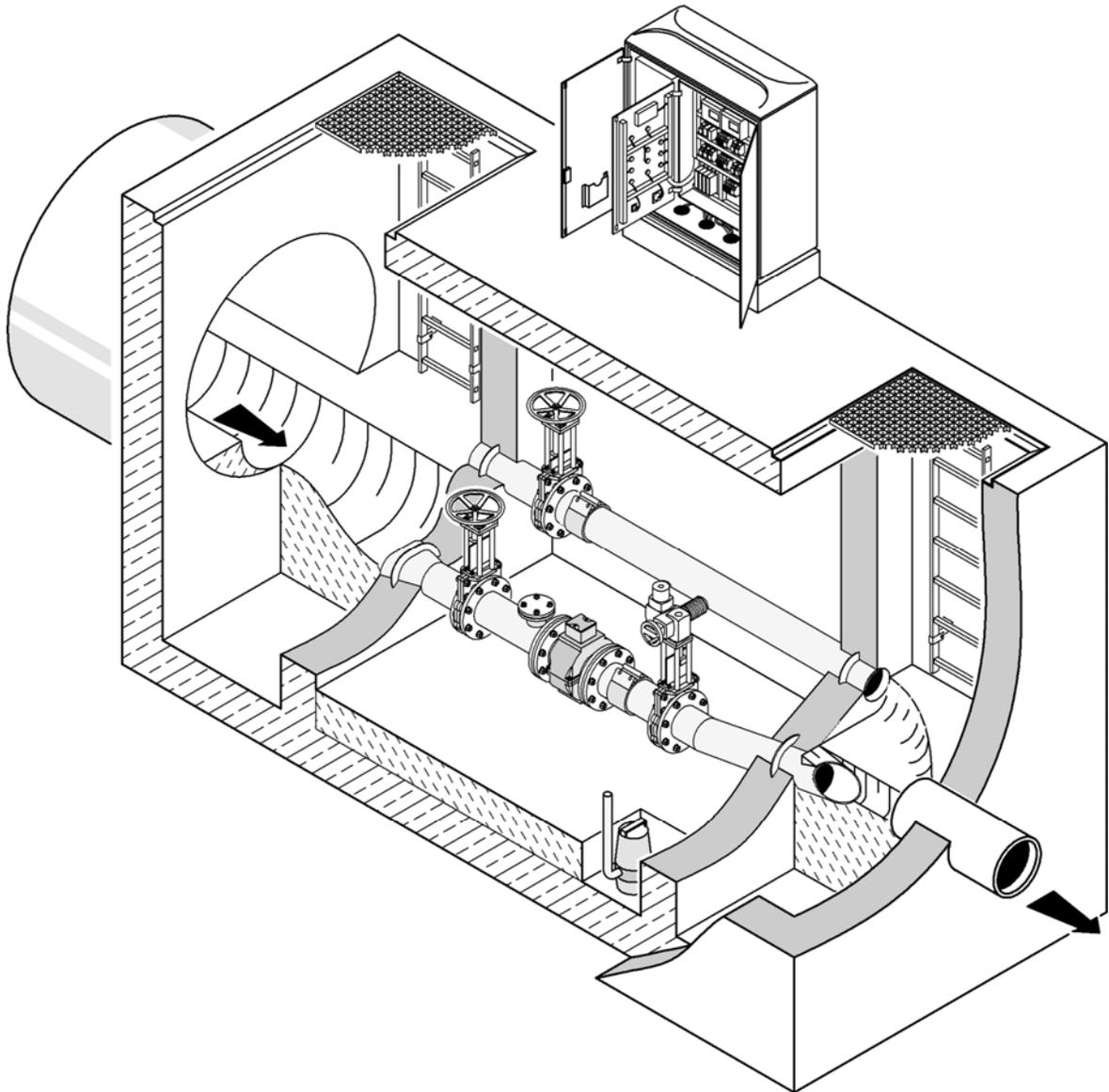


# CSO/STORMWATER MANAGEMENT



## HYDROVEX<sup>®</sup> FluidMid Flow Monitoring & Regulating Station with Siphon (Type G)



**JOHN MEUNIER**

# HYDROVEX® FLUIDMID FLOW MONITORING & REGULATING STATION WITH SIPHON (TYPE G)

## APPLICATION

The **HYDROVEX® FluidMID** flow monitoring and regulating station with siphon (**Type G**) is made especially for wastewater applications. It operates with a traditional flow monitoring system and is designed with a siphon shaped pipe.

The **FluidMIDg** is particularly appropriate for precise and continuous flow monitoring, recording and regulating flows in sewer networks and at Wastewater Treatment Facilities. The **FluidMIDg** unit can be applied only to measure flows or to fully regulate the flow with a piloted knife gate valve.

Based on the high performances and proven reliability of this system, the **FluidMIDg** is particularly suited for large retention basins, for Equalization Tanks close to pumping stations or Wastewater Treatment Plants, for sewer system's Real Time Control, for billing flow contributions of satellite communities to a regional sewer system, for exact monitoring of flows of arriving or leaving Wastewater Treatment Plants, etc.

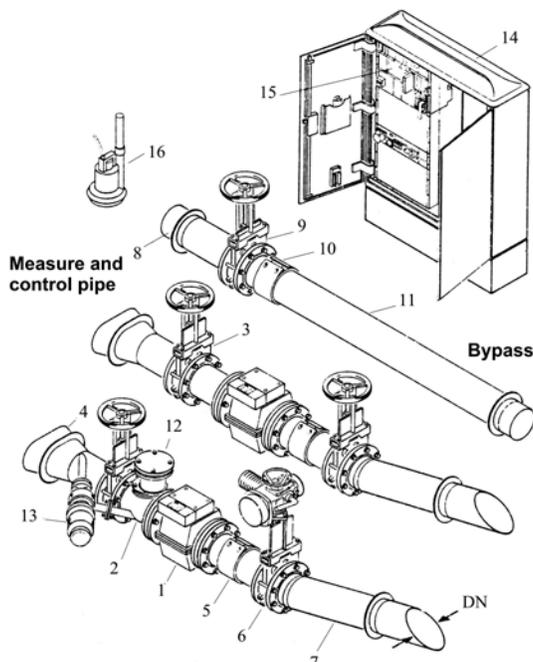
## ADVANTAGES

The hydraulic performances of the **HYDROVEX® FluidMIDg** flow regulator that uses a siphon-type pipe, were the subject of many a research and optimization efforts in a UFT laboratory, in Germany. The optimization goals were: smallest possible headloss in the system, use of the shortest sections of pipes for flow tranquillization, create a homogeneous profile for the flow pattern, build self-cleaning capacity, prevention of upstream air siphons reaching the pipe, lowest installed machine profile. The original laboratory test conclusions were subsequently confirmed by numerous successful references. The **HYDROVEX® FluidMIDg** flow monitoring and regulating stations have the following advantages:

- Uninterrupted flow monitoring, even during low flow conditions
- Precise flow monitoring provided by commercially available magnetic flowmeters
- Low installation profile
- Special inlet mouthpiece, causing low headloss and reducing nominal diameter and improving self cleaning
- Forced cleaning available for important deposition conditions
- Flow monitoring system covering all hydraulic conditions

## OPERATION & INSTALLATION

The operation principle of inductive flowmeters is based on Faraday's law of electromagnetic induction. When a water flow passes in the monitoring pipe subject to a perpendicular magnetic field, an electric current is induced between two electrodes located opposite one another in the inner wall of the pipe. This tension is proportional to the flow rate in the central portion of the pipe.



### Measuring tube with motorized valve and pumps:

- 1 Magnetic flowmeter
- 2 Pipe, stilling length
- 3 Manual valve
- 4 Incoming mouthpiece
- 5 Self adjusting collar for unit dismantling
- 6 Motor piloted valve to regulate the flow
- 7 Angled siphon pipe
- 8 Bypass pipe and wall thimble
- 9 Bypass valve
- 10 Dismantling collar on bypass
- 11 Bypass extension pipe
- 12 Pressure head recorder (optional) or cleaning orifice
- 13 Booster pump (optional)
- 14 Above-ground control panel
- 15 PLC system, monitoring, recording and instrument adjustments
- 16 Sump pump

**Figure 1:** Parts of a Hydrovex® FluidMID Flow Monitoring and regulating station with siphon (Type G)

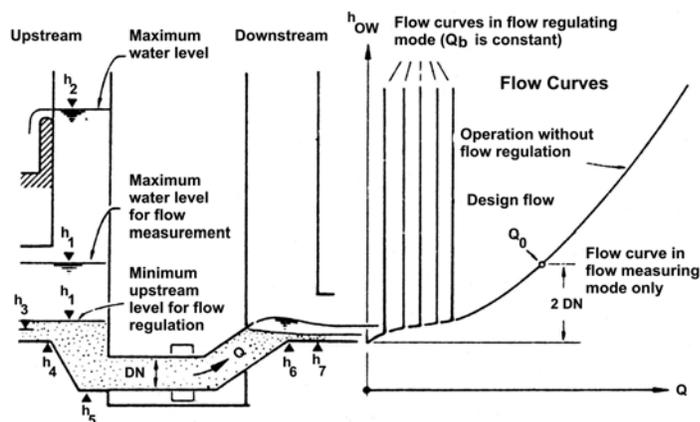
For monitoring station application only, the **HYDROVEX® FluidMIDg** requires a two-room chamber arrangement, made of the instrument chamber with all the pipes and equipment, and a downstream pressure release chamber. Applications involving flow regulation, require the installation of an upstream chamber for maintenance access. Please see cover drawing for arrangement. The magnetic flowmeter, valves and accessories are always based on a “dry well” installation.

In siphon configuration, the flowmeter is always completely filled with water, even during low flow conditions. Therefore the **FluidMIDg** is always ready to operate. Even backflows can be measured by the magnetic flowmeter. Lowering the monitoring pipe inlet in the upstream access chamber’s sump creates the station’s siphon. The lowered elevation is called “dimension of the siphon”. The outlet end of the station is slanted upwards, right after the flowmeter and flow regulating section. The special inlet mouthpiece creates improved hydraulic conditions that lower headloss and enhance self-cleaning capacities. The absence of the special inlet mouthpiece can lead to the creation of surface swirls that will suck air into the unit pipe section. The presence of an air swirl in the pipe can affect the capacity of the unit to precisely measure flow conditions. Consequently, installation of the special inlet mouthpiece reduces only the price of the station (by making it one diameter smaller or more) and its construction, but at the same time increases the flowrate in the monitoring pipe. The overall monitoring performances are more precise and the self-clearing of the system is reinforced.

Modeling has shown that siphon pipe operation is often jeopardized by deposition of solids in the lower section of the pipe, where the magnetic flowmeter is located. The inlet to the system is inside a pipe section and not in a channel on purpose. The open diameter remains small and the dynamic shearing forces of the water large. As an option, we can supply an automatic cleaning system operating on a timer. This booster pump generates a swirling jet of water inside the **FluidMIDg** pipe section (see “**Stress**” section).

In parallel with the monitoring pipe, there should always be a by-pass. This is required for maintenance purposes. Floating debris can accumulate in the inlet mouthpiece of the monitoring pipe, for example: balls, pieces of polystyrene, etc. These debris need to be removed and can sometimes require the opening of the bypass valve.

The instrument chamber should also include a sump equipped with an automatic sump pump that empties the chamber. This pump can prevent instrument submergence, motors getting wet, etc. by water accumulating in the instrument chamber.



*Figure 2: Operation of a **HYDROVEX® FluidMIDg** for flow monitoring only and flow monitoring with regulation.*

## FLOW CONFIGURATION

The **HYDROVEX® FluidMIDg** applies to two distinct types of operation: the flow monitoring function alone and the combined function of monitoring and regulating the flow.

For flow monitoring alone, the motorized valve is not required. The flow characteristics are related only to the headloss at the inlet of the pipe, friction in the monitoring pipe as well as outlet headlosses. The relevant flow curve is slightly “S” shaped (**Figure 2**). The headloss is very small, based on the hydraulic coefficient of the flow-monitoring pipe. In general, we assume a hydraulic coefficient of  $\mu = 0,75$ .

For combined flow monitoring and flow regulation, the motorized valve regulates the flow by closing the open flow area. For flows up to design flow, the knife gate remains entirely open. If the design flow  $Q_b$  is exceeded, the valve starts to control motorized flow and keeps, by correction of the opening, constant flow. A digital and programmable PLC system independently maintains a constant adjustment to maintain the design flow, with a minimum of valve movements. The optimal adjustment program of the PLC is proprietary. **Figure 2** shows the vertical flow curves that the unit can maintain, depending on the design flow. The head,  $H$ , indicates the upstream water level required to reach design flow.

## HYDRAULIC BEHAVIOR

The nominal pipe diameter DN of the monitoring pipe is defined according to the flow of  $Q_b$ . For quick selections, please see **Table 1**.  $Q_b$  is the regulated flow;  $Q_0$  is the base flow when selecting a monitoring station without regulation function.

Each installation requires hydraulic dimensioning. This is particularly true for projects involving small slopes or when the application is complicated. The design head and limitations for minimum and maximum flows must be defined in advance for all conditions upstream and downstream from the siphon system. These calculations are complicated and very precise monitoring pipe hydraulic data must be available. We will supply this full calculation upon request (see “**calculation sheet**”).

Nominal Diameter DN	Flow Monitoring and Regulation		
	$Q_{bmin}$ l/s (cfs)	$Q_{bmax}$ l/s (cfs)	$Q_0$ l/s (cfs)
100 (4")	2.0 (0.071)	13 (0.45)	10.5 (0.37)
150 (6")	4.4 (0.15)	34 (1.2)	28 (1.0)
200 (8")	8.0 (0.28)	66 (2.3)	55 (1.9)
250 (10")	12.0 (0.42)	124 (4.4)	103 (3.6)
300 (12")	18.0 (0.63)	196 (6.9)	163 (5.7)
350 (14")	24.0 (0.85)	288 (10.2)	240 (8.5)
400 (16")	31.0 (1.1)	402 (14.2)	335 (11.8)
500 (20")	49.0 (1.73)	702 (24.7)	585 (20.6)

*Table 1 : Operation for flow monitoring and monitoring / regulation of a Hydrovex® FluidMIDg*

### Tangential constraints and auxiliary flushing system

The tangential load in a pipe is the force applied per unit of surface area. The larger the tangential load, the smaller the possibility of sediments building up in the monitoring pipe. If the tangential load is very low in dry time conditions or during the night, there are three possibilities of clearing:

**a. Clearing out by hand:**

This process is sufficient for systems where water flows are always important. The idea is to occasionally close the motorized valve or manual valve, thus creating water retention upstream that will, upon reopening, flush the pipe by natural pressure. The pressure jet that passes under the valve can push debris, up to fist-size stones, towards the outlet of the monitoring pipe.

**b. Automatic rinsing program:**

This is the *FluidMIDg*'s normal way to operate. By action of a preset timer, activated only during dry weather conditions, the motorized valve is closed and the water is stored upstream. A pressure sensor in front of the flow meter regulates the flushing process to avoid useless overflows.

**c. Automatic rinsing forced by intermediate pump:**

We recommend this system for very difficult cases, such as: very small dry time flows or very bad flow conditions involving backflow from downstream. Upon signal from a clock, and during dry time conditions, the pump sucks water close to the surface and beside the inlet mouthpiece, and projects it in a high velocity tangential jet towards the downstream side of the pipe system. Under the powerful spiral jet, the sediments are evacuated from the siphon and the electrodes of the flow meter cleaned at the same time. For the duration of the booster pump flushing, the monitoring function of the *FluidMIDg* is stopped.

## MATERIAL

All parts installed in the flow-monitoring unit are made of corrosion resistant materials. The inlet mouthpiece is always made of stainless steel. For all pipes diameters, we use stainless steel. The knife gate valves are specially modified for the application by John Meunier Inc.

## INSTALLATION DIMENSIONS

Standard installation dimensions for **FluidMIDg** stations are indicated on a separate chart. In certain cases, we can modify our standard design once we get full approval from our Engineering Department. However; deviation must always be minor, to prevent changing the hydraulic behavior of the **FluidMIDg**. We can also supply custom-built AUTOCAD drawings upon special request.

## ELECTRIC DRIVES

All the instrument modules and motor control systems are located in a surface control panel. This panel can be located either in a small building or directly outside, close to the **FluidMIDg** station. It should never be installed underground for explosion proof regulation limitations. It always includes enough space for all meters, heating, lighting and a mounting frame. On this mounting frame, the operating modules and indications are installed.

A PLC module controls the complete installation. The set points can be adjusted manually or by a remote system, if SCADA or the like is available. The flow recordings can be carried out made by printers, linear recorder, Datalogger or recorder with needles.

## SPECIFICATIONS

The content of the **HYDROVEX® FluidMIDg** monitoring and flow regulating station is defined one site after the other. We can supply technical specifications of a selected unit at all times.

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ISO 9001 : 2000

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