CHRYSSAFIDIS

The evolution of the TUBE,

SESTA SRL

technical catalog 1/2014

ENG

you've seen from the SESTA?

Sesta srl, was founded on more than 40 years' experience in the industrial and civil plumbing and heating sector.

The Sesta system, consisting of multilayer tubes and brass press fittings has been designed for constructing domestic hot and cold water distribution networks, air conditioning circuits, heating at high and low temperature and gas supply installations.
The creation of the system has been characterised by using the latest and most advanced materials and production technology for both tubes and pressed fittings.

For the tubes:

- The best plastic material adapted to withstand cross-linked polyethylene type b (PE-Xb) at high temperatures indoors and outdoors.
- Aluminium alloy 8006, more resistant than others, suitable for reduced thicknesses that allow great flexibility;
- TIG butt-to-butt aluminium welding which provides maximum reliability for bends, as a result of the characteristics of uniformity and strength.

For the fittings:

- CW617N brass with reduced amounts of lead and nickel which makes it corrosion resistant and suitable for distributing drinking water;

- Stainless steel bushing enables a more reliable press fitting than with other metals in use;
- Peroxide vulcanised EPDM O-ring, suitable for drinking water, or conforms to UNI EN 682 for gas.

The quality of the multilayer tubes, fittings and the total Sesta System is certified by two of the most prestigious European institutes: the DVGW and the Italian Institute of Plastics (IIP).

reference standards
UNI EN ISO 21003

The Sesta system complies with UNI EN ISO 21003:
21003-1 General
21003-2 Tubing
21003-3 Fittings
21003-5 Suitability for use of the system
21003-7 Guide to assessing compliance

In 2009 standard **UNI EN ISO 21003** was introduced as a replacement for UNI 10954 that changed the logic: it requires the various producers to develop their own regression curves through certified laboratories and consequently to define the temperature and pressure parameters that the product can withstand over time.

The classification of the system derives from the results obtained in accordance with the 4 established classes:

class	Design T °C	Time to design temperature YEARS	max T of project °C	Time to T max YEARS	T malfunction °C	Time to T mal. h	scope
5	20-60-80 più	14-25-10	90	1	100	100	Radiator temperature
4	20-40-60 più	2,5-20-25	70	2,5	100	100	Underfloor heating and radiators low temperature
2	70	49	80	1	95	100	Hot water 70°C
1	60	49	80	1	95	100	Cold water 60°C

Tab. 1

UNI EN ISO 21003 requires the execution of the long-term pressure resistance tests, thermal durability (8760 h at 110°C), and the bending and removal test.

Tab. 2

Long-term pressure resistance (measured or calculated)	ISO 17456 ISO 1167 a) evaluation - ISO 17456 b) validation 8760 h (1 year)
Thermal durability	Appendix C + D UNI EN ISO 21003 a) inner layer 8760 h (1 year) b) outer layer : bending and traction
Resistance welding line	ISO 17456 ISO 1167 the test is satisfied if you exceed the thermal durability test

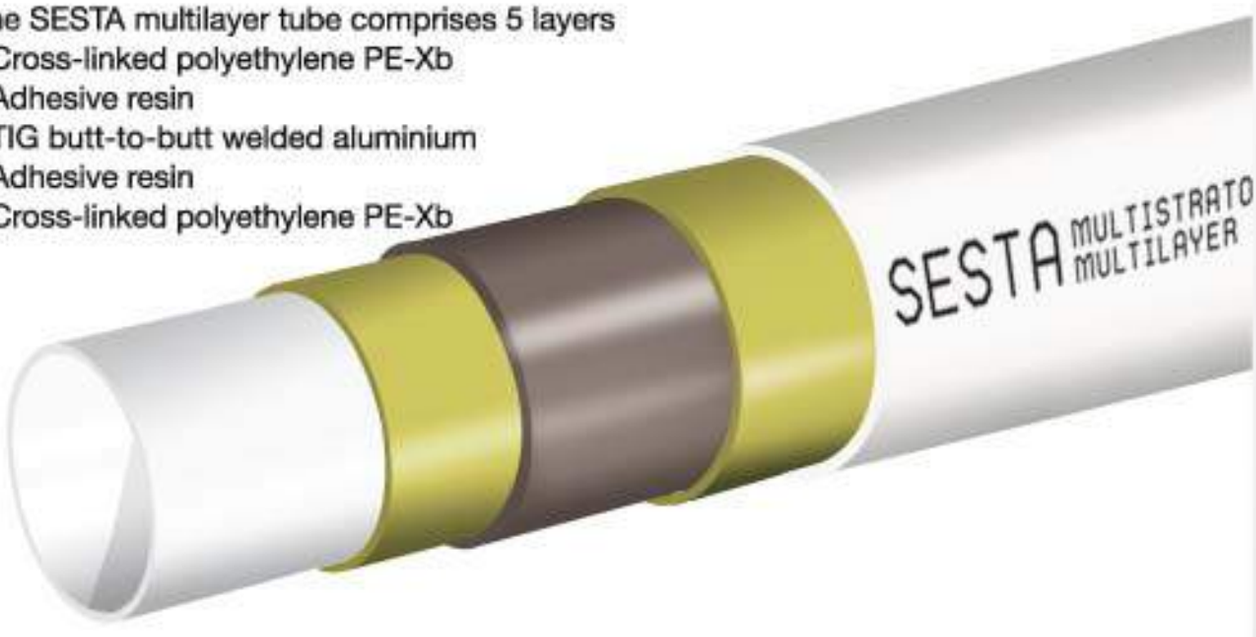
The tests demonstrated that the Sesta system is suitable for all classes of the UNI EN ISO 21003.

the Sesta system uni en iso 21003

health - heating - air conditioning

The multilayer tube

The SESTA multilayer tube comprises 5 layers
- Cross-linked polyethylene PE-Xb
- Adhesive resin
- TIG butt-to-butt welded aluminium
- Adhesive resin
- Cross-linked polyethylene PE-Xb



The limits of the individual materials are overcome by coupling:
The negative aspects of metal, such as corrosion, rigidity, high load loss incrustations are neutralised by the layer of cross-linked polyethylene in contact with the fluid. The negative aspects of plastic such as permeability to gas and UV rays, the high thermal expansion and instability are neutralised by the aluminium layer interposed between the two layers of Pe-Xb.

For the tubing Sesta has selected the most advanced process and product technologies. It is equipped with a production line with components provided by the most prestigious companies on the market and with very advanced control systems that allow you to obtain very narrow tolerances in the thickness of all layers.

For the product inner and outer PE-Xb has been provided for the tubing and aluminium butt welding.
This technology, as opposed to others such as the aluminium welding with overlapping edges, given the inherent characteristic of uniformity of the thickness of the tube, offers maximum reliability in terms of the danger of cracking during bending operations. The perfect control of the thicknesses and diameters of the various layers and the use of appropriate adhesive resins, allows for a perfect bonding between the layers which makes the tube consistently resistant.

The advantages of aluminium

Workability
Thanks to the aluminium core, the multilayer tube has no "memory effect" like all plastic tubes have: once it is bent and formed, it keeps the assumed shape.

Dimensional stability
The resistance that characterises the aluminium makes crushing more difficult due to external stresses.

Flexibility, crush-proof and stability
The multilayer tube bends very easily, like the plastic tube, but remains stable in the desired position like a metal tube. It is possible to operate on it several times without damaging it.

Low linear expansion
The table below shows that the thermal expansions of the multilayer are close to those of the metals and much lower than those of plastics

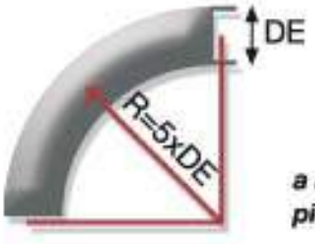
Comparative table of elongation in mm of 5 metres of tubes with Δ 50°C

Tab. 4

PE-X	50
PP	45
PB	37,5
PVC	20
MULTILAYER PIPE	6,50
COPPER	4,12
GALVANIZED IRON	2,85
STEEL	2,75

Oxygen barrier
The aluminium protects the inner plastic tube forming an absolute barrier to oxygen and light.

Bending
By hand: 5 times the tube's outer diameter
With a tube bender: 3.5 times the tube's outer diameter.



Tab. 5

	14x2	16x2	18x2	20x2	26x3	32x3
a mano	70	80	90	100	130	160
piegatubi	49	56	63	70	91	112

corrosione correnti vaganti

Tabella comparativa

Tab. 6

CHARACTERISTICS	Multilayer SESTA	COPPER	PLASTIC
oxygen absorption	NO	NO	SI
thermal conductivity	0,43 W/m°K	380 W/m°K	0,38 W/m°K
expansion coefficient	0,026 mm/m °C	0,017 mm/m °C	0,13/0,25 mm/m °C
stray current corrosion	NO	SI	NO
cold workability	SI	SI	NO
mechanical degradations	NO	WORK HARDENS	SHOCK
Aging uva	NO	NO	SI

The advantages of PE-Xb

Corrosion resistance
The outer PE-Xb tube prevents the materials used in construction (lime, cement) from corroding the metal part of the tube.

Load loss
The inner surface of the PE-Xb tube, free of roughness, minimises load loss and also prevents the formation of blockages caused by limestone.

Potability
The cross-linked polyethylene that constitutes the inner part of the tube meets the hygiene requirements which makes it suitable for transporting drinking water and food liquids.

Resistance to high temperatures
The PE-Xb used inside and outside is by its nature resistant to high temperatures, and allows the use of the multilayer tube either in underfloor heating systems and with conventional radiators.

Lightness
The lightness of the plastic makes the tube very manageable during transport, storage and installation. A 100-metre roll of DN 16x2 weighs just 11 kg.

Noise levels
The two layers of plastic attenuate noise caused by fluid flowing in the tube even in the presence of water hammers.

Cross-linked polyethylene

Simple polyethylene (PE) is a thermoplastic material whose temperature increases the molecule chains that compose it (Fig. 1) mutually slide irreversibly deforming the plastic layers of the tube.

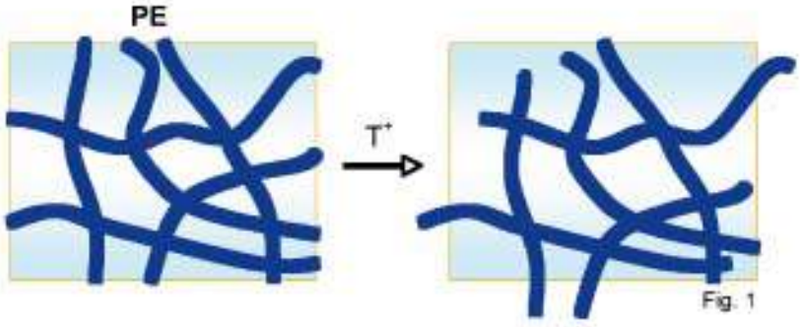


Fig. 1

To ensure the use of the multilayer tube up to a temperature of 95°C, for a period of up to 50 years, it is necessary to chemically modify polyethylene, linking the majority of the macromolecules to each other (the percentage is expressed by the degree of cross-linking), through chemical bonds.
This process takes the name of CROSS-LINKING of the Polyethylene and is indicated with the letter X (FIG. 2) in PE-X, which indicates the chemical bond established between the polymer chains. Cross-linking begins with the breakdown of the carbon-hydrogen bond in one or more points of most of the polymer chains and continues with the formation of new cross-links between the chains. This prevents them from sliding as the temperature increases and therefore the irreversible deformation of the tube. It should be added that cross-linking polyethylene may NOT be total (degree of cross-linking 100%) since this would make the materials fragile, which would lead to the creation of a cross-link that clearly could not slide. This would prevent the smallest deformation of the tube. Cross-linked polyethylene with a percentage of between 60 and 80% enjoys the properties of composite materials, in which the cross-linked part confers resistance and shape stability even at high temperatures, while the chains remain free to ensure flexibility.

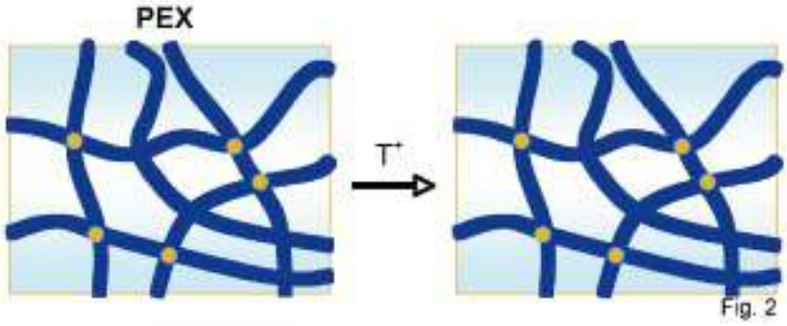


Fig. 2

A more economical - but less effective - alternative to improve polyethylene's resistance to temperature is to polymerise ethylene and brass together thus causing a copolymer in which the polymer chains are on average shorter, however, they have a number of lateral branches on chains that hinder but do not prevent it from sliding when the temperature rises (FIG. 3). Polyethylene produced in this way is called PE-RT - "Raised Temperatures" and NOT "ReTicolato" and its use in the production of multilayer tubing limits the maximum permissible temperature to lower values (70°C).

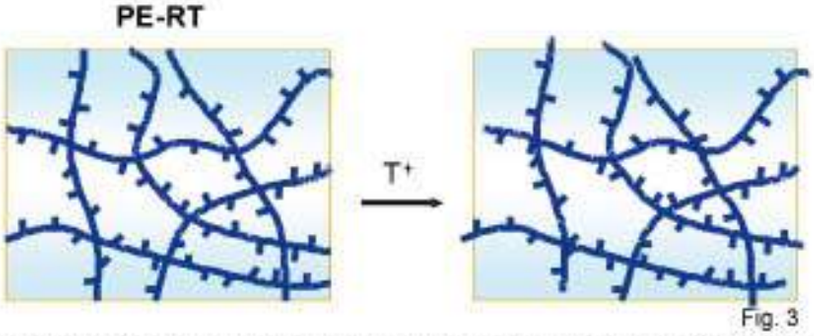
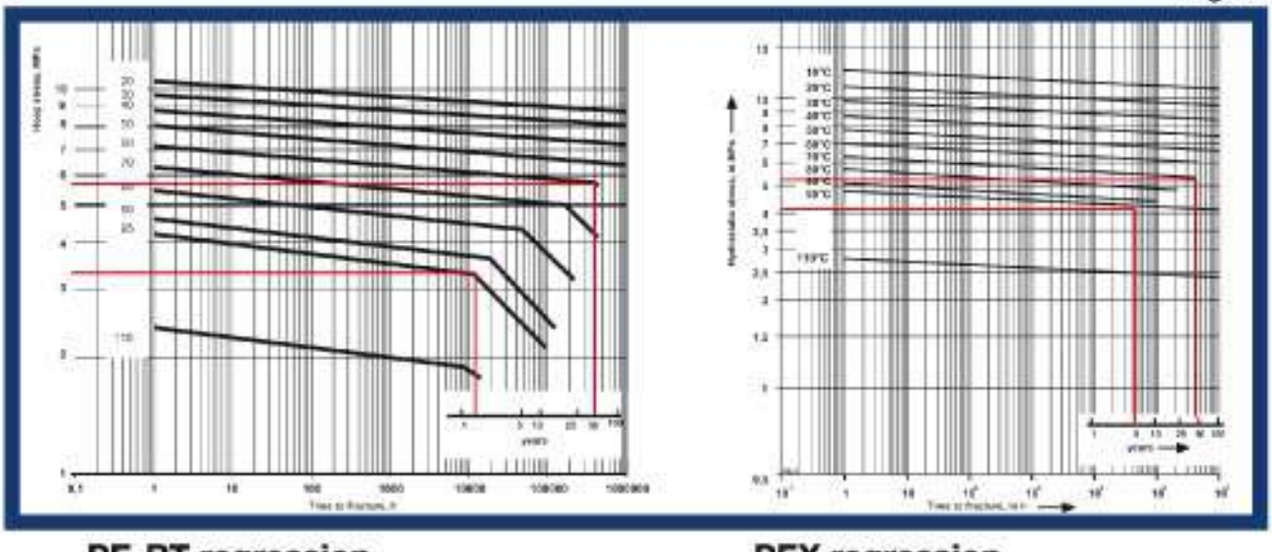


Fig. 3

As mentioned above it is accurately described through the typical regression curves that relate resistance to internal pressure to fracture time at different temperatures; it is evident that the regression curves of PE-RT are lower and substantially different from those of PEX.

PE-RT curves show that already at operating temperatures above 60°C, there is a significant and sudden decrease in performance after a year of service, as is clear from the "knee" of the curves.

Fig. 4



PE-RT regression
curve:
50 years 60°C
95°C : 1.2 years, 3.2 Mps
ISO TC 138 SC2
N 961

PEX regression
curve:
50 years :70°C, 5.1MPa
95°C : 1.2 years, 4.1 Mps
ISO15875-2

This phenomenon of a decline in mechanical performance is completely absent in the regression curve for PeX for which there are linear characteristics of the curves and significantly higher resistance values.

Type of cross-linking

Polyethylene (PE) used to make the multilayer SESTA Tube is cross-linked (X) using the "b" PEXb method

The cross-linking of the polyethylene consists of breaking the carbon-hydrogen bond in one or more points of most of the polymer chains and in the formation of new cross-links between the chains: this can happen using three methodologies defined as "a" "b" and "c".

a: **Chemical method**, with the addition of peroxide directly during the extrusion and formation of the tube process. Peroxide decomposes forming highly reactive free radicals and is thus able to extract hydrogen atoms to the polyethylene and create a chemical cross-link bond between the polymer chains at those points.

b: **Chemical method**, performed in two steps, firstly by adding a SILANE compound a cross-linkable polyethylene is obtained, i.e. with chemically active sites along the polymer chains. The actual cross-linking occurs during tube extrusion facilitated by the addition of a catalyst and then hot water (80°C - 95°C) or steam.

c: **Physical method**, by blasting the tube with a high energy rays in special bunkers.

Alternatives to PEX-Al-PEX

There are other multilayer tubes on the market whose plastic parts are not 100% PEX (cross-linked polyethylene). There are PERT, PE-HD, or even PEX-PE blends made ad hoc which are obviously less efficient "alternatives" in terms of pressure, temperature and duration (Fig. 4).

The choice of non-cross-linked plastic material is only made due to the economic benefits linked to the cost of the raw material and the simpler production process. As confirmation of the above, the new UNI TS 11344 for combustible gas, clearly establishes the exclusive use of PEX for the inner layer.

SESTA fittings

The Sesta product range has included Sesta brass press fittings since 2008, including the tube + fitting system which it designed and made.
Since the very beginning of the multilayer product production, Sesta has always had both press and screw fittings of other brands in its product list. The shift to creating its own proprietary Sesta system was needed, first and foremost, to guarantee quality and assurance of compatibility and then to eliminate the passing of liability among tubing and fittings manufacturers.
The most widely used thicknesses on the market have been adopted for the tubes of the Sesta system to ensure that the system's use is a choice made by the user and not an obligation. The tubing and fittings are compatible with the majority of products on the market.

Sesta's investment is oriented toward the brass press fittings range, which represents the best solution between convention and innovation among the alternatives offered by technology. This type exceeds the limits of the classic screw type system and is preferable to the quick-release fittings and all those made of plastic material, which are not yet supported by sufficient field experiments and offer no substantive and significant advantages in terms of speed of installation.
Assembly is accomplished by permanently pressing the tube on the rubber holder of the fitting using a crimper press equipped with appropriate jaws

This permanently deforms a stainless steel bushing designed to ensure the pressing of the tube even in the presence of significant variations in temperature and pressure. The seal is ensured by the special anti-shear profile of the rubber holder and two o-rings on which the tube applies a uniform pressure.

Among the many benefits that the press type has with respect to compression fittings the following should be noted:

a) The locking of the tube on the press fitting is mainly entrusted to standardised mechanical equipment, specially designed and easy to use; it includes the best reliability with respect to compression fitting where the seal greatly depends on the operator's skill

b) The speed in the press-fitting assembly is a specific characteristic

c) The SESTA press-fitting, being pre-assembled in the factory, minimises assembly errors due to the possible loss of essential components

d) Finally, the press-fitting is inherently disposable, yet another guarantee of reliability.

The sum of the advantages listed above ensures the installation of SESTA press-fittings, even involving conduits, without any problems.

Press profiles

Of the various pressing profiles available on the market, SESTA has designed its fittings for the use of crimper pliers with a TH profile, certainly the most widely used and tested.

The TH crimper pliers have a groove that, during pressing,hooks the plastic coloured bushing holder that acts as a guide and ensures the exact positioning of the crimper pliers.

The three SESTA pressing profiles

During the design of the rubber holder the possibility of using crimper pliers with a different profile was also studied.

The positioning of the o-rings of SESTA fittings for 16 and 20 mm tubes is compatible with two other profiles, which are also very popular on the market: H and U. Several shear, seal and duration tests have been carried out, the result of which ensures complete compatibility of the SESTA press-fitting with the H and U type crimper pliers.

Potability

The Sesta system is suitable for the supply of drinking water in compliance with the regulations on global migration and specification provided by Ministerial Decree 174/2004 over KTW 20°C and 60°C - W270 DVGW reference.

Hygiene-Institut
des Ruhrgebiets

SESTA SRL
Via Lancia, snc c/da Olivola, Z.I.
82100 BENEVENTO (BN)
ITALY

TEST CERTIFICATE

Enhancement of Microbial Growth on Materials to Come into Contact w
Test pursuant to DVGW Technical Standard W 270, Novembe

Client:	SESTA SRL Via Lancia, snc C/da Olivola, Z.I. 82100 BENEVENTO (BN) ITALY
Test material:	PE-Xb/Al/PE-Xb
Test method:	Material test

According to test report **W-211701e-11-SI** of **20.12.2011**, the multilayer pi
(specification see test report) is conform to the requirements for the use in
water systems pursuant to DVGW Technical Standard W 270. Detail
procedure and test results are itemized in the test report.

This test certificate is valid from the date of issue and, given that the conditions and requirements remain unaltered, expires on **20.12.2016**. Upon request, the validity may be extended up to another 5 year term provided that the specifications of Technical Standard W 270 are met.

The Director of the Institute

P.P.

Dr. Ch. Schell
Head of Laboratory
Department of Water Hygiene and Environmental Microbiology

Hygiene-Institut
des Ruhrgebiets

SESTA Srl.
Via Lancia, snc c/da Olivola, Z.I.
82100 BENEVENTO
ITALIEN

TEST CERTIFICATE
according to the KTW-Guideline

Product: Multilayerpipe for water supply PE-Xb/AL/PE-Xb
BAM-No. DV 211-09-357, Registration-No. DW-8231BU0247
(marking: see sampling record)

Specimen: pipe SESTA 25x2,5 mm (white)

Kind of test: [X] Supervision test 2013 (review initial test acc. to the KTW-Guideline: 18.08.2008)

The test specimen meets the requirements according to the test report dated **04.09.2013 Ref.-No.: H 234034 13-Bs** for the following applications and temperatures, as far as technically suited.

Applications	cold water (23°C)	warm water (60°C)	hot water (80°C)
Pipes with DN < 80 mm (domestic distribution)	passed	passed	---
Pipes of diameter 80 mm ≤ DN < 300 mm (supply pipes)	passed	passed	---
Pipes of diameter DN ≥ 300 mm (riser pipes)	passed	passed	---
Fittings for pipes with DN < 80 mm	passed	passed	---
Fittings for pipes with 80 mm ≤ DN < 300 mm	passed	passed	---
Fittings for pipes with DN ≥ 300 mm	passed	passed	---
Sealings for pipes with DN < 80 mm	passed	passed	---
Sealings for pipes with 80 mm ≤ DN < 300 mm	passed	passed	---
Sealings for pipes with DN ≥ 300 mm	passed	passed	---
Tanks in the domestic installations including repair systems	passed	passed	---
Tanks other than in domestic installations including repair systems	passed	passed	---

If pipes, sealings or fittings and auxiliaries do not differ in their material composition and process of manufacture, testing of the smallest diameter of the product range is sufficient.

This test certificate is valid beginning with the date of issue and is ending by **18.08.2018** as far as there are no changes in the formula.

The Director of the Hygiene-Institute
on behalf

Dr. rer. nat. Andreas Kuck
Head of the DIN/S for water
hygienic material testing

technical characteristics

The tubing

The SESTA multilayer tube is produced both in rolls of various lengths and in bars. It meets the characteristics listed in the following table:

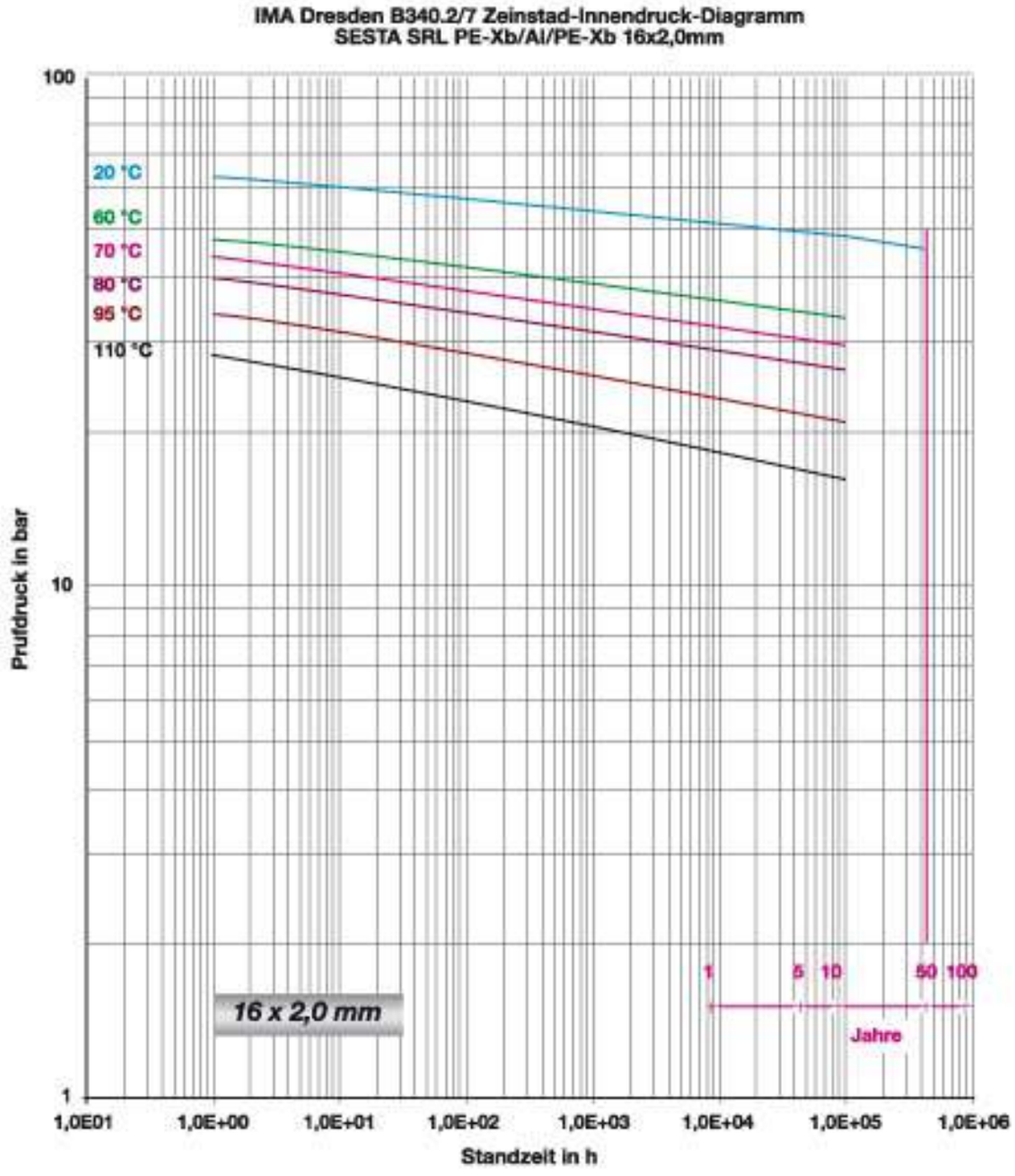
Tab. 7

OUTER DIAMETER	14 mm	16 mm	18 mm	20 mm	26 mm	32 mm	40 mm	50 mm	63 mm
INTERNAL DIAMETER	10 mm	12 mm	14 mm	16 mm	20 mm	26 mm	33 mm	42 mm	54 mm
ROLL LENGTH NUDE TUBE	100 m	100 m 250 m 500 m	100 m	100 m 400 m	50 m	50 m			
BAR LENGTH_NUDE TUBE	4 m	4 m	4 m	4 m	4 m	4 m	4 m	4 m	4 m
COATED ROLL LENGTH	50 m	50 m 100 m	50 m	50 m	50 m 25 m	25 m			
COATING THICKNESS polyethylene closed-cell PE-LD	6 mm 10 mm	6 mm 10 mm	6 mm 10 mm	6 mm 10 mm	6 mm 10 mm	10 mm			
WEIGHT PER METER	90 g	110 g	130 g	145 g	260 g	340 g	528 g	766 g	1155 g
ALUMINUM THICKNESS	0,2 mm	0,2 mm	0,2 mm	0,25 mm	0,4 mm	0,45 mm	0,7 mm	0,9 mm	1,2 mm
WALL THICKNNESS	2 mm	2 mm	2 mm	2 mm	3 mm	3 mm	3,5 mm	4 mm	4,5 mm
VOLUME OF WATER	0,078 l/m	0,113 l/m	0,154 l/m	0,200 l/m	0,314 l/m	0,531 l/m	0,803 l/m	1,32 l/m	2,042 l/m

INTERNAL ROUGHNESS	0,007 mm
THERMAL CONDUCTIVITY	0,43 w/m°C
COEFFICIENT OF THERMAL EXPANSION	0,026 mm/m°C
CONTINUOUS USE TEMPERATURE	95°C
MOMENTARY TEMPERATURE MAX	110°C
MAXIMUM OPERATING PRESSURE	10bar
DEGREE OF CROSSLINKING PEXB	>65%
OXYGEN DIFFUSION	0,00 mg/lh
RADIUS OF CURVATURE	fino a 5 volte il diametro

Regression curves

The tube quality is evaluated by analysing the regression lines specific to that product. The regression curves in the figure below have been prepared, in the context of tests for product certification, by a specialist institute that operates in compliance with UNI IEC EN ISO/IEC17025, which DVGW commissioned to conduct a large series of tests on the Sesta system over a year.



The X-axis shows the time in hours and years, the Y-axis shows the pressure at which the tube resists over time at different temperatures (20°C, 60°C, 70°C, 80°C, 95°C, 110°C).

The results of the regression curves and the analysis of drinking water indicate that **thermal, mechanical and hygienic characteristics of the SESTA SYSTEM are such as to cover all classes of application defined by UNI EN ISO 21003. (Ref. table 1)**

- Class 1 Hot water supply 60°C
- Class 2 Hot water supply 70°C
- Class 4 Underfloor heating and low temperature radiators
- Class 5 High temperature radiators.

Fittings

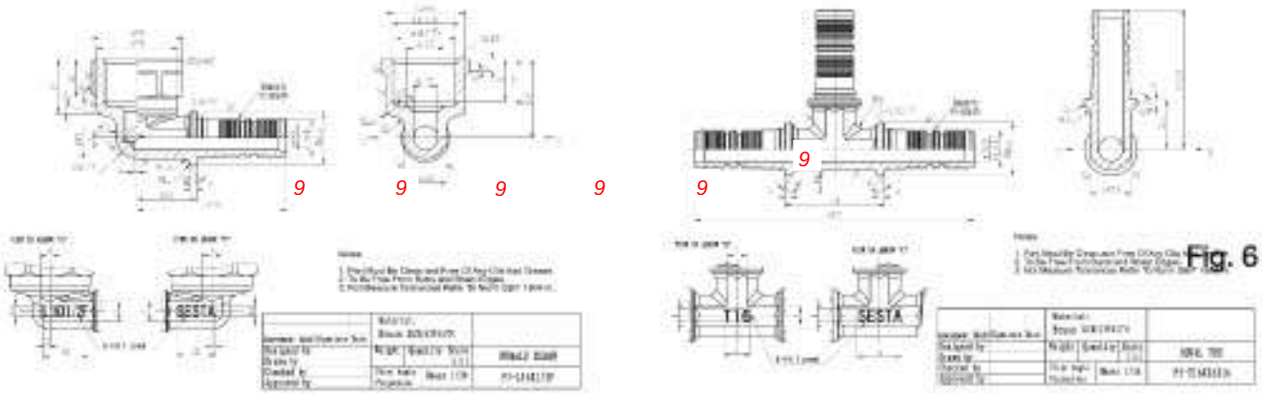


Fig. 6

The main technical characteristics of the SESTA press fitting are:

o Suitable to connect multilayer tubes with the following dimensions:

outer diameter (mm)	16	20	26	32
thickness (mm)	2	2	3	3

Tab. 9

o Brass body CW617N with less than standard lead and nickel content, corrosion-resistant and suitable for supplying drinking water.
It has the following chemical characteristics:

		min	max
COPPER	Cu	57%	60%
LEAD	Pb	1,6%	2,2%
IRON	Fe		0,3%
NICHEL	Nl		0,1%
ARSENIC	As		0,1%
ALUMINIUM	Al		0,05%
POND	Sn		0,3%
MANGANESE	Mn		0,1%
OTHER IMPURITIES			0,02%
ZINC	Zn		resto

o Coloured plastic bushing holder, not removable, which prevents contact between the aluminium of the multilayer tubing and the brass of the fitting and ensures, therefore, the absence of electrochemical corrosion
o Coloured plastic bushing holder which acts as a guide for the pressing crimper plier
o Hot stamping of the body of the fitting, according to European standard EN 12165, to ensure the absence of porosity in the material

o Stainless steel bushing with three slots to visually inspect the correct insertion of the tube on the fitting
o Certified EPDM peroxide vulcanised o-ring, suitable for contact with drinking water
o EN 682 certified o-ring for transporting combustible gaseous.
o Rubber holder with special anti-slip profile and o-rings placed in an optimal position for crimping TH, H and U pliers;

Sesta three profiles system jaws-dimensions

Tab. 11

	DIAMETER PIPE THICKNESS			
Pressing profile	16X2	20X2	26X3	32X3
TH	X	X	X	X
U	X	X		
H	X	X		

coatings

SESTA provides Pe-Xb multilayer tubes also coated with insulating material or with a protective sheath with the technical characteristics described below.

Insulating coating for water, heating and air-conditioning systems a closed cell foamed polyethylene and polyethylene finishing film, in accordance with Law 10/91:

- Sheath made of PE-LD closed-cell foam polyethylene
- Outer polyethylene PE-LD finishing film
- Free of CFCs and HCFCs
- Self-extinguishing "CLASS 1"
- Thermal conductivity at 40°C: 0.0397 W/m°K
- Operating temperature: -30°C +95°C
- Resistance factor to the dispersal of steam: 5.482μ

The exterior finish can be red, blue and white and the thickness varies from 6 mm to 10 mm depending upon the diameters and applications.

The corrugated sheath has the following characteristics:

- Composition:
  - o PP 88.2%
  - o Master dye 1.8%
  - o Flame-retardant 10%
- Density: 0.89%
- Type of use: -25°C + 105°C
- Resistance to crushing: 350 N/5 cm
- Shock resistance: 1 kg/10 cm.

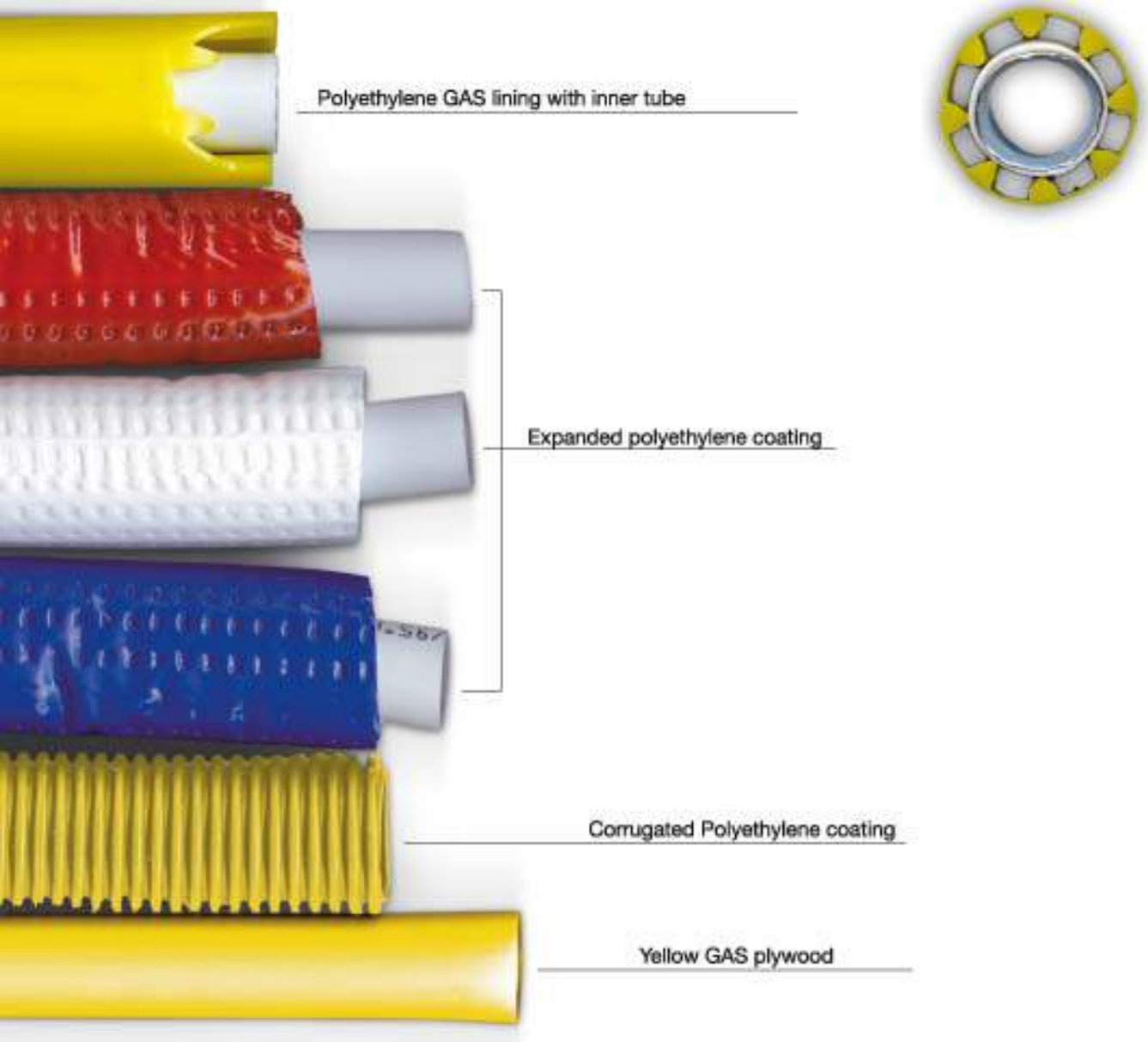
The smooth sheath with an air chamber has the following characteristics:

- Composition:
  - o PE-LD: 83%
  - o Nucleating: 2%
  - o Master dye: 3%
  - o Flame-retardant: 10%
  - o Collapse-resistant: 2%
- Density: 130 kg/m3
- Type of use: -30°C + 95°C

Both types of sheath meet the requirements of Art. 6 of the Ministerial Decree no. 37 of 22-1-2008 and UNI TS 11343 that govern, in Italy, the laying of multilayer tubes for domestic combustible gas networks.
The sheath-tubes coated can also be supplied combined, with the sheaths welded together at regular intervals.

Application in air conditioning systems

SESTA tubes and fittings can be used in air conditioning systems that use refrigerated water (usually around 7∞C and 1-2 bar) because the operating conditions are fully compatible with those permitted by the system. A mixture that, in addition to water, contains ethylene glycol as an antifreeze agent is also permitted. For other refrigerants you should check that they are not aggressive to PEX and brass. Using the SESTA System for transporting cryogenic fluids such as freon (HFCs and HCFCs) and ammonia is not recommended. Regarding the possibility of the formation of condensation it must be said that, being a phenomenon that does not depend solely on the degree of insulation, but also on the temperature of the refrigerant fluid and on the temperature and humidity of the environment, you should check the suitability of the coating with the specific conditions in which the tube will be used as indicated in UNI EN ISO 12241.



quality control

SESTA ensures, by means of a rigorous "self-checking system", the perfect correspondence of its products to UNI EN ISO 21003 certified by the Italian Institute of Plastics (IIP) no. 348, and the technical standards W534 and W542, certified by German DVGW no. DW-8231BU0247 (tubing) and no. DW-8501BU0248 (system).

Below are a few of the main checks and tests.

Raw material checks

All raw materials are supplied by leading companies. Suppliers and their products are entered in a special "Suppliers List".
The use of a new product requires prior certification that is carried out by a long (over a month) and thorough series of tests carried out on a production batch that uses the new material. Only then are tubes or fittings that use the new raw material commercially available and able to exhibit the marks of the certification bodies.

Compliance regarding:

Certifications: compliance with the technical mechanical characteristics required according to Sesta specifications

Melt flow index: degree of fluidity
- it heats up the polymer base of the PE-X with a special instrument panel and it measure its viscosity, which must match the given parameters.

Dry loss: degree of humidity
- the degree of humidity of the polymer base of the PE-X is measured, as an important factor for the quality of cross-linked polyethylene.

Aluminium camber:
- the perfect straightness of the aluminium strips is checked and the related absence of internal tensions, an essential condition for ensuring that in the passage under the welder, the edges are in the right position.

Degreasing: cleaning external aluminium surfaces

Surface roughness:
- It is checked that the roughness is within the SESTA specifications to ensure the bonding of the adhesive layers.

Automatic in-line checks

Diameter and thickness measurement:

- The production line has three ultrasound systems that constantly measure the diameter and thickness of the various layers and, alerts the operator if a parameter is approaching its tolerance limit.

Aluminium welding check:

- An extremely sensitive system (EddCheck) constantly checks the quality of the aluminium welding by means of induction of an electric current and measures of intensity in the area that is being welded. Minor welding imperfections are detected and reported, so that the line cuts and automatically discards the section of the tube containing the defect.

Line-end checks

On all the rolls

Check of the appearance and integrity of the outer layer.

Check of the internal diameter with a pass/fail gauge.

Ball pass test:

- A ball with a diameter slightly less than that of the interior, is passed through the roll of tubing, propelled by compressed air; this ensures that there are no bulges of the inner layer or out-of-roundness areas.

On samples taken from the line every hour

Bending test to the minimum guaranteed diameter.

- To check that there are no wrinkles or creases on the external surface that would indicate poor adhesion of the layers.

Diameter and thickness check.

Flare test:

- The end of the sample is dilated with a prescribed punch and a check is made that, over time, the inner layer does not tend to shrink and return to original size detaching itself from the aluminium.

Ungluing resistance:

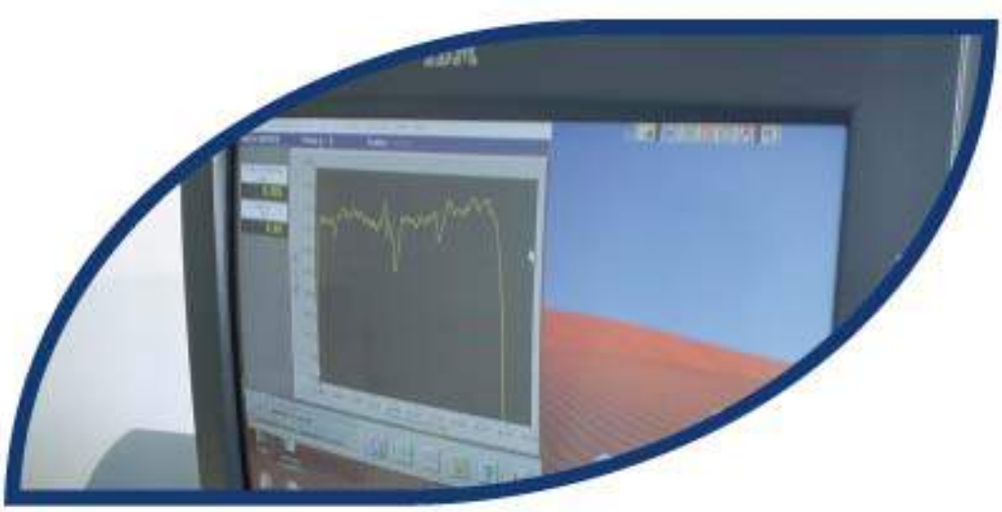
- on a small portion of the 1 cm tube the aluminium layer is removed from that in PEX and it is checked that the layers are properly glued and that there are no sections where glue is not evenly distributed.

Laboratory controls

For the production batch releases, all the samples taken for the line-end controls are brought into the lab and undergo the following tests:

Ungluing resistance

- performed with a dynamometric apparatus which records the force of becoming unstuck as the test proceeds in a graph. The entire graph must be above a minimum value.



Flare test:

- Repeated with the inclusion of a punch with a dynamometer that also measures the insertion force.

Measurement of the degree of cross-linking:

A test is carried out for each work shift and should result in a cross-linking degree of the PE-Xb greater than 65%.

Variation after heat treatment and stretching

- A 10 cm tube sample is dried and ventilated in a cabinet at 120°C;
- No ungluing or cracks should be identified between the layers;
- The stretching must not be greater than 10% of the initial size.

Fitting controls

Chemical analysis of the material

- The chemical composition must correspond to that expected to ensure the drinking water and corrosion resistance requirements (Tab. 10).

Dimensional checks

- compliance with the design drawings is constantly measured.

System checks

Resistance to pressure/temperature

- tube samples, collected for each day or for each batch, are tested at 95°C and 28 bar, respectively, for a period of 165 hours or 1,000 hours (about a week or a month);
- The tests are used to ensure the resistance of the tube at a pressure more than twice the maximum operating pressure.

Fitting shear resistance

- A section of tube between two fittings is subjected to a set traction force measured by a dynamometer and the fittings must not become detached.

Pressure cycles performed periodically on all the diameters

- A standard circuit formed by SESTA tubes and fittings undergoes 5,000 cycles of 0-10 bar pressure;
- The test simulates the resistance of the tube and the seal of the joints to water hammering suffered in the course of the system's life.

Thermal cycles performed periodically on all the diameters

- Test similar to that above; but 5,000 cycles are alternated with a temperature of 20-95°C;
- The test simulates the resistance of the tube and the seal of the joints to sudden temperature changes suffered in the course of the system's life.

Potability and hygiene requirements:

Compliance with Ministerial Decree no. 174/2004 on Specific and Global Migration, is guaranteed both by the manufacturer of the plastic material, and by twice-yearly checks on the finished product carried out by external laboratories. This test is also carried out as required by the DVGW body according to W270 and KTW at 20°C and 60°C.

(Page 13)

the sesta gas system
uni/ts 11344

In December 2009 after the entry into force of UNI/TS 11344: "*Metal-plastic tubes and fitting systems suitable for constructing internal installations for transporting combustible gases supplied by gas distribution networks with a maximum operating pressure of 0.5 bar and an operating temperature from -20°C to +70°C. The SESTA system is inherently suitable for conducting combustible gases, but requested a series of additional tests.*

Then the House has obtained from the Italian Institute of Plastics (IIP) No. ***348*** *certification compliance* ***GAS UNI TS 11344 DVGW*** *certification and no* ***DG 8505CN0430*** *of compliance with* ***DVGW*** *and* ***DVGW VP 6322 VP625****.*

Additional tests for systems for combustible gas transport

Gas constituent resistance test

- designed to verify that the materials in contact with the gas are not damaged by the substances contained within it; it is performed using appropriate reagents for predetermined times, temperatures and pressures, according to UNI EN ISO 1167-1 - 2 (Annex C).

SESTA SRL

Operating temperature resistance test
maximum operating pressure of 0.5 bar and an operating temperature of -20°C to +70°C.

- this test requires repeatedly bringing the specimens to 70°C and then to -20°C; then leak tests are performed.

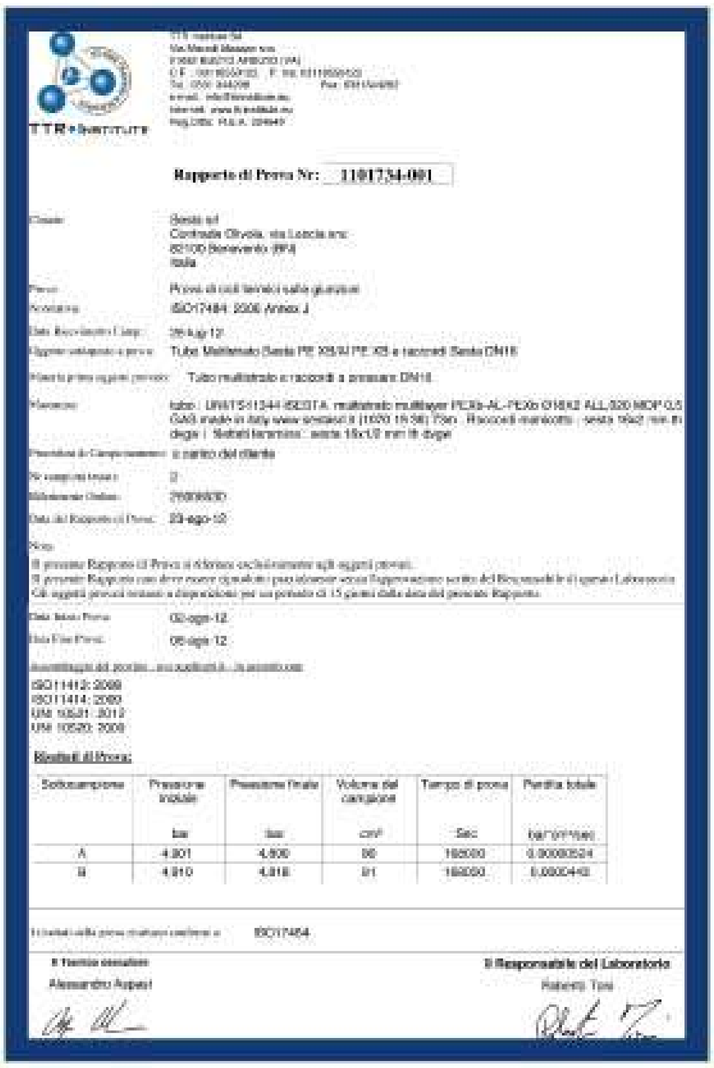
Fire reaction test

- carried out in accordance with UNI EN 13501.

O-ring

- these are specific for gas tubes and comply with UNI EN 682.

The system has been subjected to the thermal cycles at 5 bar test on joints and complies with standard ISO17484:2006 AnnexJ



TTR Institute

Rapporto di Prova Nr: 1101734-001

Sesta srl
Contrada Olivola, via Loscia snc
82100 Benevento (BN)
Italia

Prova di cicli termici sulle giunzioni
ISO17484: 2006 Annex J

Tubo Multistrato Sesta PE X8/Al PE X8 e raccordi Sesta DN16

Tubo multistrato e raccordi a pressare DN16

a carico del cliente

2

23-ago-12

02-ago-12

08-ago-12

ISO11412: 2009
ISO11414: 2009
UNI 10521: 2012
UNI 10520: 2009

Risultati di Prova:

Sottocampione	Pressione iniziale	Pressione finale	Volume del campione	Tempo di prova	Perdita totale
	bar	bar	cm³	Sec	[illegible]
A	4.801	4.800	90	192000	0.0000524
B	4.810	4.818	91	192000	0.0000440

ISO17484

Il Tecnico esecutore
Alessandro Aupasi

Il Responsabile del Laboratorio
Roberto Tosi

certificates

Since its inception Sesta has implemented a corporate process quality management system and obtained ISO 9001-2000 certification, it then updated to ISO 9001-2008. Immediately after having obtained, from the Italian Institute of Plastics, certification of the conformity of its products, at the time only consisting of multilayer tubing, UNI 10954, later implemented in accordance with the new UNI EN ISO 21003.
With the introduction of fittings it requested and obtained certification of the quality of its tubing, fittings and the entire tubing and fitting system, from the German Institute, DVGW.

Corporate processes quality certification

In accordance with ISO 9001-2008 the SESTA corporate system is certified by IIP 739 IQNET IT 16468.
The certification of corporate processes implies that the company has put in place and respects strict management procedures on all aspects of corporate management, in particular those relating to product quality control (standards, procedures, tests, etc.).

Product quality certification

no 348 ACQUA

This certification ensures that production processes and control of all Sesta pipes conform to UNI EN ISO 21003.

no 348 GAS

This certification ensures that control processes for gas SESTA SYSTEM, consisting of the set of most fittings, tubes comply with UNI TS 11344.

no DW 8231 BU 0247 DVGW

This certification ensures that production processes and control of all SESTA tubes are in compliance with KTW W534-UBA-DVGW W270.

no DW 8501 BU 0248 DVGW

This certification ensures that the control processes of the SESTA, consisting of the System along more tubes, fittings conform to W534-BGA KTW-DVGW W270.

no DG-8505CN0430

This certification ensures that control processes for SESTA gas system, consisting of the set of most fittings, tubes comply with DVGW and DVGW VP632 VP625.

Other certifications

The Sesta quality certification of its tubing has been acknowledged by the following foreign certification bodies:

installation standards

The recommendations contained in this document relate to the SESTA system and should only be used by trained and specialised personnel. They contain information of a general nature relating to sanitary water and heating distribution systems for domestic use.
This document will be integrated with more details and standards dictated by national regulations.
In particular, for Italy refer to standard UNI TS 11343:2009.

Storage end transport

Sesta tubing and fittings are packaged and protected to ensure integrity until delivery to the customer.
The tubing must be pulled.
All of the system components must be packaged, transported and stored in such a way that:

- Damage is avoided;
- No component is exposed to adverse environmental conditions (UV rays, rain, dust, etc.);
- Contact with any form of pollutants is avoided (earth, mud, sand, water, waste oil, paints, thinners, cement, gypsum, etc.);
- When removing packages it is necessary to pay attention when using sharp tools that could damage the product.

Assembly instructions for fittings to be pressed

1. Cut the tube perpendicular to its axis with a multilayer tube cutter.

2. Trim the tube using the special tool.
3. Calibrate the tube by inserting and then rotating the special calibrator pin inside the tube (if a special cutter is fitted to the bottom of the pin calibrator steps 2 and 3 are carried out together).

4. Insert the fitting and make sure, by means of the right holes in the bushing, that the tube is pushed to its end of travel limit on the coloured plastic bushing holder. Steps 2 and 3 must be performed again if the insertion of the fitting meets with excessive resistance.

5. Place the crimper pliers with the **TH**profile so that the groove in the jaws corresponds to the coloured plastic bushing holder and proceed with crimping the tube grip bushing (for the H and U profiles place the crimper pliers in contact with the plastic coloured bushing holder). The correct positioning of the tube into the fitting and of the fitting itself in the crimper pliers are essential for normal operation of the system. Consult the appropriate user manual for correct use of the crimper press.

6. When tightened, open the jaws and remove the crimper pliers.

In the case of fittings to be tightened the first 3 operations are identical, then continue with the following:

4. Thread the nut and the cut nose fairing on the tube, in order.
5. Insert the rubber holder in the tube making sure that it is pushed to its end of travel limit on the seal mounted on the fitting.
6. Screw the nut by hand as far as possible, and then tighten with the key.

Per l'istallazione dei raccordi è bene tener presente anche le disposizioni della seguente appendice B della norma UNI/TS11343: 2009

APPENDIX B (informative) **PRACTICAL ARRANGEMENTS FOR THE INSTALLATION OF UNIONS IN THE SYSTEMS MULTILAYER METAL-PLASTIC PIPES**

General Precautions

B.1

The instructions for transport, storage and installation of the system , specified on the vehicle instructions must always be available from the manufacturer and respected by the installer. The installer must always verify the integrity of the fitting before installation.
You can not:

- the use of fittings visibly damaged or otherwise not well preserved ;

- the use of tools and / or shoe / dime other than those specified by the manufacturer of system in the operating instructions and warnings ;

- the use of pipes other than those specified by the manufacturer of the system in the operating instructions and warnings ;

tamper with or replace any gasket.

In ' transport operation is desirable to support the tubes on smooth surfaces and avoid projections unnecessary . The tubes delivered to the site (normally prepared in rolls or rods) must be stored in a place away from sunlight and heat to order not to cause any damage to the tube surface . It is good practice to keep the tubes in the original packaging that contributes to the perfect preservation in order to protect the material from UV rays for solar radiation and avoid contact with sharp objects or abrasives.

B.2 **Cleaning of the jaws and pressing one thing**

The surface of the jaws / dime pressing, in the zone where they come into contact with press connection, it must be kept clean and free of scrap, as well as that lubricated.

B.3 **Maintenance should be carried out periodically by the installer with appropriate tools specified by the manufacturer.**

Maintenance and overhaul tool and pressing of the jaws
TO ensure the efficiency of the tool in time of pressing and of the jaws,
The installer must make sure to perform the maintenance and periodic review equipment, in the manner prescribed by the manufacturer.

B.4

Ends of the tube to be inserted into the fitting

In order to achieve a proper junction with the fittings, the installer must check that the end of the pipe is residue, burrs and sharp cuts not perpendicular to defense of the integrity of the seal (if any).

Provisions for the proper implementation of distribution networks

It is absolutely necessary to prevent the system from being:

- Positioned in the vicinity of high voltage ducts;
- Exposed to atmospheric agents, in particular to UV rays;
- Exposed to aggressive media or that promote corrosion;
- In contact with hot exhaust gases;
- Made in such a way as to jeopardise the stability of buildings and insulation from heat;
- Placed in lifting cages, in environments with the presence of transformers in ventilation or waste water ducts.

It is also necessary, to comply with the following criteria:

- During the implementation of the system, measures must be taken to prevent foreign substances from infiltrating the tubes;
- If foreign substances do enter the tubing and fittings, they must be removed by blowing air and/or other appropriate means;
- When setting up the network voltages and twists of the tubes should be avoided;
- The tubes must be positioned so as to avoid the risk of subsequent damage, for example, from knocks due to lifting or transport means;
- The routing of the tubes must be chosen in such a way as to reduce the risk of damage in case of minor works in the environment (nailing);
- Be careful in the installation that sharp parts made of metal or other components do not damage the tubes;
- Do not mount the tube in contact with sharp edges of the masonry or metal gutters: corners should be rounded;

Bending

During the bending process creating deformations on the inner side of the bend, heating the tube and damaging the outer PE-X coating must be avoided at all costs. The tube can be bent with a radius at least equal to 5 times the diameter, if done by hand, and up to 3.5 times the diameter, with a tube bender.
The table below shows the minimum bending radius in millimetres.

pipe diameter	14	16	18	20	26	32
hand bending radius	70	80	90	100	130	160
radius of curvature with folding tubes	49	56	63	70	91	112

Thermal expansions

Although the multilayer has a rather low thermal expansion coefficient comparable to that of the metals, 0.026 mm/(m°C), stretching due to temperature changes must be taken into account, especially when installing quite long sections.

The table below shows the thermal expansions in mm with varying lengths in m and the temperature in °C.

Lunghezza del tubo	variazione della temperatura						
	10	20	30	40	50	60	70
1	0,3	0,5	0,8	1,0	1,3	1,6	1,8
2	0,5	1,0	1,6	2,1	2,6	3,1	3,6
3	0,8	1,6	2,3	3,1	3,9	4,7	5,5
4	1,0	2,1	3,1	4,2	5,2	6,2	7,3
5	1,3	2,6	3,9	5,2	6,5	7,8	9,1
6	1,6	3,1	4,7	6,2	7,8	9,4	10,9
7	1,8	3,6	5,5	7,3	9,1	10,9	12,7
8	2,1	4,2	6,2	8,3	10,4	12,5	14,6
9	2,3	4,7	7,0	9,4	11,7	14,0	16,4
10	2,6	5,2	7,8	10,4	13,0	15,6	18,2

When installing the tubes these variations in length must be taken into account. In embedded tubes stretching/shrinking can usually be absorbed by the foam that is used for thermal insulation. Correctly fixed and sliding supports are needed for tubes in the air, so that straight-line section expansions do not get blocked. For long sections it may be appropriate to use omega-shaped expansion loops.

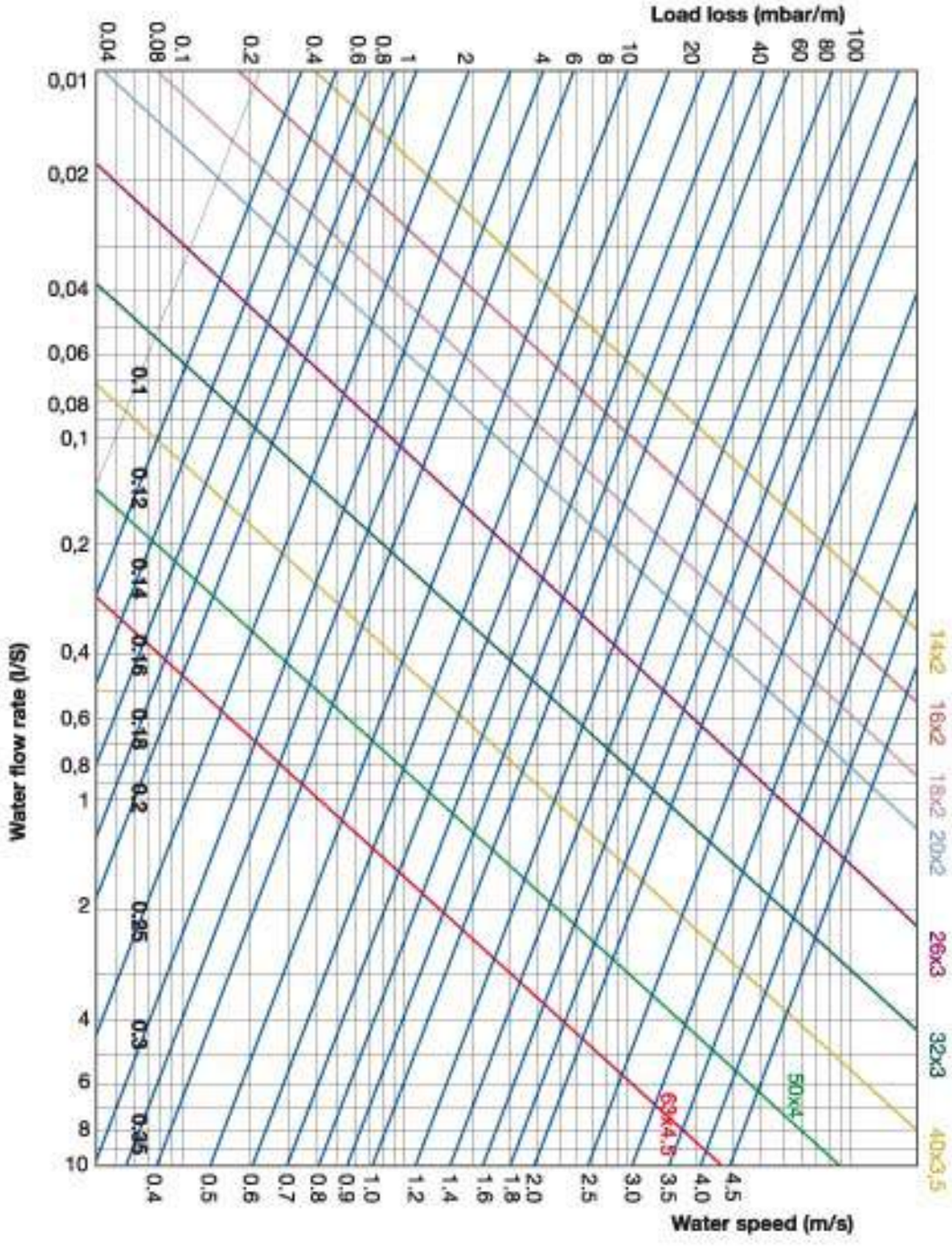
UV rays resistance

Store the Sesta multilayer tube protecting it from sunlight and UV radiation. The coating with insulating material itself constitutes protection.

Load loss

The graph below identifies the load loss in mbar/m, depending on the flow or the speed of the water for each tube in the SESTA product list.

Water temperatura 50 °C



Correction factors for different temperatures than 50°

T °C	90	80	70	60	50	30	20	10
Correction factors	0,9	0,93	0,95	0,97	1	1,05	1,09	1,14

For curves and fittings you can refer to the table below, where the load loss are indicated in "equivalent metres of tube".

DIAMETER	CURVED TUBE	STRAIGHT	ELBOW	TEE	TEE	TEE
						
14x2	0,75	1,15	1,80	1,50	1,75	1,90
16x2	0,63	0,80	1,40	1,00	1,53	1,50
18x2	0,60	0,75	1,30	0,90	1,50	1,35
20x2	0,54	0,65	1,10	0,73	1,44	1,24
26x3	0,50	0,25	1,05	0,62	1,40	1,20
32x3	0,50	0,20	0,95	0,58	1,30	1,10
40x3,5	0,45	0,35	1,15	0,55	1,20	1,25
50x4	0,48	0,45	1,15	0,65	1,20	1,30
63x4,5	0,50	0,50	1,20	0,70	1,10	1,25

To calculate the total load loss of a network section comprising tubing and fittings, it is necessary to refer to a virtual length obtained by adding the equivalent lengths corresponding to the fittings to the actual length.

Load loss for gas

To calculate load loss in combustible gas distribution networks, please refer to the Sesta technical manual for gas.

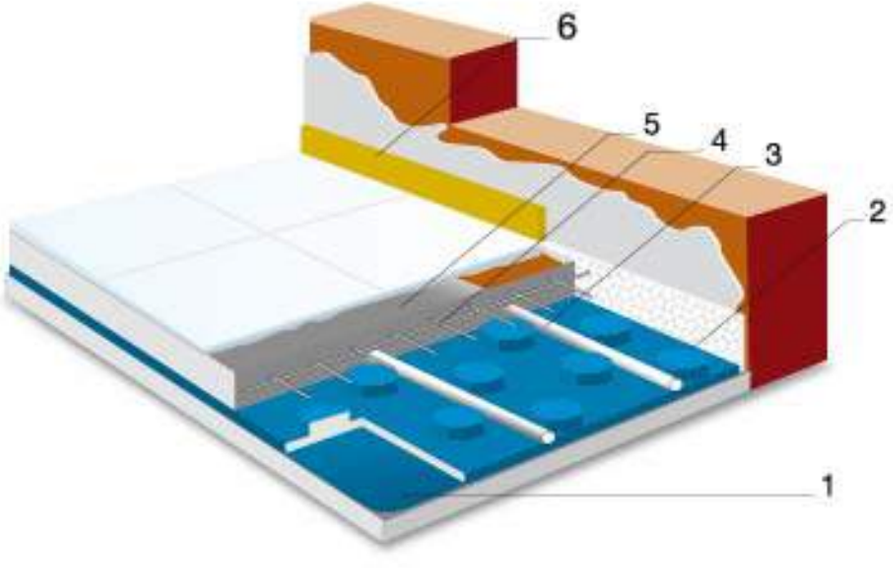
ANNEX A
floor heating

General

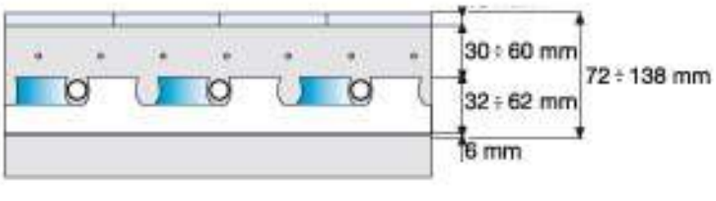
Regulations designed to save energy and cut pollutant emissions, combined with advanced control systems and the contribution of expert professionals, contribute to the ever greater dissemination of the floor heating system.
This solution is certainly one of the most valid among those offered by the heating market, both in a civil, commercial and industrial context. The plant-design techniques available allow maximum flexibility and adaptability to any type of construction-related need. By referring to specialist publications to analyse the benefits of floor heating compared to other systems, it should be noted that they improve: hygienic conditions, aesthetic aspects, wellness and energy consumption.

Laying a floor heating system

Laying the constituent elements of underfloor heating requires the following steps:
1. Make sure you have a clean and regular foundation. In the case of laying in a place in direct contact with soil, waterproofing with a moisture-barrier film is required.
2. Apply the polyethylene foam perimeter band to the base of all vertical surfaces (walls, columns etc.). This purpose of this band is to absorb the expansions of the screed that are generated as the temperature varies.



1 Moisture-barrier film
2 Insulating panel
3 SESTA tube 16 x 2
4 Anti-shrinkage mesh
5 Concrete
6 Perimeter band



3. Lay out the insulating panels taking care to connect the appropriate joints in such a way as to not create the possibility of thermal bridges in the concrete.
4. Lay out the SESTA 16x2 tube as specified in the execution plan.
5. After arranging the circuits lay out the anti-shrinkage mesh.
6. Make the screed and lay the floor.
7. Cut and remove the part of the peripheral band above the floor. The gap that is created must be covered with skirting board.

SESTA tubes

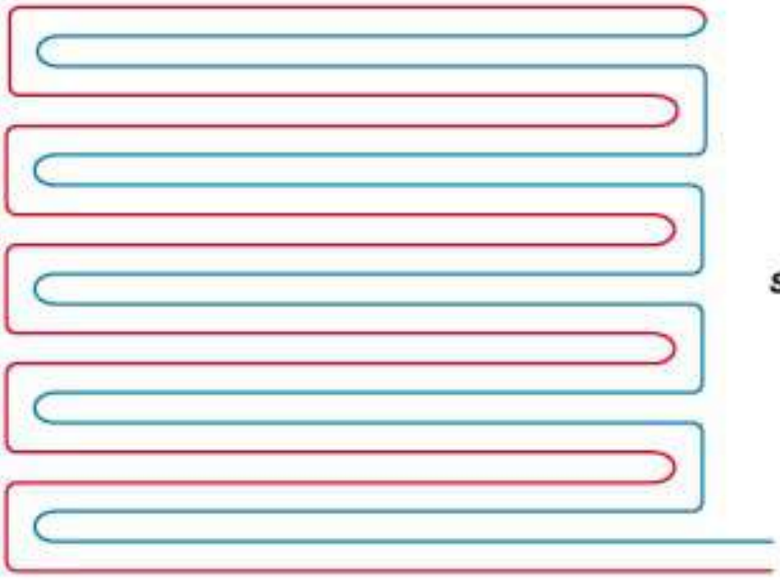
For the specific needs of underfloor heating Sesta produces its own multilayer PE-X/Al/PE-X tube also in very large rolls up to 500 m. This reduces waste to a minimum.

The multilayer PE-X /Al/PE -X, in addition to the known characteristics of resistance to high temperatures and which does not alter over time, is the ideal tube for underfloor heating because of the following qualities:

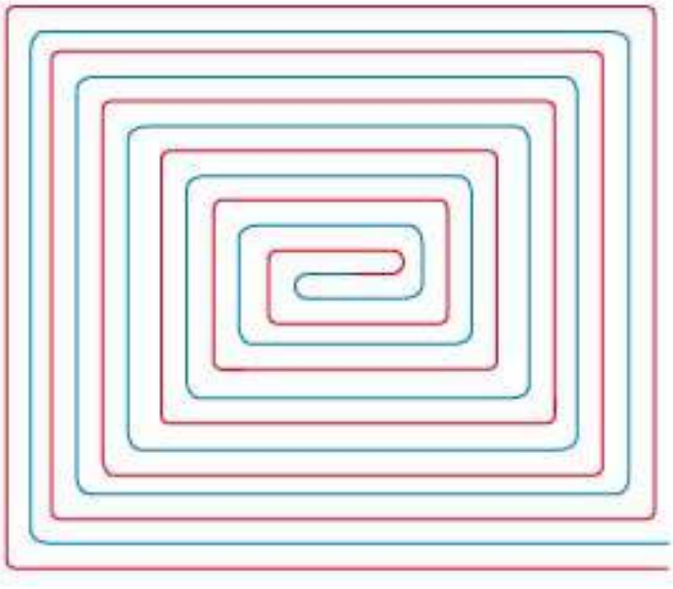
- Special mechanical characteristics that allow you to retain the circular section, corresponding to the curves and it maintains its shape after bending, with the consequent reduced need for clips.
- Thermal expansion coefficient of 0.26 mm/m°C the same as for metal tubes and about 10 times lower than that of all plastic tubes.
- PE-X is resistant to corrosion and fully protects the intermediate aluminium layer; it is also particularly resistant to abrasions and has a very smooth surface that prevents deposits from forming.
- The intermediate aluminium layer is an absolute barrier to the passage of gaseous molecules, in particular to the infiltration of oxygen.

PE-X **load loss** is particularly low, since the surface is very smooth it does not form deposits and remains unchanged over time. Due to the curves that the heating circuit has linear load loss that can be identified in the specific diagrams should be increased to:

- Approximately 13%, in the case of a spiral coil
- Approximately 17% for simple, single or double coils.



Simple double coil



Spiral coil

For the sake of convenience the following two tables indicate the load loss of PE-X tubes size 16x2 mm, for water at 30°C, which has already increased by the above percentages:

Spiral coils

Scope (l/h)	Scope (l/s)	Speed (m/s)	Pressure drops (mbar/m)
95	0,026	0,23	**0,99**
108	0,030	0,27	**1,24**
120	0,033	0,30	**1,49**
131	0,036	0,32	**1,74**
142	0,039	0,35	**1,99**
152	0,042	0,37	**2,24**
161	0,045	0,40	**2,49**
170	0,047	0,42	**2,73**
179	0,050	0,44	**2,98**
187	0,052	0,46	**3,23**
195	0,054	0,48	**3,48**
203	0,056	0,50	**3,73**
222	0,062	0,54	**4,35**
239	0,066	0,59	**4,97**
256	0,071	0,63	**5,59**
272	0,076	0,67	**6,22**
302	0,084	0,74	**7,46**
329	0,091	0,81	**8,70**
356	0,099	0,87	**9,94**
380	0,106	0,93	**11,2**
404	0,112	0,99	**12,4**
509	0,141	1,25	**18,6**
600	0,167	1,47	**24,9**

Simple coils

Scope (l/h)	Scope (l/s)	Speed (m/s)	Pressure drops (mbar/m)
95	0,026	0,23	**1,03**
108	0,030	0,27	**1,29**
120	0,033	0,30	**1,54**
131	0,036	0,32	**1,8**
142	0,039	0,35	**2,06**
152	0,042	0,37	**3,32**
161	0,045	0,40	**2,57**
170	0,047	0,42	**2,83**
179	0,050	0,44	**3,09**
187	0,052	0,46	**3,35**
195	0,054	0,48	**3,6**
203	0,056	0,50	**3,86**
222	0,062	0,54	**4,5**
239	0,066	0,59	**5,15**
256	0,071	0,63	**5,79**
272	0,076	0,67	**6,44**
302	0,084	0,74	**7,72**
329	0,091	0,81	**9,01**
356	0,099	0,87	**10,3**
380	0,106	0,93	**11,6**
404	0,112	0,99	**12,9**
509	0,141	1,25	**19,3**
600	0,167	1,47	**25,7**

Correction factors for load loss for different temperatures than 30°C

T °C	90	80	70	60	50	30	20	10
Correction factors	0,86	0,89	0,91	0,93	0,95	1	1,04	1,09

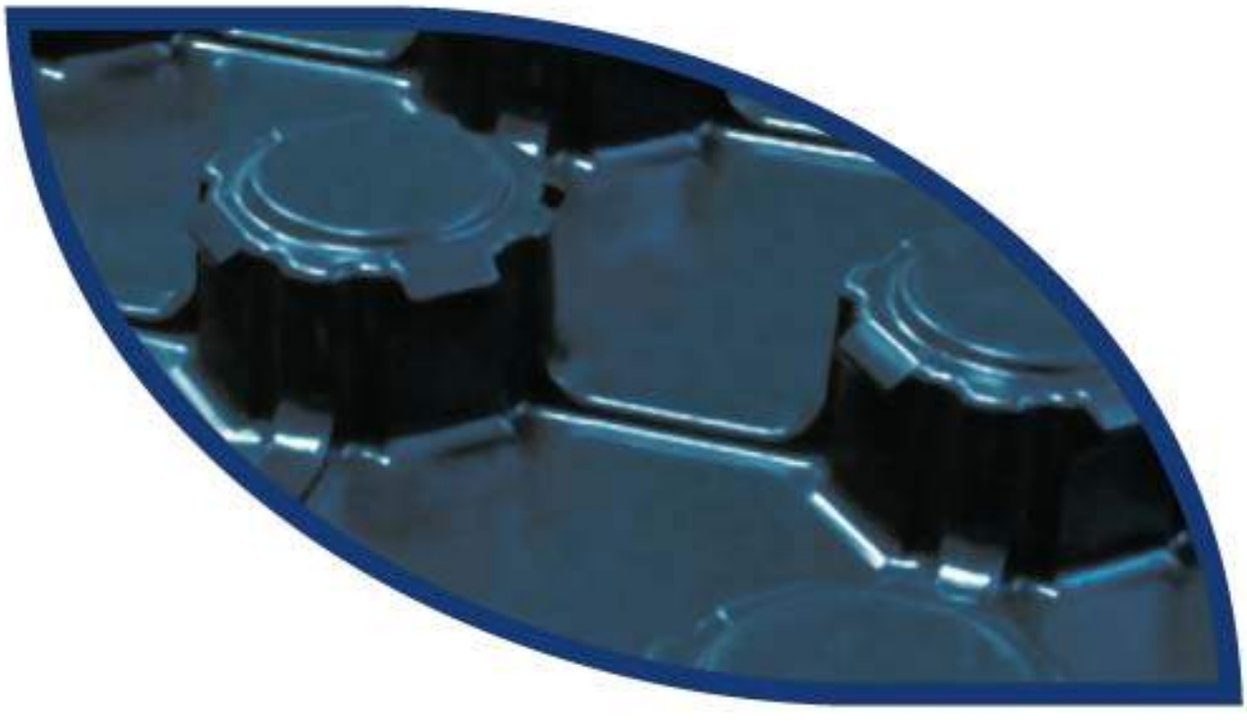
Sesta also produces a multilayer PE-RT/Al/PE-RT tube and sells a PE-X tube with an EVOH oxygen barrier. These tubes are more economical than the multilayer PE-X/Al/PE-X but they are only good for low temperature heating and not for traditional heating with radiators.

Moulded panels for thermal insulation

Sesta offers two types of thermal insulation panels and a guide to laying tubes, made of polystyrene foam and a rigid polystyrene coating (UNI EN 13163) which can be thermoformed or heat-sealed.

The panels are made of polystyrene foam for thermal insulation, have ashlar surfaces and interlocking perimeters and have the following specifications:

• Tube feed: 50 mm	50 mm
• Panel size: 1400 x 800 mm	1400x800 mm
• Total thickness: 32-62 mm	32-62 mm
• Insulation mat thickness: 10-40 mm	10-40 mm
• Thermal conductivity: 0.033 W/mK	0,033 W/mK
• Thermal resistance: 0.41 - 1.29 m2K/W	0,41-1,29 m^2K/W
• Compression strength at 10% of compression: 200 kPa	200 kPa



Manifolds

The distribution manifolds are pre-assembled and 100% tested at the factory. They are obtained from a brass-drawn bar CW614N and are nickel-plated.

Technical characteristics:

• Maximum operating temperature: 110°C	110°C
• Maximum operating pressure: 10 Bar (6 with flow metres)	10 bar (6 con misuratori di portata)
• Head threading: 1" - 1"1/4	1" - 1"1/4
• Thread derivations: 3/4" eurocono	3/4" eurocono
• Number of derivations: from 2 to 12	da 2 a 12
• Interaxis derivations: 50 mm	50mm

The manifolds are accompanied by manual valves for adjusting the flow rate, 2 vent valves and 2 drain cocks. They can also be supplied with electro-thermal heads and flow metres.

Accessories

The Sesta range is completed by the polyethylene foam perimeter band, tube-fastener clip, a fully articulated coiling unwinding tool and a set of complementary items for manifolds such as butterfly valves, thermometric kit and toolboxes.

Design

Sesta can also provide the execution plan for the system based on the dimensional characteristics of the property and on thermal needs indicated by the installer.