TECHNICAL SPECIFICATIONS

U - PVC PIPES FOR CONDUCTION OF FLUIDS UNDER PRESSURE

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INTERNAL STANDARDIZATION

MATERIALS

DESCRPTION:

U - PVC pipes for the conduction of water and fluids under pressure according to UNI EN 1452 with rubber ring socket (elastomeric gasket)

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ISSUED BY STANDARD AND NORMS	
VERIFICATION OF CONFORMITY OPERATIVE SERVICES	
VERIFICATION COSTUMERS AND SERVICES	

1. AIM AND FIELD OF APPLICATION

This specification has the aim to regulate the modalities of delivery and testing of UPVC pipes.
for conduction of water and food- fluids under pressure, conforming to Dlgs 06/04/2004 n. 174 " regulation .
concerning materials and objects which can be used within fixed plants of purification, treatment, conduction, and distribution of water used for human consumption".

2. STANDARDS OF REFERENCE

UNI EN 1452 pipes systems of plastic material for conduction – unplastified Polyvinyl-chloride – UPVC.

3. REQUIREMENT PRESCRIBED

3.1. RAW MATERIAL

The blend has mainly to be made of PVC (polyvinyl-chloride) with the sole addition of not toxic fluidification material and stabilizers, inert charges and other additives in quantities necessary to extrusion and to give a guarantee of stability of the characteristics of the polymer both during the working process and the life of the product.
The blend used for the production of pipes, either in granules or powder, must not be used for any other utilisation or working process than the required for the production of pipes.

The use of the following materials is not admitted:

^ plastifiers and/or mineral charges which may alter the mechanical and hygienical characteristics of the pipe.
^ PVC from regeneration of already used polymers, even if selected.
^ the use of material having been extruded once, obtained from grinding of pipes and fittings, which had already
been extruded, even if they have the characteristics which conform to this specification.

The characteristics from PVC powder have to be conform to the requirements of UNI EN 1452-1 and satisfy the data indicated in the following table:

3.1.1. CHARACTERISTICS OF PVC RESIN (POWDER)

Characteristics	Requirements
K Value	65 ÷ 70
apparent specific weight	0,5 ÷0,6
Particle size measurement	> 250 mm 5% max. < 63 mm 5% max.
Residual VCM (Vinylchloride - Monomer)	< 1 ppm (1mg/kg max.)
Volatile substances	≤ 0,3%

3.1.2 CARACTERISTICS OF U - PVC BLEND

The characteristics of the blend in shape of a pipe, must correspond to the requirements of UNI EN 1452-1 and satisfy the following table.

Characteristics	Requirements
M.R.S. (according to ISO/TR 9080)	≥ 25 MPa
specifc weight	1,35÷1,46 g/cm^3
unitary yeld point	≥ 48 MPa
yield	< 10%
coefficient of elasticity	> 3.000 MPa
coefficient of linear thermal expansion	0,06÷0,08 mm/m°C
thermal conductivity	0,13 kcal/mh°C

3.2. PIPES

The pipes have to be produced with raw material (PVC blend) corresponding to the requirements as indicated in the previous table and as follows:

Colour	**Grey** considering that pipes may be exposed to sun-rays, a minimum fading of the colour on one part of the pipe must not compromise the quality of the pipe to be used and therefore may not be a reason of rejection of the same, on delivery. RAL 7011	RAL 7011
Aspect	the inside and outside surfaces of the pipes must be smooth, clean and without cavities, impurities and porosities or any other irregularity on the surfaces which might hinder their conformity to the norms of reference and these specifications. UNI EN 1452	UNI EN 1452

3.2.1. MECHANICAL AND PYSICAL CHARACTERISTICS

The characteristics of the pipes must conform to the requirements of UNI EN 1452-2 and satisfy the requirements of the following table:

<table>
<tr><th>Characteristics</th><th colspan="3">Requirement</th><th>Methods</th></tr>
<tr><td>shock resistence</td><td colspan="3">T = 0°C - TIR < 10%
conform to schedule 6 of UNI EN 1452-2</td><td>UNI EN 744</td></tr>
<tr><td>Resistance to interior pressure</td><td colspan="3">No yeld during the test
20 °C / 1h / sigma= 42 Mpa
20 °C / 100h / sigma= 35 MPa
60 °C / 1000h / sigma= 12.5 MPa</td><td>UNI EN 921</td></tr>
<tr><td>Temperature of softering
Vicat(VST)</td><td>≥ 80 °C</td><td colspan="2">Conform to UNI EN 727</td><td>UNI EN 727</td></tr>
<tr><td rowspan="3">Logitudinal shrinkage</td><td rowspan="3">≤ 5%
the pipe must non show delamination, blister or breakage</td><td>Testing Temperature
Time of immersion
For :
e ≤ 8 mm
e > 8 mm</td><td>150 °C

15 min
30 min</td><td>UNI EN 743
Method A: bath liquid</td></tr>
<tr><td colspan="3">or</td></tr>
<tr><td>Testing Temperature
Time of immersion:
e ≤ 8 mm
e > 8 mm</td><td>150 °C

30 min
60 min</td><td>UNI EN 743
Method B:
In air</td></tr>
<tr><td>Resistence to dichloromethane
at a specified temperature</td><td>No attack in any part of the surface of the test piece</td><td>Testing temperature
Time of immersion</td><td>15 °C
30 min</td><td>UNI EN 580</td></tr>
</table>

3.2.2. CONNECTIONS SOCKET / GASKETS

the connections are made by means of sockets with elastomeric gasket. Gaskets have not to be toxic at all according to the present norms for this subject (sanitary discipline) and conforming to norm UNI EN 681/1.

The system of connection has to correspond to the requirements of UNI EN 1452-5 for every single class of pressure (PN) and has to be tested according to:

a) EN ISO 13844 elastomeric gaskets for socket connections to be used with UPVC pipes – testing method for tightness of negative pressures;
b) EN ISO 13845 elastomeric gaskets for socket connections to be used with UPVC pipes – testing method for tightness of internal pressure with angular deflection of the connection.

3.2.3. MINIMUM MARKING

the minimum marking on each meter of pipe must be indelible and show at least the following data:

- name of the producer and/or trade mark of the product
- number of the norm of the system (UNI EN 1452)
- quality mark of the product
- raw material (U-PVC)
- outside diameter of the pipes x wall thickness
- nominal pressure (PN) and SDR and/or series (s …)
- day, month, year and shift of production
- number of the extrusion line
- date of production

Customers may anytime ask further informations to the producer

3.2.4. GEOMETRICAL CHARACTERISTICS - DIMENSION OF PIPES

3.2.4.1. Diameters, thickness and tollerances

pipes have to be formed (SDR) as forseen by the National Introduction of UNI EN 1452 and have dimensions conforming to schedules 1,2,3 of Chapter 6 of UNI EN 1452-2 “geometrical characteristics”.

Particularly in this discipline there is shown the prospectus including minimum wall thicknesses indicated in mm

Nominal outside dlameter	Nominal Wall thicknesses (minimum) (mm)			
(mm)	PN 6 bar	PN 10 bar	PN 16 bar	PN 20 bar
20			1.5	1.9
25			1.9	2.3
32		1.6	2.4	2.9
40	1.5	1.9	3.0	3.7
50	1.6	2.4	3.7	4.6
63	2.0	3.0	4.7	5.8
75	2.3	3.6	5.6	6.8
90	2.8	4.3	6.7	8.2
110	2.7	4.2	6.6	8.1
125	3.1	4.8	7.4	9.2
140	3.5	5.4	8.3	10.3
160	4.0	6.2	9.5	11.8
180	4.4	6.9	10.7	13.3
200	4.9	7.7	11.9	14.7
225	5.5	8.6	13.4	16.6
Nominal outside diameter	Nominal wall thickness (minimum) (mm)			

(mm)	PN 6 bar	PN 10 bar	PN 16 bar	PN 20 bar
250	6.2	9.6	14.8	18.4
280	6.9	10.7	16.6	20.6
315	7.7	12.1	18.7	23.2
355	8.7	13.6	21.1	26.1
400	9.8	15.3	23.7	29.4
450	11.0	17.2	26.7	33.1
500	12.3	19.1	29.7	36.8
630	15.4	24.1		
710	17.4	27.2		
800	19.6	30.6		
900	22.0			
1000	24.5			

3.2.4.2. Lenghts

pipes have to be delivered for all outside - diameters asked for in lengths of 6 meters (socket included).

3.2.4.3. Ends of pipes

the pipe has to have plain ends, sharply cut and must be perpendicular to the axis of the same pipe, having an outside chamfer of about 15°.

4. CONTROLS AND RESPONSABILITY

The contractor reserves the right to himself and to the person he is going to encharge to assist the tests and controls carried out to check if the requirements prescribed by the norms of production and by these specifications are fulfilled.

The supplier, therefore, will do his best to favour the free access of the persons encharged by the contractor to the production plants of the pipes in a moment whatever during the different phases of production and to the laboratories during the phases of control and testing, comunicating within a reasonable period of time the beginning date of production of the pipes ordered. He will further give to the persons in charge, full liberty of actions to make the controls necessary, in line with the requirements of production.

The contractor reserves himself the right to check by means of taking samples of pipes and/or of the the raw material, the corrispondance of the same to the present specifications and to the supplier’s declarations.

It is understood that the presence of the persons encharged, during the tests, will not be a substitute of the controls to be carried out by the seller, who is the only one responsible for the quality of the pipes he produces.

The seller will bear any costs deriving from the delivery of pipes not conforming to the requirements of these specifications.

5. DOCUMENTS AND CERTIFICAZIONS OF QUALITY

the supplier has to enclose to his offer:

- the certification of conformity of the Internal Quality System conforming to UNI EN ISO 9000, issued by an independ Institute or Company in conformity with UNI CEI EN 45012;
- a signed declaration regarding the use of vergin raw material (blend), which does not contain already worked material or substances which can damage the human body;
- a certificate of conformity of the product to norm UNI EN 1452 for pipes, issued by an independent Istitute, Body or Company, in conformtiy with UNI CEI EN 45011.

6. AFTER SALE ASSISTANCE

If agreed upon , when the order had been made, the supplier has to guarantee as follows:

- assistence by means of qualified technicians at the begin of work within the building yard in order to check the correct way of installation (recommendations according to UNI EN 1452-6 and ENV 1046).
- Assistence of competent personell regarding the procedures of testing the laying within the building yeard (in case of water conducts, forseen by the law according the the Ministerial Decree DM 12.12.85) of burried pipe-lines for fluids under pressure (execution according to method UNI EN 805, hydraulic test of conducts with a viscoelastic behaviour).

7. HANDLING AND TRASPORT OF MATERIALS

For the handling and transport of the pipes there have to be adopted all those procedures which are idoneous to make sure that the same reach at destination completely integral. A possible deterioration of the pipes, ascertained on delivery of the same, will turn out into a claim of defect material. The pieces claimed will remain at the disposal of the supplier.
Possible repairings or controls will be at the supplier’s charge.
As for loading, transport, unloading and storing of the pipes and special pieces, reference will be made to the prescription of the Ministerial Decree (D. M.) 12.12.1985 (and successive modifications and integration) .

7.1 TRANSPORT OF PIPES

When transporting pipes, the loading surface must not be rough. It is necessary to support pipes for their whole length, thus avoiding the possibility that pipes get damaged due to vibration. In order to fix the load, straps of hemp, nylon or similar material can be used, taking care that the pipes will not get damaged.

7.2 LOADING; UNLOADING AND HANDLING

if loading and unloading of a means of transport or, anyway the handling of the material is done by means of a crane or the arm of an excavator, pipes have to be lifted in the center by an equalizing rocker arm of at least 3 meters.
If these works are done by hand, it has to be avoided to slide pipes on to the side boards of the mean of transport or, anyway, on hard and sharp objects.
The person in charge of the building site has to check all working processes of unloading in order to be sure of their regularity.
Each damaged product will be identified by writing ‘’ not to be used’’ and will be isolated in an extra area.
The person in charge has to comunicate as soon as possible, the existence of a damaged product to the Contractor’s Director of Work, who then will take the actions necessary, according his unobjectionable opinion.
If a crane is used, there has to be an efficient system of communication between the worker inside the crane and the worker beside the mean of transport.

7.3 STORING OF PIPES

the best solution for the storage of pipes would be to use wooden crates or crates of other materials, to be able to resist to the weight of the pallet put on top. The storage has to be carried out with great care and the pallets have to be aligned.
The supporting surface of the pallets stored hs to be levelled, not to be rough and must not have stones with sharp edges. Every possible idoneous solution has to be adopted in order to avoid any interference with the local traffic, both
Vehicles and pedestrians, and with any other already existing structure.
The pipes have to stored in a way to avoid possible accidents due to an unforseen movement of the same.

7.4 CONSERVATION OF TH MATERIALS

It is absolutely necessary to adopt measures , that in case of long term storage, pipes of UPVC and plastic fittings can be put inside, away from sun-rays, in order to avoid the risk of degradation of the polymers and the decay of their chemical, physical, and mechanical properties.
Fittings may be packed in different ways according to their shape, dimensions and type of transport. If they are delivered without packaging, it has to be taken care not to pile them up without method, thus avoiding a collision between the single pieces or between the fittings and other heavier materials.
In any case they cannot be put near heating devices or exposed to direct sun-rays until they are used.
Similar indications have to be followed for the conservation of lubricants.

8 MODALITY AND PROCEDURES OF LAYING IN SITE

8.1 Tipologies of trenches

The type of trench required by the project based on the evaluation of loads, the type of soil and the organisation of the building yard, has to be scrupulously carried out in the next phase of execution..
During the phase of execution it is therefore important to have a scrupulous correspondance betweeen the project and its effective realization.
In the table below there are some main typologies of trenches showing the relationship between the diameter of the pipes (D indicated in meters), the width of the trench at the level of the upper part of pipe (B in meters) and the height of filling on the upper part of the pipes (H in meters).

Tiype of Trench	B(widht of the trench)	
Small Trench	≤ 3 D	< H/2
Large Trencj	3 < D < 10	< H/2
Embankment	≥ 10 D	≥ H/2

8.1.1 Small Trench

this is the best way to lay a U-PVC pipes. The pipe does not have to bear all the load from above, as it transmits part of it to the surrounding soil depending on the deformation due to the deflection, the product is submitted to.

8.1.2 Large Trench

the load the pipe has to bear will be more than the one it has to support in a small trench. For this reason this has to be considered during the planning. This hypothesis has to be born in mind in order to obtain a certain security when making the calculations of the dimensions.

8.1.3 Embankment (positive position)

the upper part of the pipe is put on a natural level of the soil. If there is much load passing through, this typology has <u>not to be adopted</u> due to sinking of the soil in absence of excavations on the sides.

8.1.4 Terrapieno (negative position)

The pipe is put at a lower level than the natural one of the soil.
Due to friction, even if a very light one, between the filling material put on the embankment and the natural sides of the trench, the pipes can support slightly more load than those in the positive position, but in any case less than those laid in a small and large trench. Therefore, even this typology is not advisable.

8.2 Depth of the trench

The depth of the pipes H (in meters) understood as distance between the soil and the upper part of the pipes must satisfy the most protective of the following requirements, where D is the outside diameter expressed in meters.

$H \geq 1{,}0$

$H \geq 1{,}5\ D$

8.3 Width of the trench

This is determined by the laying depth and by the diameter of the pipe, as it has to allow the settlement of the bottom, the connection of the pipes and the movement of the workers. The minimum width of the soil B (in meters) is normally:

$B = D + 0{,}5$ with $D \leq 0{,}4$ m

$B = 2D$ with $D \geq 0{,}5$ m.

On the other side, the inferior limit values have not to be exceeded very much as the efficiency of the trench is higher when the width is smaller.

8.4 Bottom of the trench

The trenches have to be made without bumps or unevenness in order to establish a continuous support for the pipes. It is not advisable to use a bottom with a concrete bed or similar as this will make the structure rigid.

When the trenches are open on heterogeneous soil, situated on hills or in the mountains, it is necessary to anchor in order to avoid possible sliding of the soil.

If there might be an instability of the soil due to water within the trench, it is necessary to re-inforce the soil bottom by means of draining pipes under the canalization.
Around these pipes has to be put a compact strata of gravel or other material suitable to this purpose.
In other words, it is necessary to make sure that there won't be any possibility that the filling material could move due to ground water.

8.5 Laying Bed

There has to be a stabil laying bed on an even level, for canalization of U-PVC pipes. It has to be free from pebbles, heap of stones and possible other materials. The laying bed must not be build before having a complete stabilization of the trench bottom. The material used in normal laying conditions is sand mixed with gravel of a maximum diameter of 20 mm. If the soil has slopes, it is advisable to avoid sand, giving preference to gravel or crushed stones without edges, cut to pieces of maximum 10/15 mm.
The material has then to be accurately compacted and has to achieve a thickness of minimum (10 + 1/10 D) cm.

8.6 Norms of compacting and quality control

As U-PVC pipes are flexible, the uniformity of the surrounding soil is basically for a correct construction of a carrying structure, because the soil, deformed by the pipes, reacts in a way to give a help in supporting the load. In order to assure stability and integrity of he pipes laid, within the time, it is pointed out that the contractor has to take a great care regarding the laying of the pipe bed, the support and the first covering of U-PVC and has to apply scrupulously the present norms.
The degree of compacting of the material, which forms the supports, has a determining influence on the value of diametral deformations (x /D) of the pipes. This value, which must not exceed the limits permitted, can be deduced by the formula of Spangler,

$$x = \frac{0{,}125 \cdot Q}{E \cdot (s/D)^3 + 0{,}0915 \cdot E_1}$$

with:
Q = total external load on the pipe [kg/m];
E = modulus of elasticity of the pipe[kg/m^2];
s = thickness of the pipe [m];
D = diameter of the pipe [m];
E_1 = modulus of elasticity of the soil [kg/m^2].
Particularly E_1 depends on the factor of compacting α' according to the relation: :

$$E_1 = \frac{9 \cdot 10^4}{\alpha'} \cdot (H + 4) \,,$$

where H [m] is the height of filling measured from the upper side of the pipe.
Furthermore α' is connected to the Proctor index as indicated in the following table:

Proctor Test	α'
95%	1,0
90%	1,5
85%	$1{,}5^2$
80%	$1{,}5^3$
75%	$1{,}5^4$

The Proctor index defines normally the degree of compacting of the soil.
For U-PVC pipes a Proctor index of at least 90% has to be considered.
The achievement of the value required for the Proctor index has to be verified by means of appropriate tests and respective certifications, the number of which is fixed during the planning.
The above mentioned tests, defined as tests of compaction and determination of the characteristics of density of materials, must be carried out with the standard method AASHO with 4 points of the curve density/content of water.
In order to obtain the density required methods of compacting are used (by hand with flat presses or with light mechanical apparata).

8.7 Laying of the pipe

before laying the pipes, they have to be checked one by one in order to discover possible defects; the end part and the socket of the pipes have ot be integral. The pipes and fittings must be put on the laying bed in a way to have a continuous contract with the bed.

The niches, excavated before, for the accomodation of the sockets (even if the dimension of the socket is minimum, it is normal to forsee a niche in correspondance of its support), if necessary, have to be accurately filled in order to avoid possible empty spaces under the sockets.

8.8 Procedure of filling

The filling of a trench and generally of the excavation, is fondamental for the laying. As we ar dealing with UPVC pipes, the uniformity of the soil is absolutely necessary in order to have a perfect construction of the carrying structure, as the soil reacts in a way, giving a contribution to support the given load. The material already used for the construction of the bed is put around the pipe and solidated by hand in order to form successive strata of 20 cm. up to half height of the pipe. It has to be taken care that there won’t remain any empty spaces under the pipes and that the strata L1 of the filling material between the pipe and the wall will be continuous and compact.
The second strata of filling L 2, reaches the upper part of the pipe. Its compactness has to be carried out with maximum care. The third strata L3 reaches 15 cm over the upper part of the pipe. Compactness has to be only at the sides of the pipes, never vertically on the same.
The solidation of filling around the pipe must be uniform and reach 90% of the optimal value determined by the modified Proctor test. The support with turfy, muddy, clayly, or frozen soil is not allowed as this kind of soil cannot be solidated as it contains too much water.
Further filling is made (strata L4 and L5) by material obtained from excavation. This material is cleaned from elements having a bigger diameter than 10 cm and from vegetal and animal fragments. The filling has to be made for the following strata up to 20 cm. It has to be compacted and eventually watered for a thickness of 1 m (measured from the upper part of the pipe), so that the density of the soil, once solidated, reaches 90% of the optimal value determined by the modified Proctor test. The bigger material (stones of a diameter > 2 cm) must not exceed the limit of 30%.
At last there has to be a free space for the last strata of vegetal soil.

8.9 Special laying conditions

If there is a ground water table, it has to be ascertained that this table does not cause any movement of the filling material surrounding the pipe. The surrounding soil has therefore to be solidated by means of draining, operating under the level of excavation, and thus avoiding every possible instability of the laying soil and brickworks.

If during the work, for limited distances, there will appear some harder laying conditions than those forseen by the project (enlargements of walls, landslides etc) works of protection have to be carried out in order to come back to laying conditions as described. There must be extra-walls of heaps of stones or concrete in order to reduce the length of the section of excavation or there must be adopted other solutions authorized by the Direction of Work.
In case, for technical reasons the height H of recovering is in some points lower than the minimum prescribed, it is necessary to absorb vertical loads by using appropriate protection devices (rigid diaphragms of protection and distribution of the loads, to be put above the last compact strata of material), following the imput of the Direction of Work.

In case of crossing railways, it is possibile to:

- Forsee a steel covered protective pipe (casing)
- Lay pipes in a tunnel of re-inforced concrete

9 ESECUTIONS OF CONNECTIONS

Connections are made, respecting the indications given in the following, both for pipes and special pieces. An accurate cleaning of the parts to be joint is forseen making sure that they are integral. The gasket has to be inserted (if not already inserted during production) in it seat, situated in the internal side of the socket. Successive steps are:

- Lubrification of the external surface of the end of the pipe (plain ended side of the pipe) and the internal surfact of the socket, using an appropriate lubricant (grease of silicone-oil, vaseline, soapy water, etc.) Avoid the use of mineral oils or greases which may damage the gasket.
- Insert the head of the pipe until the end of the socket and do not force further. The perfect execution of this working process depends only on a precise alignment of the pipes and on an accurate lubrification.

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