

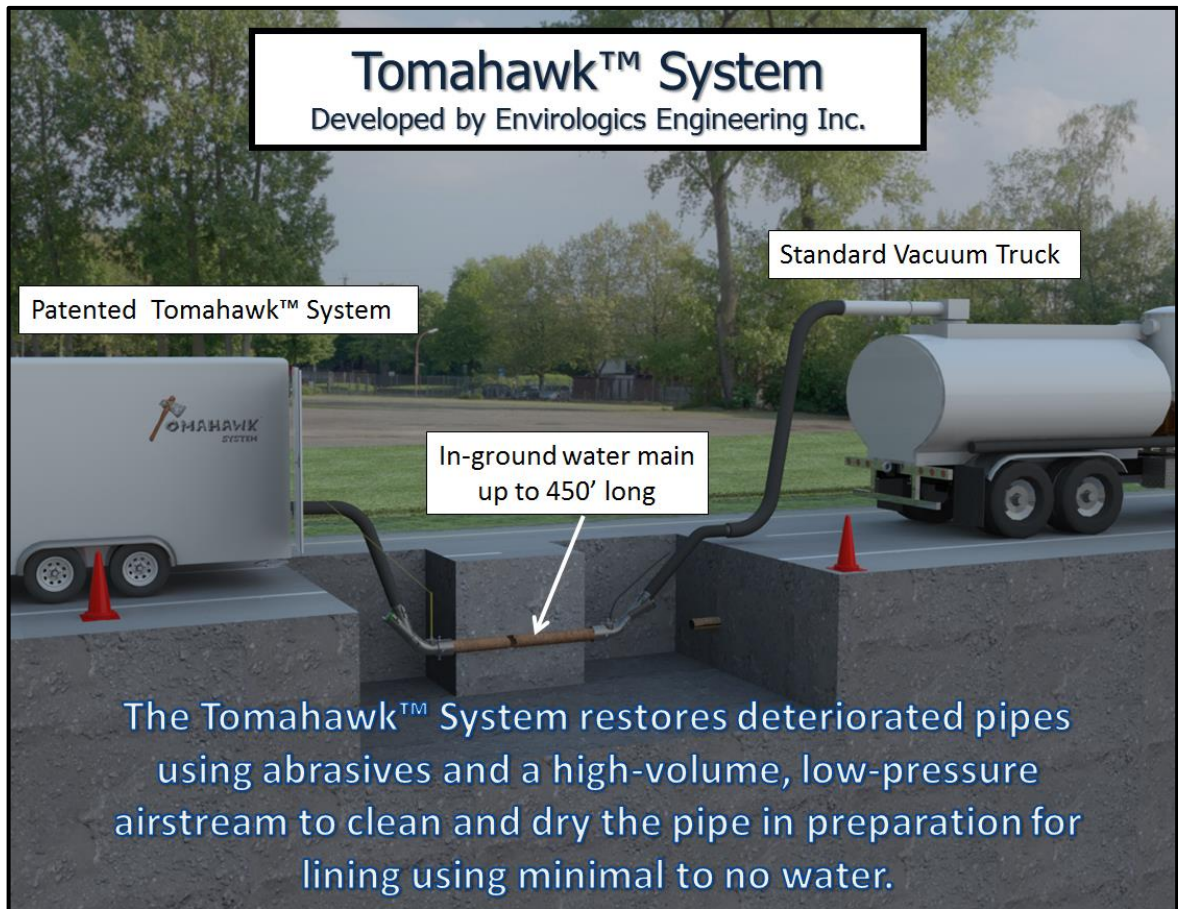


# Tomahawk™ System Cleaning Overview and Specifications



## Tomahawk Overview

The patented Tomahawk™ System is a trenchless pipe cleaning technology that injects abrasives into a high-volume, low-pressure airstream to remove internal encrustation, corrosion, biofilms and old bitumen or tar lining materials from pipes. The Tomahawk process quickly prepares the pipe for liner application by providing a clean, dry and bondable surface.



## Cleaning Capability

The Tomahawk™ System can be used to clean 100mm (4") to 300mm (12") metallic and CML watermains and industrial piping. The Tomahawk unit comes complete with the hoses and couplers required to clean the various pipe sizes. The standard unit cleans 150mm (6") and 200mm (8") pipe.

The Tomahawk™ System can clean pipes with up to 40% x-sectional tuberculation, (pipe encrustation) 100m (328') and up to 137m (450') long at lower levels up to 10%. For pipes with old coal tar or bitumen liners, 95% to 98% removal can be achieved. Tomahawk can clean pipes with one 22.5° bend per line segment.

Our process generally requires less than 500 liters (150 gallons) of water to be injected into the pipe airstream during the early stages of cleaning. This will aid in the flushing of loose residue from the pipe and increases the speed of cleaning while reducing stone usage.

To ensure hydrants and tees/crosses are clear of debris and moisture prior to lining, dry hydrants will need to be opened and live tees cycled to draw out or push debris into the pipe and on to the vac truck. Service connections valves and/or hose bibs will need to be cycled to purge debris back into the pipe and on to the vac truck.

### Vacuum Source (not included with Tomahawk™ System)

A vac truck with positive displacement (PD) blower is required in addition to the Tomahawk specific equipment. The vac truck generates the airstream within the pipe and captures the debris during the cleaning process. It is crucial to have access to reliable trucks with performance that meets the requirements listed below.

Truck debris tanks come in different sizes and pipe in different conditions, but you can generally expect to clean 2 to 4 pipe sections before being required to dump the waste.

Envirologics recommends vacuum units specified with a minimum 8,800 m³/h, (5,200 cfm) PD blower, capable of 880 to 950 mbar (26 to 28 "Hg) vacuum pressure. Depending on the blower size, two vac units may be required when cleaning 250mm (10") and 300mm (12") pipes.

The approximate open pipe air flow requirements for effective pipe cleaning are as follows;

Pipe Diameter	Open Pipe Airflow
100mm (4")	1,870 m³/hr (1,100 cfm)
150mm (6")	4,250 m³/hr (2,500 cfm)
200mm (8")	7,475 m³/hr (4,400 cfm)
250mm (10")	11,725 m³/hr (6,900 cfm)
300mm (12")	16,820 m³/hr (9,900 cfm)

**Note: Lower airflow rates may extend the cleaning time and increase stone usage rates.**

The vac truck blower specification does not represent the actual open pipe airflow capability. As a rule of thumb, a well maintained truck should be able to pull up to 85% of the blower spec through an open pipe. As an example, a 5,200 cfm blower should be able to produce up to 4,400 cfm of air through an open pipe and be able to clean both 150mm (6") and 200mm (8") pipe. For this reason, it is imperative that vac filters, tanks and cyclones are cleaned daily to ensure maximum airflow can be achieved. It is equally important to ensure there are no vacuum leaks at seals, hoses or any other locations. Ensuring the truck

is well maintained will not only benefit cleaning, but also improve fuel efficiency and extend the life of your equipment.



The required vac truck connection is an 8" Vactor Flange (above left) or 8" Bush Hog (Ring Lock) (above right). Smaller fittings may compromise the airflow for cleaning 8" and larger pipe.

## Abrasives

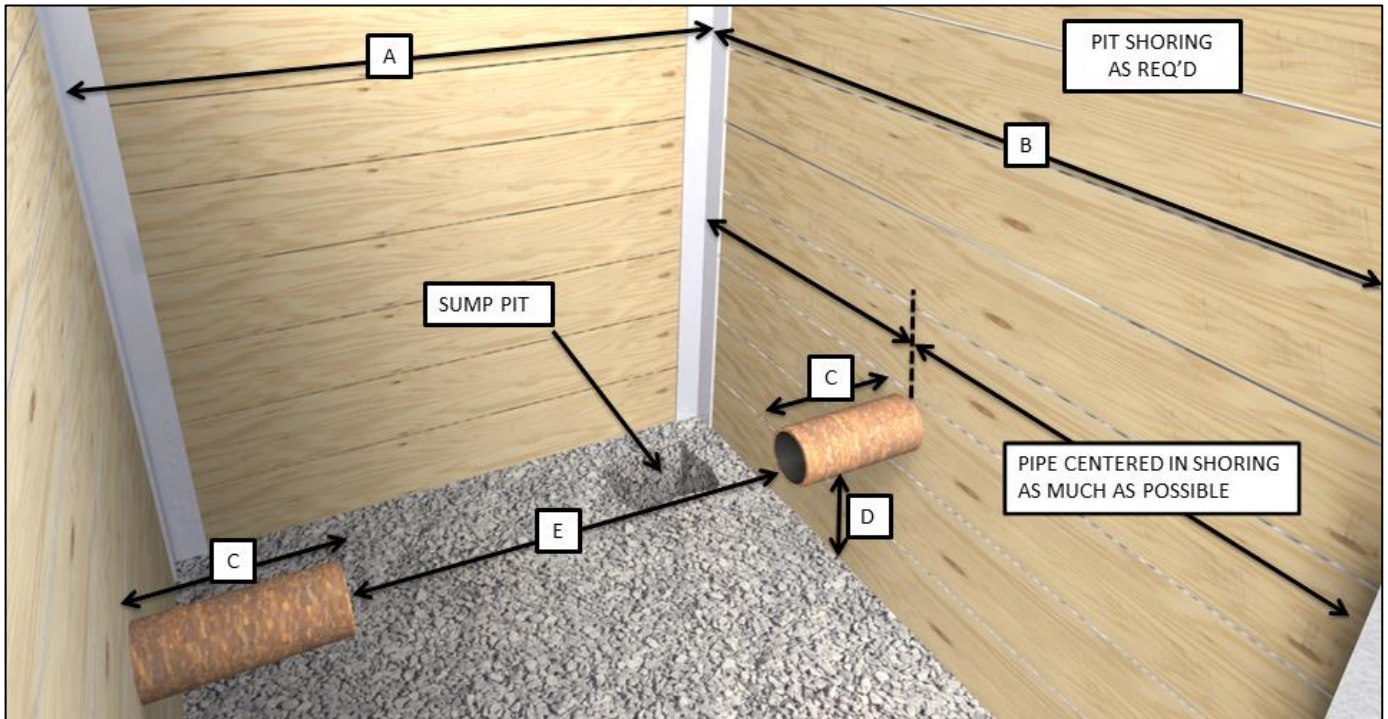
The bacteria free abrasive aggregates come screened in three different grades and packaged in 23kg (50lb) bags. The three abrasive grades are  $\frac{3}{4}$ CHD (Crushed High Density),  $\frac{1}{2}$ CHD and  $\frac{1}{4}$ CHD.

- Cleaning a 100m (328'), 150mm (6") metallic pipe section typically consumes 460 to 920kg (1,000 to 2,000lb) for typical pipe conditions.
- Cleaning a 100m (328'), 200mm (8") metallic pipe section typically consumes 600 to 1,200kg (1,350 to 2,650lb) for typical pipe conditions.
- Cleaning a 100m (328'), 250mm (10") metallic pipe section typically consumes 780 to 1,560kg (1,750 to 3,450lb) for typical pipe conditions.
- Cleaning a 100m (328'), 300mm (12") metallic pipe section typically consumes 1,000 to 2,000kg (2,200 to 4,400lb) for typical pipe conditions.

A typical pipe condition assumes up to 20% tuberculation level. More abrasives may be required for higher tuberculation levels. The abrasives are collected in the vac truck tank and can be disposed of in the pipe access pit or as clean fill as long as tar or asbestos are not present.

The abrasives come on skids of 50 bags per skid. The skids of stone must be kept dry and out of direct sunlight by storing indoors or by fully covering with tarps if left outdoors. It is important that the stone be dry when feeding through the ADU during the cleaning process.

## Access Pits and Shoring Requirements



Above, Access pit shoring dimension requirements

### For 100mm (4") to 200mm (8") Pipes:

**Dimension A:** 1.83m (6') min shoring length, preferred is 2.44m (8')

**Dimension B:** 1.83m (6') min shoring width

**Dimension C:** 0.30m (12") min of horizontal pipe exposure within shoring

**Dimension D:** 0.25m (10") min of clearance below pipe bottom

**Dimension E:** 1.22m (4') long section of pipe must be removed to access interior of pipe

### For 250mm (10") and 300mm (12") Pipes:

**Dimension A:** 2.44m (8') min shoring length

**Dimension B:** 1.83m (6') min shoring width

**Dimension C:** 0.30m (12") min of horizontal pipe exposure within shoring

**Dimension D:** 0.25m (10") min of clearance below pipe bottom

**Dimension E:** 1.68m (66") long section of pipe must be removed to access interior of pipe

Access pit shoring is to be centered on the pipe as much as possible. The area where the pipe is removed for interior access must be unobstructed to ensure couplers and hoses are unhindered from connection to the pipe. The pit bottom should be lined with several inches of gravel and must be kept dry to prevent ground water ingress into the pipe. It is good practise to provide a sump pump pit in the gravel bottom as shown above. The height of the shoring box is to be grade level or slightly above. Typical access pit locations are at valve replacement sites, intersection tees/crosses, at hydrant tees or at any other appropriate location along the pipe length.



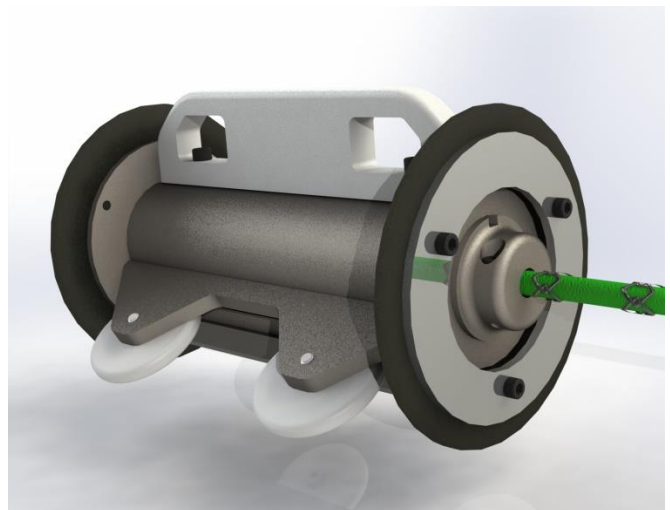
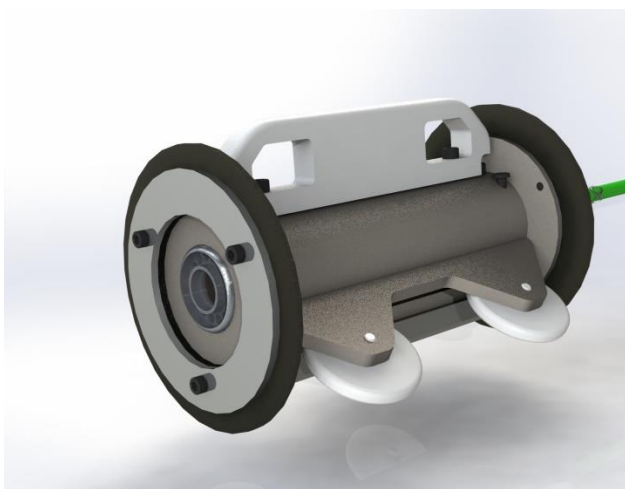


Top, single vac hose connection. Bottom, two vac truck connection for 10" and 12" cleaning

### Tomahawk Scout™

The Tomahawk Scout™ is an integral part of the Tomahawk™ System. The airstream driven Scout employs a self-leveling, forward looking camera and body, designed specifically by Envirologics for final preparation and inspection. The Scout is able to be launched into the pipe airstream during the final stage of cleaning. The Scout does its job fast and efficiently utilizing CCTV capability to spot areas that require targeted cleaning and drying while observing the action in real time. The “vaculating” or drawing out effect produced by the Scout can also aid in the discovery of trouble spots such as holes or cracks for immediate remediation.

Service connections that protrude into the pipe interior more than 25mm (1") may need to be trimmed back to allow the Scout to travel freely within the pipe.



Above: Tomahawk Scout™, latest design with camera, body and stone deflector shown.



Above, Scout view of pipe and service connection cleaned by Tomahawk

### Manpower

The Tomahawk cleaning process can be accomplished with a 2 man crew plus a single vac truck operator. You can expect 200m or 2 pipe sections can be cleaned per day with a well-trained crew. Larger crews or longer shifts may be required for additional pipe cleaning lengths/sections.

The operational requirements of the vac truck operator during cleaning are not taxing, ie. on/off/higher rpm/lower rpm/disconnect and can be easily handled by the single operator. It is preferred to have the vac truck operator able to operate the vac truck as well as connect/disconnect hoses and inspect pipe cleanliness in the access pit at the vac end. The vac truck is not operating while conducting these activities.

The crew team leader, as a minimum, must be trained and certified for cleaning operations by Envirologics.

### Standards

- Tomahawk™ meets and exceeds ASTM 3182, “Standard Practice for the Application of Spray-Applied Polymeric Liners Inside Pipelines for Potable Water”, Section 7.6 “Pipeline Cleaning and Preparation”
- Tomahawk meets up to surface preparation standard SSPC-SP 6/NACE No. 3 for service connections and pipe wall.

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For additional information about the Tomahawk™ System and Tomahawk Scout™, please visit our website at: [www.envirologics.ca](http://www.envirologics.ca)

Please reference “Envirologics BluKote Lining Overview and Specifications” document for airborne lining information.

Only licensed operators can use the Tomahawk equipment and practice the Tomahawk cleaning processes which are protected by the Tomahawk License Operator Agreement and the following patents: CA2714831, CA2844419, CA2868987, CA2887279, CA2977340, US9085064, US9339855, US9884352, AU2011221384, AU2012370291, AU2012377361, AU2012395729, GB2511695. Other patents are pending.

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