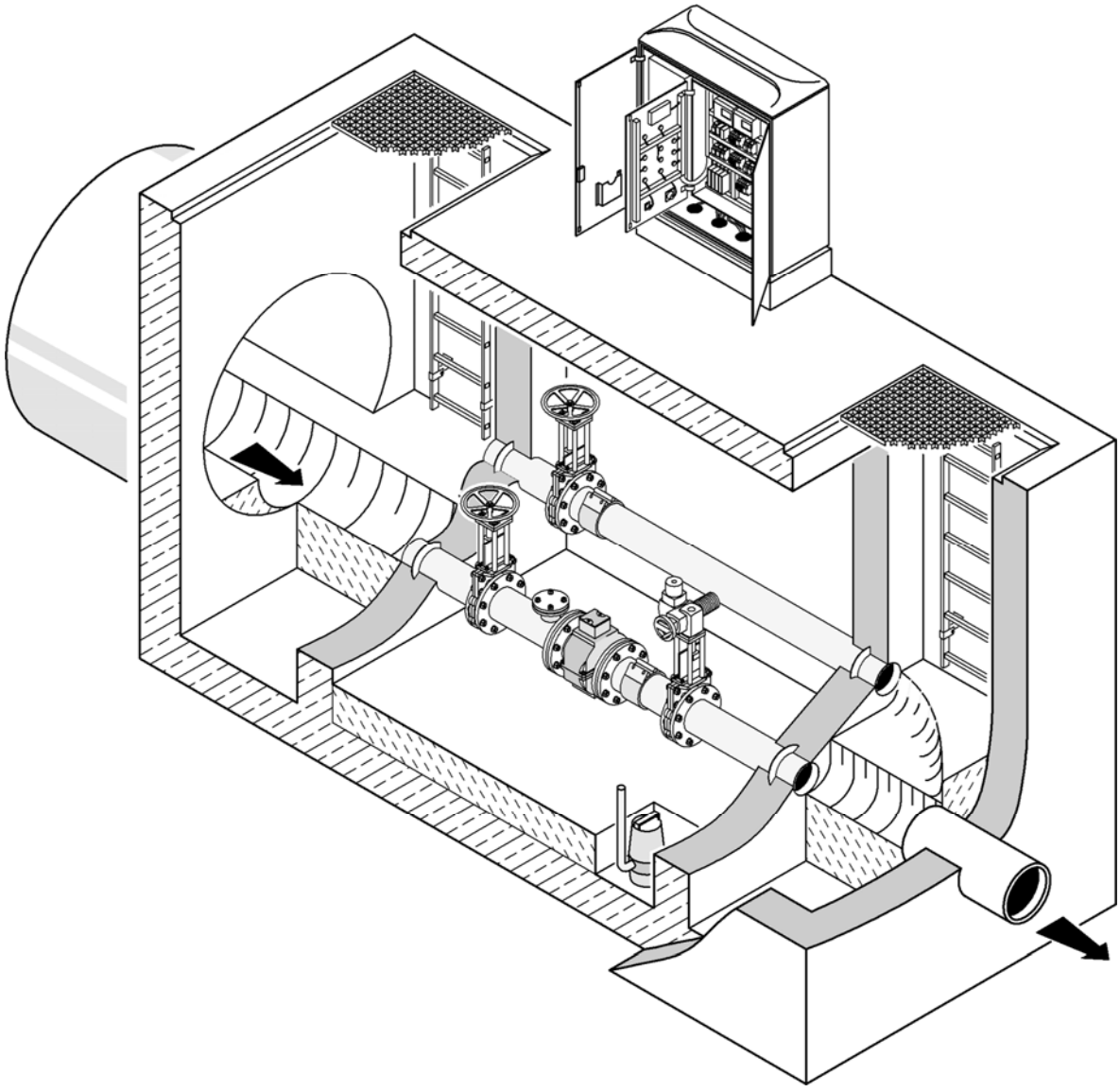
CSO/STORMWATER MANAGEMENT

HYDROVEX® *Fluid*Mid Flow Monitoring & Regulating Station without Siphon (Type U)



JOHN MEUNIER

HYDROVEX® *FLUID*MID FLOW MONITORING & REGULATING STATION WITHOUT SIPHON (TYPE U)

APPLICATION

The **HYDROVEX® *Fluid*MID** flow monitoring and regulating station without siphon (**Type U**) is made especially for wastewater application. It operates with a traditional flow monitoring and is designed to operate even with a partially filled magnetic meter. This ***Fluid*MIDu** is particularly appropriate for precise and continuous flow monitoring, recording and regulating flows in sewer networks and at Wastewater Treatment Facilities. The ***Fluid*MIDu** 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 ***Fluid*MIDu** is particularly suited for use in sewer networks with low or bad slope conditions, 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.

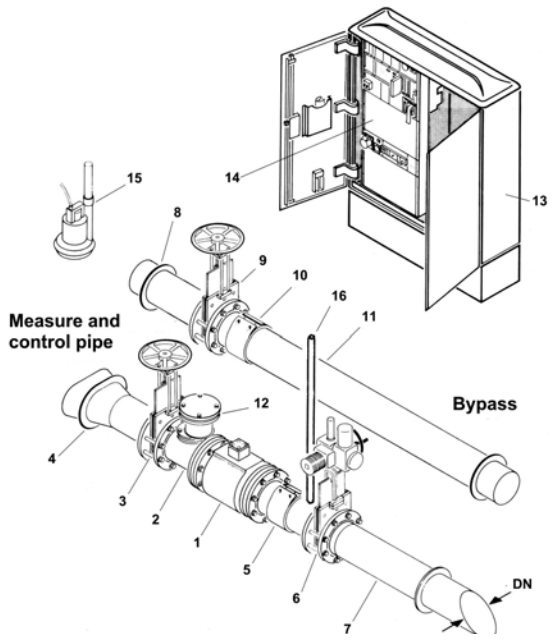
ADVANTAGES

The traditional magnetic flow meter operates with a pipe section filled with water at all times. This requires the use of a siphon structure to maintain the siphon under water. More recently, magnetic flow meters operating with partially filled pipes became available on the market. These magnetic meters were developed in Germany in cooperation with our partners, UFT, who also originally introduced the ***Fluid*MID** on the wastewater market. Following these efforts, it is no longer required to use submerged siphon structures to benefit from the large bonus of continuous operation with magnetic flowmeters and piloted valves. Nevertheless, as the units operate partially filled, the extreme conditions remain critical. For extremely small flows, the filling of the monitoring pipe should never go below a filling of $1/10^{th}$ the diameter. Otherwise the sensors in the magmeter will shut themselves off. In the same way, in partially filled pipes, the flow in the measurement tube should have a minimum of turbulence and should remain as laminar as possible. Good monitoring can only be obtained if precise hydraulic configurations can be taken into account. The **HYDROVEX® *Fluid*MIDu** flow monitoring and regulating station without siphon (**Type U**) has the following advantages:

- No siphon on the measurement tube
- No risk of accumulation of sediments in front of or inside the monitoring tube
- Measurement of flow uninterrupted, starting at a filling height of $1/10^{th}$ of Nominal Diameter
- 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

OPERATION

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 Tube, stilling length
3 Isolation manual knife gate valve
4 Incoming mouthpiece
5 Self adjusting collar for unit dismantling
6 Motor piloted valve to regulate the flow
7 Outlet tube
8 Bypass pipe and wall thimble
9 Bypass manual valve
10 Self adjusting collar for bypass dismantling
11 Bypass outlet tube
12 Pressure head recorder (optional) or cleaning orifice
13 Above ground or inside building main control panel
14 PLC system, monitoring, recording and instrument adjustments
15 Sump pump
16 Aeration vent

Figure 1: Parts of a Hydrovex® FluidMID - Flow Monitoring and regulating station without siphon (Type U)

For magnetic flowmeters with partially filled monitoring section, the flowmeter must be equipped with complementary electrodes that will remain in the water when the level of water is less than half of the nominal diameter. The depth of the flow vein is measured indirectly and uninterruptedly by the inversion of the structure of the magnetic field, and the measured inductive tension is compared with that of a microprocessor with programmed values.

Magnetic flowmeters operating partially filled are more technically elaborated and, on this basis, more expensive than flowmeters operating on fully submerged sections. The measuring accuracy, in the case of a partially filled section, is limited because of the difficult resolutions, but can reach ± 1.5% of the monitored values. The same unit, once fully submerged, falls back into the classic method of monitoring for fully submerged sections with added precision and known reliability. The inlet of the monitoring tube should be equipped with an incoming mouthpiece. This mouthpiece reduces the inlet headlosses and stabilizes the flow pattern inside the pipe while reducing air entries in the pipe.

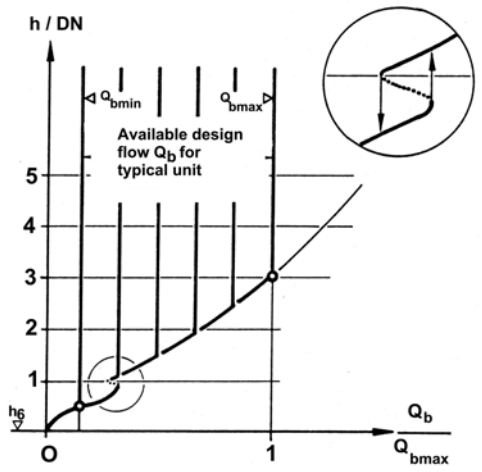


Figure 2: Operating curve of a HYDROVEX® FluidMIDu for flow monitoring only and flow monitoring with regulation.

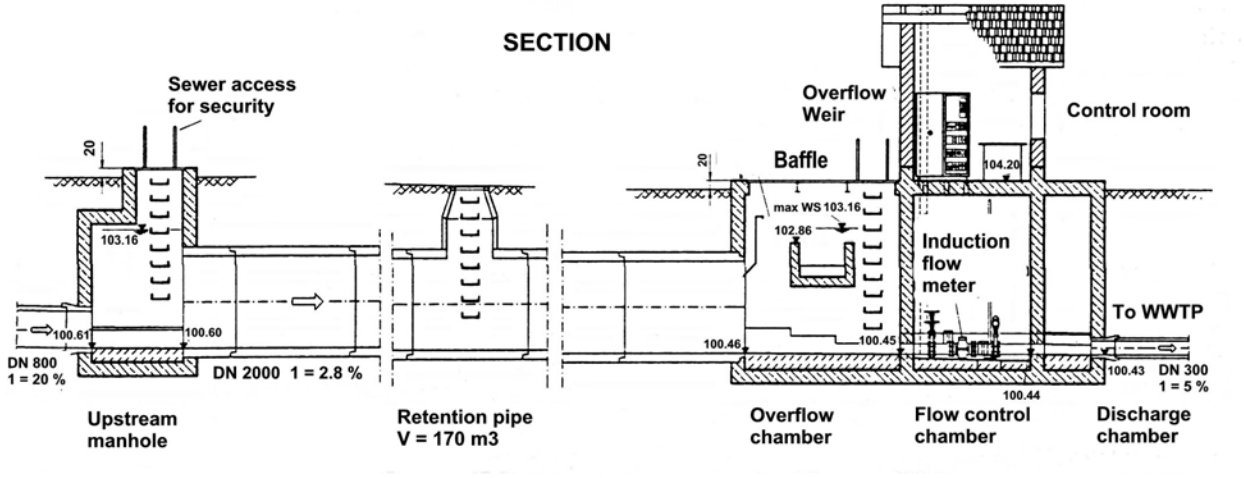


Figure 3: Example of inline storage with low slope, low head conditions equipped with a Hydrovex® FluidMIDu monitoring and regulating station without siphon

Our monitoring only or monitoring and flow regulating stations require standard two-room chambers, made of the instrument chamber with all pipes and equipment, and a downstream pressure release chamber. Applications involving flow regulation, require the installation of an upstream chamber for maintenance access (access is also necessary on the discharge side of the storage pipe (see **title page** and **Figure 3**). The magnetic flowmeter, valves and accessories are always based on a “dry well” installation.

In parallel to the measuring tube, the site requires a bypass. It is used for thorough inspection of the flowmeter or in blocking conditions. 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.

FLOW CONFIGURATION

The **HYDROVEX®** ***Fluid*MIDu** 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. The air escapes from the partially filled pipe through a vent tube located right in front of the motorized valve. 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. The smallest diameter of measurement tube available is DN 200.

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 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 measure and regulation**	
	Q_{bmin} l/s (cfs)	**Q_{bmax} l/s (cfs)**
200 mm (8")	10 (0.35)	66 (2.3)
250 mm (10")	17 (0.60)	115 (4.1)
300 mm (12")	28 (1.0)	182 (6.4)
350 mm (14")	43 (1.5)	267 (9.4)
400 mm (16")	61 (2.2)	373 (13.2)
500 mm (20")	109 (3.8)	652 (23.0)
600 mm (24")	176 (6.2)	1,029 (36.3)

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

Sediment flushing

The measuring tube is to be carefully installed with a slope of 0.3%. If the flow becomes so small that deposits cannot be avoided, a special program can be added to the package that will automatically flush the system. Based on a clock system with contacts, the flushing procedure is activated only during low flow conditions. Once per day (for example) the motorized valve will close and build an upstream pressure head by accumulating water. A pressure sensor in front of the flow meter detects the upstream head and then opens the valve again. By this operation, the measuring tube is effectively flushed of the accumulated sediments.

MATERIAL AND GUARANTEE

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 pipe diameters, we use stainless steel. The knife gate valves are specially modified for the application by John Meunier Inc.

INSTALLATION

Standard installation dimensions for ***Fluid*MIDu** 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 ***Fluid*MIDu.** 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 ***Fluid*MIDu** 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®** ***Fluid*MIDu** monitoring and flow regulating station is defined one site after the other. We can supply technical specification of a selected unit at all times.

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