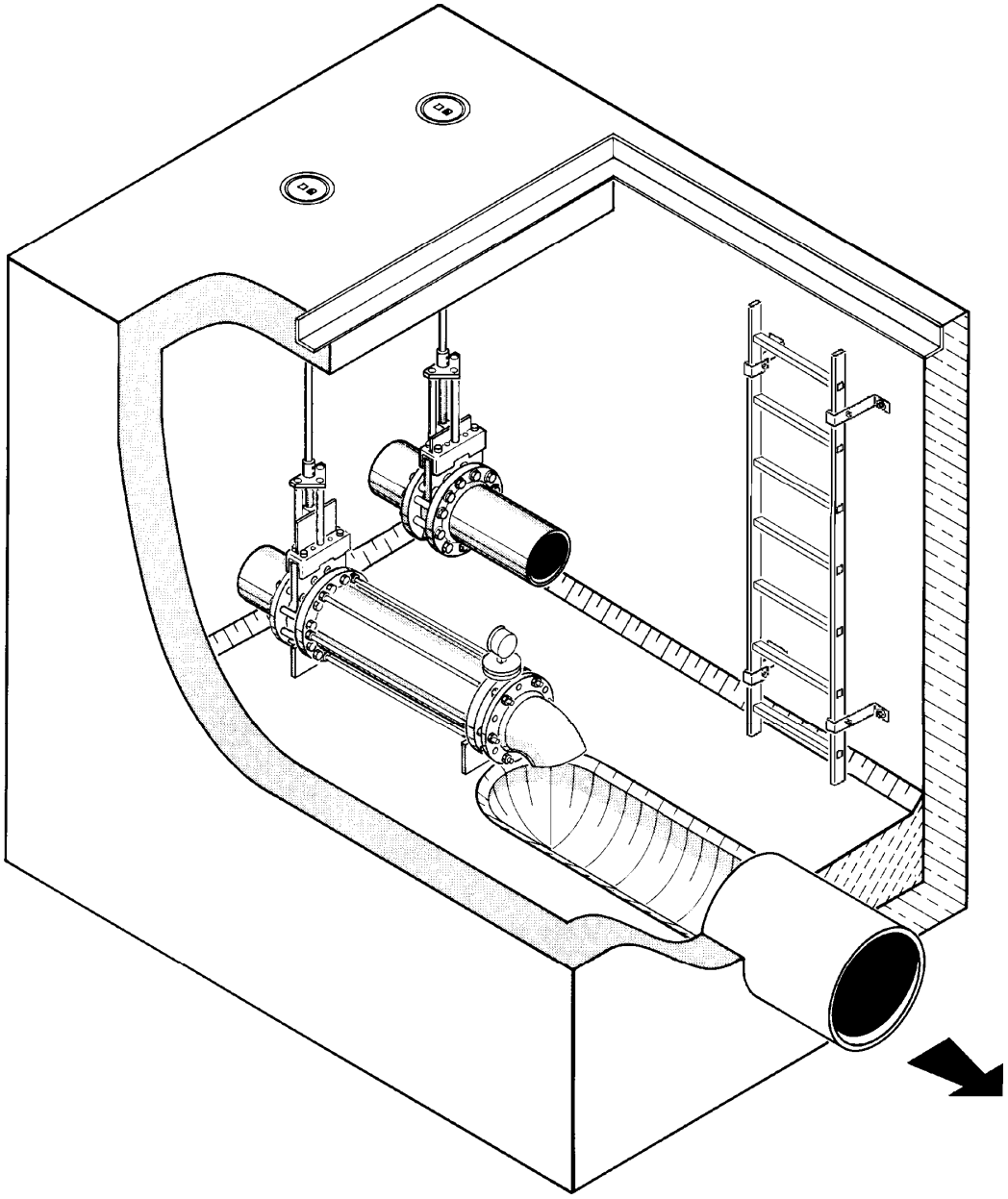
CSO/STORMWATER MANAGEMENT

HYDROVEX®

TTT Thistle Tube Throttle



JOHN MEUNIER

HYDROVEX® TTT THISTLE TUBE THROTTLE

APPLICATION

Flow regulators, for small storm drains, must be able to operate under low flow conditions. Orifice plates, big enough to prevent blockage, usually do not offer an appropriate flow control level. The technical solution of regulating stormflows with electrically activated components involves large amounts of time and money and is not particularly adaptable for small stormwater catchments. This is why the **HYDROVEX® TTT** Thistle Tube Throttle is designed to master such low flows. This equipment, without any moving parts, works solely under the effects of the flow.

AVANTAGES

The **HYDROVEX® TTT** is an easily installed regulator. It controls flow under a variable pressure head, while the discharge remains almost constant.

The **HYDROVEX® TTT** controls flow by using the difference in pressure between the inlet and the outlet of the Thistle Tube Throttle.

- Constant discharge;
- Simple construction;
- Passive device - no mechanical moving parts;
- No corrosion;
- Minimum head loss;
- Fast and easy installation;
- No adjustments required.

The principle of the **HYDROVEX® TTT** is derived from research done by Prof. D. Vischer of ETH, Zurich. The collaboration between the **HYDRAULIC LABORATORY** in Zurich and Dr. Hans Brombach of Germany has resulted in the development and finally adaptation to the specific requirements of using the **HYDROVEX® TTT** in storm drainage.

OPERATION

The operation of the **HYDROVEX® TTT** is based on the flow phenomenon better known as the Bernoulli principle.

Its principle is the following: a prestressed rubber membrane is fitted on a plastic pipe. The pipe has two oval cutouts on its sides and is installed in the reservoir, see **Figure 1.**

When the water level rises in the reservoir above the crown of the plastic pipe, there is an increase in water pressure on the exterior of the rubber membrane. The increase in velocity in the plastic pipe results in lowering the pressure thus inducing the rubber membrane to collapse around the two oval cutouts and therefore reducing the flow area.

The elasticity of the rubber membrane, as well as the precise form of the oval cutouts, is matched in such a way that after each throttling action, the flow (discharge) remains constant. When the reservoir empties, the membrane returns to its original position and form.

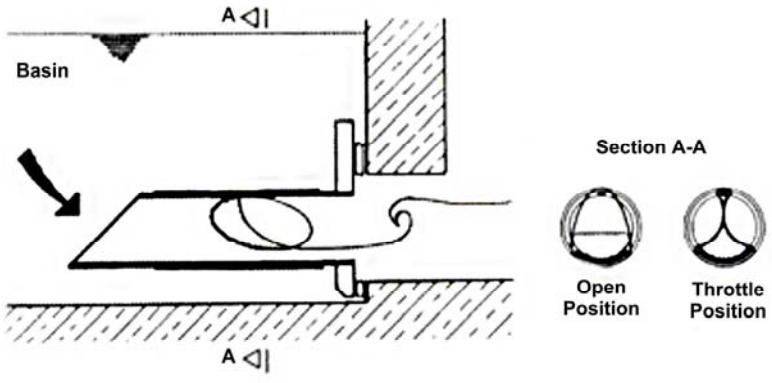


Figure 1: Hydrovex® TTT Thistle Tube Throttle, Type I

AVAILABLE MODELS

HYDROVEX® TTT Thistle Tube Throttle, Type I:

The **HYDROVEX® TTT Type I,** see **Figure 1,** is designed to be installed directly in the reservoir, whose flow must be regulated. The **HYDROVEX® TTT** is attached to a base, which in turn is anchored to the wall of the reservoir. A sump is constructed under the **HYDROVEX® TTT**, which also serves as a collector for debris.

HYDROVEX® TTT Thistle Tube Throttle, Type U:

The **HYDROVEX® TTT** Thistle Tube Throttle, **Type U,** is installed in a chamber directly connected to the stormwater reservoir. It consists of two pipes, one pipe nested into the other, as per **Figure 2.** The exterior pipe **(1)** is transparent and sealed from the ambient air. The throttling pipe **(2)** is centered in this exterior pipe. During dry weather, the discharge through the throttling pipe is flowing with a free surface (open channel).

Upstream of the rubber membrane and the two cutouts **(3),** the throttle pipe is fitted with two openings **(4)** that are covered with a screening filter. When the reservoir is filling up, the flow enters the pipes under pressure through these openings, fills up the space between the two pipes and applies pressure on the rubber membrane. As the prestressed membrane has a diameter smaller than the pipe with the two cutouts, the throttling begins.

FLOW CHARACTERISTICS

The flow characteristics of a **HYDROVEX® TTT** Thistle Tube Throttle are determined by the size of the openings covered by the rubber membrane and the characteristics of the membrane. The flow characteristics may be changed, should the need arise, by replacing the throttle tube and membrane.

Figure 3 illustrates the flow range covered by each of the **HYDROVEX® TTT** Thistle Tube Throttles of both **Types I and U.**

The curves are almost vertical for upstream water levels **(H)** equal to or greater than twice the nominal inlet diameter **(DN)**. Hysteresis effects are almost negligible. In addition, the maximum discharge occurs at very low heads, which results in high velocities in the upstream pipe or reservoir, thereby aiding in keeping the upstream reach clean, as well as reducing the frequency of overflow in stow drains.

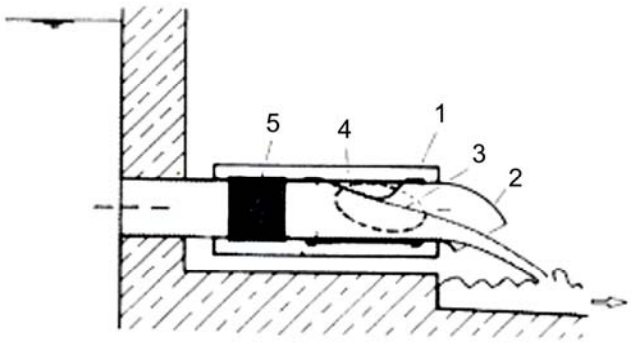


Figure 2: Operation principle of Hydrovex® TTT Thistle Tube Throttle, Type U

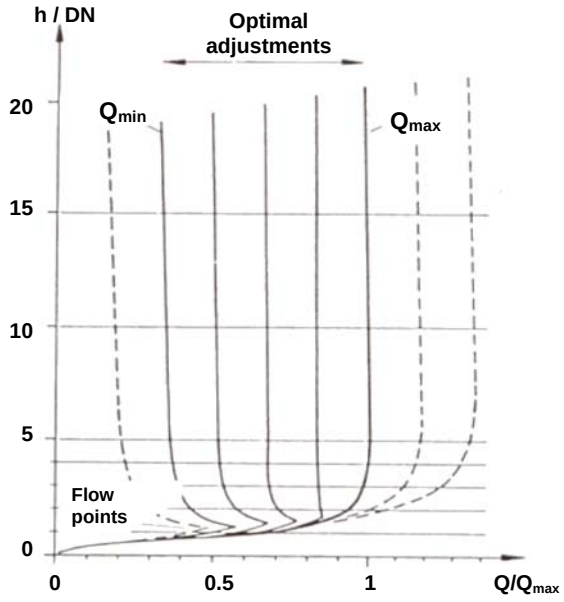


Figure 2: Hydrovex® TTT Typical flow curve for Types I and U

PERFORMANCE

HYDROVEX® TTT Thistle Tube Throttles are produced in batches, with nominal diameters ranging from 100 mm (4") to 250 mm (10"). Intermediate sizes may be fabricated to match specific needs. **Table 1** lists the minimum and maximum flows that each standard size may accommodate, as well as the maximum head each **HYDROVEX® TTT** can perform under, without plastic deformation to the membrane, for both types.

DN Nominal Diameter	TYPE 1		TYPE U		Maximum Allowable Upstream Head
	Mimimal	Maximal	Mimimal	Maximal	
mm (in.)	Flow in l/s (cfs)	Flow in l/s (cfs)	Flow in l/s (cfs)	Flow in l/s (cfs)	l/s (cfs)
100 (4")	2.5 (0.1)	7.5 (0.3)	3 (0.1)	9 (0.3)	5 (0.2)
150 (6")	6 (0.2)	18 (0.6)	7 (0.3)	21 (0.7)	5 (0.2)
200 (8")	10 (0.4)	30 (1.1)	12 (0.4)	36 (1.3)	4 (0.1)
250 (10")	16 (0.6)	48 (1.7)	19 (0.7)	57 (2.0)	3.5 (0.1)

MATERIALS

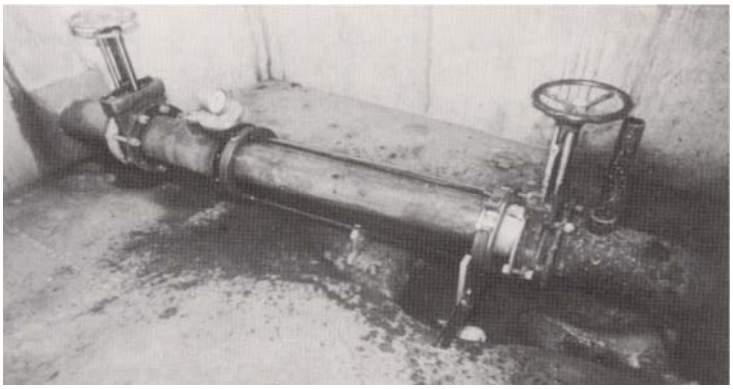
HYDROVEX® TTT Thistle Tube Throttles are designed for continuous operation for both wastewater and clean water applications. The pipe material used in Type I is PVC. The membrane used for both Types I and U is perbunan. All fixtures are in stainless steel. The outer sleeve for Type U is a polyacryllic tube.

INSTALLATION

HYDROVEX® TTT Thistle Tube Throttles are delivered ready to install. They are installed after all civil works are completed, including the wall sleeve and outlet pipe. The actual installation of the **HYDROVEX® TTT** takes no more than a couple of hours and requires no special equipment. The secondary concrete to form the channels is then poured in place.

MAINTENANCE

The **HYDROVEX® TTT** Thistle Tube Throttle regulators are ready to use and require no start-up, immediately following installation in sewer systems or in batch processes. As far as maintenance is concerned, they require no special maintenance, but we do recommend that visual inspections be carried out on a regular basis to ensure that the unit is working properly and that the membrane is in good condition.



HYDROVEX®TTT flow regulator in a dry chamber installation

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