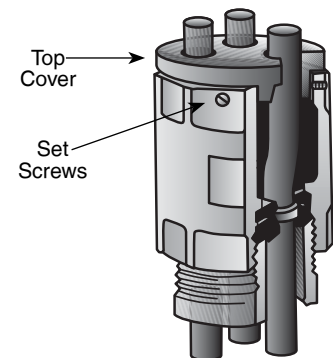
2 Neoprene rings are placed around the cables and set into recesses in the seating disc.



5 Compound is heated to the proper temperature and the body filled to the height of the set screws, making a complete seal.



3 A Canvas Bakelite pressure disc is passed over the cables and set on top of the neoprene rings, holding them firmly in place.



6 Before compound sets, Canvas Bakelite top cover is passed over the conductors, pushed down into the hot compound and secured by set screws.

Cable Terminators

With Compound Chamber For Threaded Rigid Conduit

Type CRC

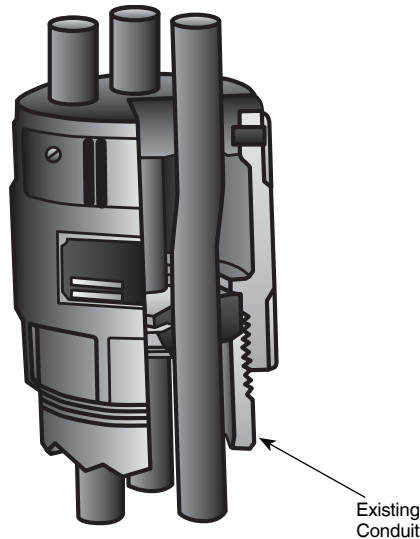
With Top Cover

Use:

To effectively seal one or more single or multiple conductor cables and the conduit against the entrance of water, damp or corrosive atmospheres, hot or cold air or dust.

Features:

- For rubber or plastic insulated cables in rigid conduit.
- Provides an ample sealing compound chamber for use indoors or outdoors.
- For applications involving IMC, EMT or PVC conduit, a short nipple of rigid conduit should be used entering the bottom threaded hub.
- For Sealing Compound, see page RA15. Sealing Compound is not included and must be ordered separately.
- Can be field-drilled, see page RA2.
- For voltage ratings, see page RA1.



Type CRC

Material/Finish:

Body: Malleable or Ductile Iron Casting with Hot Dip Galvanized finish.
Sealing Disc: Canvas Bakelite

Options:

- Fittings can be furnished for more than four wires or wires of varying sizes.
- Lay-In-Lug™ Grounding Lug can be mounted on Terminator Body, see page QA14.
- Available with tapping cones for sealing rubber or plastic insulated cables.
- Due to the possibility of Magnetic Induction Heating, a single alternating current conductor should not be used in iron fittings.
- Contact your local representative for price and availability on above options.

Third Party Certification:

 CSA Certified: 11584

TYPE CRC

Conduit Size	Max. Diameter of Wire Permitted – Inches				Catalog Number	Dim. in Inches		Approx. Compound Req'd. (Pints)
	1* Wire	2 Wires	3 Wires	4 Wires		Max. Dia.	Overall Height	
1 1/4"	1.02	.55	.50	.44	CRC-125	2 1/4	3 3/8	1/8
1 1/2"	1.20	.63	.59	.51	CRC-150	2 5/8	3 3/4	1/8
2"	1.53	.81	.73	.65	CRC-200	3	3 3/4	1/4
2 1/2"	1.83	.97	.93	.78	CRC-250	3 1/2	4 1/4	1/2
3"	2.28	1.21	1.16	.97	CRC-300	4 1/4	4 3/4	3/4
3 1/2"	2.65	1.40	1.34	1.12	CRC-350	4 3/4	5 5/8	1
4"	3.00	1.58	1.52	1.27	CRC-400	5 5/8	5 5/8	1 1/2
5"	3.75	1.99	1.91	1.60	CRC-500	6 1/2	6 1/2	2 3/4
6"	4.50	2.39	2.30	1.92	CRC-600	7 5/8	6 5/8	4

TO ORDER SPECIFY:

- 1 Catalog Number
- 2 Number of cables
- 3 Diameter over insulation of each cable

Conduit Compound Bushings

For Ends of Threaded Rigid Conduit

Type FR

Use:

To effectively seal one or more single or multiple conductor cables against the entrance of water, damp or corrosive atmospheres, hot or cold air or dust.

Features:

- For rubber or plastic insulated cables in rigid conduit.
- Provides an ample sealing compound chamber for use indoors or outdoors.
- For Sealing Compound, see page RA15. Sealing Compound is not included and must be ordered separately.
- For applications involving IMC, EMT or PVC conduit, a short nipple of rigid conduit should be used entering the bottom threaded hub.
- For voltage ratings, see page RA1.
- Lay-In-Lug™ Grounding Lug can be mounted on Terminator Body, see page QA14.
- Can be field-drilled, see page RA2.

Material/Finish:

Bodies 1" & 1¼" are Steel with Zinc Electroplate. Larger Bodes are Malleable or Ductile Iron with Hot Dip Galvanized finish. Sealing Discs are Canvas Bakelite.

Options:

- Steel Bodies 1" & 1¼" are available with Hot Dip Galvanized Finish.
- Fittings can be furnished for more than four wires or wires of varying sizes.
- Due to the possibility of Magnetic Induction Heating, a single alternating current conductor should not be used in iron fittings.
- Contact your local representative for price and availability on above options.

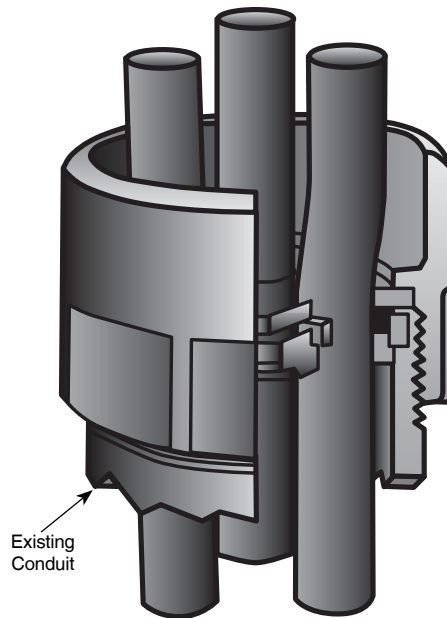
Third Party Certification:



CSA Certified: 11584

TO ORDER SPECIFY:

- 1 Catalog Number
- 2 Number of cables
- 3 Diameter over insulation of each cable



Type FR

Conduit Size	Max. Diameter of Wire Permitted – Inches				Catalog Number	Dim. in Inches		Approx. Compound Required Pints
	1* Wire	2 Wires	3 Wires	4 Wires		Max. Dia.	Overall Height	
1"	.78	.38	.34	.31	FR-100	1¾	1⅝	⅓
1¼"	1.02	.55	.50	.44	FR-125	2⅞	1¾	⅓
1½"	1.20	.63	.59	.51	FR-150	2⅞	1⅞	⅓
2"	1.53	.81	.73	.65	FR-200	3	2	⅓
2½"	1.83	.97	.93	.78	FR-250	3⅞	2½	⅓
3"	2.28	1.21	1.16	.97	FR-300	4⅞	2⅞	⅓
3½"	2.65	1.40	1.34	1.12	FR-350	4⅞	2⅞	⅓
4"	3.00	1.58	1.52	1.27	FR-400	5⅞	2⅞	⅓
5"	3.75	1.99	1.91	1.60	FR-500	6⅞	3⅞	1

Cabinet Compound Bushings

For Threaded Rigid Conduits Entering Cabinets

Type HRK

Use:

To effectively seal one or more single or multiple conductor cables against the entrance of water, damp or corrosive atmospheres, hot or cold air or dust.

Features:

- For rubber or plastic insulated cables in rigid conduit.
- Provides an ample sealing compound chamber for use indoors or outdoors.
- For Sealing Compound, see page RA15. Sealing Compound is not included and must be ordered separately.
- Supplied with two locknuts for cabinets up to 1/4" thick.
- For applications involving IMC, EMT or PVC conduit, a short nipple of rigid conduit should be used entering the bottom threaded hub.
- For voltage ratings, see page RA1.
- Lay-In-Lug™ Grounding Lug can be mounted on Terminator Body, see page QA14.
- Can be field-drilled, see page RA2.

Material/Finish:

Bodies 1" & 1 1/4" are Steel with Zinc Electroplate. Larger Bodies are Malleable or Ductile Iron with Hot Dip Galvanized finish. Locknuts are Steel or Malleable Iron with Zinc Electroplate. Sealing Discs are Canvas Bakelite.

Options:

- Bodies 1" & 1 1/4" are available with Hot Dip Galvanized Finish.
- Fittings can be furnished for more than four wires or wires of varying sizes.
- Due to the possibility of Magnetic Induction Heating, a single alternating current conductor should not be used in iron fittings.
- Contact your local representative for price and availability on above options.

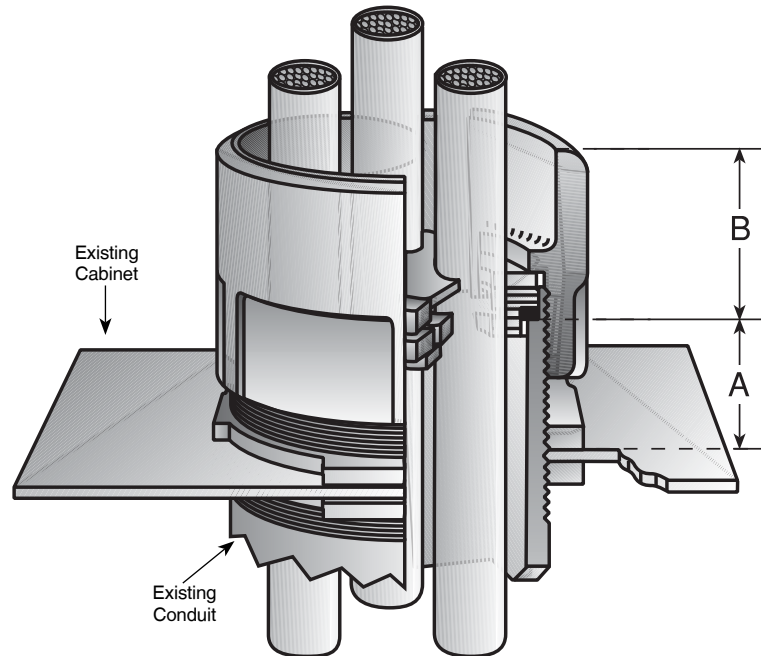
Third Party Certification:



CSA Certified: 11584

TO ORDER SPECIFY:

- 1 Catalog Number
- 2 Number of cables
- 3 Diameter over insulation of each cable



Type HRK

Conduit Size	Max. Diameter of Wire Permitted – Inches				Catalog Number	Dimensions in Inches			Approx. Compound Required Pints
	1* Wire	2 Wires	3 Wires	4 Wires		Max. Dia.	"A" Min.	"B"	
1"	.78	.38	.34	.31	HRK-100	1 3/4	1	1 1/8	1/20
1 1/4"	1.02	.55	.50	.44	HRK-125	2 3/8	1	1 1/4	1/20
1 1/2"	1.20	.63	.59	.51	HRK-150	2 5/8	1	1 1/4	1/8
2"	1.53	.81	.73	.65	HRK-200	3 1/8	1 1/8	1 1/2	1/8
2 1/2"	1.83	.97	.93	.78	HRK-250	3 5/8	1 3/8	1 3/4	1/8
3"	2.28	1.21	1.16	.97	HRK-300	4 3/8	1 1/2	1 7/8	1/2
3 1/2"	2.65	1.40	1.34	1.12	HRK-350	5	1 1/2	1 7/8	1/2
4"	3.00	1.58	1.52	1.27	HRK-400	5 1/2	1 1/2	1 7/8	3/8
5"	3.75	1.99	1.91	1.60	HRK-500	6 7/8	1 5/8	2 3/8	1

Cabinet Compound Bushings

For Exposed Cables Entering Cabinets

Type HRE

Use:

To effectively seal one or more single or multiple conductor cables against the entrance of water, damp or corrosive atmospheres, hot or cold air or dust.

Features:

- For rubber or plastic insulated cables.
- Provides an ample sealing compound chamber for use indoors or outdoors.
- For Sealing Compound, see page RA15. Sealing Compound is not included and must be ordered separately.
- Supplied with a locknut and neoprene sealing ring for cabinets up to 1/4" thick.
- For voltage ratings, see page RA1.
- Lay-In-Lug™ Grounding Lug can be mounted on Terminator Body, see page QA14.
- Can be field-drilled, see page RA2.

Material/Finish:

Bodies 1" & 1 1/4" are Steel with Zinc Electroplate. Larger Bodes are Malleable or Ductile Iron with Hot Dip Galvanized finish. Locknut is Steel or Malleable Iron with Zinc Electroplate. Sealing Discs are Canvas Bakelite.

Options:

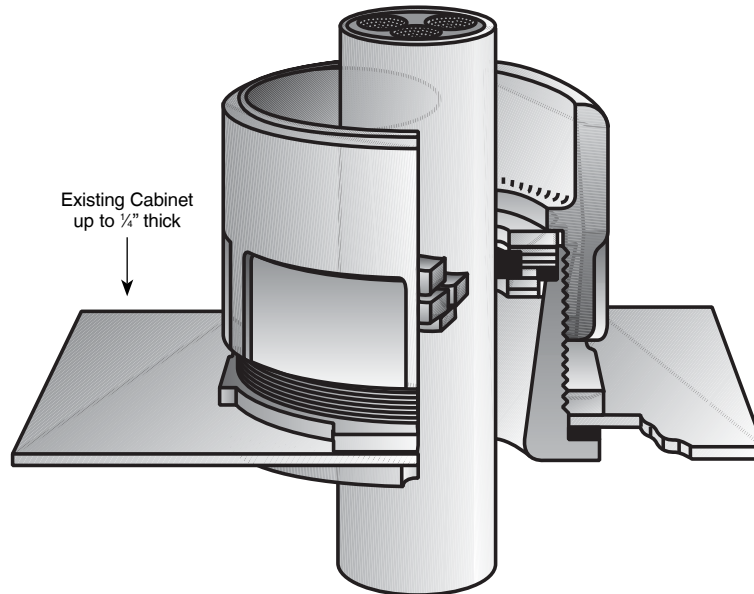
- Bodies 1" & 1 1/4" are available with Hot Dip Galvanized Finish.
- Fittings can be furnished for more than four wires or wires of varying sizes.
- Due to the possibility of Magnetic Induction Heating, a single alternating current conductor should not be used in iron fittings.
- Contact your local representative for price and availability on above options.

Third Party Certification:

 CSA Certified: 11584

TO ORDER SPECIFY:

- 1 Catalog Number
- 2 Number of conductors
- 3 Diameter over insulation of each conductor



Type HRE

Max. Dia. of Wire Permitted – Inches					Max.Overall Number	Dim. in Inches		Approx. Compound Pints
1* Wire	2 Wires	3 Wires	4 Wires	Knockout Catalog Size		Required Dia.	Required Height	
.78	.38	.34	.31	1"	HRE-100	1 3/4	2 1/8	1/20
1.02	.55	.50	.44	1 1/4"	HRE-125	2 3/8	2 1/4	1/20
1.20	.63	.59	.51	1 1/2"	HRE-150	2 3/8	2 1/4	1/6
1.53	.81	.73	.65	2"	HRE-200	3 1/2	2 3/8	1/6
1.83	.97	.93	.78	2 1/2"	HRE-250	3 3/8	3 1/8	1/3
2.28	1.21	1.16	.97	3"	HRE-300	4 3/8	3 3/8	1/2
2.65	1.40	1.34	1.12	3 1/2"	HRE-350	5	3 3/8	1/2
3.00	1.58	1.52	1.27	4"	HRE-400	5 1/2	3 3/8	2/3
3.75	1.99	1.91	1.60	5"	HRE-500	6 3/4	4	1

Cable Support Compound Bushings

For Exposed Cables Entering Cabinets – with pOZi-grip® Wedging Plug

Type HPE

Use:

Provides cable support while effectively sealing one or more single or multiple conductor cables against the entrance of water, damp or corrosive atmospheres, hot or cold air or dust.

Features:

- For rubber or plastic insulated cables.
- Supports a vertical length of cable per NEC Section 300.19(A). Refer to page QA1 for details.
- Provides an ample sealing compound chamber for use indoors or outdoors.
- For Sealing Compound, see page RA15. Sealing Compound is not included and must be ordered separately.
- Supplied with a locknut and neoprene sealing ring for cabinets up to ¼" thick.
- For voltage ratings, see page RA1.
- Lay-In-Lug™ Grounding Lug can be mounted on Compound Chamber, see page QA14.

Material/Finish:

Bodies 1" & 1¼" are Steel with Zinc Electroplate. Larger Bodies are Malleable or Ductile Iron with Hot Dip Galvanized finish. Locknut is Steel or Malleable Iron with Zinc Electroplate. Wedging Plug is Canvas Bakelite.

Options:

- Bodies 1" & 1¼" are available with Hot Dip Galvanized Finish.
- Fittings can be furnished for two or more wires or wires of varying sizes.
- Due to the possibility of Magnetic Induction Heating, a single alternating current conductor should not be used in iron fittings.
- Contact your local representative for price and availability on above options.

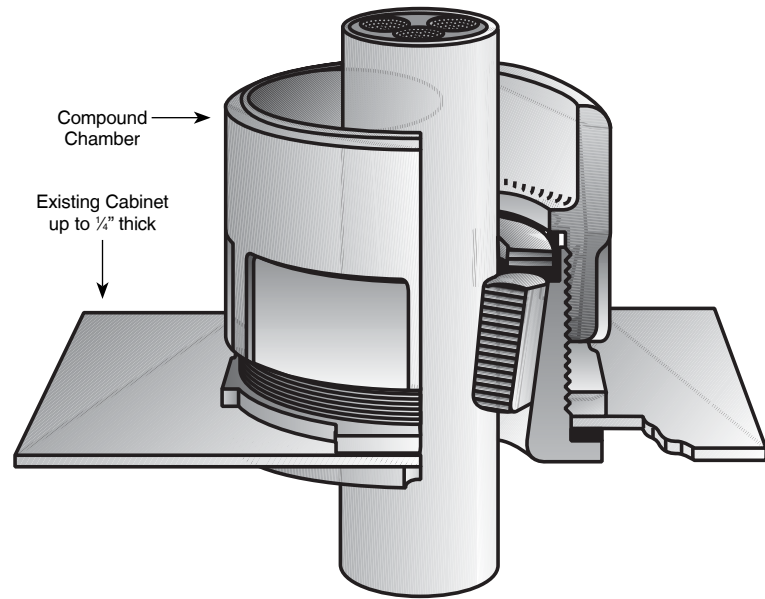
Third Party Certification:



CSA Certified: 11584

TO ORDER SPECIFY:

- 1 Catalog Number
- 2 Number of cables
- 3 Diameter over insulation of each cable



Type HPE with Canvas Bakelite Wedging Plug

Cable support plugs will not be supplied undrilled.

Max. Cable Dia. (inches)	Knockout Size	Catalog Number	Dim. in Inches		Approx. Compound Required Pints
			Max. Dia.	Height Inside Box	
.68	1"	HPE-100	1¾	2½	1/20
.93	1¼"	HPE-125	2½	2¼	1/20
1.20	1½"	HPE-150	2½	2¼	1/6
1.53	2"	HPE-200	3½	2½	1/6
1.83	2½"	HPE-250	3½	3½	1/3
2.28	3"	HPE-300	4¾	3¾	1/2
2.65	3½"	HPE-350	5	3¾	1/2
3.00	4"	HPE-400	5½	3¾	2/3
3.75	5"	HPE-500	6¾	4	1

Cable support plugs will not be supplied undrilled.

Sealing Bushings for Conduit

For Ends of Threaded Rigid Conduits

Type KR

Use:

Provides a seal at the top of a vertical conduit for one or more single or multiple conductor cables. Excludes water, damp or corrosive atmospheres, hot or cold air or dust.

Features:

- For rubber or plastic insulated cables in rigid conduit.
- For voltage ratings, see page RA1.
- Lay-In-Lug™ Grounding Lug can be mounted on Locking Collar, see page QA14.
- Can be field-drilled, see page RA2.
- For applications involving IMC, EMT or PVC conduit, a short nipple of rigid conduit should be used entering the bottom threaded hub.

Material/Finish:

Locking Collar is Malleable or Ductile Iron with Hot Dip Galvanized finish. Sealing Discs are Canvas Bakelite.

Options:

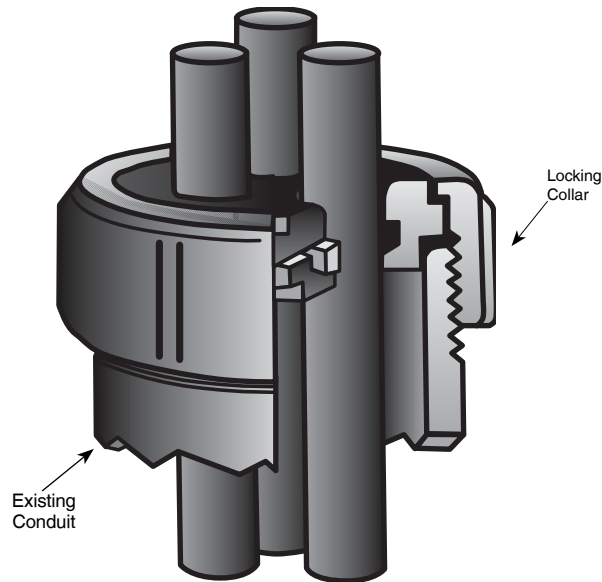
- Fittings can be furnished for more than four wires or wires of varying sizes.
- Due to the possibility of Magnetic Induction Heating, a single alternating current conductor should not be used in iron fittings.
- Contact your local representative for price and availability on above options.

Third Party Certification:

 CSA Certified: 11584

TO ORDER SPECIFY:

- 1 Catalog Number
- 2 Number of cables
- 3 Diameter over insulation of each cable



Type KR

Conduit Size	Max. Diameter of Wire Permitted – Inches				Catalog Number	Dim. in Inches	
	1* Wire	2 Wires	3 Wires	4 Wires		Max. Dia.	Overall Height
1"	.78	.38	.34	.31	KR-100	1 ⁵ / ₈	1
1 ¹ / ₄ "	1.02	.55	.50	.44	KR-125	1 ¹ / ₂	1 ¹ / ₈
1 ¹ / ₂ "	1.20	.63	.59	.51	KR-150	2 ³ / ₈	1 ¹ / ₈
2"	1.53	.81	.73	.65	KR-200	2 ¹³ / ₁₆	1 ¹ / ₈
2 ¹ / ₂ "	1.83	.97	.93	.78	KR-250	3 ³ / ₈	1 ³ / ₈
3"	2.28	1.21	1.16	.97	KR-300	4	1 ¹ / ₂
3 ¹ / ₂ "	2.65	1.40	1.34	1.12	KR-350	4 ¹ / ₂	1 ¹ / ₂
4"	3.00	1.58	1.52	1.27	KR-400	5 ¹ / ₈	1 ⁵ / ₈
5"	3.75	1.99	1.91	1.60	KR-500	6 ¹ / ₄	1 ³ / ₄
6"	4.50	2.39	2.30	1.92	KR-600	7 ³ / ₈	1 ³ / ₄

Cabinet Sealing Bushings

For Ends of Threaded Rigid Conduits Entering Cabinets

Type GRK

Use:

Provides a seal at the top of a vertical conduit entering a cabinet, for one or more single or multiple conductor cables. Excludes water, damp or corrosive atmospheres, hot or cold air or dust.

Features:

- For rubber or plastic insulated cables in rigid conduit.
- Supplied with two locknuts for cabinets up to ¼" thick.
- For voltage ratings, see page RA1.
- Lay-In-Lug™ Grounding Lug can be mounted on Locking Collar, see page QA14.
- Can be field-drilled, see page RA2.
- For applications involving IMC, EMT or PVC conduit, a short nipple of rigid conduit should be used entering the bottom cabinet sliphole.

Material/Finish:

Locking Collar is Malleable or Ductile Iron with Hot Dip Galvanized finish. Locknuts are Steel or Malleable Iron with Zinc Electroplate. Sealing Discs are Canvas Bakelite.

Options:

- Fittings can be furnished for more than four wires or wires of varying sizes.
- Due to the possibility of Magnetic Induction Heating, a single alternating current conductor should not be used in iron fittings.
- Contact your local representative for price and availability on above options.

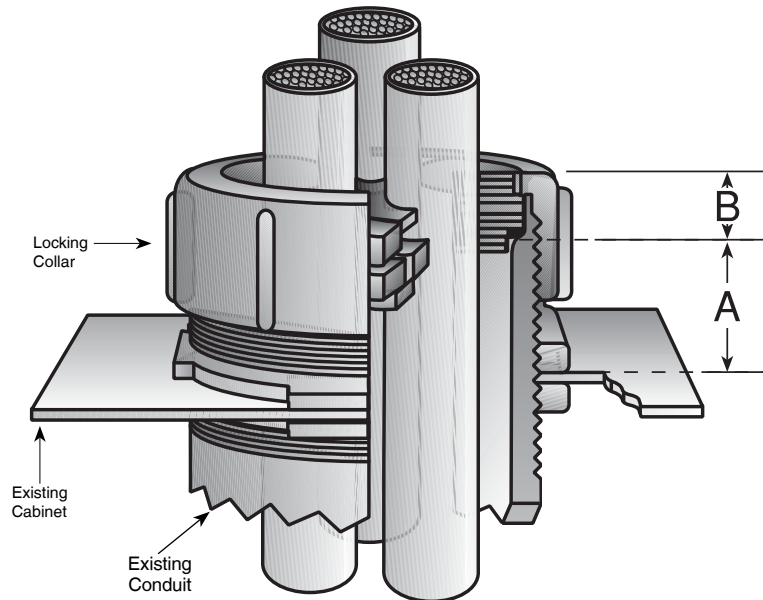
Third Party Certification:



CSA Certified: 11584

TO ORDER SPECIFY:

- 1 Catalog Number
- 2 Number of cables
- 3 Diameter over insulation of each cable



Type GRK

Conduit Size	Max. Diameter of Wire Permitted – Inches				Catalog Number	Dim. in Inches		
	1* Wire	2 Wires	3 Wires	4 Wires		Max. Dia.	"A" Min.	"B"
1"	.78	.38	.34	.31	GRK-100	1¼	1	½
1¼"	1.02	.55	.50	.44	GRK-125	2⅝	1	½
1½"	1.20	.63	.59	.51	GRK-150	2⅝	1	½
2"	1.53	.81	.73	.65	GRK-200	3⅝	1⅝	½
2½"	1.83	.97	.93	.78	GRK-250	3⅝	1⅝	⅝
3"	2.28	1.21	1.16	.97	GRK-300	4⅝	1⅝	⅝
3½"	2.65	1.40	1.34	1.12	GRK-350	5	1½	¾
4"	3.00	1.58	1.52	1.27	GRK-400	5½	1½	¾
5"	3.75	1.99	1.91	1.60	GRK-500	6⅝	1⅝	1
6"	4.50	2.39	2.30	1.92	GRK-600	7⅝	1¾	1

Cabinet Sealing Bushing

For Exposed Cables Entering Cabinets

Type GRE

Use:

To effectively seal one or more single or multiple conductor cables against the entrance of water, damp or corrosive atmospheres, hot or cold air or dust.

Features:

- For rubber or plastic insulated cables.
- Supplied with a Zinc Electroplated Locknut and Neoprene Sealing Ring for cabinets up to ¼" thick.
- For voltage ratings, see page RA1.
- Lay-In-Lug™ Grounding Lug can be mounted on Locking Collar, see page QA14.
- Can be field-drilled, see page RA2.

Material/Finish:

Locking Collar and Body is Malleable or Ductile Iron with Hot Dip Galvanized finish. Sealing Discs are Canvas Bakelite.

Options:

- Fittings can be furnished for more than four wires or wires of varying sizes.
- Due to the possibility of Magnetic Induction Heating, a single alternating current conductor should not be used in iron fittings.
- Contact your local representative for price and availability on above options.

Third Party Certification:

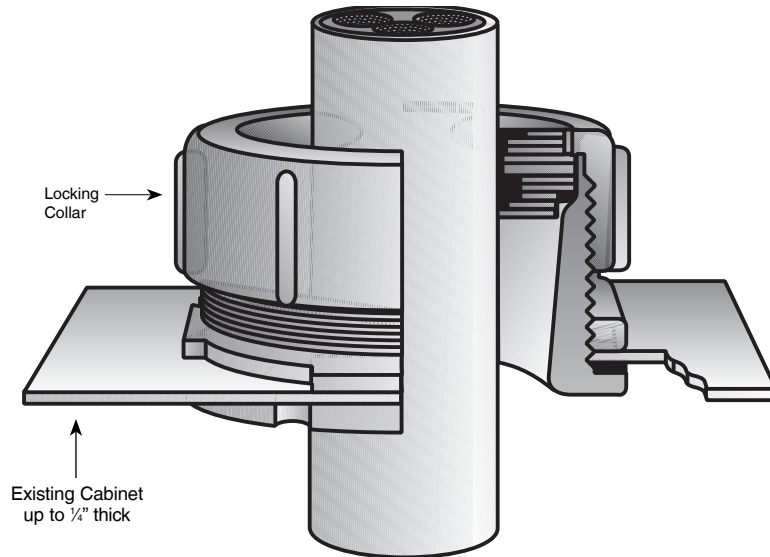
 CSA Certified: 11584

Applicable Third Party Standards:

CSA Standard: C22.2 No. 18

TO ORDER SPECIFY:

- 1 Catalog Number
- 2 Number of conductors
- 3 Diameter over insulation of each conductor



Type GRE

Max. Dia. of Wire Permitted – Inches					Catalog Number	Dim. in Inches	
1* Wire	2 Wires	3 Wires	4 Wires	Knockout Size		Max. Dia.	Overall Height
.78	.38	.34	.31	1"	GRE-100	1¼	1½
1.02	.55	.50	.44	1¼"	GRE-125	2⅝	1⅝
1.20	.63	.59	.51	1½"	GRE-150	2⅝	1⅝
1.53	.81	.73	.65	2"	GRE-200	3⅝	1⅝
1.83	.97	.93	.78	2½"	GRE-250	3⅝	2
2.28	1.21	1.16	.97	3"	GRE-300	4⅝	2⅝
2.65	1.40	1.34	1.12	3½"	GRE-350	5	2¼
3.00	1.58	1.52	1.27	4"	GRE-400	5½	2⅝
3.75	1.99	1.91	1.60	5"	GRE-500	6⅝	2⅝
4.50	2.39	2.30	1.92	6"	GRE-600	7⅝	3

*Not CSA Approved.

Cable Support Cabinet Bushing

For Exposed Cables Entering Cabinets – with pOZi-grip® Wedging Plug

Type GPE

Use:

Provides cable support for one or more single or multiple conductor cables entering a cabinet or enclosure.

Features:

- For rubber or plastic insulated cables.
- Supports a vertical length of cable per NEC Section 300.19(A). Refer to page QA1 for details.
- For information pertaining to "R" type Cable Supports, please refer to pages QA1, QA2 and QA5.
- Supplied with a Zinc Electroplated Locknut for cabinets up to 1/4" thick.
- Lay-In-Lug™ Grounding Lug can be mounted on Locking Collar, see page QA14.
- Cable Support Plugs cannot be field-drilled.

Material/Finish:

Locking Collar and Body is Malleable or Ductile Iron with Hot Dip Galvanized finish. Pressure Disc and Wedging Plug are Canvas Bakelite.

Options:

- Fittings can be furnished for more than four wires or wires of varying sizes.
- Due to the possibility of Magnetic Induction Heating, a single alternating current conductor should not be used in iron fittings.
- Contact your local representative for price and availability on above options.

Third Party Certification:



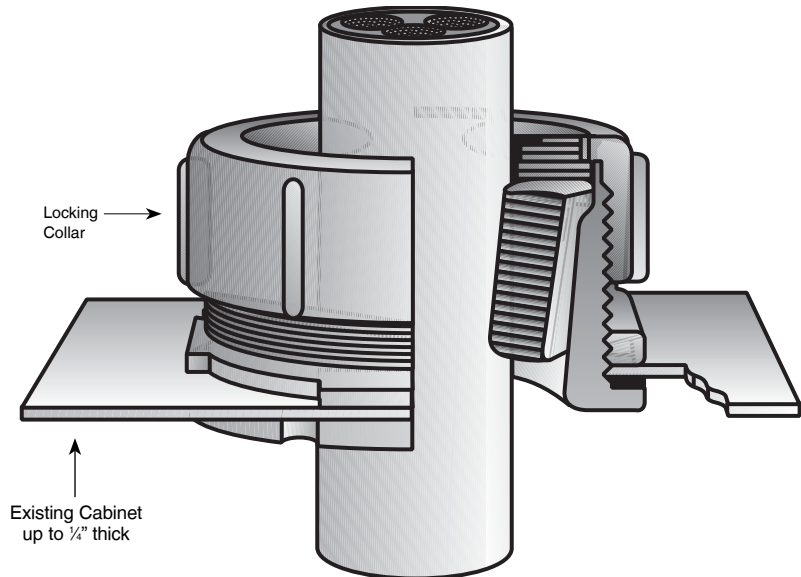
CSA Certified: 11584

Applicable Third Party Standards:

CSA Standard: C22.2 No. 18

TO ORDER SPECIFY:

- 1 Catalog Number
- 2 Number of conductors
- 3 Diameter over insulation of each conductor



Type GPE with Canvas Bakelite Wedging Plug

Cable support plugs will not be supplied undrilled.

Max. Cable Dia. (inches)	Knockout Size	Catalog Number	Dim. in Inches	
			Max. Dia.	Height Inside Box
.68	1"	GPE-100	1 1/4	1 1/2
.93	1 1/4"	GPE-125	2 3/8	1 5/8
1.20	1 1/2"	GPE-150	2 5/8	1 5/8
1.53	2"	GPE-200	3 1/8	1 5/8
1.83	2 1/2"	GPE-250	3 5/8	2
2.28	3"	GPE-300	4 3/8	2 5/8
2.65	3 1/2"	GPE-350	5	2 1/4
3.00	4"	GPE-400	5 1/2	2 3/8
3.75	5"	GPE-500	6 7/8	2 5/8
4.50	6"	GPE-600*	7 5/8	3

*Not CSA Approved.

Cable support plugs will not be supplied undrilled.

DOZSeal Sealing Insulating Compound

For Use in Terminators, Compound Bushings and Compound Type Cable Supports

DOZseal 220 is a universal medium-soft asphaltic base compound having a low softening point and low pouring temperature. The compound remains plastic at low temperatures and remains viscous at the highest cable operating temperature.

Used In:

Gasketed or Threaded Splice Fittings and Gasketed Terminators.

Use in Non-Hazardous Location With:

Any cable having solid type insulation, such as Paper, Varnished Cambric, Rubber, Butyl, Cross-Linked Polyethylene, or High Molecular weight Polyethylene rated 34.5KV and below.

DOZseal 225 is a high ambient medium-hard asphaltic base compound having a medium-low softening point and a low pouring temperature. The compound remains plastic at medium-low temperatures and remains more viscous at the highest cable operating temperature.

Used In:

Gasketed or Threaded Splice Fittings and Gasketed Terminators, when they are installed in hot climates or in hot exposures.

Use in Non-Hazardous Location With:

Cables having solid type insulation, such as Paper, Varnished Cambric, Rubber, and Butyl rated 34.5KV and below.

DOZseal 230 is a hard asphaltic base compound having a high softening point and high pouring temperature. The compound remains plastic at the highest cable operating temperature.

Used In:

Non-Gasketed Terminators or Cable Supports.

Use in Non-Hazardous Location With:

Any cable having solid type insulation.

FOR USE IN TERMINATORS, COMPOUND BUSHINGS, COMPOUND TYPE CABLE SUPPORTS				
Compound Number	Type	Catalog Number One Qt. Can	One Gal. Bucket	Five Gal. Bucket
DOZSEAL 220	Medium-soft asphaltic base	DOZ-220Q	DOZ-220G	DOZ-220G5
DOZSEAL 225	Medium-hard asphaltic base	DOZ-225Q	DOZ-225G	DOZ-225G5
DOZSEAL 230	Hard asphaltic base	DOZ-230Q	DOZ-230G	DOZ-230G5

For shipping purposes, the approximate gross weight of the above compounds is 10 lbs. per gallon.

NOTE: When ordering Compound specify by number of units only, not quarts or gallons.

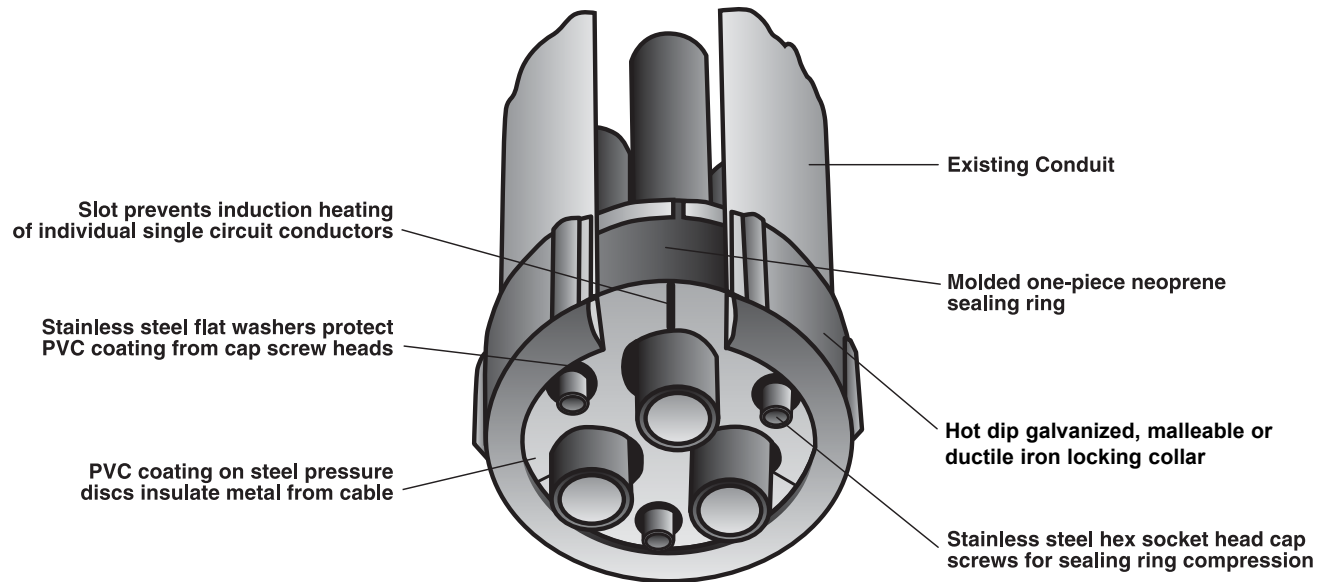
Example: To order 50 gallons of DOZSEAL 220 specify ten (10) DOZ-220G5 units.

CHARACTERISTICS				
Characteristics	Unit	DOZSEAL Filling Compounds		
		DOZSEAL 220	DOZSEAL 225	DOZSEAL 230
Softening Point	°F	115-125	165-170	230-240
Pouring Temperature	°F	325-375	325-375	375-400
Flash Point	°F	475	475	475
Dielectric Strength	KV	50	50	55

Conduit Sealing Bushings

Type CSB

For use with Cable



Details of Construction:

Pressure Discs: Thick metal discs with custom drilled holes to accommodate cables. Steel discs are slotted at cable holes to eliminate induction heating effect of single conductor alternating current. Steel discs are PVC coated for corrosion protection, to insulate cable holes and to prevent plates from bridging to other ferrous parts. Uncoated aluminum plates are available. Copper alloy, stainless steel or phenolic discs are available at price addition.

Screws & Washers: Corrosion-proof stainless steel socket head screws are used to compress the two discs against the sealing ring. Hex head stainless steel machine screws are available. PVC coated discs have stainless steel washers to prevent screws from damaging coating. (Suffix - P type only.)

Locking Collar: Malleable iron hot dip galvanized; suffix "A" for aluminum. Gaskets are provided to prevent locking collar and end of conduit from damaging PVC coated disc. (Suffix - P type only.)

Sealing Ring: Thick one-piece neoprene ring custom drilled. Neoprene is specifically compounded for the following operating characteristics:

1. Low compression modulus (the ability of the neoprene sealing ring to seal with low-tightening force).
2. Very low compression set (maintain seal over extended period without having to retighten).
3. Anti-oxidant (resistance to ozone attack).
4. Anti-oxidant (resistance to weathering).
5. Low crystallization (suitable for use at low temperatures).
6. Fire retardant (will not support combustion).

For modifications or special requirements, contact your local representative for price and availability.

Conduit Sealing Bushings

For Use with Insulated Wire, Cable and Rigid Metal Conduit

Type CSB Series

Type CSBE:

Seals against pressure from the outside of the fitting and to provide some support for the cables when fitting is used in vertical position as shown in illustration.

Type CSBI:

Seals against fluids or gases that are inside a conduit and prevents them from entering an enclosure.

Type CSBG:

Provides all the features of Types CSBE and CSBI and in addition prevents the sealing bushing from moving out of the end of the conduit should the internal pressure be high or if the fitting is used on conduit in an inverted position. The Type CSBG fittings are capable of sealing against gas or fluid pressure of 100 psig, (non-segmented) Type CSBI and CSBE – 50 psig (non-segmented.) Segmenting reduces above pressure in half. Can also be supplied with Lay-In-Lug grounding wire connector, see page QA14.

Use:

- These conduit Sealing Bushings are used for sealing the ends of conduit in applications involving higher static gas or fluid pressures than can be handled by standard sealing bushings.
- For use with IMC or EMT, a short nipple of Rigid Metal Conduit should be used to accommodate the Conduit Sealing Bushing. For Schedule 40 PVC Conduit, contact your local representative.

Features:

- The complete assembly is provided with 1 or multiple holes to accommodate the size and number of cables which emerge from the conduit. When the fitting is in place and the screws are tightened, the neoprene sealing ring is compressed between the metal plates and is forced against the inside wall of the conduit and also against the cable insulation to effect a complete seal at the conduit end.

- Blank fittings are available. These are intended as abandonment devices only. **Do not field drill.**
- Consult your local representative for all other applications.
- These fittings are simple to install. They eliminate the special preparation of the end of the conduit or the compounding of the conduit thread which is required on other types of sealing fittings used to seal against high pressures.

Materials:

Slotted PVC coated steel discs, neoprene sealing ring and stainless steel socket head cap screws and washers. Locking collars on type CSBG are hot dipped galvanized malleable or ductile iron.

Optional Materials:

Also available with aluminum or brass/bronze pressure discs (Metal Plates) on Type CSBI and CSBE bushings. To specify, substitute suffix "A" or "B" for "P" in catalog number. (Example: CSBI-200A-1) Locking Collar and Pressure Discs are also available in Aluminum or Bronze on Type CSBG Bushings. Example (CSBG-200A-1) Consult your local representative for price and availability.

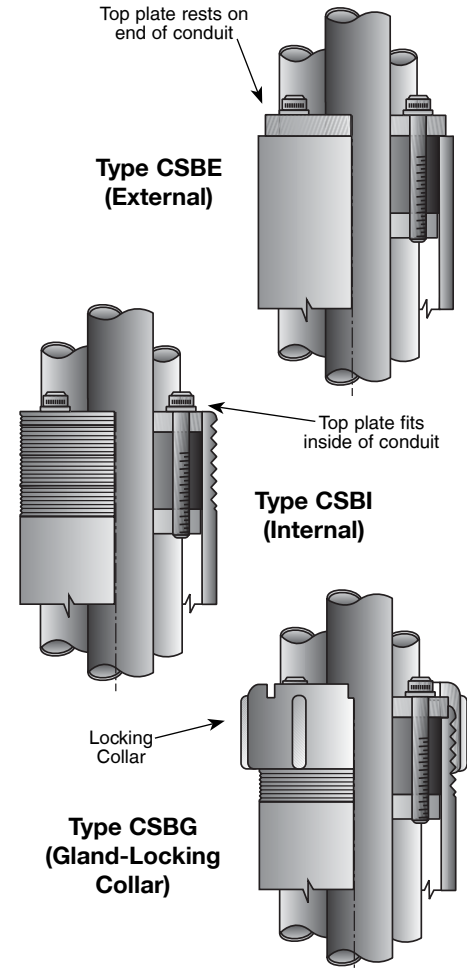
Alternate Construction: (Catalog # SEG)

Segmented Design – Segmental pressure discs and slit-neoprene sealing ring produce a come-apart design which allows the sealing bushing to be installed without having to thread it along the cable or allows installation around cables already pulled.

Also available with slit neoprene sealing ring and one piece pressure discs.

Third Party Certification:

UL Listed: E-11857
 Type CSBG with aluminum pressure disks is Listed by Underwriters Laboratories, Inc. as an outlet bushing, service entrance seal or service head.



TO ORDER SPECIFY:

- 1 Catalog Number
- 2 Conduit Size
- 3 Number of Cables
- 4 Outside Diameters of Cables Over Insulation
- 5 Segmented, if Required
- 6 Two Neoprene Sealing Rings, if required (prices on application). Suffix G-2.

Conduit Size	Max. Diameter of Wire Permitted – Inches				Type CSBE Catalog Number		Type CSBI Catalog Number		Type CSBG Catalog Number	
	1 Wire	2 Wires	3 Wires	4 Wires	Blank†	One to Four Wires	Blank†	One to Four Wires	Blank†	One to Four Wires
1½"	.78	.59	.54	.44	CSBE-150P-0	CSBE-150P-1	CSBI-150P-0	CSBI-150P-1	CSBG-150P-0	CSBG-150P-1
2"	.89	.77	.71	.59	CSBE-200P-0	CSBE-200P-1	CSBI-200P-0	CSBI-200P-1	CSBG-200P-0	CSBG-200P-1
2½"	1.32	.96	.89	.78	CSBE-250P-0	CSBE-250P-1	CSBI-250P-0	CSBI-250P-1	CSBG-250P-0	CSBG-250P-1
3"	1.89	1.26	1.13	.96	CSBE-300P-0	CSBE-300P-1	CSBI-300P-0	CSBI-300P-1	CSBG-300P-0	CSBG-300P-1
3½"	2.13	1.38	1.38	1.13	CSBE-350P-0	CSBE-350P-1	CSBI-350P-0	CSBI-350P-1	CSBG-350P-0	CSBG-350P-1
4"	2.63	1.63	1.51	1.26	CSBE-400P-0	CSBE-400P-1	CSBI-400P-0	CSBI-400P-1	CSBG-400P-0	CSBG-400P-1
5"	3.45	2.00	1.88	1.63	CSBE-500P-0	CSBE-500P-1	CSBI-500P-0	CSBI-500P-1	CSBG-500P-0	CSBG-500P-1
6"	4.32	2.44	2.21	2.07	CSBE-600P-0	CSBE-600P-1	CSBI-600P-0	CSBI-600P-1	CSBG-600P-0	CSBG-600P-1

† Blank fittings are intended as abandonment and future use devices only. Blank fittings cannot be field drilled.

Conduit Sealing Bushings

Type CSB Series

1 Segmental Design (Figure 1):

Segmental pressure discs and slit neoprene sealing ring produce a come-apart design which allows the sealing bushing to be installed without having to thread it along the cable or allows installation around cables already terminated. Maximum diameter of wire or cable may need to be reduced. (Include Catalog Number "SEG"). Also available with slit neoprene sealing ring and one piece pressure discs.

2 Double Sealing Ring:

A second neoprene sealing ring may be added for cable support applications. Add suffix "G2" to catalog number. Contact your local representative for price and availability.

3 Close/Short Nipples:

Short nipples which can be screwed into conduit hubs or couplings. Seal Fittings are then installed in the open ends of these nipples. To specify a fitting complete with nipple add "N" after Catalog Number. (Example: CSBG 200P-N).

4 Type GL Cabinet Adapter (Figure 2):

For use with sealing bushings when exposed wires enter cabinets. Hot dip galvanized malleable or ductile iron is standard; aluminum if specified. Adapter assembly includes special smooth bore nipple, gasket and locknut. Type GL Cabinet Adapters must be ordered separately. See table for catalog numbers.

Thread length on special smooth bore nipples will accommodate $\frac{1}{8}$ " thick cabinet or structure on Type CSBG (specify if thicker than $\frac{1}{8}$ "), and up to $\frac{3}{4}$ " thickness on Types CSBE & CSBI.

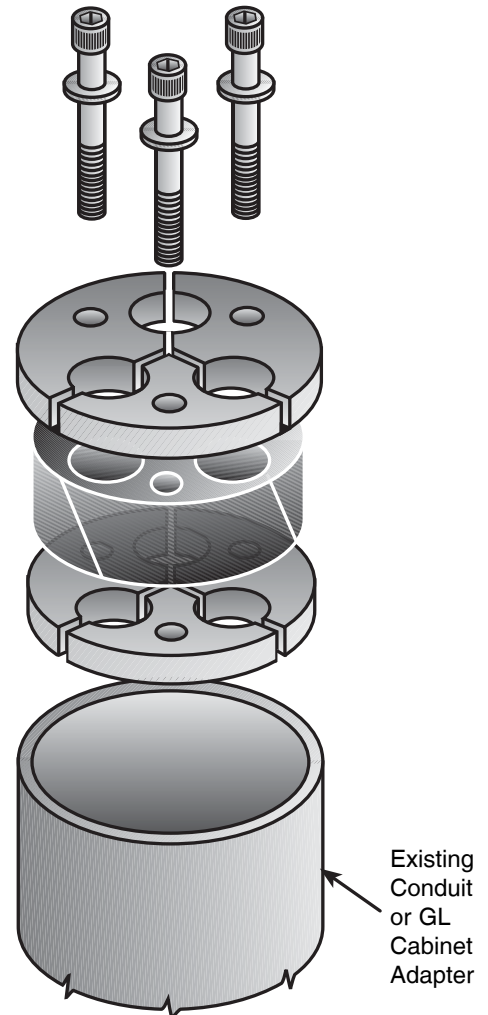
These fittings are designed for use in schedule 40 Rigid Metal Conduit. For use with IMC or EMT, a short nipple of Rigid Metal Conduit should be used to accommodate the Conduit Sealing Bushing. Contact your local representative for application involving Schedule 40 or Schedule 80 PVC Conduit.

Blank fittings are intended as abandonment and future use devices only.
DO NOT FIELD DRILL.

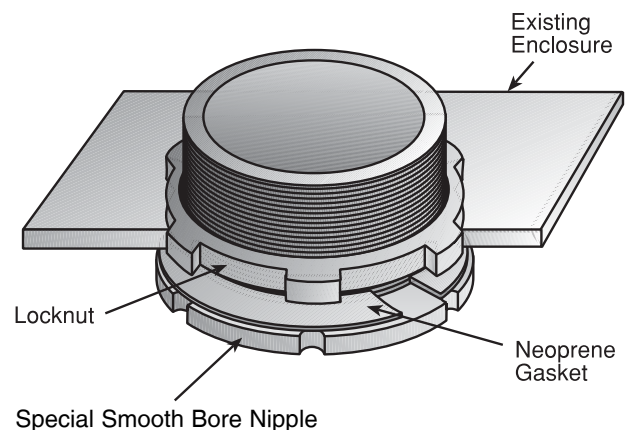
Dimensional Data:

See Page RA19

Type CSBE
Segmental Design
Figure 1



Conduit Size	Catalog Number
1½	GL150
2	GL200
2½	GL250
3	GL300
3½	GL350
4	GL400
5	GL500
6	GL600



Type GL
Cabinet Adapter
Figure 2

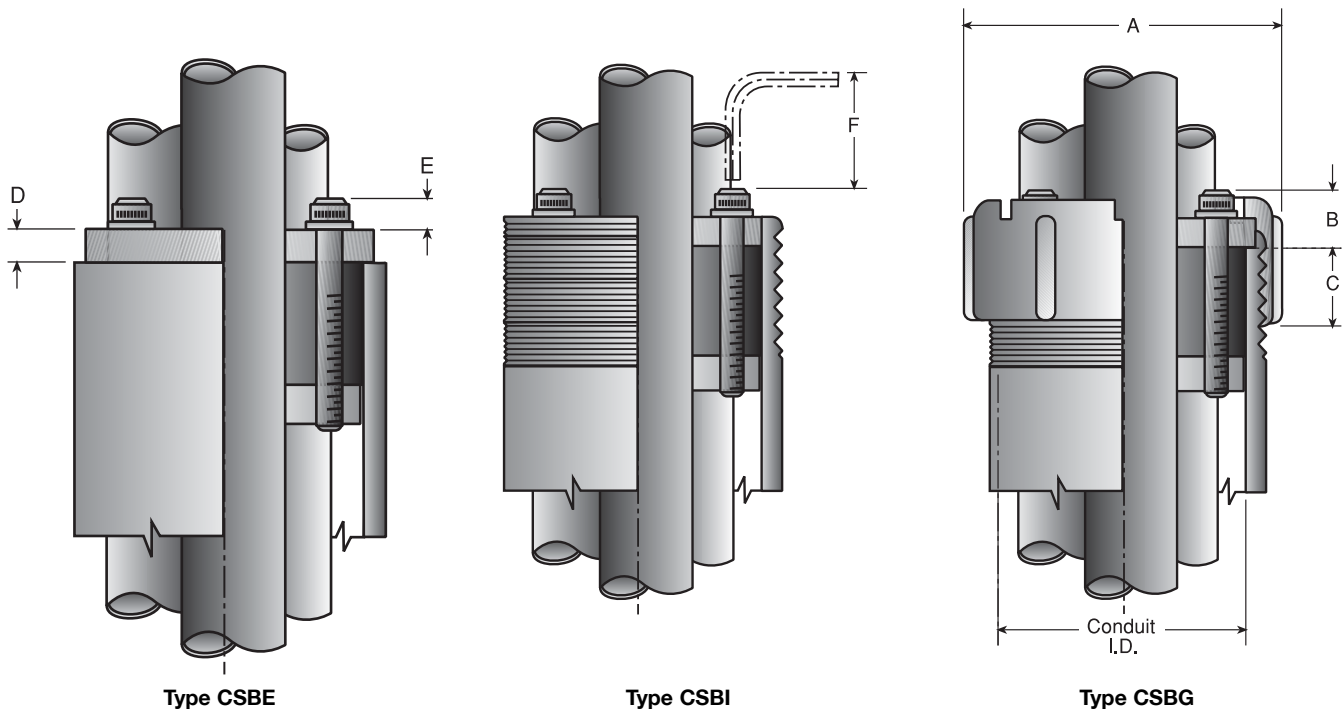
Conduit Sealing Bushings

For Use with Cable in Rigid Conduit*

Type CSB Series Dimensional Data:

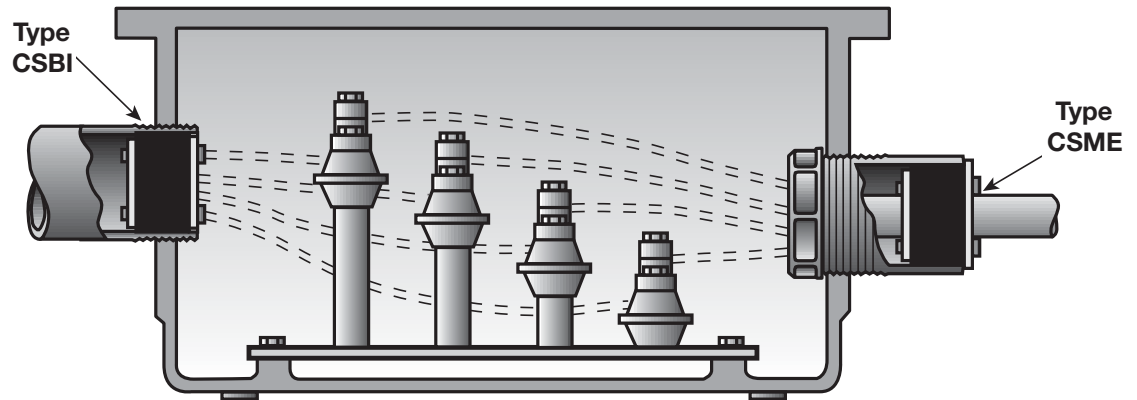
Conduit* Size	Max. Diameter of Wire Permitted – Inches (non segmented)				Conduit ID	Dimensions in Inches					
	1 Hole	2 Holes	3 Holes	4 Holes		A Dia.	B	C	D	E	F Min
1½"	.78	.49	.53	.44	1.610	2 ³ / ₈	5/ ₈	7/ ₈	5/ ₁₆	5/ ₁₆	1¼
2"	1.02	.77	.71	.61	2.067	2 ¹³ / ₁₄	5/ ₈	7/ ₈	5/ ₁₆	5/ ₁₆	1¼
2½"	1.32	.96	.89	.78	2.469	3 ³ / ₈	¾	7/ ₈	5/ ₁₆	5/ ₁₆	1¼
3"	1.89	1.20	1.13	.96	3.068	4 ¹ / ₈	¾	7/ ₈	5/ ₁₆	5/ ₁₆	1¼
3½"	2.13	1.32	1.32	1.13	3.548	4 ⁹ / ₁₆	7/ ₈	7/ ₈	7/ ₁₆	3/ ₈	1½
4"	2.57	1.63	1.51	1.26	4.026	5 ³ / ₈	5/ ₁₆	1	7/ ₁₆	3/ ₈	1½
5"	3.45	2.00	1.88	1.63	5.047	6 ¹ / ₄	5/ ₁₆	1	7/ ₁₆	3/ ₈	1½
6"	4.32	2.51	2.38	2.13	6.065	7 ³ / ₈	5/ ₁₆	1	7/ ₁₆	3/ ₈	1½

*Standard fittings may be used with corresponding sizes of schedule 40 pipe or tubes and cored holes which have the same internal diameter as conduit I.D. shown above.



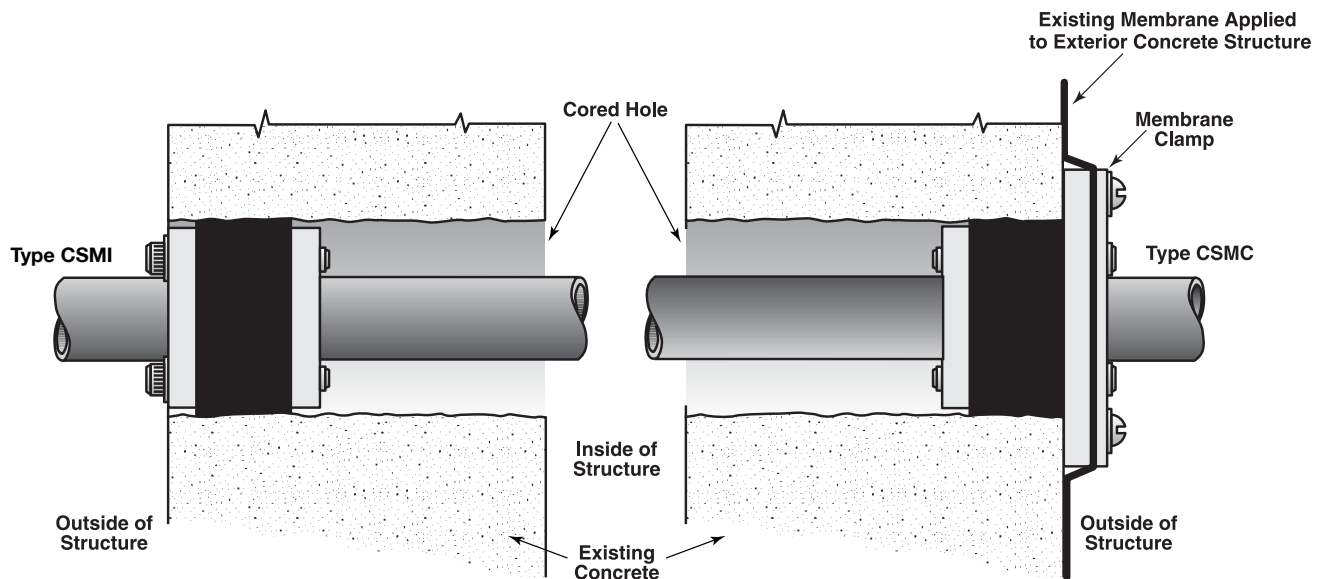
Conduit Sealing Bushings

Typical Applications:



Type CSBI & Type CSME

Used to seal conduits entering an enclosure to prevent condensation and water from entering.



Type CSMI & Type CSMC Core Drilled Hole Application

Conduit Sealing Bushings

For Use with Pipe, Conduit or Tubing

Type CSM Series

Use:

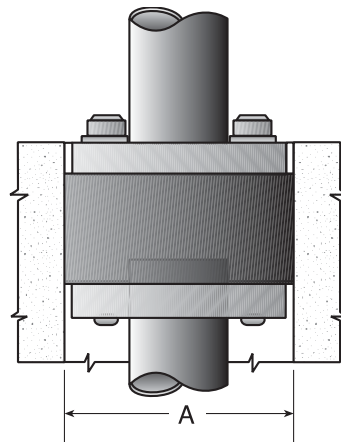
These Sealing Bushings are used to seal against fluid and gas pressure around mechanical pipes, casing, conduits or tubes. They have the same details of construction and are used for the same applications as the Type CSB Series described on Pages RA17 and RA18. In addition to sealing a pipe within a pipe, some types are specifically designed for use in core bit drilled holes or precast holes in concrete. Most of the options for the Type CSB are available in the Type CSM Series.

Dimensional Data:

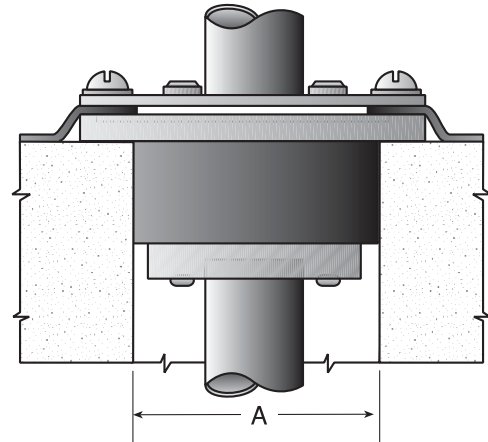
See Pages RA22, RA23

TO ORDER SPECIFY:

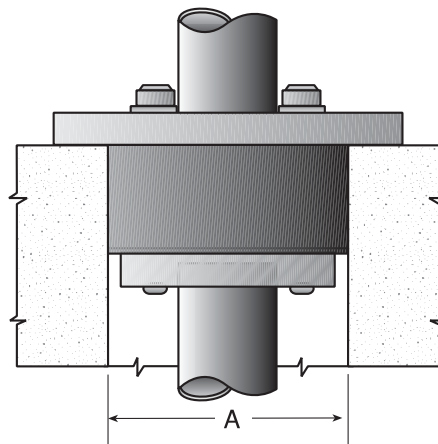
- 1 Catalog Number
- 2 Diameter of core bit drilled hole, precast hole or I.D. of pipe.
- 3 Number and O.D. of penetrating pipe, conduit or tube
- 4 Disc material finish: PVC Coated Steel Discs (standard); Uncoated Aluminum Discs.
- 5 Segmental design, if required (prices on application)
- 6 Two Neoprene Sealing Rings (if required) Prices on Applications. Suffix G2.



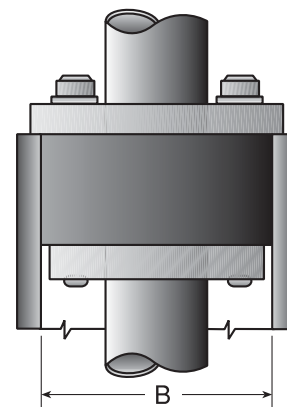
Type CSMI Internal



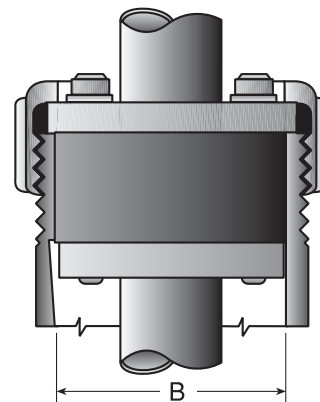
Type CSMC
with steel membrane clamp
for holding existing moisture membrane



Type CSML Large Top Plate



Type CSME External

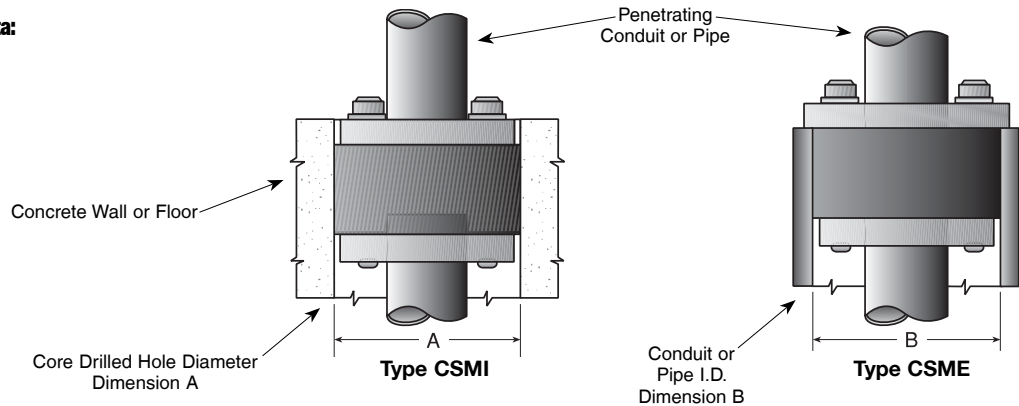


Type CSMG Gland-Locking Collar

Conduit Sealing Bushings

For Use with Pipe, Conduit or Tubing

Type CSM Dimensional Data:



Use with Core Drilled Hole Dia. "A"	Conduit or Pipe I.D. "B"	Single Penetration Applications Dimension in Inches						Multiple Penetration Max. O.D. for More Than One Pipe			Catalog Numbers				
		Steel Pipe or Conduit Nom I.D.	O.D.	Cast Iron Pipe Nom I.D.	O.D.	Copper Tubing Nom I.D.	O.D.	2 Holes	3 Holes	4 Holes	Type CSMI	Type CSML	Type CSMC	Type CSME	Type CSMG
2	2.067	$\frac{3}{8}$ $\frac{1}{2}$ $\frac{3}{4}$	.675 .840 1.050			$\frac{3}{8}$ $\frac{1}{2}$ $\frac{3}{4}$	.500 .625 .875	.790	.710	.600	CSMI-200P	CSML-200P	CSMC-200P	CSME-200P	CSMG-200P
2½	2.469	1	1.315			1	1.125	.970	.930	.730	CSMI-250P	CSML-250P	CSMC-250P	CSME-250P	CSMG-250P
3	3.068	1¼ 1½	1.660 1.900			1¼ 1½ 1¾	1.375 1.625 1.875	1.210	1.110	.930	CSMI-300P	CSML-300P	CSMC-300P	CSME-300P	CSMG-300P
3½	3.548		2.000			2	2.125	1.375	1.315	1.125	CSMI-350P	CSML-350P	CSMC-350P	CSME-350P	CSMG-350P
4	4.026	2	2.375	2	2.500 2.625	2¼ 2½	2.375 2.625	1.625	1.460	1.315	CSMI-400P	CSML-400P	CSMC-400P	CSME-400P	CSMG-400P
5	5.047	2½ 3	2.875 3.000 3.500	2	2.750			2.000	1.875	1.625	CSMI-500P	CSML-500P	CSMC-500P	CSME-500P	CSMG-500P
6	6.065	3½ 4	4.000 4.500	3 3 3	3.660 3.800 3.960			2.500	2.125	2.000	CSMI-600P	CSML-600P	CSMC-600P	CSME-600P	CSMG-600P
8	7.981	4½ 5 6	5.000 5.250 5.500 5.563 6.000 6.625	4 4	4.800 5.000			3.000	3.000	2.875	CSMI-800P	CSML-800P	CSMC-800P	CSME-800P	•
10	10.020		7.000	6 6	6.900 7.100			Single Penetration Only			CSMI-1000P	CSML-1000P	•	CSME-1000P	•
12	11.938	8	8.000 8.625	8 8	9.050 9.300			Single Penetration Only			CSMI-1200P	CSML-1200P	•	CSME-1200P	•
14	13.126	10	10.000 10.750	10 10	11.100 11.400			Single Penetration Only			CSMI-1400P	CSML-1400P	•	CSME-1400P	•
16	15.000	12	12.000 12.750	12 12	13.200 13.500			Single Penetration Only			CSMI-1600P	CSML-1600P	•	CSME-1600P	•

The suffix P in the Catalog Number indicates PVC Coated Steel Pressure Discs. For Aluminum Pressure Discs, change P to A.

•Type CSMG and CSMC are not available in these sizes.

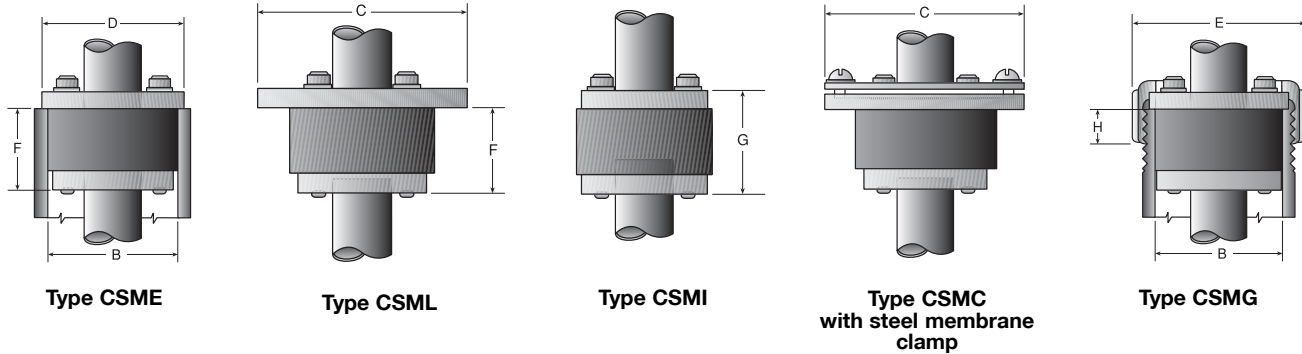
† Blank fittings are intended as abandonment and future use devices only. Do not field drill.

NOTE: For additional information on Type CSM Series See Pages RA21, RA 23

Conduit Sealing Bushings

For Use with Pipe, Conduit or Tubing

Type CSM Dimensional Data:



Use with Core Conduit Drilled or Pipe Hole Dia. I.D. "A" "B"	Single Penetration Applications Dimension in Inches						Catalog No. CSMI— CSML— CSMC— CSME— CSMG—	Multiple Penetration Max. O.D. for More Than One Pipe								
	Steel Pipe or Conduit Nom I.D.	O.D.	Cast Iron Pipe Nom I.D.	O.D.	Copper Tubing Nom I.D.	O.D.		2 Holes	3 Holes	4 Holes	C Dia.	D Dia.	E	F	G	H
2 2.067	3/8 1/2	.675 .840			3/8 1/2	.500 .625	200P	.790	.710	.600	3	2 5/16	2 3/16	1 1/16	1 1/8	5/8
2 1/2 2.469	1	1.315			1	1.125	250P	.970	.930	.730	3 1/2	2 5/16	3 3/8	1 1/16	1 1/8	7/8
3 3.068	1 1/4 1 1/2	1.660 1.900			1 1/4 1 1/2 1 3/4	1.375 1.625 1.875	300P	1.210	1.110	.930	4	3 3/16	4 1/8	1 1/16	1 1/8	7/8
3 1/2 3.548		2.000			2	2.125	350P	1.375	1.315	1.125	4 7/16	3 3/16	4 1/8	1 1/16	1 1/8	7/8
4 4.026	2	2.375	2 2	2.500 2.625	2 1/4 2 1/2	2.375 2.625	400P	1.625	1.460	1.315	5	4 3/16	5 1/8	1 1/16	1 1/8	1
5 5.047	2 1/2 3	2.875 3.000 3.500	2	2.750			500P	2.00	1.875	1.625	6	5 1/4	6 1/4	1 1/16	1 1/8	1
6 6.065	3 1/2 4	4.000 4.500	3 3 3	3.660 3.800 3.960			600P	2.500	2.125	2.000	7 1/16	6 3/4	7 3/8	1 1/16	1 1/8	1
8 7.981	4 1/2 5 6	5.000 5.250 5.500 5.563 6.000 6.625	4 4	4.800 5.000			800P*	--	--	--	9 1/16	--	--	1 1/16	1 1/8	--
10 10.020		7.000	6 6	6.900 7.100			1000P*	--	--	--	11 1/16	--	--	1 1/16	1 1/8	--
12 11.938	8	8.000 8.625	8 8	9.050 9.300			1200P*	--	--	--	13 1/16	--	--	1 1/16	2 1/8	--
14 13.126	10	10.000 10.750	10 10	11.100 11.400			1400P*	--	--	--	15 1/16	--	--	1 1/16	2 1/8	--
16 15.000	12	12.000 12.750	12 12	13.200 13.500			1600P*	--	--	--	17 1/16	--	--	1 1/16	2 1/8	--

*Type CSMG and CSMC are not available in these sizes.

NOTE: For additional information on Type CSM Series See Pages RA21, RA22