



Single Main Drains

Guidelines for Regulated Pool Owners, Operators, Designers, and Builders

Pools* with single main drains have a higher risk of creating entrapment problems than properly designed multiple drain facilities. The State Board of Health passed rules in October, 2004 that set minimum protections for single main drains, requiring all pools with single main drains to install an emergency manual shut-off switch and alarm by June 2008. The Board also directed the Department of Health to develop guidance for alternative protections beyond the minimum manual shut-off switch and alarm. This guide presents design and operational information for additional entrapment prevention.

Since the state rule was adopted in 2004, the *Virginia Graeme Baker Pool and Spa Safety Act*, has been enacted. This new federal law requires all main drain covers in public pools meet the new national performance standard, entitled “*Suction Fittings for Use in Swimming Pools, Wading Pools, Spas, and Hot Tubs*,” ASME A112.19.8-2007.

For public facilities with single main drains, additional entrapment protection is required. The federal law identifies several equipment options, but does not include manual shut-off switches and alarms. To meet the new federal law, pools in Washington with manual shut-off switches and alarms will need to select one of the following six options:

- Safety Vacuum Release Systems (Page 2)
- Suction Limiting Vent Systems (Page 3)
- Gravity Drainage Systems (Page 4)
- Drain Disablement (Page 5)
- Multiple Main Drains (Page 6)
- Unblockable Drains with Emergency Shut-off Switches and Alarms (Page 7)

To verify compliance with the federal law and Washington State requirements, pool owners will need to maintain written records and have them readily available. These records will include any pertinent engineering drawings, equipment installation, and field test results. When planning to install any one of the six available options for additional entrapment protection for single main drain pools, contact your local health jurisdiction if your pool is in Clark, King, Pierce, Snohomish, or Spokane counties. For all other counties, contact the state health department. These contacts are at www.doh.wa.gov/ehp/wr/contactlist.htm.

There are other requirements in the new federal law related to main drains and equalizer lines that are not discussed in this guidance document. For additional detail on the new federal law, see *Pool Main Drain Safety – Guidance for Complying with the New Federal Law* at www.doh.wa.gov/ehp/wr/guidance-maindrainlaw.pdf.

**Pools – For purposes of this document, pool refers to all regulated public water recreation and water contact facilities in Washington State, including all types of pools, spas, and water features.*

Option 1 - Safety Vacuum Release System

A Safety Vacuum Release System (SVRS) works on the principle of detecting a blocked suction outlet and automatically releasing the entrapping suction and/or shutting off the recirculation pump. Proper function of the SVRS may depend on accurate setting of the SVRS and addressing non-entrapment conditions, such as a buildup of leaves or other materials over a drain that mis-trigger suction release and/or pump shut down.

Design Elements

SVRS must be tested, certified and listed as conforming to one of the following two standards by nationally recognized testing laboratories:

- *ANSI/ASME A112.19.17 – 2002 Manufactured Safety Vacuum Release Systems (SVRS) for Residential and Commercial Swimming Pool, Spa, Hot Tub and Wading Pool Suction Systems*, or
- *ASTM F2387-04 Standard Specification for Manufactured Safety Vacuum Release Systems (SVRS) for Swimming Pools, Spas and Hot Tubs*.

The designer or installer shall confirm with the SVRS manufacturer that the product is compatible with the hydraulic components in the pool, prior to installation and use. Incompatible configurations may include the presence of check valves, two or more suction outlets, hydrostatic relief valves, skimmers, solar systems, elevated or submerged pump suction, multilevel bodies of water, and water features.

When installing a recirculation pump with a built-in SVRS:

- If the pump has variable flow capability, operational flows need to be maintained at or below the maximum design flows established for the pool. Steps to prevent tampering with the flow settings need to be taken, such as having the pump installation company be the keeper of the password codes needed to adjust pump flows.
- Pumps that can automatically reset and restart after a vacuum release and pump shut-down rather than require manual startup, need to be set for manual restart when the pool is in use. Automatic reset and restart functions may be used only when the pool is not accessible for use.

SVRS needs to be installed with an audible alarm that is located either:

- In the pool area and rated at 80-85 decibels, or
- Where staff is always present when the pool is open.

Once installed, the SVRS needs to be tested to demonstrate that suction is released and/or the pump is shut off when the drain is blocked.

Operational Elements

Pool staff need to know what to do when they hear the alarm:

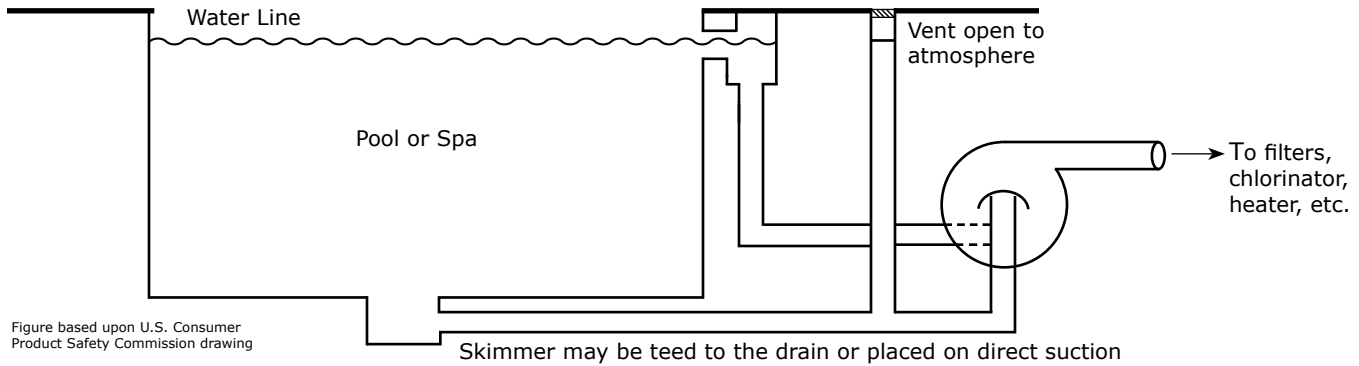
- Check the drain for entrapment or entanglement, responding to any dangers that may exist.
- Check the recirculation system for any other causes for the alarm, responding to any conditions that may exist.
- Reset and restart the recirculation treatment system.

Pool staff need to test the SVRS at least once every six months and maintain a written log of test results.

Option 2 - Suction Limiting Vent System

A Suction Limiting Vent System (vent line) works on the principle that a properly sized and located vent line installed between the pool and the pump can limit the amount of suction created when the main drain is blocked. See Figure 1. When the main drain is blocked, the recirculation pump initially draws water from the vent line and then draws air from the vent, causing the pump to lose prime and limit suction.

Figure 1. Suction Limiting Vent System



Design Elements

Pipe sizing and layout of the suction line and the vent line are critical to the function of the Vent Line. Failure to get these design elements correct can result in an insufficient column of water in the vent line, such that when the pump draws from the vent line during normal operation, the pump will lose its prime and cavitate. The engineer is encouraged to thoroughly research this entrapment prevention option.

The open end of the vent line needs to be located on the pool deck or other walking surfaces in a manner that does not present a tripping hazard. It needs to also be protected from accidental placement of materials on or in the vent system, rendering the vent system inoperative. Label the vent with a sign, such as “Safety Vent – Do not Block.” Screen the vent to prevent animal entry.

The vent line needs to be installed with an audible alarm that will be triggered when the vent line is activated and is located either:

- In the pool area and rated at 80-85 decibels, or
- Where staff is always present when the pool is open.

Once installed, the vent line needs to be tested to demonstrate that the alarm sounds and the Suction Limiting Vent System functions as expected when the drain is blocked. When testing, also block the overflow system to simulate worst-case conditions.

Operational Elements

Staff need to know what to do when they hear the alarm:

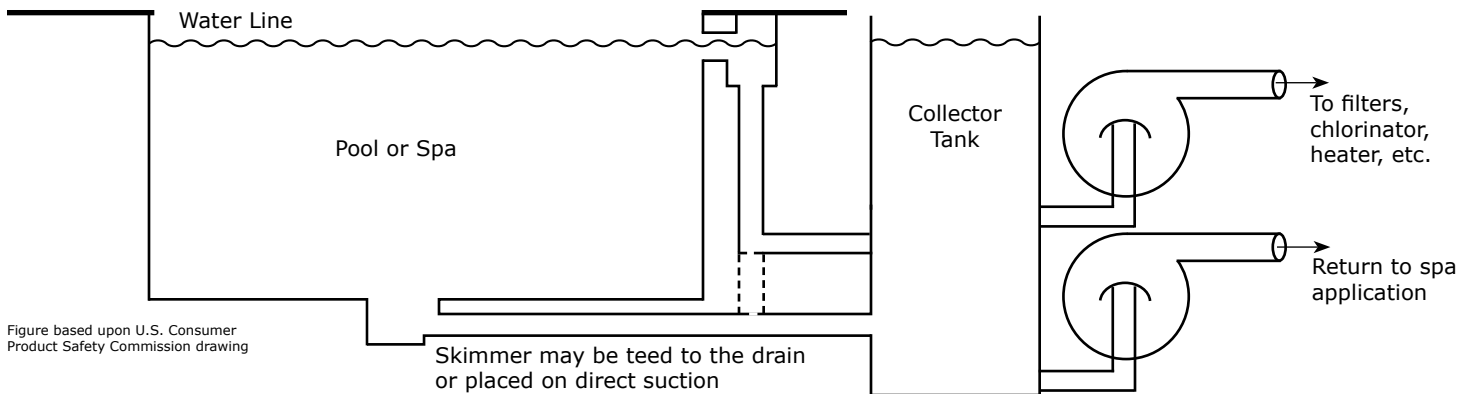
- Check the drain for entrapment or entanglement, responding to any dangers that may exist.
- Check the recirculation system for any other causes for the alarm, responding to any conditions that may exist.
- Reset and restart the recirculation treatment system.

Staff need to inspect the open end of the Vent Line **each week** to see that it hasn't been covered or otherwise tampered with and maintain a written log of inspection results.

Option 3 - Gravity Drainage System

Staff need to test the vent line at least once every six months and maintain a written log of test results. A Gravity Drainage System (GDS) works on the principle that a properly sized and located tank installed between the pool and the pump can limit the amount of suction created when the main drain is blocked. See Figure 2. The suction line to the pump is connected to the collector tank, not to the main drain. Water flows from the main drain in the pool to the collector tank by gravity, and from the collector tank to the pump by pump-caused suction. With this recirculation system, the main drain is not a source of pump-caused suction. This entrapment prevention approach is commonly used on pools with overflow channels, where large capacity balancing tanks are used.

Figure 2. Gravity Drainage System



Design Elements

All water volume and velocity calculations are based on 100% of the recirculated flow.

Recirculated water flow through the overflow skimmer system needs to be maintained at 60% or more of the system's recirculated flow.

Collector tank needs to:

- Provide a working volume equal at least the volume of one minute of recirculated flow.
- Provide a minimum of 2.25 square feet of water surface area, open to the atmosphere.
- Be located below the level of the pool water surface.
- Have connections for the main drain at the base of the tank.
- Be protected from unauthorized access.

Main drain lines need to:

- Be connected to the bottom half of the collector tank.
- Be sized so that the maximum velocity of water flow from the main drain to the collector tank does not exceed 3 fps.
- Be sized so that the maximum velocity across the main drain cover does not exceed 1.5 fps.

The function of any control valves in the system, collector tank, or piping needs to be clearly posted at the valves.

The function of the Gravity Drainage System needs to be tested before placing the system in service. A sustained vacuum at the main drain will constitute failure of the system. Tests shall be done with the overflow system blocked to simulate worst-case conditions.

Operational Elements

Staff need to check the collector tank, water levels and any control valves regularly to ensure that the Gravity Drainage System is operating properly as designed.

Option 4 - Drain Disablement

Drain Disablement works on the principle that if there is no suction outlet in the pool, there is no suction entrapment hazard. For protection against entrapment, the Consumer Product Safety Commission advocates disabling main drains in existing facilities and constructing new facilities without them. There are two approaches to drain disablement: 1) reversing the flow making the main drain outlet an inlet; or 2) completely sealing the existing drain outlet. Disabling main drains may, however, impact water circulation patterns in the pool, resulting in poor water quality and reduced water clarity, creating a different set of health and safety hazards.

Current Washington State rules require main drains on all pools (Chapter 246-260-031(8) (a) WAC). **To eliminate a main drain will require a variance.**

General Design Elements

The drain disablement options described here are limited to pools with skimmer overflow systems. For information about drain disablement at pools with overflow channels, contact the Washington State Department of Health at www.doh.wa.gov/ehp/wr/contact.htm.

The skimmer overflow system and the piping leading to the pump need to be able to:

- Handle 100% of the system flow.
- Maintain acceptable turnover rates.
- Operate within a flow range of 3 to 5 gpm per lineal inch of weir.
- Not exceed proper pipe velocities (generally <6 fps per ANSI/APSP standards).

Engineering justification will be needed for higher velocities over the weir or in the overflow system piping.

Drain sumps with hydrostatic relief valves or hydrostatic relief plugs in place, needs to be covered with drain covers, fittings and fasteners that conform to ASME A112.19.8-2007 standards. If the hydrostatic relief features are abandoned, the potential for pool damage occurring when the pool is emptied will need to be addressed.

With drain disablement, there is no longer a collection point to brush settleable materials to and for removal with the return flow to the system filter to occur. An automated pool cleaning system used when the pool is closed for use is an acceptable solution to this problem.

Outlet-to-Inlet Conversion Design Elements

The converted outlet:

- Needs to be fitted with an adjustable inlet and be installed flush with the pool bottom.
- May be either an additional inlet or a replacement inlet, depending on system flows. All inlets need to be sized to provide effective flow patterns to distribute water throughout the pool.

Re-plumbing pump suction and pressure pipes needs to not allow water flow from the skimmer overflow system to bypass the water filtration, treatment and heating systems. The new piping arrangement needs to be protected against reattaching the converted drain outlet-to-inlet connector pipe to the suction side of the pump. This would create a severe suction entrapment hazard.

The converted outlet-to-inlet needs to be dye tested to demonstrate water circulation patterns in the pool. Inlets may need to be adjusted to maximize circulation efficiency.

Option 4 continues on next page.

Sealed Outlet Design Elements

The impact of sealing the main drain on water flow patterns throughout the pool needs to be demonstrated by a dye test or evaluated by flow analysis. Plans for disabling the main drain needs to account for the identified impact on water flow patterns in the pool.

Dye testing, first with the main drain connected to the recirculation system under normal operation, and then again with the main drain temporarily disconnected, can be used to demonstrate water flow under both conditions. Sealing the main drain needs to be done in a permanent manner, such as filling the drain sump with concrete, to a level even with the pool bottom surface.

Disconnecting the suction piping from the suction side of the pump needs to be done in a permanent manner, such as removing exposed piping or filling the pipe with concrete.

After design modifications are made to address any circulation problems that occur or will likely occur when the drain is disabled, the water flow patterns in the pool need to be re-evaluated. This is to assure that the drain disablement and the adjustments made have not adversely impacted water flow, water quality or water clarity.

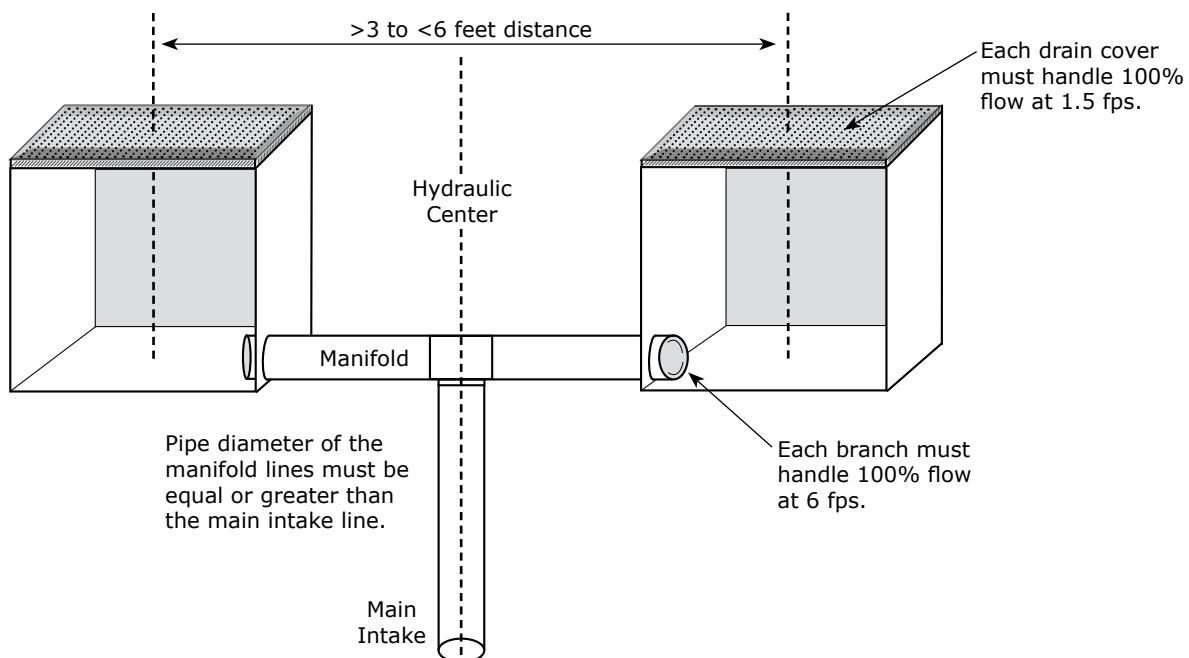
Operational Elements

Testing and visual inspection for water quality and water clarity is routinely needed for proper operation of a pool facility. When the main drain has been removed to address entrapment prevention, water quality and clarity may be adversely impacted. Particular attention may be required to assure satisfactory water quality and clarity.

Option 5 - Convert a Single Drain to Multiple Drain System

A multiple drain system works on the principle that two or more drains, properly designed and constructed so that no drain can serve as a single source of suction, can limit the amount of suction created when the main drain is blocked. See Figure 3. When one drain is blocked, water is drawn from the other drain, reducing or eliminating the entrapment potential.

Figure 3. Conversion of Single Drain to Dual Drain



Option 5 continues on next page.

Design Elements

Converting a single drain to a dual drain system is not a simple matter of extending a suction line from the existing drain sump and placing a new sump and drain cover at the end. Dual drain systems must be engineered to address all of the various design requirements established by the new federal law and Washington State requirements, including:

- The two drains must be located between 3 feet and 6 feet apart measured from the centerline of the drain covers.
- The main drain piping must be manifolded at the hydraulic center.
- The pipe diameter of the manifold lines must be equal to or greater than the main intake line.
- According to CPSC, every main drain and cover on single-drain and dual-drain systems must be rated for 100% of the maximum recirculation system flow rate. This is more restrictive than current state requirements. For multiple drain systems with three or more drains, contact the Department of Health for design specifics.
- Maximum flow rate velocity on drain covers is 1.5 fps in Washington State rule. While *ASME A112.19.8-2007* allows flow rates that exceed 1.5 fps, new construction in Washington State will need to follow State requirements. **For existing facilities working to conform to federal requirements, a variance will be required to exceed State rule.**
- The pool shell needs to not be compromised by the construction required to install the dual drain system.

Operational Elements

The critical entrapment prevention function of multiple drains is the condition that no single drain can function as a sole source of suction. Once properly designed and installed, multiple drain systems require periodic visual inspection to see that flow through the drains is not stopped by debris or other blockage.

Option 6 - Unblockable Drain with Emergency Shut-off Switch and Audible Alarm

An unblockable drain means a drain of any size and shape that a human body cannot sufficiently block to create a suction entrapment hazard. See Figures 4 – 6. The federal law allows the use of an “unblockable” drain meeting the *ASME A112.19.8-2007* standard on a single main drain without any additional entrapment prevention equipment. This provision is, however, less protective than current Washington State requirements.

Washington State requires that all pools with single-main drain systems, including those with an “unblockable” drain cover meeting the *ASME A112.19.8-2007* standard, have additional entrapment prevention equipment. An emergency shut-off switch and alarm, or any of the entrapment prevention approaches, will meet the current Washington State requirements.

Figure 4. Example 1 of Unblockable Drain Outlet

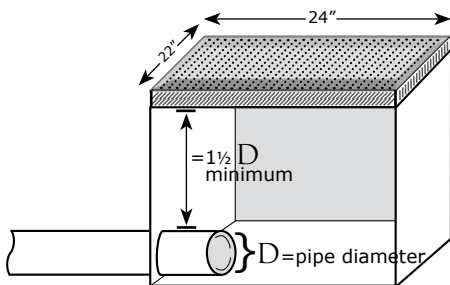


Figure 5. Example 2 of Unblockable Drain Outlet

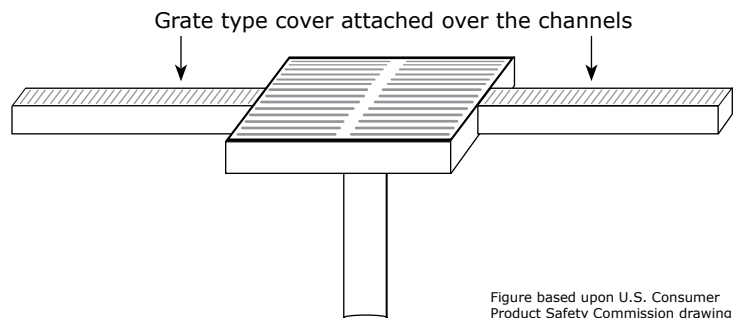


Figure based upon U.S. Consumer Product Safety Commission drawing

Option 6 continues on next page.

Design Elements

Unblockable Drains

An unblockable drain consists of an entire unblockable drain outlet, including the cover, sump, frame and fasteners. Placing an unblockable drain cover over a blockable drain sump does not constitute an unblockable drain.

An unblockable drain must comply with the *ASME A112.19.8-2007* standard and have a dimension greater than 18 inches by 23 inches.

An unblockable drain may have various configurations, such as:

- 24" x 24" or larger cover (see Figure 4).
- Long channels that cannot be blocked by the body (see Figures 5 & 6).
- Designs without fully submerged suction outlets.

Emergency Shut-off Switches

An automatic or manual shut off switch needs to turn off all pumps that recirculate pool water.

Automatic shut-off switches that can automatically reset and restart the pump after shut-down rather than require manual startup needs to be set for manual restart when the pool is in use.

Automatic reset and restart functions may be used only when the pool is not accessible for use.

Manual shut-off switches:

- Need to be located within 20 feet of the pool and plainly marked "Emergency Shut-off Switch."
- May be protected with devices such as an easily-opened fire alarm type box, to help prevent "false alarms."

Audible Alarms

The automatic or manual emergency shut-off switch needs to be connected to an audible alarm that is located either:

- In the pool area and rated at 80-85 decibels, or
- Where staff is always present when the pool is open.

Operational Elements

Staff need to know what to do when they hear the alarm:

- Check the drain for entrapment or entanglement, responding to any dangers that may exist.
- Reset the alarm.
- Reset and restart the recirculation treatment system.

Test the automatic or manual shutoff switch at least once every six months and maintain a written log of test results.

Figure 6. Example 3 of Unblockable Drain Outlet

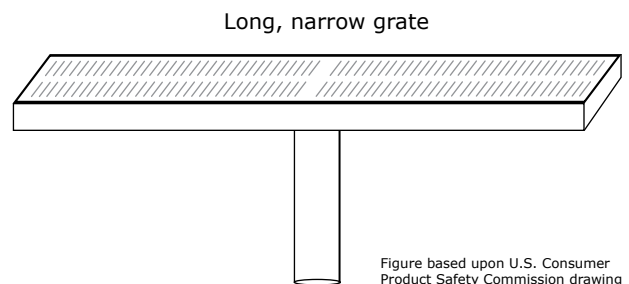


Figure based upon U.S. Consumer Product Safety Commission drawing

This document was created with input from the Washington State Environmental Health Directors' Pool Advisory Committee:

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For more information, contact the Water Recreation Program at www.doh.wa.gov/ehp/wr.