PLIABLE CORRUGATED TUBES OF THE "AQUARIUS" CSST TUBING SYSTEM BY PSP

DESCRIPTION
"AQUARIUS" CSST pliable corrugated stainless steel tubes type 3 annular conform to EN ISO 10380 for the supply of fluids under pressure suitable also for drinking water.

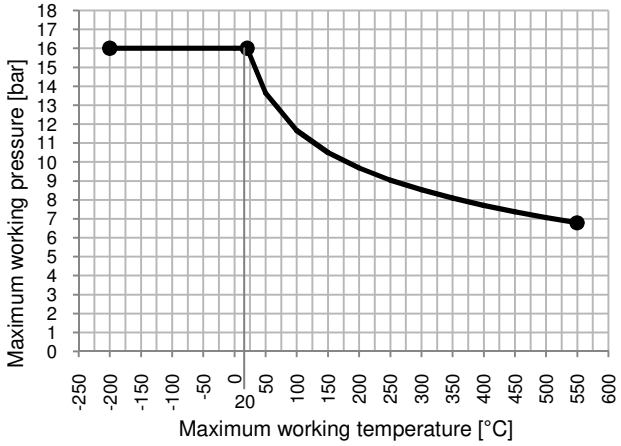
APPLICATION FIELDS
Hydro-thermo-sanitary plants for the supply of cold and hot water, supply of fluids in industrial plants (1) and connection of stationary appliances (2):
- nominal pressure (20°C): PN 16;
- maximum working pressure: 16 bar (1,6 MPa) (3);
- maximum working temperature: 550°C (3);
- minimum working temperature: -200°C (3).

MATERIAL
Austenitic stainless steel conform to EN 10028-7 type 1.4301 - X5CrNi18-10 (AISI 304) or type 1.4404 - X2CrNiMo17-12-2 (AISI 316L) with solution annealing treatment.

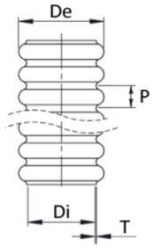
CERTIFICATIONS
- The quality management system of PSP S.r.l. is certified as conform to EN ISO 9001 : 2015 (Bureau Veritas certificate nr. IT308879).
- The "AQUARIUS" CSST pliable corrugated tubes by PSP S.r.l. are certified as conform to EN ISO 10380 : 2012 (Bureau Veritas certificate nr. 900/001).

The use of fittings other than those specifically supplied by PSP for the "AQUARIUS" CSST tubing system could not ensure a durable tightness: contact PSP to verity the compatibility of the fittings from other manufacturers.

Working pressure / temperature (3)



DIMENSIONS



Nominal dimension	DN 10	DN 12	DN 12X	DN 15	DN 20	DN 25
Connection thread	3/8"	1/2"	1/2"	3/4"	1"	1 1/4"
Thickness T [mm]	0,25	0,3	0,3	0,3	0,3	0,3
Internal diameter Di [mm]	9,3	12,0	13,2	15,8	19,7	26,5
External diameter De [mm]	12,2	15,8	16,8	20,0	25,0	33,0
Pitch P [mm]	4,0	5,0	5,1	5,5	6,4	7,1
Internal lineic surface [m^2/m]	0,041	0,054	0,057	0,070	0,091	0,131
External lineic surface [m^2/m]	0,043	0,057	0,059	0,073	0,094	0,135
Lineic volume [l/m]	0,09	0,15	0,17	0,25	0,38	0,70

CHEMICAL COMPATIBILITY (CORROSION RESISTANCE) (4)

Substance	AISI 304	AISI 316L
Acetylene	+	+
Acetone	+	+
Air	+	+
Alcohols	+	+
Amines	+	+
Ammonia	+	+
Aniline	+	+
Beer	+	+
Benzene (benzol)	+	+
Butane	+	+
Carbon dioxide	+	+
Chlorides and chlorinated	-	-
Chlorine	-	-
Citric acid	+	+
Coffee	+	+
Diesel fuel	+	+
Ethane	+	+
Ethers	+	+
Ethyl alcohol (ethanol)	+	+
Formaldehyde	-	+

Substance	AISI 304	AISI 316L
Fruit juices	+	+
Glycerine	+	+
Glycols	+	+
Hydrocarbons (aliphatic and aromatic)	+	+
Hydrochloric acid (muriatic acid)	-	-
Hydrofluoric acid	-	-
Hydrogen peroxide	+	+
Hydrogen sulfide	-	+
Ketones	+	+
Methane	+	+
Methyl alcohol (methanol)	+	+
Milk	+	+
Naphtha	+	+
Nitric acid	-	-
Nitrogen	+	+
Oils, fuel	+	+
Oils, mineral	+	+
Oils, vegetable	+	+
Oxygen	+	+
Paraffin	+	+

Substance	AISI 304	AISI 316L
Petrols	+	+
Phosphoric acid	-	-
Propane	+	+
Soaps	+	+
Sodium hydroxide	-	+
Sodium hypochlorite (bleach)	-	-
Sulforic acid (vitriol)	-	-
Sulfur dioxide	-	+
Sulphurous acid	-	-
Toluene	+	+
Trichloroethylene	-	-
Turpentine	+	+
Varnishes	+	+
Vinegar, liquid	+	+
Vinegar, vapor	-	+
Water vapor	+	+
Water, see	-	+
Water, soft	+	+
Waxes	+	+
Wine	+	+

Legend: + compatible / - not compatible (possibility of corrosion or corrosion)

1) Verify the chemical compatibility of all the components of the tubing system (tubes, fittings, sealing elements and so on).
2) The CSST pliable corrugated tubes are not suitable for the connection of moving appliances and/or parts in relative motion each other: for these purposes use only suitable flexible hoses.
3) Values valid for tubes without external coating with nominal dimensions from DN 10 to DN 25 included; for the maximum working temperature and pressure take into consideration all the components of the tubing system (tubes, fittings, sealing elements and so on).
4) The data of the chemical compatibility (resistance to corrosion) are to be considered only as indicative as the behavior of the tubes in the real working conditions depends on many factors such as the working temperature, the exposure time, the actual concentration of the substance and so on.

HYDRO-THERMO-SANITARY PLANTS WITH THE "AQUARIUS" CSST TUBING SYSTEM BY PSP

The hydro-thermo-sanitary plants must be installed in accordance with all the existing municipal, regional and national regulations and the instructions by PSP.

In the design and installation of hydro- thermo-sanitary plants, many aspects have to be taken into consideration such as:

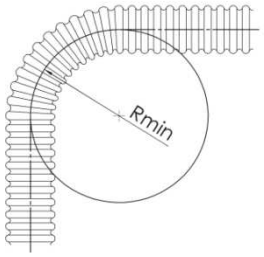
- type of system (for cold and hot sanitary water, for heating, with or without recirculation, "branched", "collector" or "ring" system, etc.);
- type of all the other components (tanks, pumps, valves, filters, vents, meters, etc.) of the system.

The design, installation, testing and maintenance of the systems must be carried out by personnel who meet the requirements of the laws and regulations in force and has suitable technical skills.
The designer, installer, tester and maintenance technician of hydro-thermo-sanitary systems must always comply with any applicable municipal, regional or national requirement.
The main, but not the only, references for hydro-thermo-sanitary systems are:

- national / local legislation implementing the Directive 98/83/EC relating to the quality of water intended for human consumption;
- national / local legislation related to the suitability of materials and objects for the transport of water intended for human consumption;
- European standard EN 806 "Specifications for installations inside buildings conveying water for human consumption";
- other National installation standards.

METHODS OF USE

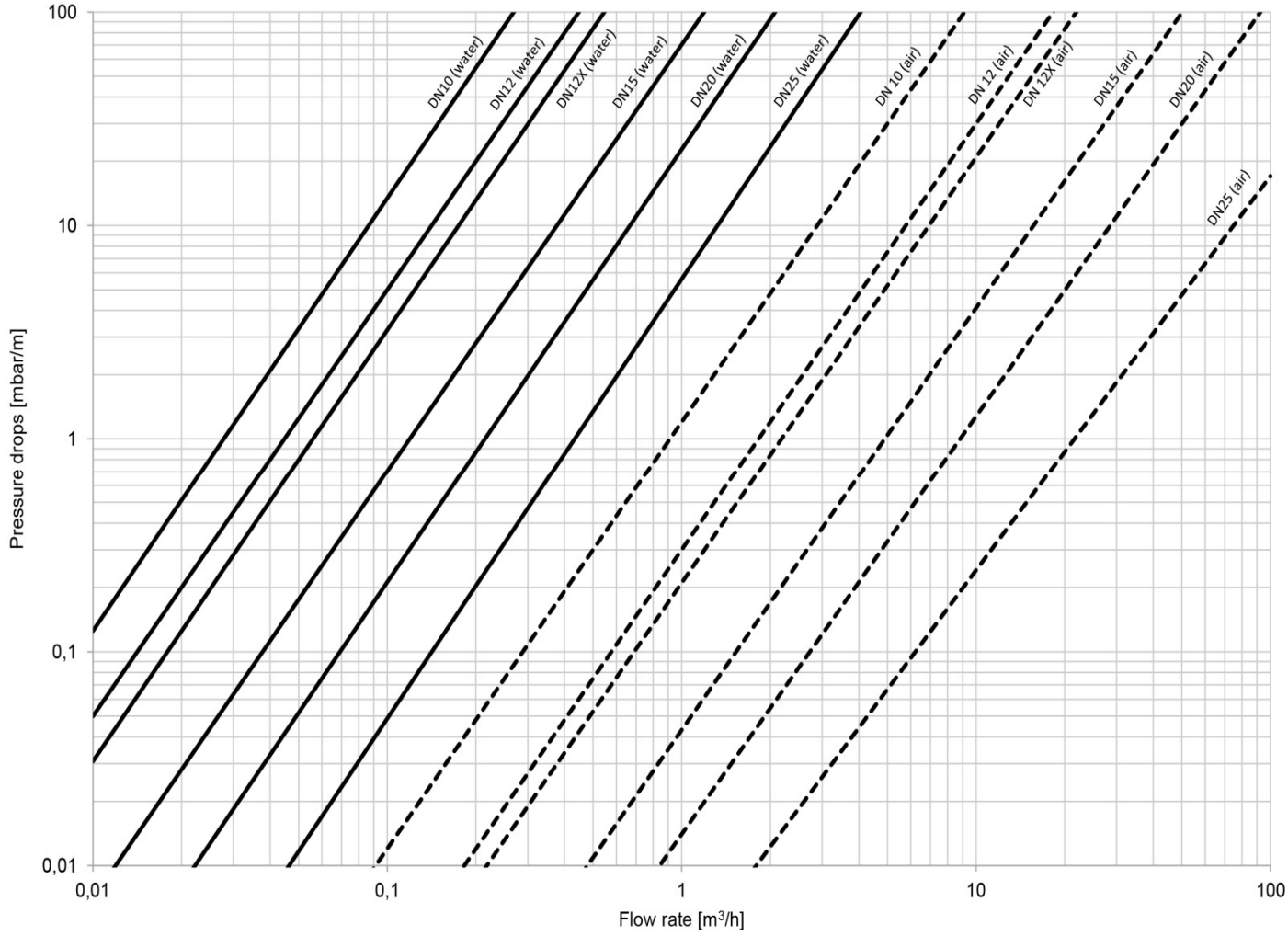
- Keep the tubes in their original packaging, in a dry place and sheltered from corrosive substances.
- Before their use, verify the integrity of the tubes.
- Do not pull or twist the tubes.
- It is possible to bend by hand the tubes complying with the following minimum bending radii:



Nominal dimension	Minimum bending radius Rmin [mm]
DN 10	20
DN 12 / DN12X	25
DN 15	25
DN 20	30
DN 25	45

- Do not submit the tubes to repeated bending.
- For the fastening of the tubes, use clamps with rubber. It is recommended to place a clamp every 2 / 3 meters.

Diagram of the pressure drops of the corrugated tubes



DIMENSIONING OF THE CSST TUBING

The diameter of the CSST tube can be determined taking into account both the pressure drops and the maximum speed of the water inside it.
For the purpose of determining the pressure drops, the length of the tubing is given by the length of the tube (distributed pressure drops) to which the "equivalent lengths" due to changes in direction of the CSST tube and the fittings have to be added (concentrated pressure drops).
Once the design flow rate is known, the pressure drops per linear meter of tube can be obtained from the diagram.
To avoid noise and water hammer, the maximum speed of the water inside it must be less than 2 m/s for the supply tubes, supply columns and service pipes on the floor and less than 4 m/s for the connection tubes to an accessory (end sections).
The system pump must be chosen so that its head is at least 3 bar (pressure at the tap) greater than the sum of the distributed and concentrated pressure drops and the piezometric height, i.e. the difference in level between the pump and the supply point of water at the highest level.

DIMENSIONING OF THE CSST TUBING (simplified method EN 806-3)

The European standard EN 806-3 describes a simplified calculation method for dimensioning of the "normalized" systems i.e. those that have lower flow rates than those in the table and do not require a continuous use of water beyond 15 minutes. This method, which is valid for the hot and cold water circuit but not for the recirculation, is based on the use of "load units" (1 load unit equals a flow rate of 0,1 l/s or 0,36 m^3/h) and can be applied to most buildings.
The tables show the UC loading units for determining the diameters of the CSST tubes by PSP which already take into account the simultaneous operation: starting from the last sampling point, i.e. the one in the most favorable position, the load units have to be determined for each section of the plant.
For "non-standardized" systems, reference can be made to UNI 9182, or other national standard, which provides for a more detailed method also valid for sizing the recirculation networks.
Unlike "manifold" systems, in "branched" systems the position / succession of the withdrawal points is important. Generally in branched systems a smaller quantity of tubes but with a larger diameter have to be used, while in “manifold” systems a greater quantity of tubes with a smaller diameter have to be used.

UC load unit for determining the diameters of CSST tubes

Maximum load of the plant section [UC]	Value of the greater withdrawal point of the plant section [UC]	DN nominal dimension of the CSST tube of the plant section
1	1	DN 10 (*)
1 ÷ 3	2	DN 12 DN 12X
3 ÷ 6	4	DN 15
7 ÷ 10	5	DN 20
11 ÷ 20	8	DN 25

(*): only for connections (maximum length: 1 meter)

Equivalent lengths	Nominal dimension				
	DN 10	DN 12/12X	DN 15	DN 20	DN 25
90° direction changes with CSST tube (*)	0,3 m	0,3 m	0,3 m	0,3 m	0,3 m
Direction changes with elbow fitting	1,0 m	1,0 m	1,0 m	1,0 m	1,0 m
Tee-fittings and manifolds	0,5 m	0,5 m	0,5 m	0,5 m	0,5 m
Taps	0,3 m	0,3 m	0,3 m	0,3 m	0,8 m

(*): changes in direction made with CSST tubes with bending radius at least double of the minimum one can be disregarded.

Maximum flow rate for supply tubes (V_{max} = 2 m/s)

Nominal dimension					
DN 10	DN 12	DN 12X	DN 15	DN 20	DN 25
0,49 m^3/h	0,81 m^3/h	0,99 m^3/h	1,4 m^3/h	2,2 m^3/h	4,0 m^3/h
0,14 l/s	0,23 l/s	0,27 l/s	0,39 l/s	0,6 l/s	1,1 l/s

Maximum flow rate for connections (V_{max} = 4 m/s)

Nominal dimension					
DN 10	DN 12	DN 12X	DN 15	DN 20	DN 25
0,98 m^3/h	1,6 m^3/h	2,0 m^3/h	2,8 m^3/h	4,4 m^3/h	7,9 m^3/h
0,27 l/s	0,45 l/s	0,55 l/s	0,78 l/s	1,2 l/s	2,2 l/s

Withdrawal flow, minimum flow at withdrawal points and load units for withdrawal points according to EN 806-3 (simplified method)

Punti di prelievo	Withdrawal flow [l/s]	Minimum flow [l/s]	Load units UC
Sink, washbasin, WC cistern	0,1	0,1	1
Kitchen sink, domestic washing machine, dishwasher, sink, shower head	0,2	0,15	2
Urinal	0,3	0,15	3
Domestic bath tub	0,4	0,3	4
Garden/garage taps	0,5	0,4	5
Non-domestic kitchen sink, non-domestic bathtub	0,8	0,8	8
Discharge	1,5	1,0	15

METHOD OF LAYING OF THE CSST TUBING

The CSST tubing by PSP can be installed inside or outside the building and with the following installation methods:

- at sight, in a channel, in a niche or in a cavity;
- concealed;
- underground.

The water supply tubing must not be laid:

- inside electrical substations and above electrical panels and equipment and in general above materials that can become dangerous if wet by water;
- inside garbage dumps and rooms where pollutants are present and through drains or sewers;
- in ducts or compartments still in use for their original purpose such as, for example, ducts for the passage of combustible gases, fumes, ventilation passages, lift compartments and wells for household waste;
- in expansion joints and seismic joints of buildings.

TUBING INSTALLATION: GENERAL PROVISIONS

In general, a water system must be designed in such a way as to:

- avoid waste, improper use and contamination of water;
- avoid excessive speed, low flow rates and stagnation areas;
- allow the water supply to all the individual withdrawal points even in the most severe operating conditions (i.e. in correspondence with the maximum simultaneous flow rate) taking into consideration the pressure, flow rate, water temperature and use of the building;
- avoid the trapping of air during supply and the formation of air pockets during the operation of the system;
- do not cause danger or disturb people and pets, or damage buildings or the goods contained therein;
- avoid damage (e.g. scale, corrosion and deterioration) and prevent water quality from being affected by the local environment;
- facilitate access to equipment and maintenance interventions on the same.

The systems must be built with the least possible number of joints (the use of CSST tubes by PSP, being pliable, limits the number of fittings, and therefore of joints, necessary for the construction of the system).
During installation, care must be taken to avoid contaminants (filings, dirt, slag, etc.) from entering the pipeline.

Tube routes to cold water taps within buildings must not follow hot water or space heating pipe laying routes or pass through heated areas: when the proximity of pipes cannot be avoided, hot pipes and cold water pipes must be insulated from each other and when the hot and cold drinking water pipes are arranged one above the other, the hot water pipe must be placed above the cold water pipe.
If possible, the positioning of the tubes above ground outside and in general in unheated environments should be avoided. When laying above ground tubes outside buildings is unavoidable, they must be protected by insulation with a weather resistant coating. If the tubes are placed in areas where freezing is possible and their heating is not possible, it must be taken into account that the insulation is not always able to prevent freezing when the system is not in service and therefore plants to drain the tubes must be planned.
Measures must be taken to prevent the external surfaces of the tubes from being exposed to moisture for prolonged periods, i.e. tubes installed in humid places must be protected from moisture. In particular, cold water tubes should be adequately protected to prevent condensation from forming.
The tubes inside each building must be connected to equipotential bars.

TESTING OF THE PLANT

Leak test: follow the procedure below:

1) remove the air from the system, fill it slowly with water, letting it flow for a few minutes in order to clean all the components of any present dirt;
2) increase the pressure inside the system until reaching a pressure of 1,1 times the maximum design pressure (if this data is not available, for domestic systems carry out the tightness test at a pressure of 4 bar having first checked the maximum allowable pressure of all the installed components) and, after a stabilization period of 30 minutes, keep it for at least 10 minutes;
3) check that during the maintenance period there has been no pressure drop and carefully visually check all the tubes, fittings and components installed and their joints to search for and eliminate any leaks.

Supply test: all the system withdrawal points must be opened at the same time and for each of these the actual flow rate delivered and, for the hot water circuit, the temperature must be checked.