WE Data Europe

Every Drop Counts

BASIC PRINCIPLES ON WATER METERING

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1 ANALOGUE WATER METERS

1.1 How does an analogue water meter measure water flows?

An analogue water meter measures water flow based on the mechanical movement of internal components driven by the water passing through the meter.

Figure 1: The internal structure inside a typical "velocity" water meter

As shown in this cutaway illustration of a residential water meter, water enters through the inlet (left side)! As water flows, the propeller spins faster or slower depending on how much water is used. This spinning movement is then transferred to the top part of the meter, where the total amount of water used is shown on the display.

1.2 How to read an analogue water meter

Analogue water meters directly display water consumption on the water meter. It should be noted that analogue water meters can sometimes differ in design. However, they always have the following:

- **An odometer and a unit of measurement**
  - The odometer is the moving number wheels.
  - The black dial figures indicate the cubic meters used.
  - The black dial figures are followed by red numbers, indicating the decimal point, usually, until the thousandth (x0,001). In the EU, it corresponds to centiliters.

All water meters indicate a unit of measurement, usually next to the volume register.

In the EU, the unit of measurement is cubic meters (m^3).

- **A sweep hand**

The sweep hands are needle-like pointers on the dial face of analogue water meters. The sweep hand rotates around a circular dial, each rotation representing a fixed volume of water. They are used to measure small amounts of water. In the example in Section 1, the sweep hand measures milliliters (x0,0001 m3). It is not only useful for high resolution measurement, but is also a good indicator of the presence of a leak: If the sweep hand moves when no water is being used, it indicates a leak.

- **A low flow indicator**

Low flow indicators are used to detect water leakage. They have different designs, usually a small wheel or a triangle. They detect very small amount of water running, down to a few milliliters per minute. While they are not used to measure a specific volume, if the wheel or triangle is spinning, it shows that any flow is happening, even below the sweep hand's detection threshold and indicates that water is running in the tubes and hence indicates a leakage.

To be noted during installation

Analogue water meters are often shipped with a non-zero display. In practice, it means that the odometer of new analogue water meters is usually showing some liters of water consumed. It is not because they are faulty, but because the manufacturing companies perform factory testing and calibration prior to being shipped. During this process, some liters of water are passed through the meter to ensure it works correctly and measures accurately.

1.3 Different designs of analogue water meters

Some old water meters, that have now been mostly replaced, are round-reading meters, also known as round-dial water meters. They differ from the straight reading meters, that display water consumption using Arabic numerals through odometers, and instead use black pointers for the integer part and red pointers for the decimal part (0.0001, 0.001, 0.01, 0.1, etc…). Each pointer represents a digit in the reading.

How is the billing carried out?

With analogue water meters, billing relies on manual in-person meter readings. The building occupants are typically required to submit their readings at fixed intervals, often only once or twice per year, either by post, via an online customer portal, or over the phone. To ensure the accuracy of self-reported readings, water suppliers have to arrange for a technician to physically intervene and check the meters regularly, usually once per year.

In multi-unit buildings, individual water meters are often located inside each apartment, meaning technicians need to coordinate appointments with tenants to gain access, creating some logistical challenges and increasing operational costs for water suppliers.

2 DIGITAL WATER METERS

More modern water meters have a digital dial on the front but use a similar analogue mechanism. The digital dial usually displays integer and decimal parts, as shown in the example below:

Figure 2: Digital Water Meter

3 SMART WATER METERS

3.1 Remotely readable water meters

A smart water meter measures water usage in the same way as a traditional (analogue or digital) water meter, as explained in the previous sections.

However, using integrated sensors to capture detailed flow rate data, they can automatically transmit meter readings for monitoring and billing purposes wirelessly using a radio module, which is a physical chip attached to the meter.

Radio modules can be retrofitted on analogue and digital water meters. In Europe, radio modules transmitting metering data operate in low range frequency (868 MHz band) and use various radio communication technologies (LoRaWAN, Wireless M-Bus or proprietary technologies). Metered data is then regularly sent to a drive-by or to a fixed network, up to every 15 minutes.

Remotely readable water meters eliminate the need for technicians to enter apartments to obtain meter readings and enable more frequent access to consumption data for building occupants. This increased data availability also enables additional services, such as leak detection.

3.2 Advanced Metering Infrastructure

Advanced Metering Infrastructure (AMI) is the current state-of-the-art smart metering technology. It succeeds legacy drive-by and walk-by systems that still required a technician to come within radio range of the meter to collect consumption data. Unlike drive-by and walk-by meters, AMI enables two-way communication between the water meter and the metering service provider through a fixed network of permanently installed communication gateways, which collect data from smart water meters and transmit it to the metering service provider. As such, AMI systems can automatically send consumption data at regular predetermined intervals, without the need for a technician to physically drive to the building.

AMI technologies allow users to access their water consumption data on a frequent basis, up to 15 minutes, and provides users with the possibility to enable a range of additional services, such as leakage detection or pipe freeze alerts, based on continuous water consumption monitoring. These functionalities can be delivered through online portals, mobile applications, or other digital channels, unlocking consequent water savings and avoiding costly infrastructural damages.

In addition, AMI systems enable predictive maintenance of meters by allowing remote diagnostic checks to verify that devices continue to provide accurate readings without requiring on-site intervention by a technician. As these technologies evolve, they may also allow meter replacement only when a device is genuinely defective, rather than based on fixed calibration intervals, thereby contributing to a reduction in electronic waste.

3.3 Leakage detection alert

While analogue and digital water meter are equipped with a low-flow indicator on their dial, users can only monitor their water consumption by manually reading their meter. Smart water meters continuously monitor water consumption and can detect sudden changes or anomalies, indicating potential leaks.

When an anomaly is detected, a notification is sent to the building manager and the tenant. Depending on the service provider, the notification can be sent via SMS, a push-up notification on the phone from the user app, or on computer software. Based on the leakage rate, the latest software by metering service providers is to predict the location of the leak (toilets, faucet, broken pipe), further reducing the time to identify and fix the leak.

Recent evidence from an open-ended study[1] demonstrates the benefits of this approach, showing that dwellings equipped with individual smart water meters featuring leak detection functionalities **achieved an additional 10% reduction in water consumption** compared to dwellings equipped with standard digital water meters that did not support leakage detection.

[1] Van Loo, Maarten, Steven Broekx, and Katrien Van Hooydonck. 2025. Evaluating the Role of Water Metering and Submetering in Reducing Water Consumption in Buildings. Final Report. Commissioned by WE Data Europe, VITO, available here.

4 BEST PRACTICES FOR SMART WATER METERS DEPLOYMENT

4.1 Combine the Installation of Smart Cold and Hot Water Meter Deployment

The roll-out of individual smart cold water meters and domestic hot water meters[2] should be coordinated and implemented simultaneously whenever possible. Combining both deployments reduces installation costs by minimising disruption for buildings occupants by avoiding multiple interventions within dwellings.

It also enables building owners to leverage the same workforce possessing the same technical expertise and build on the same digital infrastructure.

4.2 Deploy Smart Cold and Hot Water Meters to Improve Sizing of Hot Water Installations

The deployment of smart cold and hot water submeters can help better size the deployment of domestic hot water production systems, including boilers, and solar thermal installations. As they collect detailed and disaggregated consumption data before such investments are made, they provide building owners, and installers with the necessary data to enable the most accurate sizing of this equipment based on actual consumption of buildings, improving their performance, cost-effectiveness and affordability.[3]

4.3 Ensure that Buildings are Ready for Smart Water Metering

In some older buildings, units are supplied through multiple water pipes, creating technical and economic challenges for the deployment of smart water meters.

Denmark[4] offers a leading example of how to address this bottleneck through legislation. Its national law requires all new buildings and buildings undergoing major renovations to be equipped with plumbing infrastructure that enables the individual measurement of water consumption, ensuring they are ready for the installation of water meters. Moving forward, this approach can serve as a model, helping to remove barriers and accelerate the adoption of smart water metering in buildings across Europe.

[2] The deployment of individual domestic hot water meters is mandated by the Energy Efficiency Directive (Article 15) in each unit of multi-unit buildings supplied by a collective source of hot water. They should be changed or rendered remotely readable by 1 January 2027.
[3] Techem, "Digital Heating Room: New Techem Service Optimises Heating Operations with the Help of Artificial Intelligence," press release, September 28, 2023, available here.
[4] Danish Executive Order on Individual Metering of Electricity, Gas, Water, Heating and Cooling, BEK nr 563 of 02/06/2014, available here.