The Genuine Air Technology to achieve the most of PVC-O pipes

Pushing limits beyond
Molecor, your partner for success in Molecular Orientation

Molecor is a leader company specialized in the development of the latest technology applying Molecular Orientation to pipeline solutions with astonishing mechanical properties. It was founded in 2006 by highly skilled engineers in this field with a proven experience in the plastic pipe division. Molecor’s revolutionary process provides reliable and user friendly system that widen the pipe global business possibilities.

Our mission: Generating wealth in our environment making technology available to the market.

Our vision: Being a world leader in the development and application of technologies for the plastics processing industry.

Our values:
- Commitment to human capital (talent, effort and results)
- Equality opportunities
- Commitment to technological development
- Transparency, loyalty and trust
- Commitment to environmental protection

Know-How

Molecor, specialized in the water under pressure sector, is not just a machine manufacturer or engineering company, but a pipe producer too. Currently it manufactures the widest range of product in PVC-O: pipes from DN90 mm up to DN800 mm and from 12,5 up to 25 bars. Furthermore, it is preparing the field for the next development: DN1200 mm pipe.

Research & Development

Molecor invests in R&D, intellectual property, as well as in human resources. Machine design, flow mechanics, heat transfer, materials and electronics are disciplines well covered at Molecor with its specialists. In addition to its valuable workforce, Molecor uses advanced and sophisticated design and calculus tools to provide always the latest and most advanced solutions. Molecor is a pioneer company specialized in the development of the latest technology applying Molecular Orientation to pipeline solutions with astonishing mechanical properties.

100% Specialization

Molecor is exclusively dedicated to the development of the Molecular Orientation technology applied to PVC and develops highly efficient solutions for the conveyance of water under pressure.

Exclusive products

Thanks to its worldwide unique technology, Molecor has exclusive products available to the market. Among them we can find the Integrated Seal System (ISS+), a 100% automatic system that inserts the gasket inside the socket, ensuring a perfect setting and achieving significant cost savings in manpower and maintenance. Besides this, we can highlight a wide range of products with pipes of up to DN800 mm and the development of the PVC-O fittings: ecoFITTOM®.
Molecular Orientation, the PVC revolution

Molecular structure is the main feature that confers its mechanical properties to the PVC. PVC is a polymer which presents an amorphous molecular structure, where chains are arranged at random directions.

However, when stretching the material and under certain conditions of pressure, temperature and speed, the polymer molecules are aligned in the same direction as the stretching, resulting in a laminar structure.

The result: the highest properties & the lowest costs

The process of Molecular Orientation greatly enhances the PVC physical and mechanical properties, maintaining the original polymer advantages. It becomes an unbeatable plastic in terms of strength, impact resistance and flexibility without altering its chemical properties.

When applied to high pressure pipelines, they are very resistant and have an extremely long life expectancy. Besides, the pipe is highly energy-efficient and environmentally friendly during all its useful life because of the considerable savings in raw material and also the ease of installation.
Hoop and axial orientation

The orientation degree defines the PVC-O class. The higher the class, the greater the orientation degree and the better mechanical properties achieved. The class is evaluated according to the long term hydrostatic strength test. The orientation is produced in the stretching direction. Molecor’s Technology system enables to attain orientation both in the hoop and axial directions, obtaining complementary benefits.

Hoop orientation confers excellent qualities such as impact resistance and internal pressure resistance.

Axial orientation is particularly relevant in the socket, where axial strains could be produced.

Long term hydrostatic resistance

Pipes are subjected to the internal pressure produced by the fluid circulation over a long period of time. The evolution in time of the material strength is known as creep, and appears to a far lesser extent in PVC-O Class 500 than in conventional plastics, which means better long term performance. PVC-O Class 500 is the highest class recognized by the International Standard ISO 16422, presenting the best mechanical properties.
Excellent short term performance

PVC-O Class 500 pipes have a very different stress-strain curve when compared to other plastics and come very close to the curve of metals. The mechanical properties of PVC-O improve as the so called “creep valley” disappears. This phenomenon can only be achieved with the highest degree of orientation, Class 500.

Molecular Orientation increases the PVC-U pipe’s mechanical properties, obtaining a much more resistant and flexible pipe. Impact resistance, no crack propagation and fatigue resistance, among other properties, are greatly enhanced without altering the chemical properties.
Unbeatable impact resistance

PVC-O Class 500 pipes are not easily destroyed by regular impacts. The risk of bursting during installation due to stone dropping or impact is minimal. The layered structure achieved with the Molecular Orientation process keeps from crack propagation and scratches.

No crack propagation

The layered structure achieved with the Molecular Orientation process is the main feature which prevents from crack propagation along the pipe wall thickness. During the installation, scratches caused by stones on the site might be produced. When cracks appear, they progress through the amorphous wall structure. In PVC-O Class 500 pipes, these cracks remain on the first layers, not affecting the pipe’s properties at all.

Absence of RCP

The phenomenon of rapid crack propagation (RCP) can take place under certain conditions of temperature and pressure. Brittle cracks can propagate along the pipe wall in the axial direction at a speed of 100 to 400 meters/second. The energy needed for this fast propagation is supplied by the fluid under pressure within the pipe. This phenomenon, very common in some pipes, is minimized in PVC-O pipes due to the material’s nature.

High short and long term hydrostatic resistance

PVC-O Class 500 pipes offer a resistance to internal pressure up to two times the nominal pressure, which means that they can bear a sporadic excess of pressure such as water hammers in the network.

The durability of the pipe working at nominal pressure is ensured thanks to the low material creep behavior for over a hundred years.
PVC-O 500 PIPES

Increased hydraulic capacity

PVC-O Class 500 widens the pipe’s internal diameter and flow section. Besides, the perfect finishing on the internal surface makes it extremely smooth, minimizing load loss and making it more difficult for deposits to be formed on the inner walls. As a result, PVC-O Class 500 pipes offer between 15% - 40% more hydraulic capacity than pipes made from other materials (PVC-U, HDPE, ductile iron) with the same external dimensions.

Maximum ductility

PVC-O Class 500 pipes can bear big deformations of their internal diameter thanks to their excellent elasticity. When crushed, or in the event of a mechanical accident, they immediately recover their original shape, thus eliminating the risk of potential breakage by soil subsidence or sharp edges on rocks or machinery.

Excellent behaviour to extreme working temperatures

HOT: up to 45˚ C
COLD: down to -40˚ C

In general, the plastics capacity to absorb impacts is very much more related to temperature. Below -10˚C, plastics can present a brittle behavior which makes them inappropriate for cold climates. PVC-O Class 500 does not present significant variations in its capacity to absorb impacts even in the most extreme cold areas of the world.

UV Radiation

UV radiation promotes micro cracks on the PVC-U surface and another plastic pipes exposed to sunlight over a long period of time. These cracks propagate through the plastic pipe’s wall thickness. PVC-O pipes’ layered structure blocks them, so they remain on the external layer. That is why the pipe’s behavior is not affected. Tests carried out with PVC-O pipes exposed to sunlight during a period of more than a year have shown an equivalent response than those non exposed to UV.

Corrosion resistance

PVC-O Class 500 is immune to the corrosion caused by natural substances in the soil or agricultural chemicals. Therefore, it is not degradable and does not require any special protection or coating solution, which is translated into cost savings. The quality of the conveyed fluid remains always unaltered, since there is neither corrosion of the material nor migration within the pipes or on their coating. Mandatory tests show compliance with the required health standards for water human consumption.
**Molecor: TOM®**

TOM® is the registered trade mark for Molecor PVC-O Class 500 pipe. Due to the outstanding properties of these pipes, Molecor has become, within a brief period of time, a referent in the water sector, mainly Spain and France. Molecor manufacturing plant follows an Integrated Quality and Environment Management System based on the UNE-EN ISO 9001 and UNE-EN ISO 14001 standards, for the “Manufacture of PVC-O Pipes for conveyance of fluids under pressure.” TOM® PVC-O pipes are manufactured according to the Spanish Standard UNE-ISO 16422:2015 and the French Standard AFNOR NF T54-948:2010.

**Lower installation costs**

PVC-O 500 pipes are lighter and easier to handle than pipes made of other materials. In fact, no machinery is required to handle pipes up to DN315 mm. Indeed, easy-handling, better performance and installation speed compared to other kind of pipes contributes to installation cost savings.

**Lighter pipe: easy to handle, fast to connect**

PVC-O Class 500 pipes weight less than half the usual weight of PVC and HDPE, and are between six and twelve times lighter than ductile iron pipes of the same diameter. They are easy to handle and they can be lifted without mechanical assistance (for pipes up to DN315 mm). During the installation process, the connections between pipes are faster and there is no need for welded unions thanks to the pipe’s design and the PVC-O Class 500 properties. Besides, due to the PVC-O Class 500 toughness, the scratches caused by impacts are minimal and the pipes present many advantages when unloading and burying.
Applications

SUPPLYING (blue TOM®)
Conduits for potable water transport. It includes water extraction, water distribution network to city centers and industrial areas, and water transfer to tanks and reservoirs.

IRRIGATION (blue TOM®)
Water transport pipes for irrigation purposes. It includes irrigation land pipelines, water transfer to tanks and reservoirs.

RECLAIMED WATER (purple TOM®)
Pipelines for the transport of water that has been treated to remove impurities.

OTHER APPLICATIONS
• Sewage
• Fire Protection Nets
• Industrial Applications
• Infrastructural Nets

Fittings

TOM® pipes are compatible with all kinds of ductile iron fittings (T, elbows, etc) saddles and flanges.

Tapping saddles allow connecting the pipe in the perpendicular direction to all kinds of fittings, being available with screw ends and flange ends.

Fittings with euro type plugs are connected directly to the pipe allowing for deviations, reductions and connections on the net.

Flanges with anti-traction system allow connecting the spigot ends to all kinds of fittings with connection to a flange.

Certifications

PVC-O pipes manufactured with Molecor Technology are certified according to the following standards:

UNE-ISO 16422
NF T54.948
NF Mark * (France)
AS/NZS 4441
SAI GLOBAL Mark (Australia)
SANS 16422
(North Africa)
ISO 16422
INEN mark (Ecuador)
NTC 5425
ICONTEC mark (Colombia)
ISO 16422
SIRIM mark (Malaysia)
GOST R 56927
PGCT P 56927 (Russia)

* NF Mark for the range of products DN90-315, DN400 and DN500 mm PN16, DN110-315, DN400 and DN500 mm PN25.
Updated information and details can be downloaded from www.molecor.com
The most eco-friendly solution for water transportation

The environmental impact of a piping system depends on its composition and the application thereof, being the kind of material used, the manufacturing process, the high quality of the finished product and its useful life, the main factors that determine the efficiency and sustainability throughout all its life cycle.

Class 500 TOM® PVC-O Pipes are the most ecological solution in the market, as many worldwide studies has demonstrated, due to their better contribution to correct sustainable development of the planet, presenting environmental advantages during all their lifecycle.

Efficiency in resources

Embodied energy is defined as the non-renewable energy consumed in all the activities associated to the pipe’s lifecycle. This lifecycle includes raw material extraction, manufacture, installation and other supporting functions, such as transport.

The exceptional mechanical properties allow very important savings in raw materials. Only 43% of PVC composition depends on oil. Therefore, the consumption required of this resource for manufacturing is lower compared to other plastic solutions.

The energy consumption required by the Molecor Technology is not only lower than the required by pipes made of other materials, but also compared to the required by other PVC-O pipe’s production processes. The lower consumption of raw materials results in energy savings during the extraction and the material production. It is also a key factor during conveyance and installation: their lower weigh makes the installation process quicker and easier.

Requested by Foro Iberico del PVC.

Water networks manufactured of traditional materials, currently register a percentage of channeled water leakages’ up to 25%. Moreover, chemical deterioration makes some canalizations to be replaced few years after being installed.

**PVC-O Class 500 pipes’** inner walls are extremely smooth, what minimizes heat loss. Hence the energy needed for the conveyance is lesser, avoiding an unnecessary huge consumption of energy resources and reducing CO₂ emissions into the atmosphere.

The Molecor Technology is committed to collaborate with the reduction of the greenhouse effect. **PVC-O Class 500 pipes** reduce CO₂ emissions in every link of its lifecycle chain and are, therefore, a tool for managing water resources for the generations to come. PVC-O Class 500 pipes avoid unnecessary energy consumption throughout their long lifecycle.
Hydraulic capacity

The reduction of raw materials consumption is a common international goal in the field of sustainable development.

The spectacular PVC-O Class 500 properties, thanks to Molecular Orientation, implies less material per pipe and consequently, a reduction in the associated costs.

Water pipes not only have to be pressure-resistant, but they also have to transport the highest amount of water while consuming the least amount of energy.

PVC-O Class 500 pipes’ walls are thinner than those of conventional plastic pipes and smoother than those of metal pipes, which means greater hydraulic capacity.

Efficiency in resource management

PVC-O 500 pipes are 100% recyclable. They can be ground and processed as rework material to be used in pipe production again or in the manufacturing of other plastic products, without losing any of their properties.

Sustainability

TOM® is a sustainable pipe in which design the environment preservation has been taken into account considering aspects as: energy saving, sustainable use of natural resources, constructions durability and respect to environment.
Molecor has evaluated TOM® pipes environmental impact in all the stages of their lifecycle following the 179/2013/CE Recommendation, the last common calculation methodology proposed by the European Comission for the study of the Product Environmental Footprint (PEF). That is to say from the raw material extraction to the final product including the manufacturing process, their distribution and their different applications.

According to this, the effect that TOM® pipes caused in 14 environmental impacts has been estimated.

- **Air and atmosphere**: climate change, acidification, depletion of the ozone layer and formation of photochemical ozone.
- **Water**: resource depletion (water), fresh water ecotoxicity and water eutrophication.
- **Soil**: resource depletion (minerals), land eutrophication and the use of the ground.
- **Human health**: respiratory inorganic elements, ionizing radiation, effects on human health (carcinogenics) and effects on the human health (no carcinogenics).

### Environmental impacts

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

The Carbon Footprint is the best known environmental parameter. It takes into account the emission of greenhouse gases into the atmosphere which are known as CO₂ that are the responsible of the current climate change.

TOM® pipes are provided with the Huella Ambiental FVS ecolabel, promoted by the “Fundación Vida Sostenible” and the Working and Social Safety Ministry’s company’s responsibility.
THE GENUINE AIR SYSTEM

- Efficiency and cleanness: easy maintenance, start-up and diameter change
- Safety: the absence of boiling water prevents from leakage risks
- Cost effectiveness: energy applied just to the pipe throughout specific air distribution

INTEGRATED SOCKET SYSTEM

- Socket conformed at the same time as orientation takes place
- Guaranty of no orientation degree loss
- No extra maintenance, time for changing, etc.

IN LINE PROCESS

- Minimum labor and maximum effectiveness achieved
- Standard factory lay-out
- Shortest line length even for the biggest pipes

WIDEST RANGE OF PRODUCTS

- DN: from 90 mm to 800 mm (4” to 30”)
- PN: up to 25 bar (365 psi) / 305 psi (21 bar)
- Compliance with worldwide standards
- Special projects for larger diameters

FLEXIBILITY IN THE PROCESS

- Designed to work in line or in batch, small pipe batches may be produced if required by market demands
- Capability of producing “Taylor-made pipe solutions” under client’s request
MOLECOR SYSTEM FEATURES

HIGHEST ORIENTATION DEGREE: UP TO CLASS 500

- The best mechanical properties
- Maximum material savings
- The real guaranty for competition, being the best and the cheapest at the same time

STABILITY

- Easy and fast start-up, less than 1 hour
- Normal production with recycled material at any percentage
- Independent extrusion and orientation processes, disconnected to avoid collapse in the whole line when singular failures in production occur.

INTEGRATED SEAL SYSTEM (ISS+)

- 100% Automatic system
- Reinforced rubber gasket
- Excellent mechanical properties in the socket

FULLY AUTOMATED PROCESS: RECIPE SYSTEM

- Easy manufacturing
- Logic intuitive control for the operator
- Low learning curve

TECHNICAL SUPPORT

- Remote internet assistance
- Immediate technical support
Molecor socketing system features

The socket is the most important part of the pipe. Socket geometry is complexer than in the rest of the pipe, and stresses are higher, mainly in the axial direction. Moreover, its extra dimension compared to the barrel makes it more exposed to impacts, scratches and other damages during installation.

Molecor has researched all aspects surrounding the correct way of working of a rubber ring socket union, in order to design the best system for a PVC-O pipe. The mechanical and geometrical parameters of a socket need to be considered. However, the aspects related to the orientation process, commonly underestimated, are the real issue for a proper PVC-O pipe equipment design.

Fundamentals of a proper socketing system for PVC-O

The sockets purpose is the union between pipes ensuring leak tightness and enabling a quick and easy installation on site. Sockets have to be designed so as to provide mechanical resistance. The socket’s design in PVC-O pipes does not only depend on certain geometry criteria or thickness distribution. Sockets are expected to maintain the excellent properties attained during Molecular Orientation. For that reason it is important to attain the right orientation degree on each part of the socket, since it is known how stresses are different along the different sections of the socket.

FEM simulation of a PVC-O pipe behaviour with axial and hoop orientation
Socket design improvements

Molecor has enhanced the classical socket shape to give it extra security with an extra large depth of engagement to enable a safer installation. Molecor’s special design includes an open lip with a bell shape that improves the pipe’s assembly process. Furthermore, Molecor provides local orientation to reinforce the stress concentration areas.

- Large lip with “bell” mouth for easy and fast engagement
- Extra dept of engagement, longer than ISO specifications (ISO 2045)
- Ultra smooth surface without mold marks for perfect gasket positioning
- Extreme axial and hoop orientation to withstand axial stress
- Hoop and axial extra orientation

Smooth air molding

Socket shaping is done with air, thus avoiding marks of mold unions and scratches on the inner surface, which provides perfect leak tightness and very easy gasket positioning.

Integral socket

In opposition to other existing systems, Molecor Technology produces the socket at the same time as the rest of the pipe to achieve the optimum conditions for Molecular Orientation. Therefore, there is no secondary process of reheating and reorientation which could result in a degradation of the properties. In addition to the process simultaneity and stability, Molecor’s patented technology allows for different degrees of orientation in the required sections of the socket and for specific wall thickness distribution. In any case, it can be adapted to external machinery devices specially designed for socketing PVC-O pipes.
The biggest PVC-O pipe in the world so far

The biggest PVC-O pipe has been developed by Molecor, a pipe of DN800 mm (30”).

The manufacturing of this pipe is preparing the field for our next development DN1200 mm (48”).

Technological improvements to meet PVC-O market demands: M-OR-P 3180

Molecor has developed the first system in the world able to manufacture PVC-O pipes up to diameters DN800 mm (30”). This system M-OR-P 3180, is able to manufacture from DN315 mm (12”) to DN800 mm (30”). Due to the bigger dimensions of these pipes this machine has been upgraded.

- Very robust system for heavier pipes
- Molds and receivers with high safety factors using international designing code ASME VIII
- Mechanical and electrical security systems. Fail-Safe concept
- Servo-Hydraulic devices in order to achieve more accurate results
- More powerful and energy efficient oven

This system allows, in less than 60 meter length, to manufacture a DN800 mm PVC-O pipe. This length includes the extruder, a nine meter vacuum tank, a six meter spray tank, the haul off, the saw, and the orientation equipment. It is 100% compatible with standard layouts on plastic pipe factories.
Molecor®, pushing limits beyond

Integrated Seal System (ISS+)

Molecor has developed a new system, patent pending, to manufacture PVC-O pipes with Integrated Seal System. The joining of PVC-O pipes is achieved by means of a rubber sealing ring seated on the pipe bell to effectively prevent leakage between the two adjoining pieces of pipe after the spigot (male end) is inserted into the bell (female end). Molecor has implemented an Integrated Seal System in order to introduce a reinforced rubber gasket inside the pipe right after orientation, keeping the excellent mechanical properties of PVC-O pipes especially in the socket.

Steps:
1- Gasket Positioning  2- Heating up  3- Cooling down  4- Extraction

The Integrated Seal System ISS+ applied to PVC-O pipes presents improvements in the pipes behavior, especially in larger diameters and high pressures. Up to now, this technology had not been applied to PVC-O pipes.

- 100% Automatic system
- Reinforced rubber gasket
- Mechanical and electrical security systems
- Fail-Safe concept
- Excellent mechanical properties in the socket

PVC-O Larger Sizes Technology: M-OR-P 5012

A new project is ongoing for manufacturing pipes up to DN1200 mm. This new machine will allow manufacturing PVC-O pipes from DN500 mm (20") up to DN1200 mm (48"). The machine has an output up to 1,400 Kg/h and can be installed with conventional extrusion lines. Total length of the machine is 38 m and 19 m wide when used with ISS+ (Integral Seal System), although it can be slimmer up to 9 m without ISS+. Its total length with the extrusion line can be of 70 m.
Worldwide regulations support

PVC-O pipes manufacture is worldwide supported. There is an International Standard as well as national Standards in USA, France, South Africa, Australia/NZ, Spain, Canada, Brazil, Colombia, Saudi Arabia, Peru, UK, India and Paraguay.

Mark for DN90 to DN500 mm in PN16, DN110 to DN500 mm in PN25.

Orientation degree: Class

The material class is defined by the material behavior in the long term test. The higher the class achieved, the better the mechanical properties attained. There are two main classifications, the International Standard and the American Standard. As reported by the International Standard, ISO 16422, the PVC-O Class 500 is the highest. It is based on the ISO 9080 test conducted at 10^4 hours and extrapolated to 50 years. For PVC-O Class 500 the MRS (Minimum Required Strength) is at least 50 MPa in 50 years, whereas for example for the class 400 the nominal test pressure minimum value is 40 MPa.

For the American Standards the class should be 1135, according to ASTM D 1483-12. The value is related to the Hydrostatic design Basis (HDB), tested at 104 hours and extrapolated to 105 hours. Class 1135 means that after 105 hours the material withstands at least 6810 psi (46.92 MPa).

### HYDRAULIC DESIGN

<table>
<thead>
<tr>
<th>Standard</th>
<th>CLASS</th>
<th>$\sigma_s$</th>
<th>$Cs$</th>
<th>HDB (psi) (MPa)</th>
<th>MRS (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 16422:2014</td>
<td>500</td>
<td>36-32-25</td>
<td>1.4-1.6-2</td>
<td>50</td>
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<td>SANS 16422</td>
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<td>32-28-23</td>
<td>1.4-1.6-2</td>
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<tr>
<td>SAI-ISO 16422</td>
<td>400</td>
<td>25-20</td>
<td>1.6-2</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

### STRESS REGRESSION LINE

- **SHORT TERM**
  - 10 hours
  - 1,000 hours
- **LONG TERM**
  - HDB: 10^4
  - MRS: 50 years

PVC-O Class 500 and Class 400.
**MRS - Minimum Required Strength**

The Minimum Required Strength (MRS) is determined by the materials degree of orientation and therefore it is a key factor in order to determine the hydraulic design stress. The higher the MRS the longer useful life expected and the better guaranty for long term behavior.

**Overall service design coefficient: C**

This variable takes into consideration service conditions as well as the properties of the piping system components. It goes from 1.25 to 2.0, being 1.25 the lowest overall service design coefficient allowed only for the French Standard NF T54-948:2010 and for the highest classes 450 and 500.

**HDB - Hydraulic design stress**

It is the estimated maximum tensile strength the material is capable of withstanding continuously with the confidence that pipe failure will not occur. It is related to the MRS and C by the following equation.

\[ \sigma_s = \frac{MRS}{C} \]

**PVC-O vs. PVC-U**

The substantial improvement of the PVC-Os mechanical properties due to Molecular Orientation results in a reduction of the material needs compared to PVC-U. The following chart compares the raw material needs for PVC-O and PVC-U according to the different Standards.

**Rework material**

Molecor Technology is very stable and robust. Therefore, it works perfectly with rework material. Most of Standards reviewed on the table on the preceding page allow the use of the manufacturer’s own reprocessable material produced during the manufacture and testing of products.
MOLECOR IN THE WORLD

Canada

A company with more than 50 years of experience in plastic pipes manufacturing technologies also uses Molecor Technology to manufacture PVC-O pipes. This technology, together with efficient distribution centers and customer support, has made this company a reference in quality, innovation and performance.

MOLECOR HEADQUARTERS (Spain)

Located in the industrial area of Madrid, only 40 minutes from the Barajas International Airport, Molecor has a manufacturing plant for PVC-O pipes, and also an industrial site to manufacture the machines for producing PVC-O pipes, taking advantage of these two complementary points of view and learning from both of them. Molecor offers tailor made solutions to its customers adjusting its technology to their needs.

PLASTICOS RIVAL (Ecuador)

RIVAL, is a leader company with over 35 years of experience in manufacturing plastic pipes in Ecuador. As a result of its strategy, it has completed its PVC, HDPE and GRP pipeline range with the most advanced technology for water solutions, PVC-O with Molecor Technology. They are currently producing PVC-O pipes in its modern plant located in the city of Cuenca.

COES COMPANY (Italy)

COES COMPANY is composed by two historical firms that are working today in a sole big Company. Since March 2010 they are manufacturing PVC-O pipes with Molecor Technology. They obtained in a record time the NF mark certificate according to NF T54-948:2010 for the range of products DN110-250 mm PN16 bars.

GERFOR (Colombia)

GERFOR is a multinational company 100% Colombian with 44 years of experience in producing and trading of PVC pipes and fittings, taps, PVC slates and geosystems, with presence in various countries in South America and it exports its products to more than 10 countries in America. Since 2011, PVC-O pipes are being manufactured with Molecor Technology.

The highest engineering capabilities in addition to a real production experience make of Molecor system a brilliant, robust and reliable technological item. Molecor completes a circle of successful implementation, achieving its vision of being a global leader of Molecular Orientation technologies through innovation and commitment.

MOLECOR SOUTH AFRICA

Molecor decided to invest in this African country forming a joint venture with the company Sizabantu Piping Systems (PTY) LTD. The new factory is located in Richards Bay (KwaZulu-Natal region) and manufactures TOM® PVC-O pipes under the license of Molecor Tecnología, for the Southern African countries.
PIPM makers Australia is a leading manufacturer and supplier of PVC piping to the construction and building industry. The Australian company, committed to the latest modern practices, has incorporated the technology developed by Molecor in order to provide the most advanced solutions for water transport, manufacturing PVC-O pipes since June 2014.

Floking Pipes Pvt. Ltd. is promoted by Electro Group of Companies and Modi Group of Companies. Equipped with the ground-breaking technology developed by Molecor, Floking Pipes becomes the first PVC-O pipe manufacturer and is all set to revolutionize the PVC-O pipe segment in India.

Pipe manufacturing facility of Moletech Astana has recently started in the capital of the Republic of Kazakhstan Astana-city. The plant, in which PVC-O pipes are manufactured with the Molecor Technology, will participate in various pipeline projects of water supply, irrigation, reclaimed water and other applications in Kazakhstan and other countries of the region.

Molecor (SEA) was incorporated in 2013 to manufacture and distribute PVC-O pipes in South East Asia, under the “HYPRO” brand. We are committed to manufacturing and delivering products and services of the highest possible quality, on time, guaranteed to meet or exceed their customer’s expectations at the most economical level.
**M-OR-P 1640**

**LAY-OUT**

- Total line length: 42.5 meters | 140 ft
- Orientation: 17.5 meters | 58 ft
- Extrusion: 25 meters | 82 ft

**RANGE OF PRODUCTS**
- DN: 90 mm to 400 mm (4” to 14”)
- PN: up to 25 bar (365 psi) or 305 psi (21 bar)

**RECOMMENDED EXTRUSION LINE**
- ARGOS 93, PH 4, PH 5

**OUTPUT**
- 3,000 Tons/year

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**M-OR-P 3163**

**LAY-OUT**

- Total line length: 47.4 meters | 156 ft
- Orientation: 19.2 meters | 63 ft
- Extrusion: 28.2 meters | 93 ft

**RANGE OF PRODUCTS**
- DN: 315 mm to 800 mm (12” to 30”)
- PN: up to 25 bar (365 psi) or 305 psi (21 bar)

**RECOMMENDED EXTRUSION LINE**
- ARGOS 114, PH 5 to PH 7

**OUTPUT**
- 5,000 Tons/year

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**M-OR-P 3180**

**LAY-OUT**

- Total line length: 59.7 meters | 196 ft
- Orientation: 22.2 meters | 73 ft
- Extrusion: 37.5 meters | 123 ft

**RANGE OF PRODUCTS**
- DN: 315 mm to 800 mm (12” to 30”)
- PN: up to 25 bar (365 psi) or 305 psi (21 bar)

**RECOMMENDED EXTRUSION LINE**
- ARGOS 135, PH 5 to PH 7

**OUTPUT**
- 6,000 Tons/year
Range of products highlighted in blue are special adaptations processed under request. The diameters in blue print are not contemplated in the Standards.
PVC-O fittings

Molecor’s technological development, specialized in Molecular Orientation, has allowed the expansion of the use of PVC-O pipes, known since the ‘70’s.

Due to the high technical performance of Oriented PVC applied to pipes, and thanks to the knowledge of the industry, Molecor has developed a line of research towards the launching of PVC-O fittings, an exclusive product worldwide.

Currently, Molecor is working on a range of products: elbows, couplings, repairing couplers, reducers in PVC-O, fittings with which the company will offer a totally innovative solution for the conveyance of water under pressure. These fittings may be used for irrigation, drinking water conveyance, industrial uses, sewage water, infrastructure and fire protection nets, etc. among other applications. These fittings, compared to products made of other materials, present an important number of advantages, among which stand out:

- **Absolute corrosion resistance**: PVC-O is immune to corrosion and therefore non-degradable. Besides it does not need special coatings which results in important cost savings.
- **Lightness and ease of installation**: ecoFIT TOM® are lighter and easier to manipulate than those fittings made of other materials. They can be easily handled, without the need of extra machinery, whereby the performance and speed of installation are higher.
- **100% recyclable**: As in the case of TOM® pipes, PVC-O fittings are fully recyclable.
- **Total water quality**: The quality of the liquid flowing through PVC-O fittings remains always unaltered since the material does not corrode and there is no migration within the fittings or on their coating.

This project has received funding from the Horizon 2020 research and innovation program of the European Union under Grant Agreement No. 756698.