JET FILTER
DEWATERING FILTRATION & EROSION CONTROL
www.jetfiltersystem.com

21st Century Drainage by Jet Filter System
Introduction & Installation Guide

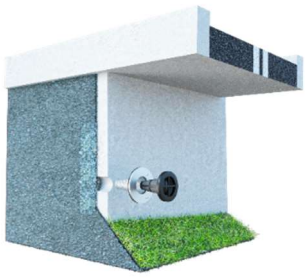
INTRODUCTION TO JET FILTER

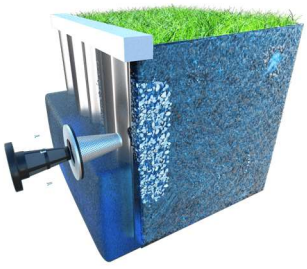
Jet Filter System's maintainable weep hole filters are unique innovative products, the first major advancement in substructure drainage and filtration in 60 years. Accessible for maintenance Jet Filters provide sustainable operation indefinitely to better meet or exceed infrastructure design life.

Where are Jet Filter products used?

Jet Filter products are used in many different markets around the world where Earth Retaining Structures (ERS) experience hydrostatic pressure. A lack of adequate drainage or impermeability of the backflow materials can cause significant forces resulting in structural failures. Particularly in areas of significant rain fall, flooding, storm surges or frequent freeze and thaw cycles. Thus, filtration and drainage are critical for Earth Retaining Structures to meet their design life. The following is a summary of where Jet Filter products are used.

Markets:	Marine, Transportation, Flood Control / Dams
Applications:	Box Culverts, Bridge Abutments, Wing Walls, Retaining Walls, Coastal Seawalls, Bulkheads, Dam Spillways, Riverbank Stabilization, Flood Control Channels, Canals.
Jet Filter Products:	2 ½ ABS, 3" SS, 4" SS, 4" PC, 6" SS
Accessory Components:	Backwash Prevention Valve, Louvered Vent
Wall Type:	Steel and Vinyl Sheet Pile, Concrete, MSE and Wood Walls





When are Jet Filter products needed?

Walls are designed to retain the lateral force of the soil, but when the soil holds water, as it general does, the hydrostatic pressure can more than double the force on the wall. Design criteria generally provides for methods of removing this pressure by draining the water away from the back of the wall or even through weep holes strategically placed in the wall. However, over time, these drainage systems can fail. They are prone to clogging as the soil blocks the designed filtration system installed behind the wall or soil penetrates through the filtration system causing erosion of the soil. If no action is taken the wall will eventually fail early in its design life and need to be completely replaced. The traditional early action solution is to excavate behind the wall to replace or repair the drainage system. Excavation is expensive and generally cost ~70% of what a new wall would cost. ***The alternative solution for existing walls would be to install Jet Filters through the front face of the wall, thereby relieve hydrostatic pressure and preserve design life. For new construction Jet Filters can be a reliable investment as primary or secondary drainage solution.***

How does Jet Filters work?

Jet Filters provide a solution to remove the water from behind the wall without excavation. Weep holes are cored into the face of the wall and Jet Filters are installed through these holes, from the front of the wall to provide water an easy flow path. Once installed Jet Filters allows water to flow through the built-in geotextile filtration system that prevents soil erosion. A series of Jet Filters mounted low on a wall will reduce the hydrostatic pressure behind the wall extending the life of the wall. If the wall had not been damaged previously Jet Filters can support meeting the original design life of the wall.

Why don't Jet Filters fail?

Traditional drainage systems generally fail due to the failure of the filtration system. If the filtration system becomes clogged the hydrostatic pressure will increase applying high forces on the wall. If the filtration system is damaged, installed incorrectly or designed incorrectly soil erosion can also occur, causing soil voids that can lead to sink holes on the backside of the wall.

Jet Filters are designed with an accessible filtration system. The filter cartridges are removable from the housing that is mounted in the front face of wall, allowing for maintenance. When the cartridges are removed, they can be inspected for damage or soil clogging. Based on the findings the cartridges can be cleaned and reinstalled or replaced, as necessary.

How do you know if Jet Filter units are necessary in my application?

Regular inspections of all walls are necessary to preserve the wall's integrity. There are many areas to inspect that do not have to do with Jet Filters. However, two critical areas that Jet Filter can address a solution for:

1) Look for signs of hydrostatic pressure behind the wall
    a. Water will try to escape from behind a wall any way it can.
    b. If the wall has weep holes are the weep holes dry? If so, the current filtration system maybe clogged, forcing water to seek other paths.
    c. Look for wet areas on the wall where pressurized water may be passing through to get out.
    d. Are cracks or seams wet. This seepage may be a sign of water finding the path of least resistance.
    e. Is there vegetation growing in cracks or seams? If so, water maybe present, but not yet at the point of showing itself.
    f. More advanced failure signs include buckling or bowing of the wall, splitting at the seams, or cracking. Is the wall still straight and at the original vertical angle? If not, the movement could be caused by hydrostatic pressure excreting lateral forces on the wall or it could be the hydrostatic pressure applying a buoyancy force to the walls' footing. Splitting or cracking could also be a sign of hydrostatic pressure trying to find a path for the water to get out.

2) Looking for signs of soil erosion from behind the wall
    a. If the wall was designed with weep holes or has cracks or seams check below these areas to see if soil is piled up. If so, the soil may be eroding from the back side of the wall, leaving soil voids or sink holes behind.
    b. If there is a drainage system behind the wall, follow it to the end where water behind the wall will exit. Again, is the area free of soil deposits

If you have one or more signs of a failed filtration system you should consider a maintainable drain, such as Jet Filters as a solution.

How many Jet Filters do I need to preserve my wall?

There is no exact answer to this question, as walls and soils vary in each application. It will also depend on which Jet Filter is selected (2.5”, 3”, 4”, 6”, 8"). A Civil Engineer should be consulted for each unique application. When making the decision note that generally, hydrostatic pressure will be the lowest behind each Jet Filter. Therefore, the closer the Jet Filters are the lower the overall pressure will be on the wall. Since it is not reasonable to have continuous Jet Filters, spacing needs to be determined. For a first-round budgeting purpose a spacing of 8’-10’ would be a good start for a wall <60” tall using the 4” Jet Filters. This spacing would be closer to 6’ for the 3” Jet Filters. If the wall is taller the spacing should be narrower, and if the wall is >72” a two-row solution maybe best. The 2.5” Jet Filter should be used on walls <4’ with spacing ~6’. Under the same condition narrower spacing will provide longer times between

maintenance and vise-a-versa. Consideration for special application needs may narrow the spacing. Including the following needs.

1) Quick time to drain in areas of where floods or storms can quickly damage walls.
2) Maintenance intervals are not well adhered to.

Where should the Jet Filters be installed in the wall?

The hydrostatic pressure will be reduced above the Jet Filters. Therefore, installation as low as possible would be the ideal. However, consideration must be made to prevent wildlife or debris from roads, landscaping or water lines entering the filter. Once a vertical lower limit is defined along the wall, making a horizontal line. The next consideration is to determine what is inside and behind the wall. If the wall is concrete it may have rebar in it. The rebar should be located prior to coring. Ground Penetrating Radar can help define the horizontal and vertical rebar positions.

Other considerations should include seams that may be built into the wall. Seams are the weak points and should be targeted to have the lowest hydrostatic pressure. Therefore, when possible the Jet Filters should be mounted on or near the seams.

INSTALLATION GUIDE

These instructions are designed to aid in installing Jet Filter System's maintainable weep hole geotextile filtration & erosion control products for multiple markets and applications. The instructions are inclusive, but each application and installation have its own unique requirements based on access, wall type, soil type, soil hydrology, available tools, and particularly unforeseen challenges. Safety recommendations are provided for the Jet Filters, but the installer should read and be aware of the safety instructions for each tool used in the installation, particularly around water.

Equipment required to install Jet Filters

As stated earlier each application is unique and different tools may be needed. However, there are many standard toolbox items used for every installation. Here is a list of the types of equipment used:

Creating access by clearing snow with torch

1) Be sure to have the Jet Filters in the quantity required and at the size and accessories specified for the project. The Jet Filters are shipped with the proper fasteners for the application, please see the fastener list on the last page.
2) Special tools to help access to the installation locations are suggested, such as *pruners, rakes, shovels, blowers, heaters and perhaps planks* to stand on.
3) Optional PVC piping with or without slots, if required in design specifications. If used, do not connect the PVC piping to other drainage systems, unless design particularly for that purpose.
4) Utilities that are needed would include 110V AC power and a water supply if required for the core drill cooling. The 110V AC power may require a generator.
5) General tools to keep the work area clean before and after installation could include a broom, leaf blower, trash bag, dustpan, rake, stiff brush, and air compressor to clean our core holes.
6) Tools to mark the location of each Jet Filter position along the wall, including tape measure, chalk line, wax pencil or permanent marker, horizontal level, plum level, original wall drawings, if available, and Ground Penetrating Radar when needed.
7) A gas or electric powered **coring drill with the proper bit** to accommodate the diameter of the Jet Filter (2.5", 3", 4" or 6"). This can be used for concrete, steel, wood, or vinyl walls. *Note: If a PVC sleeve will be used the bit size will need to accommodate the outside diameter of the PVC pipe*.
8) As an option for steel walls is a **plasma torch** to cut access holes and a **welder** can be used to mount the steel housing flange (be sure to remove the ABS filter cartridges prior to protect it from the heat).
9) **Depending on the material to be drilled a standard or hammer drill with the proper bit size** (3/16" for masonry, 7/32" for steel or vinyl sheet pile) to mount the Jet Filter hosing flange to the wall.
10) **A 3/8" socket** with a cordless nut driver, ratchet or wrench to tighten provided ¼-20 provided bolts. Note: **DO NOT** use a hammer drill to tighten any fasteners.
11) If the plans call to recess the Jet Filter flanges in concrete a grinder, like a **turbo cup wheel**, can smooth the wall surface or carve out a recess.
12) **Epoxy sealant** to be used if the wall features are extremely rough such that the filter flange gasket will not seal. Also epoxy sealant should be used to seal any exposed rebar.
13) **General safety equipment**: Read and follow recommendations from the manufacture's manuals for the tools to be used, such as air compressor, generator, core drill, hammer drill, standard drill etc. For general installation activity safety equipment should include eye protection, hearing protection, GFI circuit, hard hat, appropriate work boots, gloves,

visual safety reflection attire if working near traffic or life jackets/flotation gear if working around water.

14) **Miscellaneous toolbox items**: extension cord, mallet, small shovel, bucket, flashlight
15) Knowledge of what is behind wall is always helpful.

Knowledge level needed to install Jet Filters

Fundamental knowledge of tool use is required as well as some experience in measuring, leveling and alignment. The largest obstacle in installing Jet Filters would be the coring drill. Usage and safety knowledge of the coring drill is important for a clean installation, but most importantly for safety. No electrical or pipe fitting certifications are needed. Persons experienced in maintenance or contracting positions should not find installation of Jet Filters difficult.

Preparation prior to installation

1) Jet Filter's maintainable filters are installed to extend the life of infrastructure, however, installing Jet Filter does not correct previous damages in existing walls, such as cracks, buckling, failed seams or movement. To get the most out of the Jet Filter these failure modes should be repaired.
    a. Jet Filter recommends hiring a professional contractor to repair exiting damage.
2) If this is a **new installation, clean #57 stone** should be placed behind the wall during constructed. The stone is a flowable material to aid in channeling water to the Jet Filters. Other materials that can be used would be clean **sand, pea stone or other crushed stone**.
3) If the project is to **preserve an existing wall** it is recommended that flowable material is pack into the cavity of the cored hole. However, if access permits, it would be best to add French drains behind the wall at each point where a filter is installed. This would require digging a hole down to the filter and filling it with flowable material. Topsoil and grass can be added on top.

Placement of the Jet Filters

1) Clean the area in front of the wall to gain access along it. If a stream is involved, divert the water flow where necessary. Clean areas where filters might be installed so markings can be made and clearly seen. These marking may change as the installation plan develops.
2) The Jet Filters should be installed as specified by the engineer. For vertical positioning for retaining walls as low as possible (~6" above the ground), avoiding any obstacles. For seawalls, install at the height mean waterline, for coastal applications, just above the barnacle line.

3) Horizontal positioning should be at regular intervals based on engineering design criteria. JFS recommends approximately every 6'-10' depending on the height of the wall, soil conditions, size of the Jet Filter etc. Wall pressure is relieved the greatest at the mounting location of the filters Therefore, when possible, it is recommended that the filters be on or near the weak points on the wall, such as cracks or precast / panel seams (not on steel sheet pile seams).
4) Mark along the wall, at all the locations that the Jet Filters will be installed. Use a level or chalk line to identify the horizontal or vertical positions. For an appealing look, the filters should all be installed in a horizontal row or if the wall follows a contour, in a line defined by the top of the wall or by the ground.
5) Be sure to recognize obstacles to coring, such as rebar, trees, roots, rocks etc. Offset the position of all or one of the filter positions based on these obstacles.
6) If rebar is an obstacle use a Ground Penetrating Radar (GPR) device to locate and mark the rebar lines and then adjust to avoid them.

GPR shows position of rebar in concreat bridge abutment

Coring the wall (new and preservation of existing walls)

1) There are various types of core drills, manually held in position others are fixed to the wall with screws or vacuum attachments.
    a. Use of a screw attachment makes the machine easier to manage, but extra screw holes may not be desired for appearance.
    b. Vacuum attachments may work well, but if the wall is rough a seal may not be easy to get.
    c. If the pilot hole is large enough a manual core drill may work by allowing core bit to be supported by the pilot hole prior to drilling.
2) Be sure to use a core bit that is the right diameter based on design specifications, which may or may not include a PVC sleeve. Core diameter for the JFS only would be 2.5", 3", 4" or 6". If PVC is used confirm the final diameter prior to coring.
    a. Plasma torch cutting in place of coring is acceptable for steel sheet pile, however, be sure the cut does not extend into the mounting bolt diameter.
    b. Be sure the core bit is long enough to get through the wall thickness and at least as deep as needed for the Jet Filter.

Core drill with water supply

c. If there is any geotextile fabric on the back side of the wall, be sure to drill through the geotextile and remove any that may inhibit flow. Only one geotextile is needed and that should be within the JFS' filter cartridge.
d. All coring drilling should be done perpendicular to the wall face, where the JFS flange will be mounted.
e. If rebar was cut or exposed during coring it is recommended to treat the exposed ends with epoxy sealant prior to installing Jet Filters.
f. Note that after removing the coring water may weep or flow fast from behind the wall. To prevent soil loss, the Jet Filter housing should be inserted quickly.
g. Follow all the safety instructions provided with the core drill or plasma torch.

3) Clean out installation holes
   a. After a hole is cored or cut, clean out the debris that would inhibit installation. Be sure to clean to the depth equal or greater than the depth of the Jet Filter housings. This may require removing rocks that were installed as part of the originally drainage system.
   b. Clean around the installation holes where the Jet Filter will be mounted. The housing flange will need to seal to the wall with the gasket provided on the back of the flange or use a sealant material if the wall is too rough.

Mounting Jet Filter Housing Flange

1) Use #57 stone or other flowable material to fill voids in the hole around the Jet Filter housing cone.
2) Insert the Jet Filter housings into the cored holes and rotate the flange until the Jet Filter logo is up.
3) Push the housing flange into the wall to confirm the gasket on the back of the flange seals against the wall. If the wall is not significantly rough the gasket will most likely seal as needed. If the wall is too rough, remove the filter and either grind down an area to fit the gasket or apply some epoxy sealant to the gasket to aid in sealing. Then reinsert and rotate the hosing until the Jet Filter logo is up.

#57 stone packed around filter

4) Once positioned use the housing flange as a template to locate the mounting holes.
5) With a standard or hammer drill and correct bit size, drill holes into the wall to mount. For the housing flange, 3/16" dia. (concreate) or 7/32" dia. (sheet piling).

6) Insert the provided self-tapping stainless-steel screws through the housing flange and thread them into the previously drilled mounting holes. Use a battery powered nut driver (not a hammer drill) or preferably a wrench for more torque control to tighten the mounting bolts evenly. Do not over tighten.

Installing the Filter Cartridge Assembly

1) Be sure the filter cartridges are clean of obstructions. If it has collected concrete dust or other debris, it should be washed out.
2) Insert the filter cartridge assembly (filter cartridge and faceplate) into the housing that is mounted to the wall. Rotate the filter cartridge until the drip point is pointing down. This will allow water to be channeled away from the face of the wall.
3) Slightly adjust the cartridge flange holes to align with threaded holes in the housing flange and insert the stainless-steel bolts, provided with the Jet Filters. Tighten bolts snug. Do not overtighten.
4) If the application called for a louvered vents or other accessories it will be necessary to place them over the end of the filter so that the stainless steel bolts can pass through the louvered vent, faceplate and filter flange before engaging the threaded holes in the housing.

Using cordless tools to mount Jet Filter cartridge

Final Inspection

1) Inspect all the Jet Filters to be sure they are installed properly. Be sure the flanges are sealed to the wall and fasteners tight, and no obstruction blocking water flow.
2) In most cases all the units should be draining water well. However, normally the units will not all drain at the same flow rate primarily due to their location along the wall and hydrology in the soil. Recent weather conditions will influence the volume of water being discharged too.
3) The first water to pass will be slightly clouded with soil fines, over the next few days the water clarity will clear as Jet Filter and the soil work together to control erosion.

4) As necessary the area around the installed Jet Filters should be cleaned and environment restored. Be sure no debris or tools will be left behind.

Jet Filter System Fastener Schedule

Jet Filter Features & Options	Jet Filter Unit Size	2.5" Ø	3" & 4" Ø Units		6" Ø Units					
	Material	ABS	SS	SS	SS	SS				
	Valve Type	Open	Open	1-Way	Open	1-Way	Socket	Pilot Hole		
	Cover			Louver		Louver	Size	Concrete	Sheet	Vinyl
Flange Mount	Elco EAJ415 Stainless Steel **1/4"-14 x 1" HWH DrillFlex**	4					3/8"	3/16"	7/32"	Self Tapping
	BTS4H13SL Blue Tap Stainless Steel **1/4" x 1 3/4"self-tapping Hex Washer Head W/washer & cap**		4	4	6	6	5/16"	3/16"	7/32"	N/A
Filter Cartridge, Valve & Cover Mount	HJMSSS14C16 **1/4"-20 x 1" Hex Washer Head MS 316 Stainless Steel**						3/8"			
	HJMSSS14C14 **1/4"-20 x 7/8" Hex Washer Head MS 316 Stainless Steel**		4		6		3/8"			
	HJMSSS14C20 **1/4"-20 x 1 1/4" Hex Washer Head 316 Stainless Steel**			4		6	3/8"			