Item No 17: ORIENTED PVC PIPE (O-PVC)

RECEPTION, STORAGE, INSTALLATION AND TEST INSTRUCTIONS

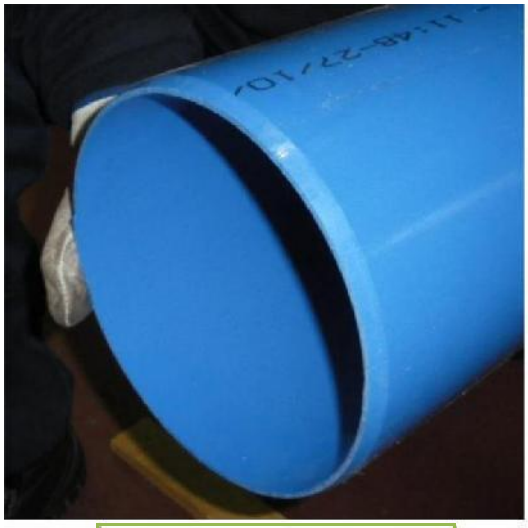
IS 16647-201, ISO16442-2014

RECEPTION

After the reception of the pipes, it is necessary to check their state. Before its installation, you should remove the caps and make a sampling to verify that all the pipes are correct.

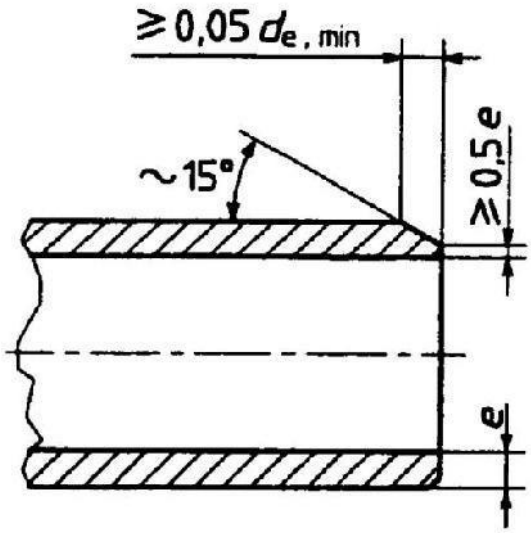
Checking the next points is particularly important:

- The pipes should be free of dirt.
- The chamfer in the spigot end should not be damaged.

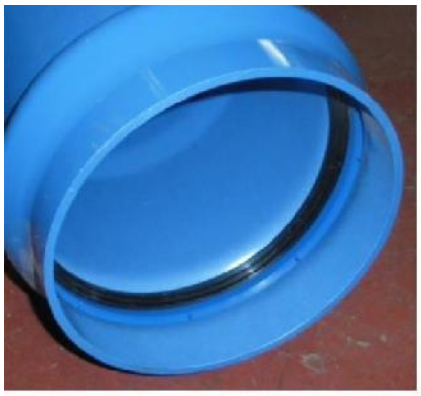


CORRECT

INCORRECT



- The seals should be placed correctly in their housings.



CORRECT

INCORRECT

- The surface and the inner part of the pipes and sockets should not be damaged.

STORAGE

We suggest the following guidelines:

- Store the pipes horizontally on a flat surface and place supports every 1.5 meters to avoid the bending of the product.
- Avoid scratches especially in the crest of the socket, due to dragging the pipe on the ground, mainly if the surface is made of stone, concrete or asphalt.
- Do not stack more than 1.5 meters high, as this can damage lower pipes or even the upper pipes could fall.
- The sockets should be free, alternating sockets and ends.
- In case of prolonged sun exposure, protect pallets with an opaque material. White colour is preferable because it avoids the over-heating of the pipes.

REALIZATION OF THE TRENCH

The trench must be free of stones at the bottom and at the sides.
Stones smaller than 10-20 mm are allowed, but they cannot be the main size of the ground particles.

Minimum trench width:

DN (mm)	Minimum width of trench B (m)
90-250	0.60
315	0.85
355	1.00
400	1.10
450	1.15
500	1.20
630	1.35
800	1.65

Depth of trench H (m)	Minimum width of trench B (m)
h < 1.00	0.60
1.00 < h < 1.75	0.80
1.75 < h < 4.00	0.90
h > 4.00	1.00

As a rule of thumb, when there is no road traffic involved, the pipes' crown will be at a minimum depth of 0.6 meters; with road traffic, the minimum depth is 1 meter.

BEDDING AND FILLING THE TRENCH

Pipe must be installed in the following circumstances:

1. Before placing the pipe, a sand bed should be prepared (a fine granular material could be used instead of sand) with a thickness from 10 cm to 15 cm. The pipe should be well aligned and levelled.
2. The pipe must lie on the sand bed. It must be ensured that all the lower part of the pipe is settled on the sand bed trying to soak as much as possible in order to make the angle of sand that supports the kidneys of the pipe as big as possible.
3. Once the pipe is placed, chamberlain sides must be filled with the selected material and compacted to achieve >95% Proctor Normal.
4. The trench must be filled with the selected material and compacted laterally until the upper part of the pipe is buried at least 30 cm.
5. Steps 3 and 4 can be done with the same natural material obtained from the excavation, trying to avoid rocks and large stones, and checking that this natural material can support the forces produced by the pressure inside of the pipe.

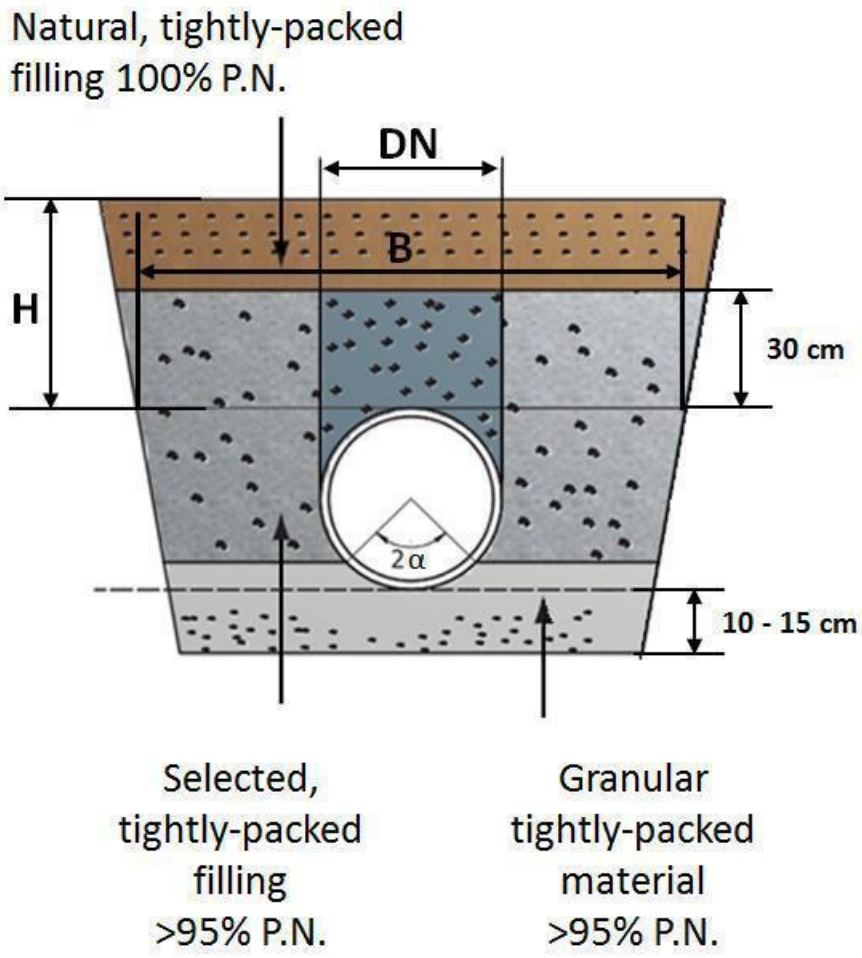
Natural soil can be used as the selected filler material whenever it fulfills the following criteria:

a) The material cannot consist of angular stones or similar material.
b) Filler material should not contain bigger particles than the ones shown in the following table.
c) Filler material should not contain blocks of soil twice the size of the maximum dimensions of the particles given in the table.

Maximum particle size

Nominal diameter DN	Maximum size mm
DN <100	15
100≤ DN <300	20
300≤ DN <600	30
600≤ DN	40

6. From the 30 cm above the pipe until the surface of the ground, the trench can be filled with natural material not specifically selected and compacting directly over the whole surface of the trench.



ASSEMBLY

- Remove the protection caps.
- Verify that the pipe is clean and in good condition. Paying attention to the sockets and spigot
- ends. Check that the chamfer is correct and free of cracks.
- Verify that the seal is in its place, clean and free of foreign materials (stones, sand, etc.).
- Lubricate the chamfer of the spigot and the seal with joint lubricant.
- Line up the pipe as much as possible horizontal and vertically.
- Insert only the chamfer edge of the socket, just to support the pipe but leaving the socket lip free.
- In the case of pipes with nominal diameter ≤250 mm, a firm and dry push should be given to seize the momentum produced by the free movement in the lip of the socket and introduce it until the mark is
- hidden into the socket.
  When installing diameters >250mm, one should use mechanical means to introduce the pipe using materials such as wood, hoists, tackles or slings.

In the next table, you can find an approximated number of assemblies per diameter with 1kg of lubricant.

DN (mm)	90	110	140	160	200	225	250	315	355	400	450	500	630	800
Assemblies	87	76	54	46	34	32	30	25	21	17	16	14	12	9

PIPE CUTTING

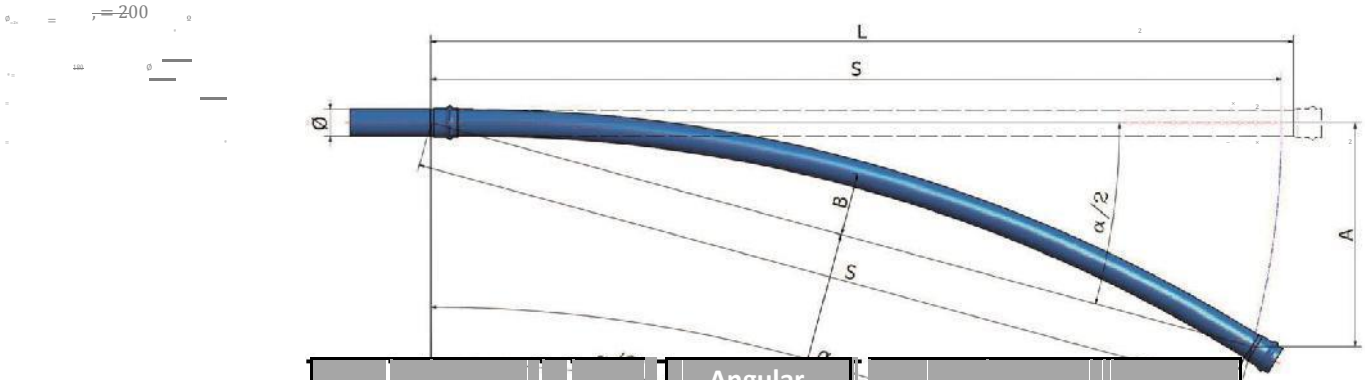
Pipes can be cut transversally using a circular saw or a hacksaw. The resulting male cut ends should be chamfered in order to be entered manually in another socket pipe or fitting. The chamfer can be made with a circular saw and be reviewed later with a file. The chamfer should be approximately of 15º.

A mask must be worn to prevent dust inhalation and protections and safety measures must to be taken for cutting machines.

Pipes chamfered on-site are less accurate than those made at the factory. Because of that, they could require higher introduction efforts or even require simple mechanical means to place the spigot inside the socket.

COLD BENDING OF PIPE (23º C)

The pipe can bend at room temperatures (± 23ºC) in the trench up to the limits defined in the next table. These curves must to be done always in cold (don't heat any part of the pipe or socket) by manual efforts (you can use simple items to help in case of pipes DN> 250mm) and without damaging the geometry of the plugs.



		Pipe curvature			Angular deviation of the socket	Curvature + angular deviation (full angle) angular		
DN	L	R	α/2	A	angle	R'	α'/2	A'
mm	m	m	degrees	m	degrees	m	degrees	m
90	5,78	18	9,2	0,92	2	15	11,2	1,12
110	5,78	22	7,5	0,75	2	17	9,5	0,95
140	5,76	28	5,9	0,59	2	21	7,9	0,79
160	5,75	32	5,1	0,52	2	23	7,1	0,71
200	5,73	40	4,1	0,41	2	27	6,1	0,61
225	5,70	45	3,6	0,36	2	29	5,6	0,56
250	5,68	50	3,3	0,32	2	31	5,3	0,52
315	5,63	63	2,6	0,25	2	35	4,6	0,45
355	5,61	71	2,3	0,22	2	38	4,3	0,42
400	5,58	80	2,0	0,19	2	40	4,0	0,39
450	5,56	90	1,8	0,17	2	42	3,8	0,37
500	5,58	100	1,6	0,16	2	44	3,6	0,35
630	5,53	126	1,3	0,12	2	49	3,3	0,31
800	5,42	160	1,0	0,09	2	52	3,0	0,28

The pipes may be subjected to greater curvatures with high efforts, but it is not recommended to overcome these limits to avoid compromising the safety coefficient of the pipe.

ANGULAR DEVIATION ALLOWED IN THE SOCKET

In addition to the curvature of the pipe, an angular deviation is allowed at the junction between pipes. Therefore in the final layout of the pipes, one can add both effects.

It is important not to exceed the established values of angular deviation in the socket-end when bending the pipe.

(1) Total length of the pipe: 5.95 meters.

DN	Maximum angular deviation	Displacement in the socket (D)
mm	angle (º)	D(mm) (1)
90-800	2º	200

The pipe connections can be subject to greater angular deviations if subjected to high stresses. It's recommended not to exceed those limits in order to avoid endangering the safety coefficients of the assembly under pressure.

FORCES PRODUCED BY THE BENDING OF THE PIPE

The bent pipeline behaves like a narrow -angle curve; this means that there is some backpressure on the ground as the table below shows. These cross-pressures, under normal conditions, can be supported by a sufficiently compacted soil, otherwise, if necessary, they should be supported with anchors in excessive curvatures.

			Forces in a curved pipe (α / 2) (2)			
	bar	bar	bar	bar	bar	bar
DN	1	5	10	15	20	25
mm	kN	kN	kN	kN	kN	kN
90	0,10	0,51	1,02	1,53	2,04	2,55
110	0,12	0,62	1,25	1,87	2,49	3,12
140	0,16	0,79	1,58	2,37	3,17	3,96
160	0,18	0,90	1,81	2,71	3,61	4,51
200	0,22	1,12	2,25	3,37	4,50	5,62
225	0,25	1,26	2,52	3,78	5,04	6,29
250	0,28	1,39	2,79	4,18	5,58	6,97
315	0,35	1,74	3,48	5,22	6,96	8,70
355	0,39	1,96	3,91	5,87	7,82	9,78
400	0,44	2,19	4,38	6,57	8,76	10,96
450	0,49	2,46	4,91	7,37	9,82	12,28
500	0,55	2,74	5,48	8,22	10,96	13,69
630	0,68	3,42	6,84	10,26	13,68	17,10
800	0,85	4,26	8,51	12,77	17,03	21,28

(2) Resultant forces in a pipe 5.95 meters long.

PRESSURE TEST AT WORKS

On-site testing should be performed according to local regulations and instructions laid down in the project.

During the assembly, the pipe installed should be tested in sections fully executed (the length may vary between 500 and 1.000 meters). The ends of the sections should be closed with appropriate fittings when being tested.

- Two main aspects must to be taken into account: When the assembly are exposed, the water-tightness of the network should checked, to see if there is any leak in such unions and locate them in case they exist. Except the cases of seal expulsion due to over-pressures or excessive angular deflections, leaks are manifested especially at very low pressures.
- On the other hand, for testing high-pressure pipes and fittings, they must be properly anchored (reductions, changes in direction, junctions, valves, cutting, etc.) and the pipes should be conveniently set in the trench (burial and compaction landfill). Otherwise, pipes and fittings could be unplugged by landslides in the field.

Therefore, it is recommended to test one of the following methods:

- **Method A:**

  Burying the pipe conveniently with enough compaction to be able to withstand the stresses caused by the pressure of the test, but leaving assemblies uncovered (in some circumstances it is difficult to anchor pipes and fittings, leaving the unions visible). Any reductions, changes in direction, junctions and shutoff valves must be properly anchored.

  Under these conditions, all pressure and leakage tests can be performed observing the uncovered unions and spot the appearance of leaks.

- **Method B:**

  Perform a shallower anchorage of pipes and fittings, leaving assemblies out of any possible problems. Doing a first leak test by filling the line with water and observe that there are no water losses at the unions (most of the leaks occur at low pressures). In case of leaks, the reparation would be easier than with the fully anchored and buried pipes.

  If required by local regulations, you could anchor the pipes and accessories conveniently for testing high pressure, keeping the assemblies exposed. If not, you can complete the burial of pipes and fittings with the correct compaction, thus facilitating the necessary anchorage for the high pressure test.

The pressures and time limits to test the pipes on-site are:

	Pressure	Maximum Time	Pressure	Maximum Time
PN16	Up to 21 bars	120 minutes	21 – 22.4 bars	60 minutes
PN20	Up to 25 bars	120 minutes	25 - 28 bars	60 minutes
PN25	Up to 30 bars	120 minutes	30 - 35 bars	60 minutes

PIPE OVERLAPE

Pipes are of standard length of 6.00 m length, but during laying the following overlaps have to be considered for net reduction in standard pipe length. The standard overlaps are defined in the next table and may be considered for estimating actual pipe lengths as below:

DN (mm)	110	160	200	250	315	400	450	500	560	630
Overlap %	2.92	3.35	3.75	4.50	5.42	6.25	6.4	6.5	7.15	7.75

EFFECT OF TEMPERATURE

When the temperature is high, plastic pipes undergo a loss of mechanical properties and we must take this into account. Because of that, we must avoid the following conditions during pressure tests:

- Pipe partially or fully exposed to weathering (line uncovered).
- High outside temperature.
- Standing water inside the pipe.
- Prolonged sun exposure prior to the test.

All these circumstances may increase the temperature of the pipe above its operating temperature, so the overpressure test can damage the pipeline. In order to avoid that, it is recommended to:

- Cover the pipe once the tightness of the network is verified.
- Wait for pressure testing when the pipe has been exposed to sunlight.

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

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

The derating factor (f_T) as function of operating temperature can be obtained from the graph on the right.
The derating factor related to application of the system (f_A) must be determined by the Project Manager.

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