

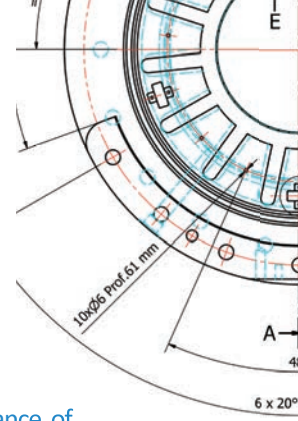


# TOM

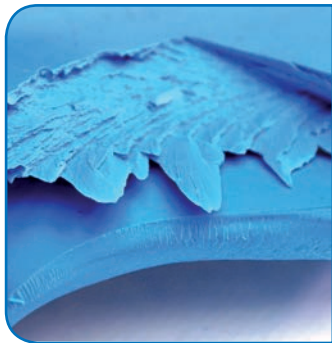
The new generation of PVC-O pipes



► Excellence in high-pressure water piping



## Molecular Orientation, a revolution in PVC

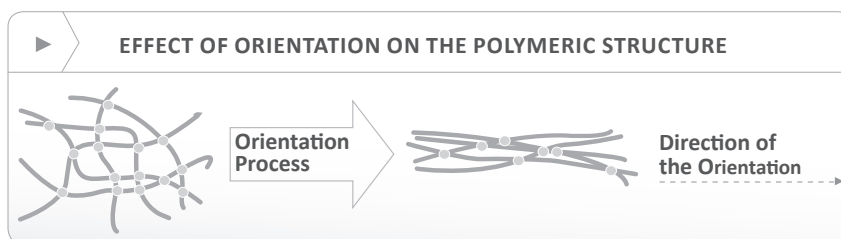


When PVC with its amorphous structure (lower section) is subjected to the orientation process, a laminate structure is obtained (upper section).

- ▶ **◎** TOM® PVC-O pipes are the most advanced pipes for the conveyance of high-pressure water currently available on the market, with a number of exceptional features for this kind of application, thanks to the process of Molecular Orientation.

PVC is essentially an amorphous polymer in which the molecules are located randomly. However, under certain conditions of pressure, temperature and speed, by stretching the material, it is possible to orient the polymer molecules in the same direction as which the material has been stretched.

Depending on the process parameters used and mostly stretch ratio, a higher or lower orientation degree will be obtained. The result is a plastic with a layered structure which layers can be seen at a glance.



The Molecular Orientation process modifies the PVC's structure by giving the polymer's molecules a linear orientation.

### A plastic with unbeatable properties

The process of Molecular Orientation greatly enhances PVC's physical and mechanical properties and gives it a number of exceptional features, without altering the advantages and properties of the original polymer. Thereby it is obtained a plastic with unbeatable qualities in terms of **resistance to traction and fatigue, flexibility and impact resistance**.

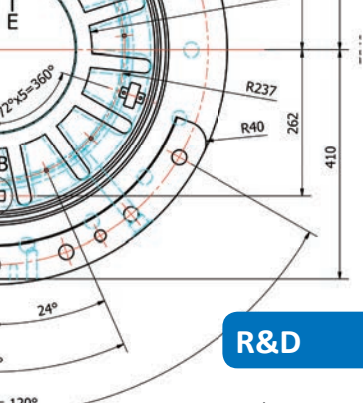
When used in high-pressure water pipelines **this type of piping has a high resistance and an extremely long lifetime**. Moreover, the pipe is highly energy-efficient and eco-friendly not only for the way it is made but also because of its subsequent use. Other advantages include reductions in costs and installation times.

For all these reasons, **TOM® PVC-O pipes are the best solution** for medium and high pressure water networks for irrigation systems, potable water supply, fire extinguishing networks and pumping systems, among other applications.



TOM® pipes





## WHY MOLECOR IS DIFFERENT? ...



### R&D

Molecor Tecnologia is a **company committed to research and development**, with clear **international vocation**, which markets products and technology developed entirely in Spain. **Molecor** firm commitment to **R&D**, goes beyond technology development and has been recognized with various **WIPO PCT** registered worldwide and with deals with the most reputable public research and development entities.

### 100% specialization

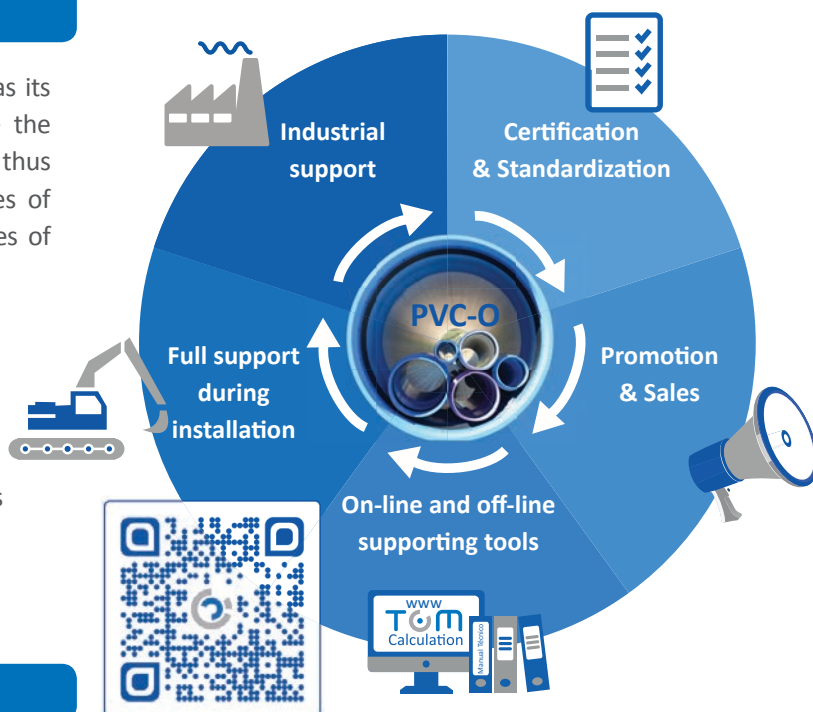
**Molecor** is dedicated exclusively to the development of the latest **technology applying Molecular Orientation** to PVC and to the implementation of **highly efficient solutions** for the conveyance of water under pressure. Throughout his trajectory **Molecor** has received several awards and recognitions that have contributed significantly to consolidate its presence and global leadership as a company dedicated to developing technology for the manufacture of **Oriented PVC pipes**.

### Know How

The effort of the company in R&D as well as its exclusive dedication to PVC-O, have made the company **fully acquainted of the sector** thus being able to provide support in all phases of the manufacturing and installation processes of the product.

#### 360° support:

- Certification & Standardization
- Promotion & Sales
- On-line and off-line supporting tools
- Full support during installation
- Industrial support



### Exclusive products

Thanks to its worldwide unique technology, Molecor has exclusive products available to the market. In its range of products, there are some outstanding diameters such as the **DN500 mm**, the **DN630 mm**, the **DN710 mm** or the **DN800 mm** PVC-O pipes; products that have been turning points in the sector since their manufacturing was unthinkable before the apparition of the Molecor technology.

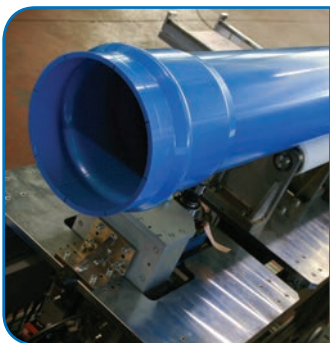


## Cutting-edge technology for water



▶ **◎** TOM® PVC-O pipes have been developed by MOLECOR®, the only company in the world conceived and dedicated entirely to researching and manufacturing PVC-O pipes. Our manufacturing process is absolutely innovative and uses the most advanced and most reliable technologies currently available.

Up until now, although PVC-O pipes are recognized as providing the highest specifications, the technical limitations of the different manufacturing processes and the shortcomings of those processes in terms of efficiency were a barrier to the extensive use of this kind of pipes.



Manufacturing process developed by Molecor® uses most advanced technologies and it is completely automatized. This gives TOM® pipes maximum guarantee and quality.

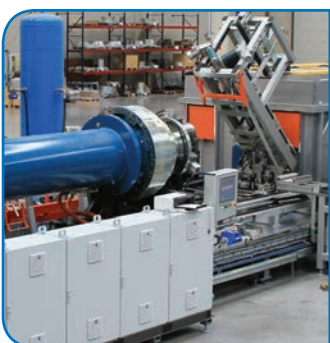
▶ The technology developed by MOLECOR® means that these limitations have now been overcome and it has also helped to make **considerable improvements** in TOM® pipes.

- Molecular Orientation is achieved by applying the precise and homogenous distribution of temperature and high pressures (up to 35 bars) thanks to **quality control checks** carried out on each individual pipe and throughout the entire manufacturing process.
- The TOM® pipes manufacturing process is continuous and fully-automated (as opposed to the traditional discontinuous method), providing **greater control over the end product and ensuring the uniform quality of each pipe**.


### Maximum Reliability and Security

▶ Thanks to the extraordinary technical advances of MOLECOR's manufacturing system, TOM® pipes offer the maximum reliability and security, as well as other attractive advantages over other products:

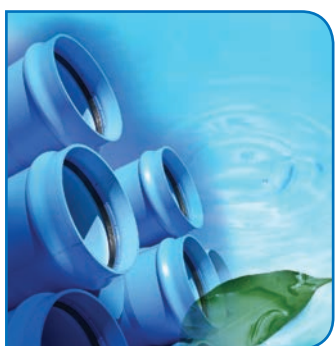
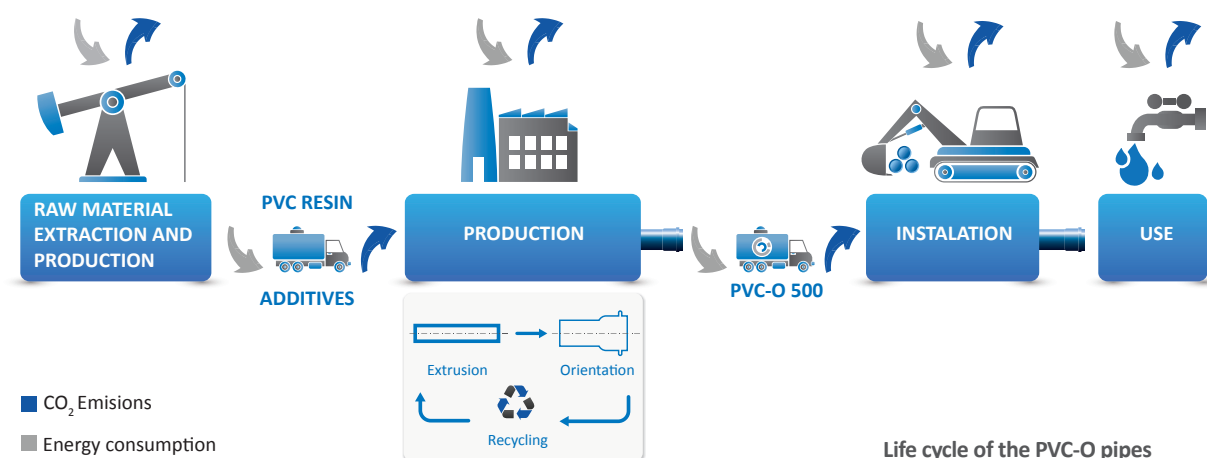
- **Maximum Molecular Orientation:** Class 500, according to the ISO 16422:2014 Standard, the highest orientation degree offering the best mechanical properties.
- **Greater reliability** of the end product.
- Strict dimensional tolerances.
- Homogeneous behavior of the materials used.
- Reinforced socket, shaped during the orientation process.



## The most eco-friendly pipes with the environment

-  The environmental impact of a piping system depends on its composition and application thereof, being the type of raw material used, the production process, the finished product and the pipe's life expectancy, the main factors that determine the efficiency and sustainability throughout their life cycle.

TOM® PVC-O is the most environmentally friendly solution existing on the market, due to its best contribution to the correct sustainable development of the planet, as it has been demonstrated by different studies worldwide, since they present **environmental benefits at all stages of their life cycle**; thus resulting in **the most efficient from the energy point of view**.



### Resources efficiency

- The exceptional mechanical properties of these pipes allow **considerable savings in raw materials**. For the same external nominal diameter, TOM® requires less PVC.
- Only 43% of the PVC composition depends on oil. Therefore, the required consumption of this resource is lower than in other plastic solutions.
- **Energy consumption is lower in all phases of the life cycle**: raw material extraction, pipe manufacturing and use.

Throughout its lifetime, TOM® prevents unnecessary consumption of energy resources and **reduces CO<sub>2</sub> emissions into the atmosphere**.

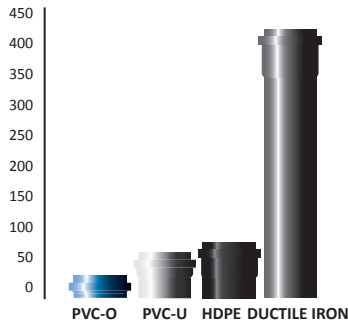
## Optimal use of water resources

- Thanks to their **long useful life and optimum water-tightness**, TOM® pipes are the best ally for the rational use of water resources.

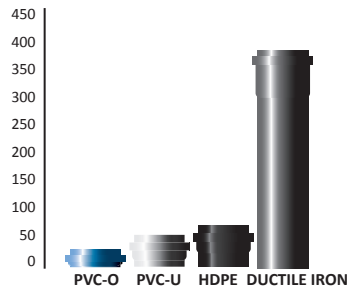
Water supply networks installed with traditional materials are currently registering a leakage rate of up to 25% of channeled water and, the latter's chemical deterioration means that some water conduits are currently being replaced despite having been laid only a few years ago.

Water pipes must not only be resistant to pressure, must also carry the maximum amount of water **consuming the least quantity of energy**. The extreme smoothness of the inner wall of the TOM® pipe minimizes pressure loss, so the energy required for transport is lower.

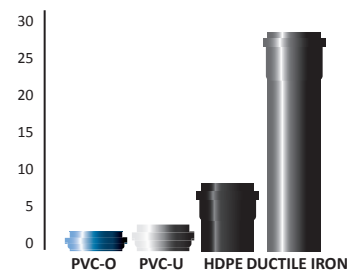
Energy consumed by pipes (raw materials + manufacture) (kWh)



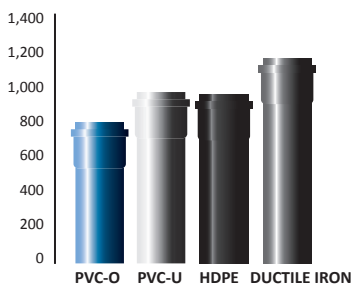
Energy consumed by raw materials (kWh)



Energy consumed in manufacturing (kWh)

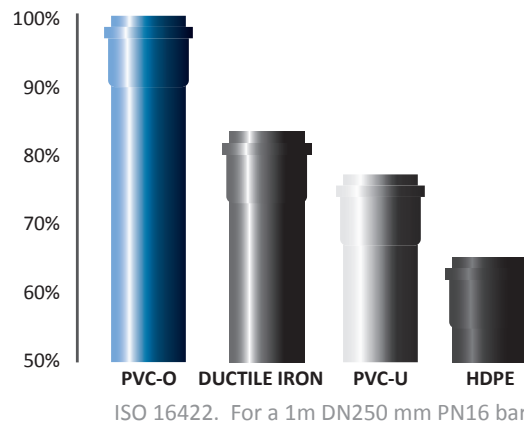


Energy consumed by pumping (kWh)



Estimated energy consumption by PVC-O, PVC-U, HDPE and Ductile Iron piping production and use. Polytechnic University of Catalonia, Spain, December 2005.

Hydraulic capacity




The infrastructures created with TOM® pipes are **an excellent tool for managing water resources for generations**.

## Waste Management Efficiency



- PVC is a **100% recyclable material**. It can be milled and processed as recycled material to be used in the manufacture of other plastic applications with less technical requirements.

## Sustainability

-  TOM® is a **sustainable** pipe, in which design it has been taken into account the preservation of the environment considering aspects such as energy saving, sustainable use of natural resources, durability of the works and environmental friendliness of the materials used.

As always at the forefront, Molecor, following the last common methodology for calculating the Recommendation 179/2013/EC proposed by the European Commission for the Study of **Product Environmental Footprint (PEF)** has evaluated the environmental impact of the TOM® pipe at all stages of its life cycle from cradle to grave, ie from the extraction of raw materials to the final disposal of the product, through manufacture, distribution and use of the pipes.

According to this, it has been studied the effect of the TOM® pipe on 14 environmental impacts that are grouped based on the condition to the different means:

### Air and atmosphere

Climate change, acidification, depletion of the ozone layer and photochemical ozone formation.

### Water

Resource depletion (water), freshwater toxicity and water eutrophication.

### Soil

Depletion of resources (minerals), land eutrophication and ground use.

### Human health

Inorganic respiratory elements, ionizing radiation, effects on human health (cancer-causing) and effects on human health (non-cancerous).

| Environmental impacts                       | Absolute |            |
|---|----------|------------|
| Climate change                              | 8.3E+01  | kg CO2e    |
| Ozone depletion                             | 5.3E-06  | kg CFC-11e |
| Ecotoxicity – aquatic, fresh water          | 1.8E+02  | CTUe       |
| Human toxicity – cancer effects             | 4.8E-06  | CTUe       |
| Human toxicity - non-cancer effects         | 8.6E-06  | CTUh       |
| Particulate matter / Respiratory inorganics | 1.3E-02  | kg PM2.5e  |
| Ionising radiation – human health effects   | 5.3E+00  | kg U235e   |
| Photochemical ozone formation               | 4.1E-01  | kg NMVOC   |
| Acidification                               | 4.1E-01  | mol H+e    |
| Eutrophication - terrestrial                | 1.0E+00  | mol Ne     |
| Eutrophication – aquatic, fresh water       | 1.6E-03  | kg Pe      |
| Eutrophication – aquatic, sea water         | 9.5E-02  | kg Ne      |
| Resource depletion – water                  | 1.9E-01  | m³ SWU     |
| Resource depletion – mineral, fossil        | 3.8E-03  | kg Sbe     |
| Land transformation                         | 1.6E+02  | kg Cdef    |

Class 500 TOM® PVC-O pipes environmental footprint according to Recommendation 179/2013/EC



The best known environmental parameter is the **Carbon Footprint**, which takes into account the greenhouse gas emissions into the atmosphere expressed as CO<sub>2</sub>, and corresponds to the result of the environmental aspect of climate change.

TOM® pipes have the eco-label **Environmental Footprint FVS Seal**, promoted by the *Sustainable Life Foundation* and the *General Directorate of Social Responsibility of the Company's Ministry of Employment and Social Security*.



## TOM®: The best choice for high-pressure fluid transport



The impact of a 500 kg rock dropped from a height of 3 metres leaves a TOM® pipe completely unscathed.

### Unbeatable impact resistance

- TOM® pipes have a **high resistance to shock**. This means that are minimized breakages during installation or during on-site trials caused by dropping or by impacts from stones.

Furthermore, Molecular Orientation prevents the propagation of cracks and scratches and eliminates the risk of rapid crack behaviour. The result is a spectacular increase in the product's useful life.

### High short- and long-term hydrostatic resistance

- TOM® pipes offer a resistance to internal pressure of up to **two times the nominal pressure** (32 bars in PN16 bar pipes or 400 psi in PN200 psi), which means that they can bear sporadic excessive pressure such as water hammers and other malfunctions in the network.

Moreover, the material creep behavior is very low, ensuring the durability of the pipe working at nominal pressure for over a hundred years.

### Excellent response to water hammers

- TOM® pipes offer lower celerity than other piping systems (four times less than ductile iron pipes), which means less water hammers caused by sudden variations in water volume and pressure. This reduces and almost **eliminates the possibility of breakage** during opening and closing in the water network and when pumping gets under way, protecting every component of the network.

### Increased hydraulic capacity

- Molecular Orientation widens the inner section of the pipe, giving TOM® pipes a **higher internal diameter and greater flow section**. Also, the internal surface is extremely smooth, reducing load loss and making it more difficult for deposits to be formed on the inner walls.

As a result, TOM® pipes offer between **15% - 40% more hydraulic capacity** than pipes made from other materials and with the same external dimensions.



### Maximum flexibility

- Thanks to their excellent elasticity, TOM® pipes can bear **big deformations of their internal diameter**. When crushed, or in the event of a mechanical accident, TOM® pipes immediately go back to its original shape, thus minimizing the risk of potential breakage by soil subsidence or sharp edges on rocks or machinery, for example. And thanks to their considerable capacity for bearing heavy loads, TOM® pipes ensure **optimum performance once laid underground**.



### Completely corrosion-resistant

- Oriented PVC is immune to corrosion and to natural chemical substances, as well as to aggression from micro- and macro-organisms. **TOM® pipes, therefore, are not degradable**. Moreover, they do not require any type of special protection or coating, which means cost-savings.

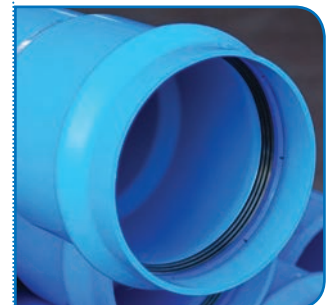


TOM® pipes will take any kind of deformation without suffering structural damage.

### Total water quality

- The quality of the fluid that circulates in TOM® pipes will **always remain unaltered**, given that the material neither suffers corrosion nor migrations within the pipes or in their coating. Mandatory tests such as those made according to the Spanish Law, RD 140/2003, show that the excellent qualities of these pipes comply with the required health standards for water for human consumption. Also TOM® pipes have the ACS (Sanitary Certification) according French legislation.

Consequently, TOM® pipes **are considered the best application for high-pressure water transport, particularly drinking water, for water supply networks**.



Locked-in ring seals ensure a perfect water-tight fit.

### Completely water-tight

- Joints are 100 percent watertight and are guaranteed not to displace once the pipes have been installed. TOM® pipes are **easy to join** and can be installed by lower-qualified workers.



TOM® pipes are extremely lightweight.

### Lower cost and easier installation

- TOM® PVC-O pipes are **lighter and easier to handle** than other pipes made from other materials: in most cases, handling does not require machinery. Beside this, due to the easiness of their union, flexibility and impact resistance these pipes allow higher **cost effectiveness, performance and installation speed in comparison with pipes of other materials**.

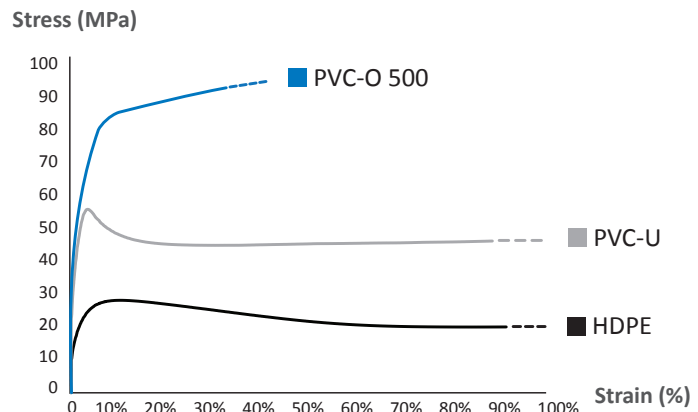
## The best mechanical properties

### Tensile resistance

🎯 The PVC-O stress strain curve changes significantly compared to conventional plastics behaviour, coming very close to the metal ones.

Mechanical properties complete transformation of PVC-O compared to conventional PVC can only be achieved in the higher class PVC-O Class 500, such as TOM® pipes.

#### STRAIN-STRESS BEHAVIOUR

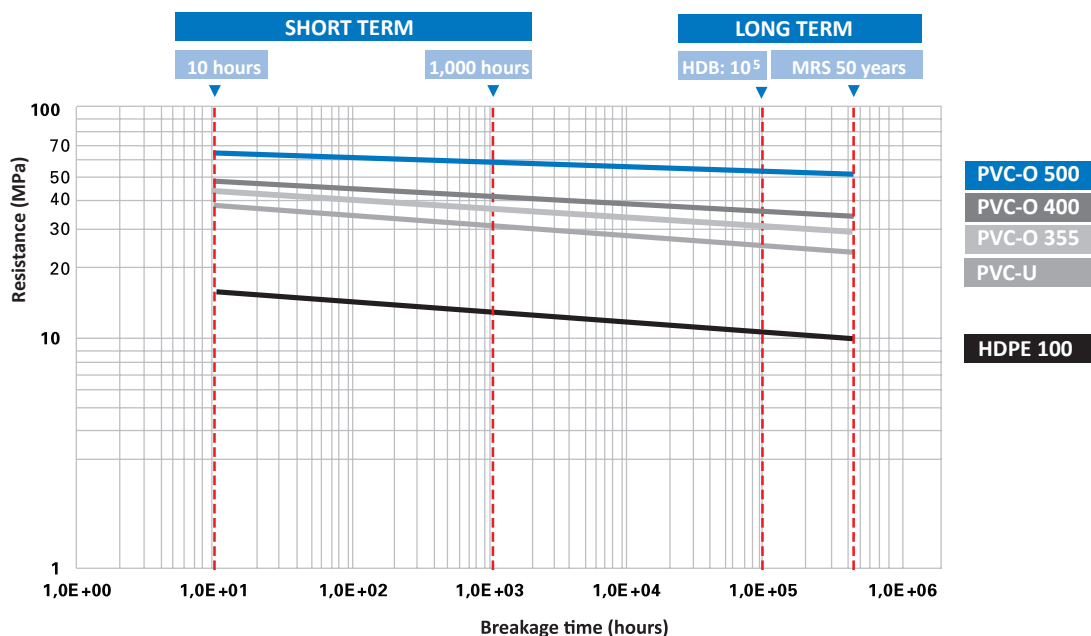


\* Circumferential tension values

### Long-term hydrostatic resistance

🎯 Materials lose their mechanical properties when they are subjected to strain over a long period of time. This characteristic, known as creep, appears to a far lesser extent in PVC-O 500 than in conventional plastics, which means better properties over the long term. Bearing in mind that PVC-O is exceptionally resistant to fatigue and has a very good chemical resistance, in common with conventional PVC, it is no exaggeration to say that this kind of piping is capable of withstanding the pressures of work for over a hundred years.

#### STRESS REGRESSION LINE



## Piping and material mechanical properties

- The following table summarizes the technical characteristics of TOM® PVC-O pipes in comparison with other plastic pipes.

| Product Standard                  | Units | TOM®<br>PVC-O 500 | PVC                | HDPE-100    | HDPE-80     |
|-----------------------------------|-------|-------------------|--------------------|-------------|-------------|
|                                   |       | ISO<br>16422      | EN<br>1452         | EN<br>12201 | EN<br>12201 |
| Minimum required strength (MRS)   | MPa   | 50.0              | 25.0               | 10.0        | 8.0         |
| Overall service coefficient (C)   | -     | 1.4               | 2.0 <sup>(1)</sup> | 1.25        | 1.25        |
| Design stress (σ)                 | MPa   | 36.0              | 12.5               | 8.0         | 6.3         |
| Short term elasticity modulus (E) | MPa   | >4,000            | >3,000             | 1,100       | 900         |
| Resistance to axial traction      | MPa   | >48               | >48                | 19          | 19          |
| Resistance to hoop traction       | MPa   | >85               | >48                | 19          | 19          |
| Shore hardness D                  | -     | 81 - 85           | 70 - 85            | 60          | 65          |

(1) For pipes with a DN ≥110.

## Other material characteristic

- The table below shows other, non-mechanical characteristics of PVC-O 500.

| CHARACTERISTIC                      | UNITS              | VALUE                      |
|-------------------------------------|--------------------|----------------------------|
| Density                             | kg/dm <sup>3</sup> | 1.35 - 1.46 <sup>(1)</sup> |
| PVC Resin K value                   | -                  | >64                        |
| Shore hardness D at 20 °C           | -                  | 81 - 85                    |
| Poisson coefficient                 | -                  | 0.35 - 0.41                |
| Vicat temperature                   | °C                 | >80                        |
| Lineal expansion coefficient        | °C <sup>-1</sup>   | 0.8·10 <sup>-4</sup>       |
| Thermal conductivity                | Kcal/mh°C          | 0.14 - 0.18                |
| Specific heat at 20 °C              | cal/g°C            | 0.20 - 0.28                |
| Dielectric stiffness                | kV/mm              | 20 - 40                    |
| Dielectric constant at 60 Hz        | -                  | 3.2 - 3.6                  |
| Transverse resistivity at 20 °C     | Ω/cm               | >10 <sup>16</sup>          |
| Absolute roughness (ka)             | mm                 | 0.007                      |
| Absolute roughness (Hazen Williams) | -                  | 150                        |
| Manning roughness coefficient (n)   | -                  | 0.009                      |

(1) Although the standard allowance includes this range. TOM® PVC-O pipe is between 1.37 and 1.43 kg/dm<sup>3</sup>.

## Characteristics of the water-tight joint

| CHARACTERISTIC     | UNITS | VALUE |
|--------------------|-------|-------|
| Elastomer hardness | IRHD  | 60 ±5 |

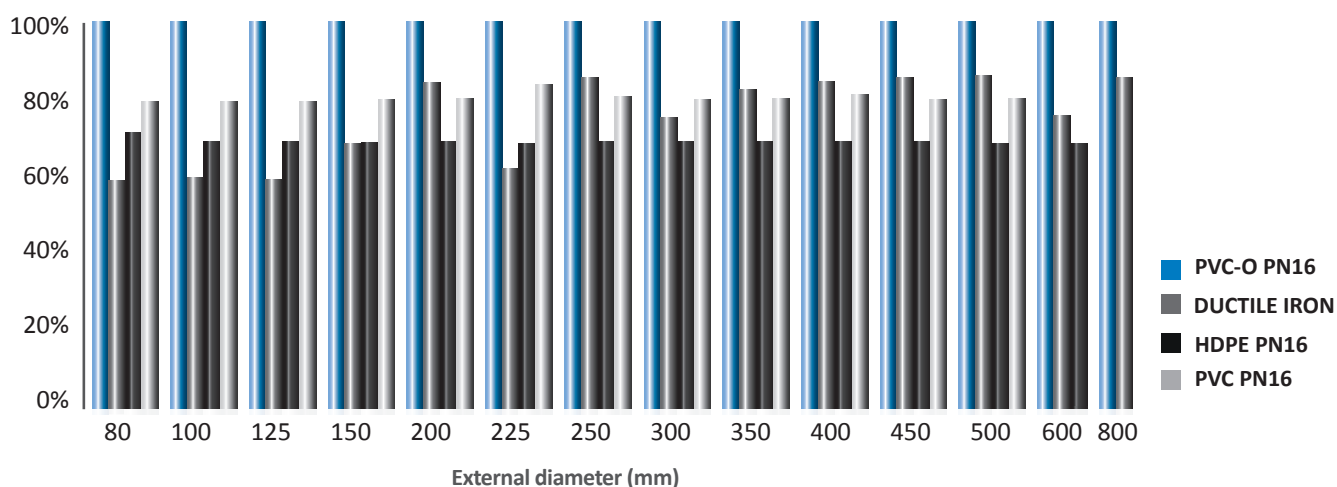


## Unbeatable Hydraulic Properties

### Hydraulic capacity

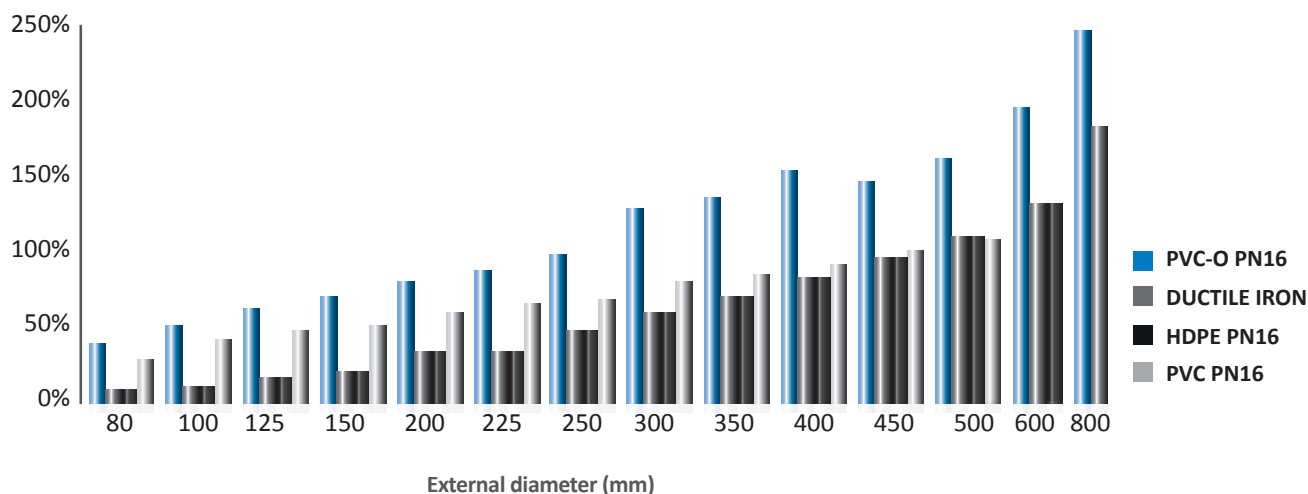
Water pipes requirements are not only related to pressure resistance; they also have to **transport the highest amount of water while consuming the least energy**. TOM® pipes walls are thinner than conventional plastic ones and are on their inside smoother than metals, which means that a greater hydraulic capacity is attained.

Comparison of hydraulic capacity: TOM® PVC-O PN16 pipes vs other materials (constant load loss)



Using pipes with a lower hydraulic capacity involves necessarily using a larger nominal diameter, which has a negative effect on both profitability and infrastructure investment costs. **Using TOM® means you get more hydraulic capacity from your investment costs.**

Hydraulic capacity/Piping costs compared to TOM® PVC-O PN16 DN250



## Water Hammer

- Water hammers occur when liquid flowing through piping stops suddenly when a valve is opened or closed, if a pump is stopped or started or by airlocks shifting within the pipe. Water hammers can result in an **higher overpressure than the pipe's working pressure and lead it to breakage**, specially when the pipe has already been damaged by impacts or corrosion.

Water hammers (P) depend on the celerity (a), which is the wave speed, and the fluid's change of speed (V). The celerity depends basically on the pipe's dimensions (the relationship between the external diameter and the minimum thickness) and the specifications of the material with which the tube is made (Young's modulus, E).

$$P = \frac{a \cdot V}{g}; \quad a = \frac{9900}{\sqrt{48,3 + K_c \cdot \frac{D_m}{e}}}; \quad K_c = \frac{10^{10}}{E}$$

a: acceleration (wave propagation speed), in m/s

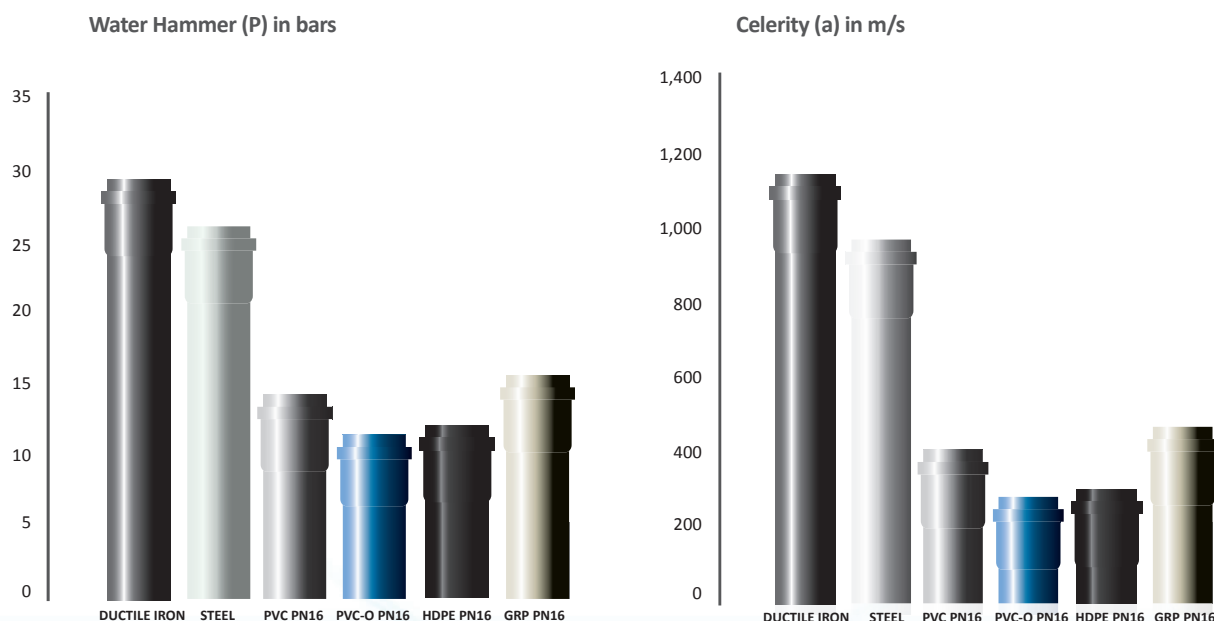
$D_m$ : average pipe diameter, in mm

e: pipe thickness, in mm

$K_c$ : function coefficient of the modulus of elasticity (E) of the material of the pipe expressed in kg/m<sup>2</sup>

E: modulus of elasticity, in kg/m<sup>2</sup> for the TOM® PVC-O pipe:  $4 \times 10^8$  kg/m<sup>2</sup>

**TOM®'s PVC-O pipes have a significantly lower celerity** than pipes made from other materials, particularly so with metal piping. It is particularly significant the difference with pipes made of metal materials, in which the water hammers effects can be very high.



Overpressure produced by sudden pipe shut down with water flowing at 2.5 m/s.

## A range for all kinds of applications

 TOM® offers a broad range of piping covering all medium- and high-pressure needs.

### Applicable Laws and Standards

TOM® PVC-O pipes are manufactured in accordance with ISO 16422:2014 standards, applied to *“Pipes and joints made of oriented unplasticized poly(vinyl chloride) (PVC-O) for the conveyance of water under pressure”* and also according to the French Standard NF T 54-948:2010 *“Tubes en poly(chlorure de vinyle) orienté biaxial (PVC-BO) et leurs assemblages”* (Pipes and joints made of biaxially oriented polyvinyl chloride (PVC-BO)).

**Other international standards** applicable to PVC-O are as follows. Molecor® could manufacture pipes according to these standards under request.

- USA: ASTM F 1483-05 *“Standard Specification for Oriented Poly(Vinyl Chloride), PVCO, Pressure Pipe”*; and *“ANSI/AWWA C909-02 “Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe for Water Distribution”*.
- Australia: AS/NZS 4441:2008 *“Oriented PVC (PVC-O) pipes for pressure applications”*.
- South Africa: SANS 16422:2007 *“Pipes and joints made of oriented unplasticized pol(vinyl) chloride (PVC-O) for the conveyance of water under pressure”*.
- Spain: UNE-ISO 16422:2015 standard applicable to *“Tubos y uniones de poli(cloruro de vinilo) orientado (PVC-O) para una conducción de agua a presión”*.
- Canada: CSA B137,3,1-09 *“Molecularly oriented polyvinylchloride (PVCO) pipe for pressure applications”*.

### Material classification

ISO 16422:2014 standard covers several types of PVC-O material, classified according to their MRS (Minimum Required Strength), because Molecular Orientation can be achieved to a greater or lesser extent through different manufacturing processes. **TOM® PVC-O pipe is manufactured only in the highest class (PVC-O 500)**, which offers the highest degree of orientation and thus ensures the best mechanical performance. Subsequently, TOM® pipes **present higher advantages** compared to other materials.

|   | TOM® PVC-O 500 PIPE |             |             |             |
|---|---------------------|-------------|-------------|-------------|
|   | PN12.5              | PN16        | PN20        | PN25        |
| Material Class  | 500                 | 500         | 500         | 500         |
| MRS (Mpa)   | 50.0                | 50.0        | 50.0        | 50.0        |
| Nominal pressure (bars)                                       | 12.5                | 16.0        | 20.0        | 25.0        |
| Burst Pressure over 50 years (bars) <sup>(1)</sup>            | 17.5                | 22.4        | 28.0        | 35.0        |
| Burst Pressure over 10 hours (bars) <sup>(1)</sup>            | 25.0                | 30.0        | 37.0        | 48.0        |
| Maximum trial pressure onsite (bars) <sup>(2)</sup>           | 17.5                | 21.0        | 25.0        | 30.0        |
| Circumferential stiffness (kN/m <sup>2</sup> ) <sup>(3)</sup> | 5                   | 7           | 11          | 20          |
| Colour <sup>(4)</sup>   | blue/purple         | blue/purple | blue/purple | blue/purple |

(1) With a temperature of 20° C.

(2) According to EN 805:2000 standard with estimated water hammer.

(3) Average stiffness per pipe according to established tolerances.

(4) Available in blue (supply), purple (reuse) and white (resistant to UV rays). For other colours, please contact us.



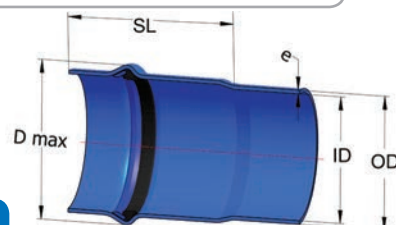
## Dimensions

| TOM® PVC-O 500 PIPE    |                       |        |                      |                    |                      |                    |                      |                    |                      |                    |
|------------------------|-----------------------|--------|----------------------|--------------------|----------------------|--------------------|----------------------|--------------------|----------------------|--------------------|
| Nominal Pressure (bar) |                       | PN12.5 |                      | PN16               |                      | PN20               |                      | PN25               |                      |                    |
| Nominal Diameter (DN)  | Outside Diameter (OD) |        | Inside Diameter (ID) | Wall Thickness (e) | Inside Diameter (ID) | Wall Thickness (e) | Inside Diameter (ID) | Wall Thickness (e) | Inside Diameter (ID) | Wall Thickness (e) |
|                        | min.                  | max.   | average              | min.               | average              | min.               | average              | min.               | average              | min.               |
| mm                     | mm                    | mm     | mm                   | mm                 | mm                   | mm                 | mm                   | mm                 | mm                   | mm                 |
| 90                     | 90.0                  | 90.3   | -                    | -                  | 84.0                 | 2.0                | 84.0                 | 2.5                | 82.2                 | 3.1                |
| 110                    | 110.0                 | 110.4  | 104.4                | 2.2                | 104.0                | 2.4                | 103.2                | 3.1                | 101.4                | 3.8                |
| 125                    | 125.0                 | 125.4  | 118.8                | 2.5                | 117.8                | 2.8                | 117.0                | 3.5                | 115.2                | 4.3                |
| 140                    | 140.0                 | 140.5  | 133.0                | 2.8                | 132.4                | 3.1                | 131.2                | 3.9                | 129.2                | 4.8                |
| 160                    | 160.0                 | 160.5  | 152.0                | 3.2                | 151.4                | 3.5                | 150.0                | 4.4                | 147.6                | 5.5                |
| 200                    | 200.0                 | 200.6  | 190.0                | 4.0                | 189.2                | 4.4                | 187.4                | 5.5                | 184.4                | 6.9                |
| 225                    | 225.0                 | 225.7  | 213.6                | 4.5                | 212.8                | 5.0                | 210.8                | 6.2                | 207.4                | 7.7                |
| 250                    | 250.0                 | 250.8  | 237.4                | 5.0                | 236.4                | 5.5                | 234.2                | 6.9                | 230.6                | 8.6                |
| 315                    | 315.0                 | 316.0  | 299.2                | 6.3                | 298.0                | 6.9                | 295.2                | 8.7                | 290.6                | 10.8               |
| 355                    | 355.0                 | 356.1  | 337.4                | 7.1                | 336.0                | 7.8                | 332.4                | 9.8                | 327.2                | 12.2               |
| 400                    | 400.0                 | 401.2  | 379.8                | 8.0                | 378.4                | 8.8                | 374.8                | 11.0               | 369.0                | 13.7               |
| 450                    | 450.0                 | 451.4  | 427.6                | 8.9                | 426.0                | 9.9                | 421.4                | 12.4               | 415.0                | 15.4               |
| 500                    | 500.0                 | 501.5  | 474.6                | 9.9                | 472.8                | 11.0               | 468.6                | 13.7               | 461.2                | 17.1               |
| 630                    | 630.0                 | 631.9  | 597.8                | 12.6               | 595.8                | 13.8               | 590.4                | 17.3               | 581.0                | 21.6               |
| 710                    | 710.0                 | 712.0  | 674.8                | 14.2               | 671.4                | 15.4               | 665.6                | 19.2               | 654.6                | 24.4               |
| 800                    | 800.0                 | 802.0  | 760.4                | 16.3               | 757.8                | 17.4               | 750.4                | 21.6               | -                    | -                  |

TOM® PVC-O pipes are supplied in total length of 5.95 metres (including the length limit mark for the socket).

For other lengths for special projects, price on request.

The inside diameters may be subjected to variation according to manufacturing tolerances.



## Packaging

| DN  | Pipes/ Pallet | Pallet/ Truck | Pipes/ Truck | Metres <sup>(1)</sup> / Truck | Pallet Width | Pallet Height | Pallet Length | Pallet Weight |      |      |      |
|-----|---------------|---------------|--------------|-------------------------------|--------------|---------------|---------------|---------------|------|------|------|
| mm  | pipes         | pallet        | pipes        | m                             | mm           | mm            | mm            | PN12.5        | PN16 | PN20 | PN25 |
| 90  | 81            | 16            | 1296         | 7711                          | 1220         | 670           | 6110          | -             | 590  | 590  | 750  |
| 110 | 76            | 12            | 912          | 5426                          | 1220         | 850           | 6130          | 715           | 775  | 775  | 940  |
| 125 | 60            | 12            | 720          | 4284                          | 1220         | 850           | 6135          | 630           | 725  | 790  | 960  |
| 140 | 45            | 12            | 540          | 3213                          | 1220         | 850           | 6140          | 590           | 690  | 745  | 905  |
| 160 | 33            | 12            | 396          | 2356                          | 1220         | 800           | 6150          | 570           | 650  | 715  | 870  |
| 200 | 24            | 12            | 288          | 1714                          | 1220         | 870           | 6185          | 630           | 695  | 800  | 970  |
| 225 | 14            | 16            | 224          | 1333                          | 1220         | 700           | 6190          | 480           | 525  | 605  | 730  |
| 250 | 11            | 12            | 132          | 785                           | 1100         | 800           | 6215          | 465           | 510  | 585  | 705  |
| 315 | 13            | 8             | 104          | 619                           | 2200         | 700           | 6260          | 860           | 950  | 1090 | 1320 |
| 355 | 11            | 6             | 66           | 393                           | 2200         | 800           | 6295          | 925           | 1020 | 1165 | 1410 |
| 400 | 11            | 6             | 66           | 393                           | 2400         | 850           | 6325          | 1165          | 1285 | 1475 | 1785 |
| 450 | 5             | 10            | 50           | 298                           | 2200         | 550           | 6330          | 685           | 755  | 860  | 1060 |
| 500 | 4             | 8             | 32           | 190                           | 1950         | 600           | 6335          | 675           | 740  | 850  | 1025 |
| 630 | 3             | 6             | 18           | 107                           | 1950         | 730           | 6410          | 795           | 875  | 1005 | 1220 |
| 710 | 3             | 6             | 18           | 107                           | 2200         | 810           | 6425          | 1005          | 1105 | 1270 | 1535 |
| 800 | 3             | 6             | 18           | 107                           | 2200         | 900           | 6425          | 1270          | 1400 | 1605 | -    |

(1) Nominal metres (5.95 metres per pipe). The effective length is the total length minus the length limit marked for the assembly.

## Joints and Watertight Seals



Apply lubricant on the chamfer of the spigot end and in the rubber ring joint.

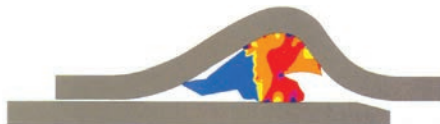


Align the pipe and place the spigot end inside the socket or bell.



Firmly push the free end into the other pipe. Introduce until the end marked is no longer seen.

The connection is done by introducing the male part of the pipe in the socket of the other where the elastic joint is placed. The watertight seal includes a Polypropylene ring and a synthetic rubber lip which allows the seal to be integrated with the pipe, avoiding joint displacement or movement while the installation is taking place.



| Nominal Diameter (DN) | Socket Length (SL) | Maximum Diameter (D max) | Length limit mark for the assembly of the pipes (1) |      |      |      |
|-----------------------|--------------------|--------------------------|---|------|------|------|
|                       |                    |                          | PN12.5  | PN16 | PN20 | PN25 |
| mm                    | mm                 | mm                       | mm  | mm   | mm   | mm   |
| 90                    | 160                | 117                      | 132   | 131  | 131  | 127  |
| 110                   | 180                | 140                      | 146   | 145  | 145  | 141  |
| 125                   | 185                | 154                      | 160   | 160  | 158  | 154  |
| 140                   | 190                | 174                      | 149   | 149  | 146  | 141  |
| 160                   | 200                | 197                      | 169   | 166  | 163  | 158  |
| 200                   | 235                | 243                      | 195   | 192  | 188  | 181  |
| 225                   | 240                | 271                      | 197   | 194  | 190  | 182  |
| 250                   | 265                | 301                      | 221   | 217  | 212  | 204  |
| 315                   | 310                | 374                      | 260   | 256  | 250  | 239  |
| 355                   | 345                | 419                      | 281   | 277  | 270  | 258  |
| 400                   | 375                | 472                      | 317   | 312  | 304  | 291  |
| 450                   | 380                | 527                      | 319   | 313  | 303  | 288  |
| 500                   | 385                | 587                      | 330   | 324  | 312  | 295  |
| 630                   | 460                | 734                      | 384   | 376  | 360  | 340  |
| 710                   | 475                | 815                      | 392   | 383  | 369  | 342  |
| 800                   | 475                | 925                      | 385   | 375  | 359  | 329  |

(1) TOM® pipes have a mark in the spigot, being the limit mark to which the male end of the pipe should be introduced during installation and thus assure water-tightness.



The length limit mark for the assembly of the pipes is the distance from the beveled end of the pipe to the printed cutting mark.



## Assembly

In order to do the assembly is necessary to apply lubricant on the chamfer of the spigot end and in the rubber ring joint, and push by hand until the mark of the spigot end is no longer seen.

## Fittings

### TAPPING SADDLES

Allow connecting the pipe in the perpendicular direction to all kinds of fittings (house connections, valves, purges, vents, etc). They are available with screws ends and flange ends.



The saddle must become in solidarity with the pipe. Multidiameter saddles must not be used, but specific PVC saddles for each DN.

### ANTI-TRACTION SYSTEM FLANGE

Allows connecting the spigot ends to all kinds of fittings with connection to a flange (valves, elbows, t's, DN reductions, caps, etc).



Anti-traction system makes the pipe absolutely fixed to the flange.

### EURO TYPE PLUG FITTINGS

Connecting the fitting directly to the pipe allows us to have deviations, reductions and connections on the net (elbows, tees, DN reductions, etc).



It is very important to fix the fitting to the ground in order to guaranty the net structural resistance.

A wide range of fittings can be used with TOM® pipes. Consult our technical service to receive advise on the fittings that may be used.



# ecoFITTOM

**ecoFITTOM®**, the first **fittings** in the world in **PVC-O**, present excellent improvements in the mechanical properties of PVC. These improvements allow to manufacture **ecoFITTOM®** consuming less raw material and less energy obtaining a product with higher hydrostatic resistance and higher resistance to impact than fittings of other materials. Besides this, **ecoFITTOM®** presents an excellent behavior against water hammer, complete watertight, maximum chemical resistance and ductility.

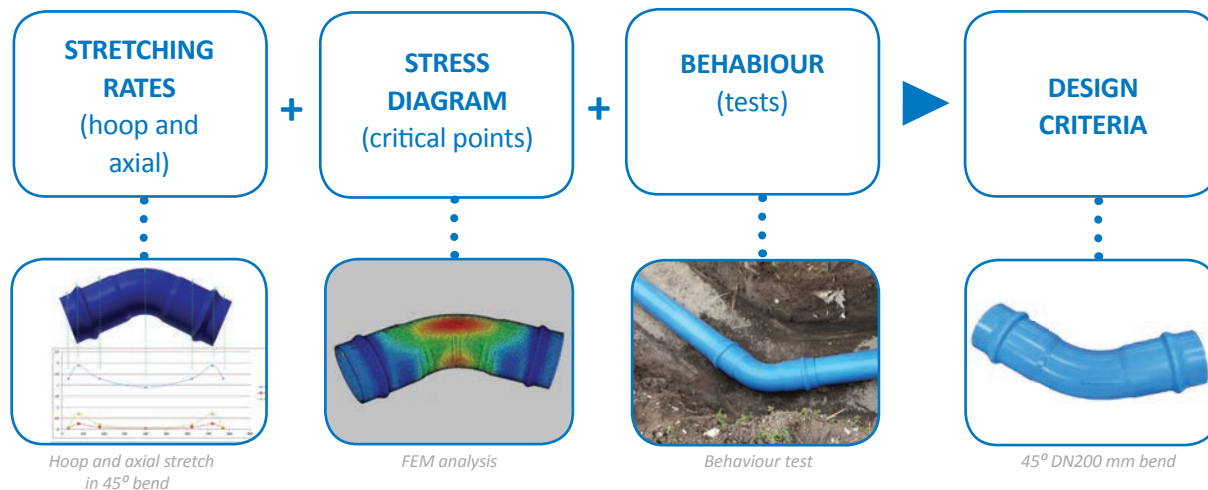
With **ecoFITTOM® Molecor** offers a **continuous system in PVC-O**; this material continuity guarantees the same hydraulic and mechanical properties in the different elements of the network, in the **pipes** as well as in the **fittings**.

This fact, guarantees, at the same time, total water quality.

These fittings can be used in networks for the transportation of drinking water, irrigation systems, industrial applications, sewage, infrastructure networks, fire protection nets, etc. among other applications.

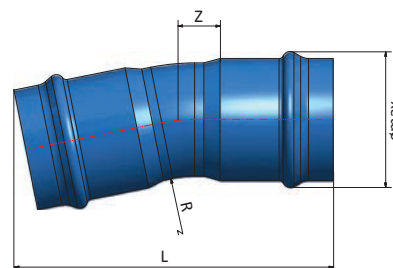


## PROCESS FOR OBTAINING PVC-O FITTINGS



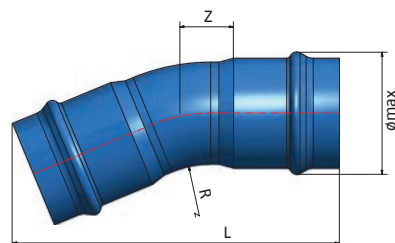
## 11,25° PN16 bar bend

| DN  | Reference  | ømax | L (mm) | Z (mm) | Radius (mm) | Weight (Kg) |
|-----|------------|------|--------|--------|-------------|-------------|
| 110 | F110C1116B | 140  | 455    | 55     | 165         | 1,0         |
| 160 | F160C1116B | 200  | 535    | 70     | 240         | 2,2         |
| 200 | F200C1116B | 245  | 595    | 80     | 300         | 4,0         |
| 250 | F250C1116B | 305  | 690    | 95     | 375         | 6,0         |
| 315 | F315C1116B | 375  | 790    | 115    | 475         | 13,0        |
| 400 | F400C1116B | 475  | 925    | 140    | 600         | 24,4        |



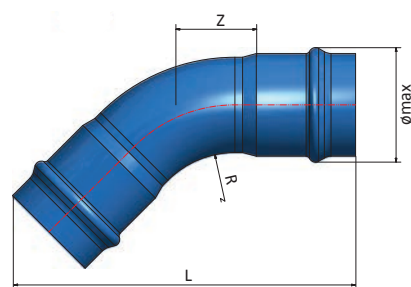
## 22,5° PN16 bar bend

| DN  | Reference  | ømax | L (mm) | Z (mm) | Radius (mm) | Weight (Kg) |
|-----|------------|------|--------|--------|-------------|-------------|
| 110 | F110C2216B | 140  | 490    | 70     | 165         | 1,0         |
| 160 | F160C2216B | 200  | 585    | 95     | 240         | 2,4         |
| 200 | F200C2216B | 245  | 655    | 110    | 300         | 4,3         |
| 250 | F250C2216B | 305  | 765    | 135    | 375         | 6,4         |
| 315 | F315C2216B | 375  | 885    | 160    | 475         | 14,5        |
| 400 | F400C2216B | 475  | 1045   | 200    | 600         | 27,5        |



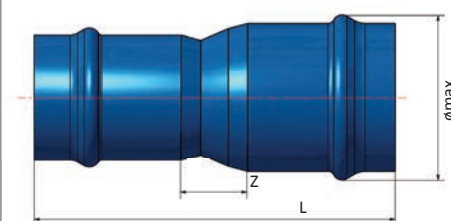
## 45° PN16 bar bend

| DN  | Reference  | ømax | L (mm) | Z (mm) | Radius (mm) | Weight (Kg) |
|-----|------------|------|--------|--------|-------------|-------------|
| 110 | F110C4516B | 140  | 555    | 105    | 165         | 1,1         |
| 160 | F160C4516B | 200  | 680    | 145    | 240         | 2,9         |
| 200 | F200C4516B | 245  | 770    | 175    | 300         | 5,1         |
| 250 | F250C4516B | 305  | 910    | 215    | 375         | 7,7         |
| 315 | F315C4516B | 375  | 1070   | 265    | 475         | 17,5        |
| 400 | F400C4516B | 475  | 1280   | 330    | 600         | 33,7        |



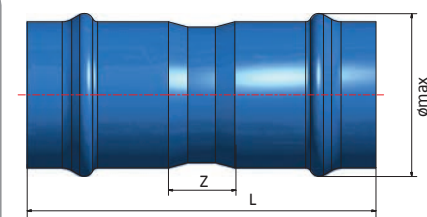
## PN16 bar reducer

| DN/DN     | Reference   | ømax | L (mm) | Z (mm) | Weight (Kg) |
|-----------|-------------|------|--------|--------|-------------|
| 110 / 90  | F110R09016B | 140  | 390    | 60     | 0,8         |
| 160 / 110 | F160R11016B | 200  | 485    | 110    | 2,0         |
| 160 / 140 | F160R14016B | 200  | 460    | 65     | 1,9         |
| 200 / 160 | F200R16016B | 245  | 530    | 105    | 3,5         |
| 250 / 200 | F250R20016B | 305  | 600    | 130    | 5,0         |
| 315 / 250 | F315R25016B | 375  | 695    | 165    | 11,4        |
| 400 / 250 | F400R25016B | 475  | 860    | 290    | 22,7        |
| 400 / 315 | F400R31516B | 475  | 810    | 200    | 21,3        |



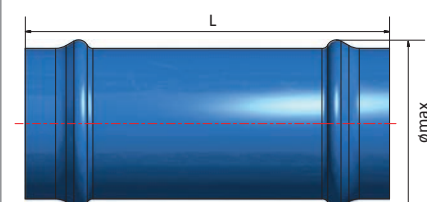
## PN16 bar coupler

| DN  | Reference | ømax | L (mm) | Z (mm) | Weight (Kg) |
|-----|-----------|------|--------|--------|-------------|
| 110 | F110M16B  | 140  | 425    | 80     | 0,8         |
| 160 | F160M16B  | 200  | 495    | 90     | 2,1         |
| 200 | F200M16B  | 245  | 535    | 100    | 3,5         |
| 250 | F250M16B  | 305  | 630    | 125    | 5,3         |
| 315 | F315M16B  | 375  | 720    | 155    | 11,8        |
| 400 | F400M16B  | 475  | 850    | 195    | 22,3        |



## PN16 bar sliding coupler

| DN  | Reference | ømax | L (mm) | Z (mm) | Weight (Kg) |
|-----|-----------|------|--------|--------|-------------|
| 110 | F110MR16B | 140  | 425    | -      | 0,8         |
| 160 | F160MR16B | 200  | 495    | -      | 2,1         |
| 200 | F200MR16B | 245  | 535    | -      | 3,5         |
| 250 | F250MR16B | 305  | 630    | -      | 5,3         |
| 315 | F315MR16B | 375  | 720    | -      | 11,8        |
| 400 | F400MR16B | 475  | 850    | -      | 22,3        |



## Applications

### SUPPLYING (blue TOM®)

Conduits for potable water transport. It includes water abstraction and water distribution network to city centers, urban network and industrial areas, and water transfer to tanks and reservoirs.



### RECLAIMED WATER (purple TOM®)

Pipelines for transport of water that have been treated to remove impurities.



### IRRIGATION (blue TOM®)

Water transport pipes for irrigation purposes. It includes irrigated land pipelines, water transfer to tanks and reservoirs.



### OTHER APPLICATIONS

Sewage

Fire Protection Nets

Industrial Applications

Infrastructural Nets



## Key Factors for Optimizing Design

### Hydraulic Design

Whether designing a pumping system or a gravity-enabled pipe system, deciding the dimensions of the pipes involves calculating losses in the terms of load, flow-volume and flow speed.

There are several methodologies for calculating these values. The most commonly used are the Hazen-Williams and Prandtl-Colebrook-White formulas.

$$\text{Flow-volume (l/s)} = \text{speed (m/s)} \cdot \text{section} \cdot (\text{m}^2) \cdot 10^3$$

Hazen-Williams Formula

$$V = 0.355 \cdot C \cdot D_i^{0.63} \cdot J^{0.54}$$

Prandtl -Colebrook-White Formula

$$V = -2 \sqrt{2 \cdot g \cdot D_i \cdot J} \cdot \log \left( \frac{k_a}{3.71 \cdot D_i} + \frac{2.51 \cdot v}{D_i \sqrt{2 \cdot g \cdot D_i \cdot J}} \right)$$

V = Average Speed in m/s

$D_i$  = Internal Diameter in m

J = Pressure loss in m/m

C = Hazen-Williams Roughness Constant (for PVC-O; C = 150)

g = Gravity acceleration in m/s<sup>2</sup> (9.81 m/s<sup>2</sup>)

$k_a$  = Absolute roughness in metres (for PVC-O;  $k_a = 0.007 \cdot 10^{-3}$  m)

v = Kinematic viscosity of the fluid (m<sup>2</sup>/s) (for water at 20 °C; v =  $1.0 \cdot 10^{-6}$ )

Another factor to be taken into account is the heat loss produced by fittings (elbows, reducers, tees, etc.) and valves.

There are tables available for calculating heat loss, flow and speeds using the Hazen-Williams formula.

Flow speed must be determined taking into account different economical factors (optimization of the investment in terms of water pumping) and the admissible values for water hammers.

In general, it is established as the minimum value for avoiding sediments 0.5 m/s and as the maximum values between 2.0 m/s and 2.5 m/s, depending on the diameter of the pipe.

## Pressure loss tables

## TOM® PVC-O 500 PN16

Pipe head loss is the energy of a hydraulic fluid that is lost along itself due to friction.

Below is the calculation of estimated water speeds depending on the selected pipe for installation.

| INTERNAL<br>DIAMETER | DN90<br>PN16<br>84.0 |        | DN110<br>PN16<br>104.0 |        | DN125<br>PN16<br>117.8 |        | DN140<br>PN16<br>132.4 |       | DN160<br>PN16<br>151.4 |       | DN200<br>PN16<br>189.2 |       | DN225<br>PN16<br>212.8 |       |
|----------------------|----------------------|--------|------------------------|--------|------------------------|--------|------------------------|-------|------------------------|-------|------------------------|-------|------------------------|-------|
| Speed                | Flow                 | J      | Flow                   | J      | Flow                   | J      | Flow                   | J     | Flow                   | J     | Flow                   | J     | Flow                   | J     |
| (m/s)                | l/s                  | m/km   | l/s                    | m/km   | l/s                    | m/km   | l/s                    | m/km  | l/s                    | m/km  | l/s                    | m/km  | l/s                    | m/km  |
| 0.1                  | 0.55                 | 0.16   | 0.85                   | 0.13   | 1.09                   | 0.11   | 1.38                   | 0.09  | 1.80                   | 0.08  | 2.80                   | 0.06  | 3.56                   | 0.05  |
| 0.2                  | 1.11                 | 0.58   | 1.70                   | 0.45   | 2.18                   | 0.39   | 2.75                   | 0.34  | 3.60                   | 0.29  | 5.62                   | 0.22  | 7.11                   | 0.20  |
| 0.3                  | 1.66                 | 1.23   | 2.55                   | 0.96   | 3.27                   | 0.83   | 4.13                   | 0.72  | 5.40                   | 0.62  | 8.43                   | 0.48  | 10.70                  | 0.42  |
| 0.4                  | 2.22                 | 2.09   | 3.40                   | 1.63   | 4.36                   | 1.41   | 5.51                   | 1.23  | 7.20                   | 1.05  | 11.20                  | 0.81  | 14.20                  | 0.71  |
| 0.5                  | 2.77                 | 3.17   | 4.25                   | 2.47   | 5.45                   | 2.13   | 6.88                   | 1.86  | 9.00                   | 1.59  | 14.10                  | 1.23  | 17.80                  | 1.07  |
| 0.6                  | 3.33                 | 4.44   | 5.10                   | 3.46   | 6.54                   | 2.99   | 8.26                   | 2.61  | 10.80                  | 2.23  | 16.90                  | 1.72  | 21.30                  | 1.50  |
| 0.7                  | 3.88                 | 5.90   | 5.95                   | 4.60   | 7.63                   | 3.98   | 9.64                   | 3.47  | 12.60                  | 2.97  | 19.70                  | 2.29  | 24.90                  | 1.99  |
| 0.8                  | 4.43                 | 7.56   | 6.80                   | 5.89   | 8.72                   | 5.09   | 11.00                  | 4.44  | 14.40                  | 3.80  | 22.50                  | 2.93  | 28.50                  | 2.55  |
| 0.9                  | 4.99                 | 9.40   | 7.65                   | 7.33   | 9.81                   | 6.34   | 12.40                  | 5.53  | 16.20                  | 4.73  | 25.30                  | 3.64  | 32.00                  | 3.18  |
| 1.0                  | 5.54                 | 11.43  | 8.49                   | 8.91   | 10.90                  | 7.70   | 13.80                  | 6.72  | 18.00                  | 5.75  | 28.11                  | 4.43  | 35.60                  | 3.86  |
| 1.1                  | 6.10                 | 13.60  | 9.34                   | 10.60  | 12.00                  | 9.20   | 15.10                  | 8.02  | 19.80                  | 6.85  | 30.90                  | 5.28  | 39.10                  | 4.61  |
| 1.2                  | 6.70                 | 16.00  | 10.20                  | 12.50  | 13.10                  | 10.80  | 16.50                  | 9.42  | 21.60                  | 8.05  | 33.70                  | 6.21  | 42.70                  | 5.41  |
| 1.3                  | 7.20                 | 18.60  | 11.00                  | 14.50  | 14.20                  | 12.50  | 17.90                  | 10.92 | 23.40                  | 9.34  | 36.50                  | 7.20  | 46.20                  | 6.28  |
| 1.4                  | 7.80                 | 21.30  | 11.90                  | 16.60  | 15.30                  | 14.40  | 19.30                  | 12.50 | 25.20                  | 10.70 | 39.40                  | 8.26  | 49.80                  | 7.20  |
| 1.5                  | 8.30                 | 24.20  | 12.70                  | 18.90  | 16.30                  | 16.30  | 20.70                  | 14.20 | 27.00                  | 12.20 | 42.22                  | 9.39  | 53.30                  | 8.18  |
| 1.6                  | 8.90                 | 27.30  | 13.60                  | 21.30  | 17.40                  | 18.40  | 22.00                  | 16.00 | 28.80                  | 13.70 | 44.00                  | 10.60 | 56.90                  | 9.22  |
| 1.7                  | 9.40                 | 30.50  | 14.40                  | 23.80  | 18.50                  | 20.60  | 23.40                  | 18.00 | 30.60                  | 15.40 | 47.80                  | 11.80 | 60.50                  | 10.32 |
| 1.8                  | 10.00                | 33.90  | 15.30                  | 26.40  | 19.60                  | 22.90  | 24.80                  | 20    | 32.40                  | 17.10 | 50.60                  | 13.20 | 64.00                  | 11.50 |
| 1.9                  | 10.50                | 37.50  | 16.10                  | 29.20  | 20.70                  | 25.30  | 26.20                  | 22.10 | 34.20                  | 18.90 | 53.40                  | 14.50 | 67.60                  | 12.70 |
| 2.0                  | 11.10                | 41.20  | 17.00                  | 32.10  | 21.80                  | 27.80  | 27.50                  | 24.30 | 36.00                  | 20.70 | 56.20                  | 16.00 | 71.10                  | 13.90 |
| 2.1                  | 11.60                | 45.10  | 17.80                  | 35.20  | 22.90                  | 30.40  | 28.90                  | 26.50 | 37.80                  | 22.70 | 59.00                  | 17.50 | 74.70                  | 15.30 |
| 2.2                  | 12.20                | 49.20  | 18.70                  | 38.40  | 24.00                  | 33.20  | 30.30                  | 28.90 | 39.60                  | 24.70 | 61.90                  | 19.10 | 78.20                  | 16.60 |
| 2.3                  | 12.70                | 53.40  | 19.50                  | 41.60  | 25.10                  | 36.00  | 31.70                  | 31.40 | 41.40                  | 26.90 | 64.70                  | 20.70 | 81.80                  | 18.10 |
| 2.4                  | 13.30                | 57.80  | 20.40                  | 45.10  | 26.20                  | 39.00  | 33.00                  | 34.00 | 43.20                  | 29.10 | 67.50                  | 22.40 | 85.40                  | 19.50 |
| 2.5                  | 13.90                | 62.40  | 21.20                  | 48.60  | 27.20                  | 42.00  | 34.40                  | 36.70 | 45.00                  | 31.40 | 70.30                  | 24.20 | 88.90                  | 21.10 |
| 2.6                  | 14.40                | 67.10  | 22.10                  | 52.30  | 28.30                  | 45.20  | 35.80                  | 39.40 | 46.80                  | 33.70 | 73.10                  | 26.00 | 92.50                  | 22.70 |
| 2.7                  | 15.00                | 71.90  | 22.90                  | 56.00  | 29.40                  | 48.50  | 37.20                  | 42.30 | 48.60                  | 36.20 | 75.90                  | 27.90 | 96.00                  | 24.30 |
| 2.8                  | 15.50                | 76.90  | 23.80                  | 59.90  | 30.50                  | 51.80  | 38.50                  | 45.20 | 50.40                  | 38.70 | 78.72                  | 29.80 | 99.60                  | 26.00 |
| 2.9                  | 16.10                | 82.10  | 24.60                  | 64.00  | 31.60                  | 55.30  | 39.90                  | 48.30 | 52.20                  | 41.30 | 81.50                  | 31.80 | 103.10                 | 27.70 |
| 3.0                  | 16.60                | 87.40  | 25.50                  | 68.10  | 32.70                  | 58.90  | 41.30                  | 51.40 | 54.00                  | 43.90 | 84.30                  | 33.90 | 106.70                 | 29.50 |
| 3.1                  | 17.20                | 92.90  | 26.30                  | 72.40  | 33.80                  | 62.60  | 42.70                  | 54.60 | 55.80                  | 46.70 | 87.20                  | 36.00 | 110.30                 | 31.40 |
| 3.2                  | 17.70                | 98.50  | 27.20                  | 76.80  | 34.90                  | 66.40  | 44.10                  | 57.90 | 57.60                  | 49.50 | 90.00                  | 38.20 | 113.80                 | 33.30 |
| 3.3                  | 18.30                | 104.30 | 28.00                  | 81.30  | 36.00                  | 70.30  | 45.40                  | 61.30 | 59.40                  | 52.40 | 92.80                  | 40.40 | 117.40                 | 35.20 |
| 3.4                  | 18.80                | 110.20 | 28.90                  | 85.90  | 37.10                  | 74.30  | 46.80                  | 64.80 | 61.20                  | 55.40 | 95.60                  | 42.70 | 120.90                 | 37.20 |
| 3.5                  | 19.40                | 116.30 | 29.70                  | 90.60  | 38.10                  | 78.40  | 48.20                  | 68.40 | 63.00                  | 58.50 | 98.40                  | 45.10 | 124.50                 | 39.30 |
| 3.6                  | 20.00                | 122.50 | 30.60                  | 95.50  | 39.20                  | 82.60  | 49.60                  | 72.00 | 64.80                  | 61.60 | 101.20                 | 47.50 | 128.00                 | 41.40 |
| 3.7                  | 20.50                | 128.90 | 31.40                  | 100.50 | 40.30                  | 86.90  | 50.90                  | 75.80 | 66.60                  | 64.80 | 104.00                 | 50.00 | 131.60                 | 43.60 |
| 3.8                  | 21.10                | 135.40 | 32.30                  | 105.50 | 41.40                  | 91.30  | 52.30                  | 79.60 | 68.40                  | 68.10 | 106.80                 | 52.50 | 135.20                 | 45.80 |
| 3.9                  | 21.60                | 142.10 | 33.10                  | 110.70 | 42.50                  | 95.80  | 53.70                  | 83.50 | 70.20                  | 71.44 | 109.60                 | 55.10 | 138.70                 | 48.00 |
| 4.0                  | 22.20                | 148.90 | 34.00                  | 116.10 | 43.60                  | 100.30 | 55.10                  | 87.60 | 72.00                  | 74.90 | 112.50                 | 57.70 | 142.30                 | 50.30 |

The values for TOM® PN12.5 are very similar to those for the previous ones which means that the same table may be used for calculations.

Shaded values: estimation of recommended water speeds to avoid sedimentation, water hammer, noises, erosion and high values of head loss according to Manning formula.

## TOM® PVC-O 500 PN16

Pipe head loss is the energy of a hydraulic fluid that is lost along itself due to friction.

Below is the calculation of estimated water speeds depending on the selected pipe for installation.

| DN250<br>PN16<br>236.4 |          | DN315<br>PN16<br>298.0 |          | DN355<br>PN16<br>336.0 |          | DN400<br>PN16<br>378.4 |          | DN450<br>PN16<br>426.0 |          | DN500<br>PN16<br>472.8 |          | DN630<br>PN16<br>595.8 |          | DN710<br>PN16<br>671.4 |          | DN800<br>PN16<br>757.8 |          |
|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|
| Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        |
| l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km |
| 4.39                   | 0.05     | 6.97                   | 0.04     | 8.87                   | 0.03     | 11.20                  | 0.03     | 14.30                  | 0.02     | 17.60                  | 0.02     | 27.90                  | 0.02     | 35.40                  | 0.01     | 45.10                  | 0.01     |
| 8.78                   | 0.17     | 13.90                  | 0.13     | 17.70                  | 0.12     | 22.50                  | 0.10     | 28.50                  | 0.09     | 35.10                  | 0.08     | 55.80                  | 0.06     | 70.80                  | 0.05     | 90.20                  | 0.04     |
| 13.20                  | 0.37     | 20.90                  | 0.28     | 26.60                  | 0.24     | 33.70                  | 0.21     | 42.80                  | 0.18     | 52.70                  | 0.16     | 83.60                  | 0.12     | 106.20                 | 0.11     | 135.30                 | 0.09     |
| 17.60                  | 0.63     | 27.90                  | 0.48     | 35.50                  | 0.42     | 45.00                  | 0.36     | 57.00                  | 0.31     | 70.20                  | 0.28     | 111.50                 | 0.21     | 141.60                 | 0.19     | 180.40                 | 0.16     |
| 21.90                  | 0.95     | 34.90                  | 0.72     | 44.30                  | 0.63     | 56.20                  | 0.55     | 71.30                  | 0.48     | 87.80                  | 0.42     | 139.40                 | 0.32     | 177.00                 | 0.28     | 225.50                 | 0.24     |
| 26.30                  | 1.33     | 41.80                  | 1.01     | 53.20                  | 0.88     | 67.50                  | 0.77     | 85.50                  | 0.67     | 105.30                 | 0.59     | 167.30                 | 0.45     | 212.40                 | 0.39     | 270.60                 | 0.34     |
| 30.70                  | 1.76     | 48.80                  | 1.35     | 62.10                  | 1.17     | 78.70                  | 1.02     | 99.80                  | 0.89     | 122.90                 | 0.79     | 195.20                 | 0.60     | 247.80                 | 0.52     | 315.70                 | 0.45     |
| 35.10                  | 2.26     | 55.80                  | 1.72     | 70.90                  | 1.50     | 90.00                  | 1.30     | 114.00                 | 1.14     | 140.50                 | 1.01     | 223.00                 | 0.77     | 283.20                 | 0.67     | 360.80                 | 0.58     |
| 39.50                  | 2.81     | 62.80                  | 2.14     | 79.80                  | 1.86     | 101.20                 | 1.62     | 128.30                 | 1.41     | 158.00                 | 1.25     | 250.90                 | 0.96     | 318.60                 | 0.83     | 405.90                 | 0.72     |
| 43.90                  | 3.42     | 69.70                  | 2.61     | 88.70                  | 2.27     | 112.50                 | 1.97     | 142.50                 | 1.72     | 175.60                 | 1.52     | 278.80                 | 1.16     | 354.00                 | 1.01     | 451.00                 | 0.88     |
| 48.30                  | 4.08     | 76.70                  | 3.11     | 97.50                  | 2.70     | 123.70                 | 2.35     | 156.80                 | 2.05     | 193.10                 | 1.81     | 306.70                 | 1.39     | 389.40                 | 1.21     | 496.13                 | 1.05     |
| 52.70                  | 4.79     | 83.70                  | 3.65     | 106.40                 | 3.18     | 135.00                 | 2.77     | 171.00                 | 2.41     | 210.70                 | 2.13     | 334.60                 | 1.63     | 424.80                 | 1.42     | 541.20                 | 1.23     |
| 57.10                  | 5.55     | 90.70                  | 4.24     | 115.30                 | 3.68     | 146.20                 | 3.21     | 185.30                 | 2.79     | 228.20                 | 2.47     | 362.40                 | 1.89     | 460.30                 | 1.64     | 586.30                 | 1.43     |
| 61.40                  | 6.37     | 97.60                  | 4.86     | 124.10                 | 4.23     | 157.40                 | 3.68     | 199.50                 | 3.20     | 245.80                 | 2.84     | 390.30                 | 2.17     | 495.70                 | 1.88     | 631.40                 | 1.64     |
| 65.80                  | 7.24     | 104.60                 | 5.52     | 133.00                 | 4.80     | 168.70                 | 4.18     | 213.80                 | 3.64     | 263.40                 | 3.22     | 418.20                 | 2.46     | 531.10                 | 2.14     | 676.50                 | 1.86     |
| 70.20                  | 8.16     | 111.60                 | 6.23     | 141.90                 | 5.41     | 179.90                 | 4.71     | 228.00                 | 4.10     | 280.90                 | 3.63     | 446.10                 | 2.77     | 566.50                 | 2.41     | 721.60                 | 2.09     |
| 74.60                  | 9.13     | 118.60                 | 6.96     | 150.70                 | 6.05     | 191.20                 | 5.27     | 242.30                 | 4.59     | 298.50                 | 4.06     | 474.00                 | 3.10     | 601.90                 | 2.70     | 766.70                 | 2.34     |
| 79.00                  | 10.10    | 125.50                 | 7.74     | 159.60                 | 6.73     | 202.40                 | 5.86     | 256.60                 | 5.10     | 316.00                 | 4.52     | 501.80                 | 3.45     | 637.30                 | 3.00     | 811.80                 | 2.61     |
| 83.40                  | 11.20    | 132.50                 | 8.56     | 168.50                 | 7.44     | 213.70                 | 6.48     | 270.80                 | 5.64     | 333.60                 | 4.99     | 529.70                 | 3.81     | 672.70                 | 3.32     | 856.90                 | 2.88     |
| 87.80                  | 12.30    | 139.50                 | 9.41     | 177.30                 | 8.18     | 224.90                 | 7.12     | 285.10                 | 6.20     | 351.10                 | 5.49     | 557.60                 | 4.19     | 708.10                 | 3.65     | 902.00                 | 3.17     |
| 92.20                  | 13.50    | 146.50                 | 10.30    | 186.20                 | 8.95     | 236.20                 | 7.79     | 299.30                 | 6.79     | 368.70                 | 6.01     | 585.50                 | 4.59     | 743.50                 | 3.99     | 947.10                 | 3.47     |
| 96.60                  | 14.70    | 153.40                 | 11.20    | 195.10                 | 9.76     | 247.40                 | 8.50     | 313.60                 | 7.40     | 386.20                 | 6.55     | 613.40                 | 5.00     | 778.90                 | 4.35     | 992.30                 | 3.78     |
| 101.0                  | 16.0     | 160.40                 | 12.20    | 203.90                 | 10.60    | 258.70                 | 9.23     | 327.80                 | 8.03     | 403.80                 | 7.11     | 641.20                 | 5.43     | 814.30                 | 4.72     | 1037.4                 | 4.10     |
| 105.30                 | 17.30    | 167.40                 | 13.20    | 212.80                 | 11.50    | 269.90                 | 9.98     | 342.10                 | 8.69     | 421.40                 | 7.70     | 669.10                 | 5.88     | 849.70                 | 5.11     | 1082.5                 | 4.44     |
| 109.70                 | 18.60    | 174.40                 | 14.20    | 221.70                 | 12.40    | 281.10                 | 10.80    | 356.30                 | 9.38     | 438.90                 | 8.30     | 697.00                 | 6.34     | 885.10                 | 5.51     | 1127.6                 | 4.79     |
| 114.10                 | 20.00    | 181.30                 | 15.30    | 230.50                 | 13.30    | 292.40                 | 11.60    | 370.60                 | 10.10    | 456.50                 | 8.93     | 724.90                 | 6.82     | 920.50                 | 5.93     | 1172.7                 | 5.15     |
| 118.50                 | 21.50    | 188.30                 | 16.40    | 239.40                 | 14.30    | 303.60                 | 12.40    | 384.80                 | 10.80    | 474.00                 | 9.57     | 752.80                 | 7.31     | 955.90                 | 6.36     | 1217.8                 | 5.52     |
| 122.90                 | 23.00    | 195.30                 | 17.50    | 248.30                 | 15.30    | 314.90                 | 13.30    | 399.10                 | 11.60    | 491.60                 | 10.20    | 780.60                 | 7.82     | 991.30                 | 6.80     | 1262.9                 | 5.91     |
| 127.30                 | 24.50    | 202.30                 | 18.70    | 257.10                 | 16.30    | 326.10                 | 14.20    | 413.30                 | 12.30    | 509.10                 | 10.90    | 808.50                 | 8.34     | 1026.7                 | 7.26     | 1308.0                 | 6.30     |
| 131.70                 | 26.10    | 209.20                 | 19.90    | 266.00                 | 17.30    | 337.40                 | 15.10    | 427.60                 | 13.10    | 526.70                 | 11.60    | 836.40                 | 8.88     | 1062.1                 | 7.73     | 1353.1                 | 6.71     |
| 136.10                 | 27.80    | 216.20                 | 21.20    | 274.90                 | 18.40    | 348.60                 | 16.00    | 441.80                 | 14.00    | 544.30                 | 12.40    | 864.30                 | 9.44     | 1097.5                 | 8.21     | 1398.2                 | 7.13     |
| 140.50                 | 29.40    | 223.20                 | 22.50    | 283.70                 | 19.50    | 359.90                 | 17.10    | 456.10                 | 14.80    | 561.80                 | 13.10    | 892.20                 | 10.00    | 1132.9                 | 8.70     | 1443.3                 | 7.60     |
| 144.80                 | 31.20    | 230.20                 | 23.80    | 292.60                 | 20.70    | 371.10                 | 18.00    | 470.40                 | 15.70    | 579.40                 | 13.90    | 920.00                 | 10.60    | 1168.3                 | 9.20     | 1488.4                 | 8.00     |
| 149.20                 | 32.90    | 237.10                 | 25.10    | 301.50                 | 21.90    | 382.40                 | 19.00    | 484.60                 | 16.60    | 596.90                 | 14.70    | 947.90                 | 11.20    | 1203.7                 | 9.70     | 1533.5                 | 8.50     |
| 153.60                 | 34.80    | 244.10                 | 26.50    | 310.30                 | 23.10    | 393.60                 | 20.10    | 498.90                 | 17.50    | 614.50                 | 15.50    | 975.80                 | 11.80    | 1239.1                 | 10.30    | 1578.6                 | 8.90     |
| 158.01                 | 36.60    | 251.10                 | 27.95    | 319.20                 | 24.30    | 404.90                 | 21.20    | 513.10                 | 18.40    | 632.00                 | 16.30    | 1003.7                 | 12.50    | 1274.5                 | 10.80    | 1623.7                 | 9.40     |
| 162.40                 | 38.50    | 258.06                 | 29.40    | 328.10                 | 25.60    | 416.10                 | 22.30    | 527.40                 | 19.40    | 649.60                 | 17.20    | 1031.6                 | 13.10    | 1309.9                 | 11.40    | 1668.8                 | 9.90     |
| 166.80                 | 40.50    | 265.00                 | 30.90    | 336.90                 | 26.90    | 427.30                 | 23.40    | 541.60                 | 20.40    | 667.20                 | 18.00    | 1059.4                 | 13.80    | 1345.4                 | 12.00    | 1713.9                 | 10.40    |
| 171.20                 | 42.50    | 272.00                 | 32.40    | 345.80                 | 28.20    | 438.60                 | 24.50    | 555.90                 | 21.40    | 684.70                 | 18.90    | 1087.3                 | 14.40    | 1380.8                 | 12.60    | 1759.0                 | 10.90    |
| 175.60                 | 44.50    | 279.00                 | 34.00    | 354.70                 | 29.50    | 449.80                 | 25.70    | 570.10                 | 22.40    | 702.30                 | 19.80    | 1115.2                 | 15.10    | 1416.2                 | 13.20    | 1804.1                 | 11.40    |

The values for TOM® PN12.5 are very similar to those for the previous ones which means that the same table may be used for calculations.

Shaded values: estimation of recommended water speeds to avoid sedimentation, water hammer, noises, erosion and high values of head loss according to Manning formula.

## Pressure loss tables

## TOM® PVC-O 500 PN20

Pipe head loss is the energy of a hydraulic fluid that is lost along itself due to friction.

Below is the calculation of estimated water speeds depending on the selected pipe for installation.

| INTERNAL<br>DIAMETER | DN90<br>PN20<br>84.0 |        | DN110<br>PN20<br>103.2 |        | DN125<br>PN20<br>117.0 |        | DN140<br>PN20<br>131.2 |       | DN160<br>PN20<br>150.0 |       | DN200<br>PN20<br>187.4 |       | DN225<br>PN20<br>210.8 |       |
|----------------------|----------------------|--------|------------------------|--------|------------------------|--------|------------------------|-------|------------------------|-------|------------------------|-------|------------------------|-------|
| Speed                | Flow                 | J      | Flow                   | J      | Flow                   | J      | Flow                   | J     | Flow                   | J     | Flow                   | J     | Flow                   | J     |
| (m/s)                | l/s                  | m/km   | l/s                    | m/km   | l/s                    | m/km   | l/s                    | m/km  | l/s                    | m/km  | l/s                    | m/km  | l/s                    | m/km  |
| 0.1                  | 0.55                 | 0.16   | 0.84                   | 0.13   | 1.08                   | 0.11   | 1.35                   | 0.10  | 1.77                   | 0.08  | 2.76                   | 0.06  | 3.49                   | 0.05  |
| 0.2                  | 1.11                 | 0.58   | 1.67                   | 0.46   | 2.15                   | 0.39   | 2.70                   | 0.34  | 3.53                   | 0.29  | 5.52                   | 0.23  | 6.98                   | 0.20  |
| 0.3                  | 1.66                 | 1.23   | 2.51                   | 0.97   | 3.23                   | 0.83   | 4.06                   | 0.73  | 5.30                   | 0.62  | 8.27                   | 0.48  | 10.50                  | 0.42  |
| 0.4                  | 2.22                 | 2.09   | 3.35                   | 1.65   | 4.30                   | 1.42   | 5.41                   | 1.24  | 7.07                   | 1.06  | 11.00                  | 0.82  | 14.00                  | 0.72  |
| 0.5                  | 2.77                 | 3.17   | 4.18                   | 2.49   | 5.38                   | 2.15   | 6.76                   | 1.88  | 8.84                   | 1.61  | 13.80                  | 1.24  | 17.50                  | 1.08  |
| 0.6                  | 3.33                 | 4.44   | 5.02                   | 3.49   | 6.45                   | 3.01   | 8.11                   | 2.64  | 10.60                  | 2.26  | 16.50                  | 1.74  | 20.90                  | 1.52  |
| 0.7                  | 3.88                 | 5.90   | 5.86                   | 4.64   | 7.53                   | 4.01   | 9.46                   | 3.51  | 12.40                  | 3.00  | 19.30                  | 2.31  | 24.40                  | 2.02  |
| 0.8                  | 4.43                 | 7.56   | 6.69                   | 5.94   | 8.60                   | 5.13   | 10.80                  | 4.49  | 14.10                  | 3.84  | 22.10                  | 2.96  | 27.90                  | 2.58  |
| 0.9                  | 4.99                 | 9.40   | 7.53                   | 7.39   | 9.68                   | 6.39   | 12.20                  | 5.59  | 15.90                  | 4.78  | 24.80                  | 3.69  | 31.40                  | 3.21  |
| 1.0                  | 5.54                 | 11.43  | 8.36                   | 8.99   | 10.75                  | 7.76   | 13.50                  | 6.79  | 17.70                  | 5.81  | 27.60                  | 4.48  | 34.90                  | 3.90  |
| 1.1                  | 6.10                 | 13.60  | 9.20                   | 10.70  | 11.83                  | 9.30   | 14.90                  | 8.10  | 19.40                  | 6.93  | 30.30                  | 5.34  | 38.40                  | 4.66  |
| 1.2                  | 6.70                 | 16.00  | 10.00                  | 12.60  | 12.90                  | 10.90  | 16.20                  | 9.52  | 21.20                  | 8.14  | 33.10                  | 6.28  | 41.90                  | 5.47  |
| 1.3                  | 7.20                 | 18.60  | 10.90                  | 14.60  | 14.00                  | 12.60  | 17.60                  | 11.00 | 23.00                  | 9.44  | 35.90                  | 7.28  | 45.40                  | 6.35  |
| 1.4                  | 7.80                 | 21.30  | 11.70                  | 16.80  | 15.10                  | 14.50  | 18.90                  | 12.70 | 24.70                  | 10.80 | 38.60                  | 8.35  | 48.90                  | 7.28  |
| 1.5                  | 8.30                 | 24.20  | 12.50                  | 19.00  | 16.10                  | 16.40  | 20.30                  | 14.40 | 26.50                  | 12.30 | 41.40                  | 9.49  | 52.40                  | 8.27  |
| 1.6                  | 8.90                 | 27.30  | 13.40                  | 21.50  | 17.20                  | 18.50  | 21.60                  | 16.20 | 28.30                  | 13.90 | 44.10                  | 10.70 | 55.80                  | 9.32  |
| 1.7                  | 9.40                 | 30.50  | 14.20                  | 24.00  | 18.30                  | 20.70  | 23.00                  | 18.10 | 30.00                  | 15.50 | 46.90                  | 12.00 | 59.30                  | 10.43 |
| 1.8                  | 10.00                | 33.90  | 15.10                  | 26.70  | 19.40                  | 23.10  | 24.30                  | 20.20 | 31.80                  | 17.30 | 49.60                  | 13.30 | 62.80                  | 11.60 |
| 1.9                  | 10.50                | 37.50  | 15.90                  | 29.50  | 20.40                  | 25.50  | 25.70                  | 22.30 | 33.60                  | 19.10 | 52.40                  | 14.70 | 66.30                  | 12.80 |
| 2.0                  | 11.10                | 41.20  | 16.70                  | 32.40  | 21.50                  | 28.00  | 27.00                  | 24.50 | 35.30                  | 21.00 | 55.20                  | 16.20 | 69.80                  | 14.10 |
| 2.1                  | 11.60                | 45.10  | 17.60                  | 35.50  | 22.60                  | 30.70  | 28.40                  | 26.80 | 37.10                  | 22.90 | 57.90                  | 17.70 | 73.30                  | 15.40 |
| 2.2                  | 12.20                | 49.20  | 18.40                  | 38.70  | 23.70                  | 33.40  | 29.70                  | 29.20 | 38.90                  | 25.00 | 60.70                  | 19.30 | 76.80                  | 16.80 |
| 2.3                  | 12.70                | 53.40  | 19.20                  | 42.00  | 24.70                  | 36.30  | 31.10                  | 31.80 | 40.60                  | 27.20 | 63.40                  | 20.90 | 80.30                  | 18.30 |
| 2.4                  | 13.30                | 57.80  | 20.10                  | 45.50  | 25.80                  | 39.30  | 32.40                  | 34.40 | 42.40                  | 29.40 | 66.20                  | 22.70 | 83.80                  | 19.80 |
| 2.5                  | 13.90                | 62.40  | 20.90                  | 49.00  | 26.90                  | 42.40  | 33.80                  | 37.10 | 44.20                  | 31.70 | 69.00                  | 24.40 | 87.30                  | 21.30 |
| 2.6                  | 14.40                | 67.10  | 21.70                  | 52.70  | 28.00                  | 45.50  | 35.20                  | 39.90 | 45.90                  | 34.10 | 71.70                  | 26.30 | 90.70                  | 22.90 |
| 2.7                  | 15.00                | 71.90  | 22.60                  | 56.60  | 29.00                  | 48.80  | 36.50                  | 42.70 | 47.70                  | 36.60 | 74.50                  | 28.20 | 94.20                  | 24.60 |
| 2.8                  | 15.50                | 76.90  | 23.40                  | 60.50  | 30.10                  | 52.30  | 37.90                  | 45.70 | 49.50                  | 39.10 | 77.20                  | 30.20 | 97.70                  | 26.30 |
| 2.9                  | 16.10                | 82.10  | 24.30                  | 64.60  | 31.20                  | 55.80  | 39.20                  | 48.80 | 51.20                  | 41.70 | 80.00                  | 32.20 | 101.20                 | 28.00 |
| 3.0                  | 16.60                | 87.40  | 25.10                  | 68.70  | 32.30                  | 59.40  | 40.60                  | 51.90 | 53.00                  | 44.40 | 82.70                  | 34.30 | 104.70                 | 29.90 |
| 3.1                  | 17.20                | 92.90  | 25.90                  | 73.00  | 33.30                  | 63.10  | 41.90                  | 55.20 | 54.80                  | 47.20 | 85.50                  | 36.40 | 108.20                 | 31.70 |
| 3.2                  | 17.70                | 98.50  | 26.80                  | 77.50  | 34.40                  | 66.90  | 43.30                  | 58.50 | 56.50                  | 50.10 | 88.30                  | 38.60 | 111.70                 | 33.70 |
| 3.3                  | 18.30                | 104.30 | 27.60                  | 82.00  | 35.50                  | 70.80  | 44.60                  | 62.00 | 58.30                  | 53.00 | 91.00                  | 40.90 | 115.20                 | 35.60 |
| 3.4                  | 18.80                | 110.20 | 28.40                  | 86.70  | 36.60                  | 74.90  | 46.00                  | 65.50 | 60.10                  | 56.00 | 93.80                  | 43.20 | 118.70                 | 37.70 |
| 3.5                  | 19.40                | 116.30 | 29.30                  | 91.40  | 37.60                  | 79.00  | 47.30                  | 69.10 | 61.90                  | 59.10 | 96.50                  | 45.60 | 122.20                 | 39.70 |
| 3.6                  | 20.00                | 122.50 | 30.10                  | 96.30  | 38.70                  | 83.20  | 48.70                  | 72.80 | 63.60                  | 62.30 | 99.30                  | 48.00 | 125.60                 | 41.90 |
| 3.7                  | 20.50                | 128.90 | 30.90                  | 101.40 | 39.80                  | 87.60  | 50.00                  | 76.60 | 65.40                  | 65.50 | 102.10                 | 50.50 | 129.10                 | 44.00 |
| 3.8                  | 21.10                | 135.40 | 31.80                  | 106.50 | 40.80                  | 92.00  | 51.40                  | 80.50 | 67.20                  | 68.80 | 104.80                 | 53.10 | 132.60                 | 46.30 |
| 3.9                  | 21.60                | 142.10 | 32.60                  | 111.70 | 41.90                  | 96.50  | 52.70                  | 84.40 | 68.90                  | 72.20 | 107.60                 | 55.70 | 136.10                 | 48.60 |
| 4.0                  | 22.20                | 148.90 | 33.50                  | 117.10 | 43.00                  | 101.20 | 54.10                  | 88.50 | 70.70                  | 75.70 | 110.30                 | 58.40 | 139.60                 | 50.90 |

Shaded values: estimation of recommended water speeds to avoid sedimentation, water hammer, noises, erosion and high values of head loss according to Manning formula.



## TOM® PVC-O 500 PN20

Pipe head loss is the energy of a hydraulic fluid that is lost along itself due to friction.

Below is the calculation of estimated water speeds depending on the selected pipe for installation.

| DN250<br>PN20<br>234.2 |          | DN315<br>PN20<br>295.2 |          | DN355<br>PN20<br>332.4 |          | DN400<br>PN20<br>374.8 |          | DN450<br>PN20<br>421.4 |          | DN500<br>PN20<br>468.6 |          | DN630<br>PN20<br>590.4 |          | DN710<br>PN20<br>665.6 |          | DN800<br>PN20<br>750.4 |          |
|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|
| Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        |
| l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km |
| 4.31                   | 0.05     | 6.84                   | 0.04     | 8.68                   | 0.03     | 11.00                  | 0.03     | 13.90                  | 0.02     | 17.20                  | 0.02     | 27.40                  | 0.02     | 34.79                  | 0.01     | 44.20                  | 0.01     |
| 8.62                   | 0.18     | 13.70                  | 0.13     | 17.40                  | 0.12     | 22.10                  | 0.10     | 27.90                  | 0.09     | 34.50                  | 0.08     | 54.80                  | 0.06     | 69.59                  | 0.05     | 88.50                  | 0.05     |
| 12.90                  | 0.37     | 20.50                  | 0.28     | 26.00                  | 0.25     | 33.10                  | 0.21     | 41.80                  | 0.19     | 51.70                  | 0.17     | 82.10                  | 0.13     | 104.38                 | 0.11     | 132.70                 | 0.10     |
| 17.20                  | 0.63     | 27.40                  | 0.48     | 34.70                  | 0.42     | 44.10                  | 0.37     | 55.80                  | 0.32     | 69.00                  | 0.28     | 109.50                 | 0.22     | 139.18                 | 0.19     | 176.90                 | 0.16     |
| 21.50                  | 0.96     | 34.20                  | 0.73     | 43.40                  | 0.64     | 55.20                  | 0.55     | 69.70                  | 0.48     | 86.20                  | 0.43     | 136.90                 | 0.33     | 173.97                 | 0.28     | 221.10                 | 0.25     |
| 25.80                  | 1.34     | 41.10                  | 1.02     | 52.10                  | 0.89     | 66.20                  | 0.77     | 83.70                  | 0.68     | 103.50                 | 0.60     | 164.30                 | 0.46     | 208.77                 | 0.40     | 265.40                 | 0.34     |
| 30.20                  | 1.78     | 47.90                  | 1.36     | 60.70                  | 1.19     | 77.20                  | 1.03     | 97.60                  | 0.90     | 120.70                 | 0.79     | 191.60                 | 0.61     | 243.56                 | 0.53     | 309.60                 | 0.46     |
| 34.50                  | 2.28     | 54.80                  | 1.74     | 69.40                  | 1.52     | 88.30                  | 1.32     | 111.60                 | 1.15     | 138.00                 | 1.02     | 219.00                 | 0.78     | 278.36                 | 0.68     | 353.80                 | 0.59     |
| 38.80                  | 2.84     | 61.60                  | 2.17     | 78.10                  | 1.89     | 99.30                  | 1.64     | 125.50                 | 1.43     | 155.20                 | 1.26     | 246.40                 | 0.97     | 313.15                 | 0.84     | 398.00                 | 0.73     |
| 43.10                  | 3.45     | 68.40                  | 2.64     | 86.80                  | 2.29     | 110.30                 | 1.99     | 139.50                 | 1.74     | 172.46                 | 1.54     | 273.80                 | 1.17     | 347.95                 | 1.02     | 442.30                 | 0.89     |
| 47.40                  | 4.12     | 75.30                  | 3.14     | 95.50                  | 2.74     | 121.40                 | 2.38     | 153.40                 | 2.08     | 189.70                 | 1.83     | 301.10                 | 1.40     | 382.74                 | 1.22     | 486.50                 | 1.06     |
| 51.70                  | 4.84     | 82.10                  | 3.69     | 104.10                 | 3.22     | 132.40                 | 2.80     | 167.40                 | 2.44     | 207.00                 | 2.15     | 328.50                 | 1.65     | 417.54                 | 1.43     | 530.70                 | 1.24     |
| 56.00                  | 5.61     | 89.00                  | 4.28     | 112.80                 | 3.73     | 143.40                 | 3.24     | 181.30                 | 2.83     | 224.20                 | 2.50     | 355.90                 | 1.91     | 452.33                 | 1.66     | 574.90                 | 1.44     |
| 60.30                  | 6.44     | 95.80                  | 4.92     | 121.50                 | 4.28     | 154.50                 | 3.72     | 195.30                 | 3.24     | 241.40                 | 2.87     | 383.30                 | 2.19     | 487.13                 | 1.90     | 619.20                 | 1.65     |
| 64.60                  | 7.32     | 102.70                 | 5.58     | 130.20                 | 4.86     | 165.50                 | 4.23     | 209.20                 | 3.69     | 258.70                 | 3.26     | 410.70                 | 2.49     | 521.92                 | 2.16     | 663.40                 | 1.88     |
| 68.90                  | 8.25     | 109.50                 | 6.29     | 138.80                 | 5.48     | 176.50                 | 4.76     | 223.20                 | 4.15     | 275.90                 | 3.67     | 438.00                 | 2.80     | 556.72                 | 2.44     | 707.60                 | 2.12     |
| 73.20                  | 9.23     | 116.40                 | 7.04     | 147.50                 | 6.13     | 187.60                 | 5.33     | 237.10                 | 4.65     | 293.20                 | 4.11     | 465.40                 | 3.14     | 591.51                 | 2.73     | 751.80                 | 2.37     |
| 77.50                  | 10.30    | 123.20                 | 7.83     | 156.20                 | 6.82     | 198.60                 | 5.92     | 251.00                 | 5.17     | 310.40                 | 4.57     | 492.80                 | 3.49     | 626.31                 | 3.03     | 796.10                 | 2.64     |
| 81.80                  | 11.30    | 130.00                 | 8.65     | 164.90                 | 7.53     | 209.60                 | 6.55     | 265.00                 | 5.71     | 327.70                 | 5.05     | 520.20                 | 3.85     | 661.10                 | 3.35     | 840.30                 | 2.91     |
| 86.20                  | 12.50    | 136.90                 | 9.52     | 173.60                 | 8.28     | 220.70                 | 7.20     | 278.90                 | 6.28     | 344.90                 | 5.55     | 547.50                 | 4.24     | 695.90                 | 3.68     | 884.50                 | 3.20     |
| 90.50                  | 13.60    | 143.70                 | 10.40    | 182.20                 | 9.07     | 231.70                 | 7.88     | 292.90                 | 6.87     | 362.20                 | 6.07     | 574.90                 | 4.64     | 730.69                 | 4.03     | 928.70                 | 3.51     |
| 94.80                  | 14.90    | 150.60                 | 11.40    | 190.90                 | 9.88     | 242.70                 | 8.59     | 306.80                 | 7.49     | 379.40                 | 6.62     | 602.30                 | 5.06     | 765.49                 | 4.40     | 973.00                 | 3.82     |
| 99.10                  | 16.10    | 157.40                 | 12.30    | 199.60                 | 10.70    | 253.80                 | 9.33     | 320.80                 | 8.14     | 396.70                 | 7.19     | 629.70                 | 5.49     | 800.28                 | 4.77     | 1017.2                 | 4.15     |
| 103.40                 | 17.50    | 164.30                 | 13.30    | 208.30                 | 11.60    | 264.80                 | 10.09    | 334.70                 | 8.80     | 413.90                 | 7.78     | 657.00                 | 5.94     | 835.08                 | 5.16     | 1061.4                 | 4.49     |
| 107.70                 | 18.80    | 171.10                 | 14.40    | 216.90                 | 12.50    | 275.80                 | 10.90    | 348.70                 | 9.49     | 431.20                 | 8.39     | 684.40                 | 6.41     | 869.87                 | 5.57     | 1105.6                 | 4.84     |
| 112.00                 | 20.30    | 177.90                 | 15.50    | 225.60                 | 13.50    | 286.90                 | 11.70    | 362.60                 | 10.20    | 448.40                 | 9.02     | 711.80                 | 6.89     | 904.67                 | 5.99     | 1149.9                 | 5.21     |
| 116.30                 | 21.70    | 184.80                 | 16.60    | 234.30                 | 14.40    | 297.90                 | 12.60    | 376.60                 | 10.90    | 465.60                 | 9.67     | 739.20                 | 7.39     | 939.46                 | 6.42     | 1194.1                 | 5.58     |
| 120.60                 | 23.20    | 191.60                 | 17.70    | 243.00                 | 15.40    | 308.90                 | 13.40    | 390.50                 | 11.70    | 482.90                 | 10.30    | 766.60                 | 7.90     | 974.26                 | 6.87     | 1238.3                 | 5.97     |
| 124.90                 | 24.80    | 198.50                 | 18.90    | 251.70                 | 16.50    | 320.00                 | 14.30    | 404.50                 | 12.50    | 500.10                 | 11.00    | 793.90                 | 8.43     | 1009.1                 | 7.33     | 1282.5                 | 6.37     |
| 129.20                 | 26.40    | 205.30                 | 20.20    | 260.30                 | 17.60    | 331.00                 | 15.30    | 418.40                 | 13.30    | 517.40                 | 11.80    | 821.30                 | 8.98     | 1043.8                 | 7.81     | 1326.8                 | 6.79     |
| 133.50                 | 28.10    | 212.20                 | 21.40    | 269.00                 | 18.70    | 342.00                 | 16.20    | 432.40                 | 14.10    | 534.60                 | 12.50    | 848.70                 | 9.54     | 1078.6                 | 8.30     | 1371.0                 | 7.21     |
| 137.90                 | 29.80    | 219.00                 | 22.70    | 277.70                 | 19.80    | 353.10                 | 17.20    | 446.30                 | 15.00    | 551.90                 | 13.30    | 876.10                 | 10.10    | 1113.4                 | 8.80     | 1415.2                 | 7.60     |
| 142.20                 | 31.50    | 225.90                 | 24.10    | 286.40                 | 20.90    | 364.10                 | 18.20    | 460.20                 | 15.90    | 569.10                 | 14.00    | 903.40                 | 10.70    | 1148.2                 | 9.31     | 1459.5                 | 8.10     |
| 146.50                 | 33.30    | 232.70                 | 25.40    | 295.00                 | 22.10    | 375.10                 | 19.20    | 474.20                 | 16.80    | 586.40                 | 14.80    | 930.80                 | 11.30    | 1183.0                 | 9.84     | 1503.7                 | 8.60     |
| 150.80                 | 35.10    | 239.50                 | 26.80    | 303.70                 | 23.40    | 386.20                 | 20.30    | 488.10                 | 17.70    | 603.60                 | 15.60    | 958.20                 | 11.90    | 1217.8                 | 10.39    | 1547.9                 | 9.00     |
| 155.10                 | 37.00    | 246.40                 | 28.30    | 312.40                 | 24.60    | 397.20                 | 21.40    | 502.10                 | 18.70    | 620.90                 | 16.50    | 985.60                 | 12.60    | 1252.6                 | 10.94    | 1592.1                 | 9.50     |
| 159.40                 | 39.00    | 253.20                 | 29.70    | 321.10                 | 25.90    | 408.20                 | 22.50    | 516.00                 | 19.60    | 638.10                 | 17.30    | 1012.9                 | 13.20    | 1287.4                 | 11.51    | 1636.4                 | 10.00    |
| 163.70                 | 40.90    | 260.10                 | 31.20    | 329.80                 | 27.20    | 419.20                 | 23.60    | 530.00                 | 20.60    | 655.40                 | 18.20    | 1040.3                 | 13.90    | 1322.2                 | 12.09    | 1680.6                 | 10.50    |
| 168.00                 | 42.90    | 266.90                 | 32.80    | 338.40                 | 28.50    | 430.30                 | 24.80    | 543.90                 | 21.60    | 672.60                 | 19.10    | 1067.7                 | 14.60    | 1357.0                 | 12.69    | 1724.8                 | 11.00    |
| 172.30                 | 45.00    | 273.80                 | 34.30    | 347.10                 | 29.90    | 441.30                 | 26.00    | 557.90                 | 22.70    | 689.80                 | 20.00    | 1095.1                 | 15.30    | 1391.8                 | 13.30    | 1769.0                 | 11.60    |

Shaded values: estimation of recommended water speeds to avoid sedimentation, water hammer, noises, erosion and high values of head loss according to Manning formula.

## Pressure loss tables

## TOM® PVC-O 500 PN25

Pipe head loss is the energy of a hydraulic fluid that is lost along itself due to friction.

Below is the calculation of estimated water speeds depending on the selected pipe for installation.

| INTERNAL<br>DIAMETER | DN90<br>PN25<br>82.2 |        | DN110<br>PN25<br>101.4 |        | DN125<br>PN25<br>115.2 |        | DN140<br>PN25<br>129.2 |       | DN160<br>PN25<br>147.6 |       | DN200<br>PN25<br>184.4 |       | DN225<br>PN25<br>207.4 |       |
|----------------------|----------------------|--------|------------------------|--------|------------------------|--------|------------------------|-------|------------------------|-------|------------------------|-------|------------------------|-------|
| Speed                | Flow                 | J      | Flow                   | J      | Flow                   | J      | Flow                   | J     | Flow                   | J     | Flow                   | J     | Flow                   | J     |
| (m/s)                | l/s                  | m/km   | l/s                    | m/km   | l/s                    | m/km   | l/s                    | m/km  | l/s                    | m/km  | l/s                    | m/km  | l/s                    | m/km  |
| 0.1                  | 0.53                 | 0.16   | 0.81                   | 0.13   | 1.04                   | 0.11   | 1.31                   | 0.10  | 1.71                   | 0.08  | 2.67                   | 0.06  | 3.38                   | 0.06  |
| 0.2                  | 1.06                 | 0.59   | 1.62                   | 0.47   | 2.08                   | 0.40   | 2.62                   | 0.35  | 3.42                   | 0.30  | 5.34                   | 0.23  | 6.76                   | 0.20  |
| 0.3                  | 1.59                 | 1.26   | 2.42                   | 0.99   | 3.13                   | 0.85   | 3.93                   | 0.74  | 5.13                   | 0.64  | 8.00                   | 0.49  | 10.10                  | 0.43  |
| 0.4                  | 2.12                 | 2.15   | 3.23                   | 1.68   | 4.17                   | 1.45   | 5.24                   | 1.27  | 6.84                   | 1.08  | 10.70                  | 0.84  | 13.50                  | 0.73  |
| 0.5                  | 2.65                 | 3.25   | 4.04                   | 2.54   | 5.21                   | 2.19   | 6.56                   | 1.92  | 8.56                   | 1.64  | 13.40                  | 1.26  | 16.90                  | 1.10  |
| 0.6                  | 3.18                 | 4.55   | 4.85                   | 3.56   | 6.25                   | 3.07   | 7.87                   | 2.68  | 10.30                  | 2.30  | 16.00                  | 1.77  | 20.30                  | 1.55  |
| 0.7                  | 3.71                 | 6.05   | 5.65                   | 4.74   | 7.30                   | 4.08   | 9.18                   | 3.57  | 12.00                  | 3.06  | 18.70                  | 2.36  | 23.60                  | 2.06  |
| 0.8                  | 4.25                 | 7.75   | 6.46                   | 6.07   | 8.34                   | 5.23   | 10.50                  | 4.57  | 13.70                  | 3.91  | 21.40                  | 3.02  | 27.00                  | 2.63  |
| 0.9                  | 4.78                 | 9.64   | 7.27                   | 7.55   | 9.38                   | 6.50   | 11.80                  | 5.69  | 15.40                  | 4.87  | 24.00                  | 3.76  | 30.40                  | 3.27  |
| 1.0                  | 5.31                 | 11.72  | 8.08                   | 9.17   | 10.42                  | 7.90   | 13.10                  | 6.91  | 17.10                  | 5.92  | 26.70                  | 4.56  | 33.80                  | 3.98  |
| 1.1                  | 5.84                 | 14.00  | 8.88                   | 10.90  | 11.47                  | 9.40   | 14.40                  | 8.25  | 18.80                  | 7.06  | 29.40                  | 5.45  | 37.20                  | 4.75  |
| 1.2                  | 6.40                 | 16.40  | 9.70                   | 12.90  | 12.50                  | 11.10  | 15.70                  | 9.69  | 20.50                  | 8.30  | 32.00                  | 6.40  | 40.50                  | 5.58  |
| 1.3                  | 6.90                 | 19.00  | 10.50                  | 14.90  | 13.50                  | 12.80  | 17.00                  | 11.20 | 22.20                  | 9.62  | 34.70                  | 7.42  | 43.90                  | 6.47  |
| 1.4                  | 7.40                 | 21.90  | 11.30                  | 17.10  | 14.60                  | 14.70  | 18.40                  | 12.90 | 24.00                  | 11.00 | 37.40                  | 8.51  | 47.30                  | 7.42  |
| 1.5                  | 8.00                 | 24.80  | 12.10                  | 19.40  | 15.60                  | 16.70  | 19.70                  | 14.60 | 25.70                  | 12.50 | 40.10                  | 9.67  | 50.70                  | 8.43  |
| 1.6                  | 8.50                 | 28.00  | 12.90                  | 21.90  | 16.70                  | 18.90  | 21.00                  | 16.50 | 27.40                  | 14.10 | 42.70                  | 10.90 | 54.10                  | 9.50  |
| 1.7                  | 9.00                 | 31.30  | 13.70                  | 24.50  | 17.70                  | 21.10  | 22.30                  | 18.50 | 29.10                  | 15.80 | 45.40                  | 12.20 | 57.40                  | 10.63 |
| 1.8                  | 9.60                 | 34.80  | 14.50                  | 27.20  | 18.80                  | 23.50  | 23.60                  | 20.50 | 30.80                  | 17.60 | 48.10                  | 13.60 | 60.80                  | 11.80 |
| 1.9                  | 10.10                | 38.50  | 15.30                  | 30.10  | 19.80                  | 25.90  | 24.90                  | 22.70 | 32.50                  | 19.40 | 50.70                  | 15.00 | 64.20                  | 13.10 |
| 2.0                  | 10.60                | 42.30  | 16.20                  | 33.10  | 20.80                  | 28.50  | 26.20                  | 25.00 | 34.20                  | 21.40 | 53.40                  | 16.50 | 67.60                  | 14.40 |
| 2.1                  | 11.10                | 46.30  | 17.00                  | 36.20  | 21.90                  | 31.20  | 27.50                  | 27.30 | 35.90                  | 23.40 | 56.10                  | 18.00 | 70.90                  | 15.70 |
| 2.2                  | 11.70                | 50.50  | 17.80                  | 39.50  | 22.90                  | 34.00  | 28.80                  | 29.80 | 37.60                  | 25.50 | 58.80                  | 19.70 | 74.30                  | 17.10 |
| 2.3                  | 12.20                | 54.80  | 18.60                  | 42.90  | 24.00                  | 37.00  | 30.20                  | 32.30 | 39.40                  | 27.70 | 61.40                  | 21.30 | 77.70                  | 18.60 |
| 2.4                  | 12.70                | 59.30  | 19.40                  | 46.40  | 25.00                  | 40.00  | 31.50                  | 35.00 | 41.10                  | 29.90 | 64.10                  | 23.10 | 81.10                  | 20.10 |
| 2.5                  | 13.30                | 64.00  | 20.20                  | 50.10  | 26.10                  | 43.10  | 32.80                  | 37.70 | 42.80                  | 32.30 | 66.80                  | 24.90 | 84.50                  | 21.70 |
| 2.6                  | 13.80                | 68.80  | 21.00                  | 53.80  | 27.10                  | 46.40  | 34.10                  | 40.60 | 44.50                  | 34.70 | 69.40                  | 26.80 | 87.80                  | 23.40 |
| 2.7                  | 14.30                | 73.70  | 21.80                  | 57.70  | 28.10                  | 49.70  | 35.40                  | 43.50 | 46.20                  | 37.20 | 72.10                  | 28.70 | 91.20                  | 25.00 |
| 2.8                  | 14.90                | 78.90  | 22.60                  | 61.70  | 29.20                  | 53.20  | 36.70                  | 46.50 | 47.90                  | 39.80 | 74.80                  | 30.70 | 94.60                  | 26.80 |
| 2.9                  | 15.40                | 84.20  | 23.40                  | 65.90  | 30.20                  | 56.80  | 38.00                  | 49.70 | 49.60                  | 42.50 | 77.40                  | 32.80 | 98.00                  | 28.60 |
| 3.0                  | 15.90                | 89.60  | 24.20                  | 70.20  | 31.30                  | 60.50  | 39.30                  | 52.90 | 51.30                  | 45.30 | 80.10                  | 34.90 | 101.4                  | 30.40 |
| 3.1                  | 16.50                | 95.30  | 25.00                  | 74.60  | 32.30                  | 64.20  | 40.60                  | 56.20 | 53.00                  | 48.10 | 82.80                  | 37.10 | 104.70                 | 32.30 |
| 3.2                  | 17.00                | 101.00 | 25.80                  | 79.10  | 33.40                  | 68.10  | 42.00                  | 59.60 | 54.80                  | 51.00 | 85.50                  | 39.30 | 108.10                 | 34.30 |
| 3.3                  | 17.50                | 106.90 | 26.60                  | 83.70  | 34.40                  | 72.10  | 43.30                  | 63.10 | 56.50                  | 54.00 | 88.10                  | 41.70 | 111.50                 | 36.30 |
| 3.4                  | 18.00                | 113.00 | 27.50                  | 88.50  | 35.40                  | 76.20  | 44.60                  | 66.70 | 58.20                  | 57.10 | 90.80                  | 44.00 | 114.90                 | 38.40 |
| 3.5                  | 18.60                | 119.30 | 28.30                  | 93.30  | 36.50                  | 80.40  | 45.90                  | 70.40 | 59.90                  | 60.20 | 93.50                  | 46.50 | 118.20                 | 40.50 |
| 3.6                  | 19.10                | 125.60 | 29.10                  | 98.30  | 37.50                  | 84.70  | 47.20                  | 74.10 | 61.60                  | 63.50 | 96.10                  | 48.90 | 121.60                 | 42.70 |
| 3.7                  | 19.60                | 132.20 | 29.90                  | 103.50 | 38.60                  | 89.20  | 48.50                  | 78.00 | 63.30                  | 66.80 | 98.80                  | 51.50 | 125.00                 | 44.90 |
| 3.8                  | 20.20                | 138.90 | 30.70                  | 108.70 | 39.60                  | 93.70  | 49.80                  | 81.90 | 65.00                  | 70.10 | 101.50                 | 54.10 | 128.40                 | 47.20 |
| 3.9                  | 20.70                | 145.70 | 31.50                  | 114.10 | 40.60                  | 98.30  | 51.10                  | 86.00 | 66.70                  | 73.60 | 104.20                 | 56.80 | 131.80                 | 49.50 |
| 4.0                  | 21.20                | 152.70 | 32.30                  | 119.50 | 41.70                  | 103.00 | 52.40                  | 90.10 | 68.40                  | 77.10 | 106.80                 | 59.50 | 135.10                 | 51.90 |

Shaded values: estimation of recommended water speeds to avoid sedimentation, water hammer, noises, erosion and high values of head loss according to Manning formula.

## TOM® PVC-O 500 PN25

Pipe head loss is the energy of a hydraulic fluid that is lost along itself due to friction.

Below is the calculation of estimated water speeds depending on the selected pipe for installation.

| DN250<br>PN25<br>230.6 |          | DN315<br>PN25<br>290.6 |          | DN355<br>PN25<br>327.2 |          | DN400<br>PN25<br>369.0 |          | DN450<br>PN25<br>415.0 |          | DN500<br>PN25<br>461.2 |          | DN630<br>PN25<br>581.0 |          | DN710<br>PN25<br>654.6 |          | DN800<br>PN25<br>737.8 |          |
|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|------------------------|----------|
| Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        | Flow                   | J        |
| l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km | l/s                    | m/<br>km |
| 4.18                   | 0.05     | 6.63                   | 0.04     | 8.41                   | 0.03     | 10.70                  | 0.03     | 13.50                  | 0.02     | 16.70                  | 0.02     | 26.50                  | 0.02     | 33.65                  | 0.01     | 42.80                  | 0.01     |
| 8.35                   | 0.18     | 13.30                  | 0.14     | 16.80                  | 0.12     | 21.40                  | 0.10     | 27.10                  | 0.09     | 33.40                  | 0.08     | 53.00                  | 0.06     | 67.31                  | 0.05     | 85.50                  | 0.05     |
| 12.50                  | 0.38     | 19.90                  | 0.29     | 25.20                  | 0.25     | 32.10                  | 0.22     | 40.60                  | 0.19     | 50.10                  | 0.17     | 79.50                  | 0.13     | 100.96                 | 0.11     | 128.30                 | 0.10     |
| 16.70                  | 0.64     | 26.50                  | 0.49     | 33.60                  | 0.43     | 42.80                  | 0.37     | 54.10                  | 0.32     | 66.80                  | 0.29     | 106.00                 | 0.22     | 134.62                 | 0.19     | 171.00                 | 0.17     |
| 20.90                  | 0.97     | 33.20                  | 0.74     | 42.00                  | 0.65     | 53.50                  | 0.56     | 67.60                  | 0.49     | 83.50                  | 0.43     | 132.60                 | 0.33     | 168.27                 | 0.29     | 213.80                 | 0.25     |
| 25.10                  | 1.37     | 39.80                  | 1.04     | 50.50                  | 0.91     | 64.20                  | 0.79     | 81.20                  | 0.69     | 100.20                 | 0.61     | 159.10                 | 0.46     | 201.93                 | 0.40     | 256.50                 | 0.35     |
| 29.20                  | 1.82     | 46.40                  | 1.39     | 58.90                  | 1.21     | 74.90                  | 1.05     | 94.70                  | 0.91     | 116.90                 | 0.81     | 185.60                 | 0.62     | 235.58                 | 0.54     | 299.30                 | 0.47     |
| 33.40                  | 2.33     | 53.10                  | 1.78     | 67.30                  | 1.55     | 85.60                  | 1.34     | 108.20                 | 1.17     | 133.60                 | 1.04     | 212.10                 | 0.79     | 269.24                 | 0.69     | 342.00                 | 0.60     |
| 37.60                  | 2.89     | 59.70                  | 2.21     | 75.70                  | 1.92     | 96.20                  | 1.67     | 121.70                 | 1.46     | 150.40                 | 1.29     | 238.60                 | 0.98     | 302.89                 | 0.86     | 384.80                 | 0.74     |
| 41.80                  | 3.52     | 66.30                  | 2.68     | 84.10                  | 2.34     | 106.90                 | 2.03     | 135.30                 | 1.77     | 167.10                 | 1.57     | 265.10                 | 1.20     | 336.54                 | 1.04     | 427.50                 | 0.90     |
| 45.90                  | 4.19     | 73.00                  | 3.20     | 92.50                  | 2.79     | 117.60                 | 2.42     | 148.80                 | 2.11     | 183.80                 | 1.87     | 291.60                 | 1.43     | 370.20                 | 1.24     | 470.30                 | 1.08     |
| 50.10                  | 4.93     | 79.60                  | 3.76     | 100.90                 | 3.28     | 128.30                 | 2.85     | 162.30                 | 2.48     | 200.50                 | 2.19     | 318.10                 | 1.68     | 403.85                 | 1.46     | 513.00                 | 1.27     |
| 54.30                  | 5.72     | 86.20                  | 4.36     | 109.30                 | 3.80     | 139.00                 | 3.30     | 175.80                 | 2.88     | 217.20                 | 2.55     | 344.70                 | 1.94     | 437.51                 | 1.69     | 555.80                 | 1.47     |
| 58.50                  | 6.56     | 92.90                  | 5.01     | 117.70                 | 4.36     | 149.70                 | 3.79     | 189.40                 | 3.30     | 233.90                 | 2.92     | 371.20                 | 2.23     | 471.16                 | 1.94     | 598.50                 | 1.69     |
| 62.60                  | 7.45     | 99.50                  | 5.69     | 126.10                 | 4.95     | 160.40                 | 4.30     | 202.90                 | 3.75     | 250.60                 | 3.32     | 397.70                 | 2.53     | 504.82                 | 2.20     | 641.30                 | 1.92     |
| 66.80                  | 8.40     | 106.10                 | 6.41     | 134.50                 | 5.58     | 171.10                 | 4.85     | 216.40                 | 4.23     | 267.30                 | 3.74     | 424.20                 | 2.86     | 538.47                 | 2.48     | 684.00                 | 2.16     |
| 71.00                  | 9.39     | 112.80                 | 7.17     | 142.90                 | 6.24     | 181.80                 | 5.43     | 230.00                 | 4.73     | 284.00                 | 4.18     | 450.70                 | 3.20     | 572.12                 | 2.78     | 726.80                 | 2.42     |
| 75.20                  | 10.40    | 119.40                 | 7.97     | 151.40                 | 6.94     | 192.50                 | 6.03     | 243.50                 | 5.26     | 300.70                 | 4.65     | 477.20                 | 3.55     | 605.78                 | 3.09     | 769.60                 | 2.69     |
| 79.40                  | 11.50    | 126.00                 | 8.81     | 159.80                 | 7.67     | 203.20                 | 6.67     | 257.00                 | 5.81     | 317.40                 | 5.14     | 503.70                 | 3.93     | 639.43                 | 3.42     | 812.30                 | 2.97     |
| 83.50                  | 12.70    | 132.70                 | 9.69     | 168.20                 | 8.44     | 213.90                 | 7.33     | 270.50                 | 6.39     | 334.10                 | 5.65     | 530.20                 | 4.32     | 673.09                 | 3.76     | 855.10                 | 3.27     |
| 87.70                  | 13.90    | 139.30                 | 10.60    | 176.60                 | 9.24     | 224.60                 | 8.03     | 284.10                 | 7.00     | 350.80                 | 6.19     | 556.80                 | 4.73     | 706.74                 | 4.11     | 897.80                 | 3.58     |
| 91.90                  | 15.10    | 145.90                 | 11.60    | 185.00                 | 10.07    | 235.30                 | 8.75     | 297.60                 | 7.63     | 367.50                 | 6.74     | 583.30                 | 5.15     | 740.40                 | 4.48     | 940.60                 | 3.90     |
| 96.10                  | 16.40    | 152.50                 | 12.60    | 193.40                 | 10.90    | 246.00                 | 9.50     | 311.10                 | 8.28     | 384.20                 | 7.32     | 609.80                 | 5.59     | 774.05                 | 4.87     | 983.30                 | 4.23     |
| 100.20                 | 17.80    | 159.20                 | 13.60    | 201.80                 | 11.80    | 256.70                 | 10.28    | 324.60                 | 8.96     | 400.90                 | 7.92     | 636.30                 | 6.05     | 807.71                 | 5.27     | 1026.1                 | 4.58     |
| 104.40                 | 19.20    | 165.80                 | 14.70    | 210.20                 | 12.80    | 267.40                 | 11.10    | 338.20                 | 9.67     | 417.60                 | 8.55     | 662.80                 | 6.53     | 841.36                 | 5.68     | 1068.8                 | 4.94     |
| 108.60                 | 20.60    | 172.40                 | 15.80    | 218.60                 | 13.70    | 278.00                 | 11.90    | 351.70                 | 10.40    | 434.40                 | 9.19     | 689.30                 | 7.02     | 875.01                 | 6.11     | 1111.6                 | 5.31     |
| 112.80                 | 22.10    | 179.10                 | 16.90    | 227.00                 | 14.70    | 288.70                 | 12.80    | 365.20                 | 11.10    | 451.10                 | 9.85     | 715.80                 | 7.53     | 908.67                 | 6.55     | 1154.3                 | 5.70     |
| 116.90                 | 23.70    | 185.70                 | 18.10    | 235.40                 | 15.70    | 299.40                 | 13.70    | 378.70                 | 11.90    | 467.80                 | 10.50    | 742.30                 | 8.05     | 942.32                 | 7.01     | 1197.1                 | 6.09     |
| 121.10                 | 25.30    | 192.30                 | 19.30    | 243.80                 | 16.80    | 310.10                 | 14.60    | 392.30                 | 12.70    | 484.50                 | 11.20    | 768.80                 | 8.59     | 975.98                 | 7.48     | 1239.8                 | 6.50     |
| 125.30                 | 26.90    | 199.00                 | 20.50    | 252.30                 | 17.90    | 320.80                 | 15.50    | 405.80                 | 13.50    | 501.20                 | 12.00    | 795.40                 | 9.15     | 1009.6                 | 7.96     | 1282.6                 | 6.92     |
| 129.50                 | 28.60    | 205.60                 | 21.80    | 260.70                 | 19.00    | 331.50                 | 16.50    | 419.30                 | 14.40    | 517.90                 | 12.70    | 821.90                 | 9.72     | 1043.3                 | 8.46     | 1325.3                 | 7.36     |
| 133.60                 | 30.30    | 212.20                 | 23.10    | 269.10                 | 20.20    | 342.20                 | 17.50    | 432.80                 | 15.30    | 534.60                 | 13.50    | 848.40                 | 10.30    | 1076.9                 | 8.97     | 1368.1                 | 7.80     |
| 137.80                 | 32.10    | 218.90                 | 24.50    | 277.50                 | 21.30    | 352.90                 | 18.50    | 446.40                 | 16.20    | 551.30                 | 14.30    | 874.90                 | 10.90    | 1110.6                 | 9.50     | 1410.9                 | 8.30     |
| 142.00                 | 33.90    | 225.50                 | 25.90    | 285.90                 | 22.50    | 363.60                 | 19.60    | 459.90                 | 17.10    | 568.00                 | 15.10    | 901.40                 | 11.50    | 1144.2                 | 10.04    | 1453.6                 | 8.70     |
| 146.20                 | 35.80    | 232.10                 | 27.30    | 294.30                 | 23.80    | 374.30                 | 20.70    | 473.40                 | 18.00    | 584.70                 | 15.90    | 927.90                 | 12.20    | 1177.9                 | 10.59    | 1496.4                 | 9.20     |
| 150.40                 | 37.70    | 238.80                 | 28.80    | 302.70                 | 25.10    | 385.00                 | 21.80    | 487.00                 | 19.00    | 601.40                 | 16.80    | 954.40                 | 12.80    | 1211.6                 | 11.16    | 1539.1                 | 9.70     |
| 154.50                 | 39.70    | 245.40                 | 30.30    | 311.10                 | 26.40    | 395.70                 | 22.90    | 500.50                 | 20.00    | 618.10                 | 17.70    | 980.90                 | 13.50    | 1245.2                 | 11.74    | 1581.9                 | 10.20    |
| 158.70                 | 41.70    | 252.00                 | 31.80    | 319.50                 | 27.70    | 406.40                 | 24.10    | 514.00                 | 21.00    | 634.80                 | 18.60    | 1007.5                 | 14.20    | 1278.9                 | 12.33    | 1624.6                 | 10.70    |
| 162.90                 | 43.70    | 258.70                 | 33.40    | 327.90                 | 29.10    | 417.10                 | 25.30    | 527.50                 | 22.00    | 651.50                 | 19.50    | 1034.0                 | 14.90    | 1312.5                 | 12.94    | 1667.4                 | 11.30    |
| 167.10                 | 45.80    | 265.30                 | 35.00    | 336.30                 | 30.50    | 427.80                 | 26.50    | 541.10                 | 23.10    | 668.20                 | 20.40    | 1060.5                 | 15.60    | 1346.2                 | 13.56    | 1710.1                 | 11.80    |

Shaded values: estimation of recommended water speeds to avoid sedimentation, water hammer, noises, erosion and high values of head loss according to Manning formula.

## Water Hammer

To **calculate possible excess pressures** (P) produced by water hammers, the celerity ( $\alpha$ ) must be first determined. It is a characteristic of the pipe and the fluid that it transports, and it evaluates the change in the water speed (V) which can occurs in the valvel openings and closings or for startups or shutdowns of the pump.

$$P = \frac{a \cdot V}{g}; \quad a = \frac{9900}{\sqrt{48,3 + K_c \cdot \frac{D_m}{e}}}; \quad K_c = \frac{10^{10}}{E}$$

TOM® PN16 (230 psi) PIPES

| V   | a   | P (water hammer) |      |
|-----|-----|------------------|------|
| m/s | m/s | m                | bar  |
| 0.5 | 293 | 15               | 1.5  |
| 1.0 | 293 | 30               | 3.0  |
| 1.5 | 293 | 45               | 4.5  |
| 2.0 | 293 | 60               | 6.0  |
| 2.5 | 293 | 75               | 7.5  |
| 3.0 | 293 | 90               | 9.0  |
| 3.5 | 293 | 105              | 10.5 |
| 4.0 | 293 | 119              | 11.9 |

K9 DUCTILE IRON PIPES

| V   | a    | P (water hammer) |      |
|-----|------|------------------|------|
| m/s | m/s  | m                | bar  |
| 0.5 | 1100 | 56               | 5.6  |
| 1.0 | 1100 | 112              | 11.2 |
| 1.5 | 1100 | 168              | 16.8 |
| 2.0 | 1100 | 224              | 22.4 |
| 2.5 | 1100 | 280              | 28.0 |
| 3.0 | 1100 | 336              | 33.6 |
| 3.5 | 1100 | 392              | 39.2 |
| 4.0 | 1100 | 449              | 44.9 |

Air locks in the pipes during filling can be highly damaging when water hammers arise and can cause excess pressure far beyond the levels established in the tables above. Thus it is important to follow the following **recommendations**:

- **Filling the pipe** should only be carried out at low speed (approximately 0.05 m/s) and at the lowest point in the pipe system.
- **When installing purging mechanisms** (double effect suction mechanisms) at the highest points on each section of pipe.
- During filling it is important to leave opened the elements capable of **evacuating air** (valves), and close them from bottom to top in the pipe as the pipe fills up with water.

## Reduction ratios: Temperature and Application

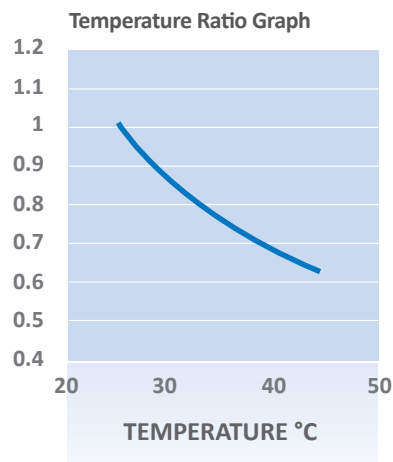
High temperatures (over 25 °C) or demanding or aggressive applications can reduce Allowable Operating Pressure (**PFA**) of pipes in comparison to the Nominal Pressure (**NP**).

$$PFA = PN \cdot f_T \cdot f_A$$

The derating factor ( $f_T$ ) as function of operating temperature can be obtained from the graph on the right.

The derating factor related to application of the system ( $f_A$ ) must be determined by the Project Manager.

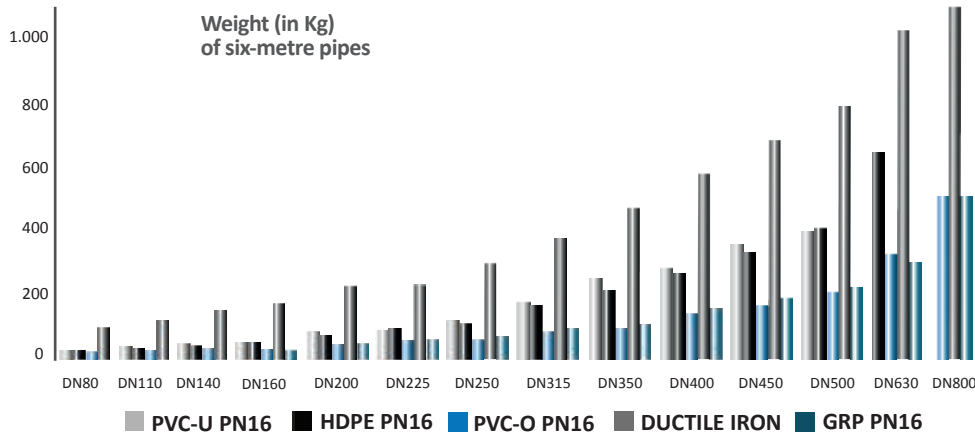
Note: Project design and execution is responsibility of the Project Manager and the Contractor, respectively.





## Quick, low-priced installation

- TOM® PVC-O pipes are less than half PVC and HDPE pipes weight:** between six and twelve times less per linear metre than ductile iron pipes of the same nominal external diameter. Due to their lightness, **they can be lifted without mechanical assistance** (cranes, hoists, etc), up to a diameter of DN315 mm, which brings down the overall cost of installation.



Because TOM® pipes have a high resistance, they offer considerable **advantages in terms of unloading, installation in trenches and pipe-to-pipe connection**. Moreover, these pipes are so easy to connect to one another that they offer very high performance: they can be handled and installed by lower-qualified workers and without machinery (up to DN 315).

For all these reasons **TOM® pipes offer huge advantages in terms of installation in metres/installation-hours** compared to other solutions.

## Transport and Storage

- TOM® pipes characteristics make them easy to transport and store,** which means considerable savings in costs.

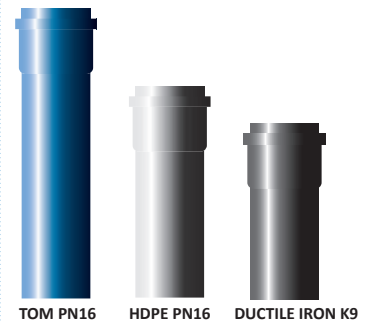
**To optimize transport,** it is advisable to stick to the following guidelines:

- If different diameters are going to be transported in the same batch, the biggest diameters must be placed below.
- Leave the sockets free, alternating sockets and free ends.

**To avoid damaging pipes in storage,** it is advisable to:

- Store the pipes horizontally on a flat surface, on supports spaced 1.5 metres apart, to keep the pipes from bowing.
- Do not stack higher than 1.5 metres.
- Leave the sockets free, alternating sockets and free ends.
- If the pipes are stored in direct sunlight, cover the pallets with opaque material and with ventilation to prevent overheating.

Installation  
performance (m/hour)



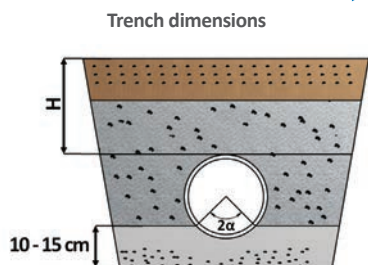
Figures for DN 200-250 mm

Installation  
Costs (euro/m)



Figures for DN 200-250 mm





## Excavation

- Although other types of applications are possible, **TOM® pipes are particularly recommended for underground installation**. The dimensions of the trench will depend on the loads to which pipes will be submitted (road traffic, soil types, etc). As a rule of thumb, when there is no road traffic involved, the pipes' crown will be at a minimum depth of 0.6 metres (60 cm); with road traffic, the minimum depth is 1 metre.

The **minimum width of the trench** can be calculated using the following tables:

| DN (mm) | Minimum with of trench B (m) |
|---------|------------------------------|
| 90-250  | 0.60                         |
| 315     | 0.85                         |
| 355     | 1.10                         |
| 400     | 1.10                         |
| 450     | 1.15                         |
| 500     | 1.20                         |
| 630     | 1.35                         |
| 710     | 1.60                         |
| 800     | 1.65                         |

| Depth of trench H (m) | Minimum with of trench B (m) |
|-----------------------|------------------------------|
| H < 1,00              | 0.60                         |
| 1,00 < H < 1,75       | 0.80                         |
| 1,75 < H < 4,00       | 0.90                         |
| H > 4,00              | 1.00                         |

The **bottom of the trench** should be homogeneous, uniform and ensure a solid support along the entire length of the pipe.

## Assembly

- Checks must be made to **ensure that joints are clean** both inside the pipe and outside.
- To facilitate assembly, it is advisable to **lubricate the sockets and free ends using lubricating soap**.
- Align the pipe-ends** and slot the sockets into place.
- Pipes can be slotted into one another** using levers (use only materials that will not damage the pipes, e.g. wood), or slings. With small diameters, however, owing to the elastic joint system and the lightness of the pipe, a short, sharp movement of the hand is enough to couple the pipes.

## Angular Deviation

- Angular deviations in the union system are allowed. This means that the piping can be channeled following a desired line.

| DN (mm) | Maximum angular deviation Angle (°) | Displacement between sockets D (mm) <sup>(1)</sup> |
|---------|-------------------------------------|--|
| 90-800  | 2°                                  | 200  |

(1) Pipes not exceeding 5.95 metres in length.



## Anchoring

- Pipes that are subjected to internal hydrostatic pressure are also subjected to thrust forces at every point of change of direction (angular deviation of the pipe, elbows, curves, etc) and in parts and components that increase or reduce the pipe's cross-section, such as valves, branches, overflows, etc.

These forces can be extremely strong and are even capable of moving the ground, causing pipes to uncouple. In general terms, the thrust forces can be gauged using the following formula:

$$\text{Force(kg)} = k \cdot \text{Pressure (bars)} \cdot \text{Pipe Cross-Section (cm}^2\text{)}$$

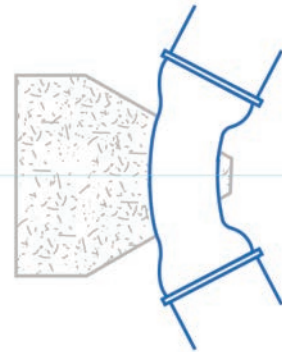
$$\text{In caps and tees at 90°: } k=1$$

$$\text{In reducers: } k=1 - = \frac{\text{Smallest cross-section}}{\text{Biggest cross-section}}$$

$$\text{In changes of direction: } k=2 \cdot \sin \frac{\beta}{2}$$

It is important to ensure that the concrete is poured directly into the previously positioned ground and that it has the required mechanical resistance. When designing the anchoring, bear in mind that **the joints must be left free** to enable its subsequent inspection during hydraulic trials.

◀ Anchoring at points of change of direction



## Bedding and Filling the Trench

- To analyze the optimal and most efficient way for the preparation of bedding on which to settle the pipe and the subsequent filling and compacting the ground on the sides and top of the pipe, see our installation instructions or contact with our technical and commercial service.

## Fields trials and Entry into Service

- The **EN 805:2000 Water Supply Standard** is applicable to all aspects of on-site trials and Entry into Service. During installation, it is important to carry out trials on the lengths of completely laid pipeline (the length can vary between 500 and 1,000 metres). The ends of each length of pipeline will be sealed off using the appropriate components, and the pipeline must be partly filled with the joints in full view.

The trial pressure (STP) in N/mm<sup>2</sup> (0.1 N/mm<sup>2</sup> = 1 atm) will be as follows:

- If the water hammer has been calculated precisely: STP = MDP + 0.1
- If the water hammer is estimated, use the lesser of the following two values: STP = MDP + 0.5 and STP = 1.5 · MDP

MDP is the Maximum Design Pressure, i.e. the maximum allowable pressure in a pipe, including the effect of a water hammer.

The Entry into Service of piping for drinking water must comply with the required health standards for water for human consumption.

## Certificates

Quality System Certification according to UNE-EN ISO 9001:2015.



AENOR Product certification according to UNE ISO 16422:2015. Mark.



AFNOR Product certification according to NF T 54-948:2010. Mark.



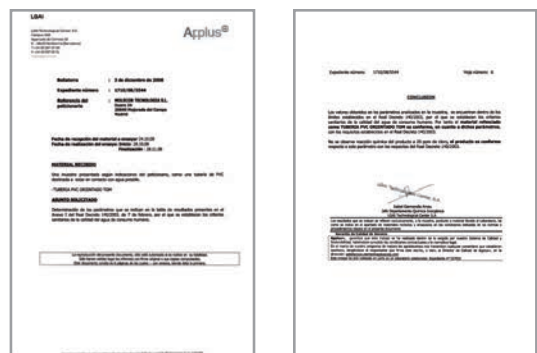
Attestation de Conformité Sanitaire (ACS) according to French legislation.



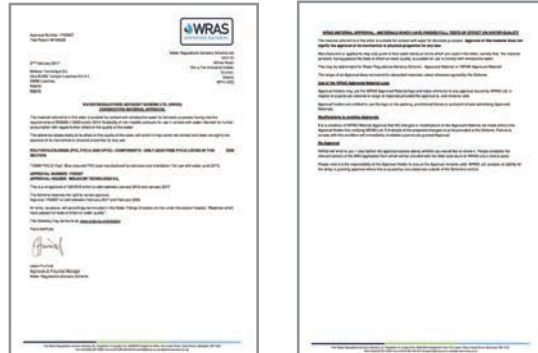
Sanitary certificate HYDROCHECK (Belgium)



Approval test of RD 140/2003 “Criterios Sanitarios de la calidad del agua de consumo humano” (Sanitary Criteria for human water quality consumption).



Water Regulations advisory scheme (WRAS) Material approval - materials which have passed full tests of effect on water quality.






## Notes

Handwriting practice lines consisting of multiple horizontal dotted lines. A large, faint, stylized circular logo is visible in the bottom right corner of the page.

## Notes



A series of horizontal dotted lines for writing notes.



ics, as well as the data grid and figures included in this document  
reserves the right to modify the characteristics of its products  
gies and the current legislation in order to have a continuous  
hout prior notice.



Ctra. M-206 Torrejón - Loeches Km 3.1  
28890 Loeches  
Madrid - Spain  
Phone: +34 911 337 088  
Fax: +34 902 106 273  
e-mail: [canalizaciones@molecor.com](mailto:canalizaciones@molecor.com)  
[www.molecor.com](http://www.molecor.com)

