InstalPlast Łask®

Technical and Commercial Information

2019

InCor SN12

DN/ID 160 - 1000 mm

InCor®

Structured-wall piping system made of PP for drains and sewers

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This manual provides the geometrical, physical, mechanical and functional properties, as well as the information about the appearance and color of hub and non-hub **InCor®** PP double wall corrugated pipes and injection, welded and rotomolded fittings used for non-pressure under ground drainage and sewerage.

1. System features

Pipes and fittings meet the requirements of the PN-EN 13476-3:2018-05 standard for PP material with nominal inner diameter of B type pipes **DN/ID 160÷1000 mm**.

Pipes made by extrusion molding have a double-walled closed structure, a smooth inner surface and a corrugated outer wall. Fittings made entirely by injection or rotomolding or by welding pipe and injection-molded components have a smooth inner surface and a smooth or ribbed outer surface.

Pipes are connected using hubs made during the production or by means of fittings. Sealing is achieved by means of elastomeric seals, meeting the requirements of the PN-EN 681 -1:2002/A3:2006 standard, located at the final corrugated section of the pipe.

Pipes are manufactured in sections of working lengths of 3 or 6 m in nominal stiffness SN4, SN8, **SN12**.

The basic raw material for the production of pipes and fittings is a PP block copolymer. Rotomolded fittings are produced using PE-HD or PE-LLD.

Standard pipes and fittings are colored using the orange and brown mass, approximately RAL 8023. Inner walls of pipes may come in white. Additionally, outer walls of pipes and fittings for storm drain may come in black. The inner layer may come in white or blue. The code of the Polish Classification of Goods and Services (KM) is 22.21.21.0.

1.1 Purpose of the system

InCor® pipes are used for non-pressure under ground combined sewage, drainage and storm water drainage systems outside buildings - application symbol "U" - performed in accordance with PN-EN 752:2017-06 and designed in accordance with PN-EN 1295-1:2019-05.

(**U:** indicates the area of usage of pipes and fittings located at a distance greater than 1 m from the buildings to which a buried pipe system is connected).

Pipes can also be used in the water and drainage construction, agriculture, environmental protection, the construction of drainage pipelines and drainage systems, as well as cable protection in the telecommunications and energy industries.

1.2 Scope of the system use

The use of modern PP block copolymer and optimized geometry of the wall structure offer a number of advantages, which distinguish PP double wall corrugated pipes from other sewer systems:

1. A significant reduction in weight not only in relation to the concrete and stoneware clay pipes, but also PVC, PE-HD and solid PP. Pipes with various diameters can be installed quickly and easily without the use of heavy construction equipment and access roads to construction sites, which reduces the cost and time of investment.

SN 8 sewer pipes weight ratio	
PP **InCor®**	1.0
PE-HD corrugated	1.1
PP-B RIB ribbed	1.5
PVC-U foamed	1.8
PP-B solid	2.3
PVC-U solid	2.6
Stoneware clay	15.0
Concrete	20.0

2. The cost of the material is about 75% of the total cost of manufacturing the pipe. The lowest cost weight per unit causes that PP structured wall pipes may be the cheapest of all the sewage pipe systems made of plastics.

3. High chemical resistance of polypropylene causes that **InCor®** pipes may be used not only for drainage and storm water drainage, but also for industrial installations and for chemically contaminated soils. In the case of using the pipes for purposes other than domestic sewage or storm water drainage, you need to check for the material's resistance in the tables of resistance in the ISO/TR10358 standard.

4. In contrast to concrete pipes, the use of smooth, even inner surfaces is not conducive to the growth of microorganisms and bacteria. The decomposition of sewage by anaerobic bacteria typically causes the formation of a strong acidic environment, which causes the corrosion of the surfaces of concrete pipes. PP pipes are resistant to the phenomenon (pH 2 - pH 12).

5. PP pipes are characterized by the highest abrasion resistance among materials used in the production of pipes. This enables the construction of sewers with large declines and the transport of domestic sewage heavily contaminated by sludge and sand.

6. High thermal endurance of the material causes that the transported domestic sewage can reach 60°C with a continuous flow and 95°C with a short term flow.

7. At the same time, PP pipes have a high impact resistance even at low temperatures so they can be used at temperatures from -20°C. No other plastic pipes have such a wide temperature range.

Temperature ranges for the application of sewer pipes			
material	**minimum**	**maximum**	**instantaneous**
PP	-20°C	60°C	95°C
PE HD	-40°C	40°C	70°C
PVC-U	0°C	40°C	60°C

8. Pipes can be cut by means of simple tools. Pipe sections can be easily connected using fittings and gaskets. This facilitates the construction of the pipeline and prevents the buildup of scrap materials.

9. In contrast to concrete and stoneware clay pipes, PP pipes are resistant to loads that have not been taken into account in the design stage. Overloading concrete or stoneware clay pipes causes them to rupture, whereas the PP pipe will only bend causing the reduction of the flow capacity.

10. PP pipes are non-toxic and neutral to the environment. The material from which they are made can be entirely re-processed.

1.3 InCor® SN12 pipes

As part of the Innovative Economy Operational Programme, InstalPlast Łask introduced a new range of corrugated pipes, namely the **InCor® SN12** system (12 kN/m2). The innovative solution being the Company's proprietary technology, sets us apart from the competition. The existing product offer of corrugated polypropylene pipes in stiffness class SN8 (8 kN/m2) has been extended not only by an additional stiffness class but also by additional range of diameters (160-1000 mm).

The general tendency of producing better and more efficient products and reducing the costs of production contributed to the implementation of this solution. In effect, the resulting product has an increased stiffness class (by 50%) compared to the existing pipes (**InCor®** SN8 pipes) with a 10-percent increase in the weight of the finished products only. The key to the success and the achievement of such great results is the unique technological process based on the first-class production line.

The competitive nature of **InCor® SN12** in relations to PP pipe systems in stiffness class SN8 is beyond dispute. In addition, **InCor® SN12** pipes are an excellent alternative to the following, currently used smooth pipes:

-PP SN 10

- Solid PVC SN 12.

All this is due to the new corrugated shape of the pipes introduced by InstalPlast Łask. Our competition achieves an increased stiffness of their products by increasing the wall thickness.

Comparison of select parameters of InCor® SN12 and solid PVC SN12 pipes

InCor® SN12	InCor® SN12		PVC SN12	
	Diameter	Weight	Diameter	Weight
Weight of linear meter of the pipe , [kg]	160	1,4	160	5,0
	200	2,2	200	7,0
	250	3,3	250	11,0
	300	4,7	300	17,0
	400	7,8	400	29,0
	500	13,5	500	40,0
	600	20,0	600	82,0
Maximum sewage temperature	+95°C		+60°C	
Recommended minimum temperature of transportation and installation	-30°C		+5°C	
Forming hubs in the production (impact on the need for additional fittings, an increased number of connections and possible leakage)	All diameters		DN 315 - DN 630	
Pipe inner diameter [mm] **Cross section [m2]** Sample dimensions for pipes 400 mm in diamerer	393,0 0,12		374,8 0,11	
Roughness coefficient K [mm]	0,00011		0,00015 ÷ 0,01	

2. Raw materials and components

The basic raw material for the production of pipes and fittings is a block copolymer polypropylene PP-B. Dyes and substances are added to the raw material which facilitate the production of components meeting the requirements of this standard.

It is allowed to add your own secondary material in the quantity which meets the requirements of the technological standard.

Sealing rings of thermoplastic elastomer are used to seal the connections in accordance with PN-EN 681-1:2002/A3:2006.

Technical properties of PP			
property	**conditions**	**unit**	**value**
Mass flow rate (MFR)	230°C÷2.16kg	g/10min	0.3÷1.0
Oxidation induction time (OIT)	200°C	min	≥8
Density		kg/m3	900
Short-term elastic modulus	2mm/min	MPa	≥1200
Long-term elastic modulus		MPa	≥300
Hardness	Shore D	-	≥50
Linear expansion	-20°C÷100°C	K^{-1}	$\leq 2.0 \times 10^{-4}$
Resistance to internal pressure	80°C÷4,2Mpa	godz.	>140
	80°C÷3,6MPa		>1000

Each delivery of raw materials is accompanied by the certificate of quality control or other equivalent document. The certificate of quality control includes all above information. The raw material producer is responsible for the compliance of technical properties of the raw material.

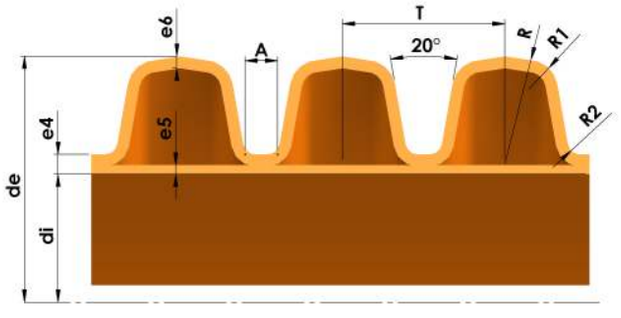
In the case of non-compliance or any doubts, the batch of raw materials may be conditionally approved for production. However, in such case full explanation and confirmation of the properties of the raw material is needed.

The rules of conduct in cases of dispute are subject to separate arrangements between the producers of raw materials and the producers of sewer pipes and fittings.

3. Geometry of pipes

3.1 Dimensions

Pipes and fittings meet the requirements of **PN-EN 13476-3:2018-05**, for PP material with nominal inner diameters of B type pipes DN/ID **160; 200; 250; 300; 400; 500; 600; 800: 1000** in circumference stiffness class **SN4, SN8, SN12.**



Geometry of InCor® pipes										
DN	**di**	**de**	**e4**	**e5**	**e6**	**T**	**A**	**R**	**R1**	**R2**
160	148	170	1,5	1,1	1,0	19,9	4,2	10	3	1,5
200	198	227	2,4	1,1	1,4	22,4	4,9	13,5	3,5	1,5
250	248	283	3	1,5	1,6	26,2	5,1	16	4	1,5
300	297	340	3,6	1,7	2,0	31,4	5,5	19,5	5	2
400	396	453	4,8	2,3	2,6	39,3	7,9	26	7	3
500	495	567	6	3,0	3,1	52,8	9,4	33	9	3
600	594	680	7,2	3,5	3,8	66	13,2	40	10	5
800	792	906	9,6	4,5	5,2	88	19,3	49	12	6
1000	988	1160	8,9	5,1	5,3	132,8	30	56	16	8

The thickness of walls of e5, e6 pipe is related to the relevant, required circumference hardness SN4, SN8 or SN12 of the pipe and is each time selected by the producer of the pipe.

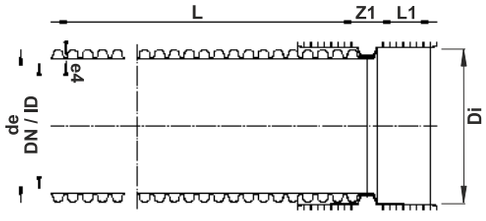
The measurement of dimensions is performed in accordance with PN-EN 476:2012.

Non-hub pipes are produced in standard sections of working length of 6 m. On request, we can produce pipes in sections of other lengths but no longer than 12 m.

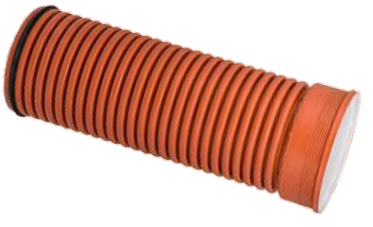
Hub pipes are produced in sections of working lengths of "L" provided in the table.

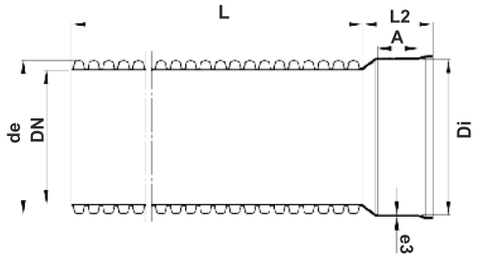
Pipes are connected using hubs made during the production or by means of fittings. Sealing is achieved by means of elastomeric seals at the final corrugated section of the pipe.

The circumference stiffness of the connection between the pipe and the smooth hub of **InCor®** is in accordance with the algorithm provided in PN-EN 13476-3:-052018; SN of the hub + SN of the spigot end = SN of the pipe.



Dimensions of InCor® double-hub pipes							Weight
DN	de	Di	e4	Z1	L1	L	kg/m
160	170	172	2,0	-	98	3000 6000	1,4
200	227	230	2,4	60	110	3000 6000	2,5
250	283	287	3,0	62	137	3000 6000	3,5
300	340	344	3,6	64	150	3000 6000	5,1
400	453	458	4,8	70	200	3000 6000	9,0
500	567	574	6,0	74	262	3000 6000	14,5
600	680	686	7,2	80	270	3000 6000	20,5
800	906	912	9,6	90	325	3000 6000	32,5
1000	1160	1166	8,9	-	-	3000 6000	55





Dimensions of InCor® double-hub pipes							Weight
DN	de	Di	e3	A	L2	L	kg/m
160	170	172	2,8	84	110	3000 6000	1,4
200	227	230	4,2	53	117	2900 6000	2,5
250	283	287	5,2	62	130	2900 6000	3,5
300	340	344	6,2	75	165	2850 6000	5,1
400	453	458	8,3	94	205	2800 6000	9,0
500	567	574	9,2	126	240	2750 5900	14,5
600	680	686	9,2	158	295	2700 5850	20,5
800	906	912	9,2	211	400	2600 5750	32,5
1000	1160	1166	10,7	253	350	2750 6000	55

3.2 Surfaces

Inner and outer surfaces of pipes and fittings are smooth. clean, free of raggedness, bubbles, contaminations, pores and any other surface defects. The ends of the pipes and fittings are cut straight and perpendicular to their axis.

The outer layer of the pipes and fittings is colored using the orange and brown mass (RAL 8023) or black. The inner layer of the pipes is white for easy inspection of the pipeline by means of cameras. However, it may be of the same color as the outer layer.

Default properties:

- sewer pipes:
  - outer layer in orange and brown
  - inner layer in white
  - fittings in orange and brown.
- drainage pipes:
  - outer layer in black
  - inner layer in white
  - fittings in black.

4. Geometry of fittings

4.1 Dimensions

Fittings are produced entirely by injecting polypropylene (PP) or by rotomolding polyethylene (PE) or by welding structured-walled **InCor®** pipes, injection-molded smooth pipes and injected components. The inner surface of the fittings is smooth and the outer surface is smooth or ribbed.

We produce double-hub fittings, pipe-joining sleeves, elbows, equal tees, plugs as well as transitions fittings and transition tees for PVC pipes with diameters DN/ID 160; 200; 250; 300; 400; 500; 600; 800; 1000.

Dimensions of the fittings are in accordance with the production documentation. The minimum average inner diameter of a fitting, in accordance with PN-EN 13476-3:2018-05, is not less than 98% of the minimum average inner diameter of the pipe to which the fitting is to be connected.

The minimum thickness of injection-molded fittings e4 correspond to the values in the standard.

The wall thickness of the body of the welded fittings meets the requirements for the pipes to which the fittings are to be connected. The wall thickness reduction is permissible provided that it is not less than the nominal value.

4.2 Types of fittings

Types of manufactured fittings										
Fitting type	**DN1**	**DN**								
		160	200	250	300	400	500	600	800	1000
Double-hub fitting		+	+	+	+	+	+	+	+	+
Pipe-joining sleeves		+	+	+	+	+	+	+	+	+
Transition fittings for PVC pipes EN1401	200	+	+							
	250			+						
	315				+					
	400					+				
		+	+	+	+	+	+	+	+	+
Elbows 15°, 30°, 45°, 60°, 90° Transition fittings	200			+						
	250				+					
	300					+				
	400						+			
	500							+		
		+	+	+	+	+	+	+	+	+
Tees 45°, 90° Tees for PVC pipes 45°, 90°	160	+	+	+	+	+	+	+	+	+
	200			+	+	+	+	+	+	+
	250				+	+	+	+	+	+
	315					+	+	+	+	+
		+	+	+	+	+	+	+	+	+
Pipe caps		+	+	+	+	+	+	+	+	+
Pipe plugs		+	+	+	+	+	+	+	+	+
Leak-proof sewer pipe connections		+	+	+	+	+	+	+	+	+

4.2.1 Smooth PP pipes

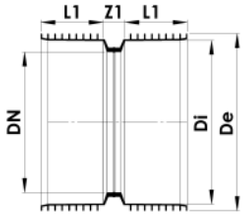
Pipe components with smooth walls used in the production of **InCor®** fittings are made by extrusion molding of a polypropylene material as described in point 1 of this manual.

The geometry and mechanical and physical properties of the pipes are in accordance with PN-EN 1852-1:2018-02.

DN	DN max	SN4	SN8
mm	**mm**	**e, mm**	**e, mm**
200	200,6	6,2	8,6
250	250,8	7,7	10,7
315	316,0	9,7	13,5
400	403,6	12,3	17,1

4.2.2 Double-hub fittings

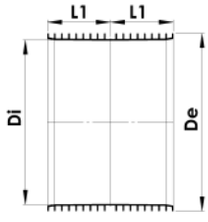
Double-hub partition fittings are made by welding together two **InCor®** joints.



Dimensions in mm					Weight
DN	De	Di	L1	Z1	kg/pc
160	196	172	98	-	0,65
200	252	230	110	60	1,0
250	312	286	137	62	1,6
300	375	344	150	64	2,4
400	498	458	200	70	4,6
500	624	574	262	74	8,1
600	748	686	270	80	13,6
800	960	912	325	90	25,0
1000	1189	1166	435	50	37,0

4.2.3 Pipe-joining sleeves

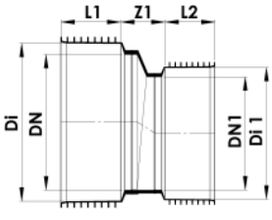
Pipe-joining sleeves are made by welding together two **InCor®** joints with a cut off partition.



Dimensions in mm				Weight
DN	De	Di	L1	kg/pc
160	196	170	98	0,63
200	252	230	110	0,7
250	312	286	137	1,2
300	375	344	150	1,8
400	498	458	200	3,4
500	624	574	262	6,2
600	748	686	270	10,8
800	960	912	325	20,0
1000	1189	1166	435	37,0

4.2.4 Transition fittings

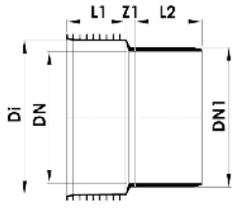
Transition fittings are made by welding together two **InCor®** joints with various diameters by using an injection-molded transition component.



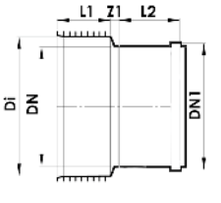
Dimensions in mm							Weight
DN	DN1	Di	Di1	Z1	L1	L2	kg/pc
250	200	286	230	129	137	110	1,6
300	250	344	286	136	150	137	2,3
400	300	458	344	146	200	150	4,2
500	400	574	458	159	262	200	7,6
600	500	686	574	171	270	262	12,7

4.2.5 Transition fittings for PVC pipes

Transition fittings for PVC pipes EN 1401 are by welding an **InCor®** joint with a smooth PP pipe component or PP hub for butt welding in accordance with PN-EN 1852-1:2018-02.



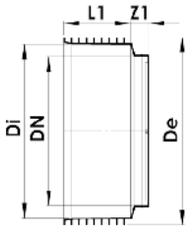
Dimensions in mm						Weight
DN	DN1	Di	Z1	L1	L2	kg/pc
160	160	172	3	101	115	0,62
200	200	230	30	110	118	1,0
250	250	286	31	137	138	1,9
300	315	344	32	150	164	2,7
400	400	458	35	200	198	5,7



Dimensions in mm						Weight
DN	DN1	Di	Z1	L1	L2	kg/pc
160	160	172	-	101	88	0,56
200	200	230	30	110	118	1,2
250	250	286	31	137	138	2,0
300	315	344	32	150	164	3,2
400	400	458	35	200	198	6,2

4.2.6 Pipe caps

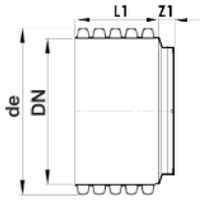
Pipe caps are made by welding an **InCor®** joint and an injection-molded cap component.



Dimensions in mm					Weight
DN	Di	De	L1	Z1	kg/pc
160	172	196	98	14	-
200	230	252	110	60	0,7
250	286	312	137	62	1,1
300	344	375	150	64	1,8
400	458	498	200	70	3,2
500	574	624	262	74	5,6
600	686	748	270	80	9,3
800	912	924	670	-	26
1000	1166	1190	920	-	37

4.2.7 Pipe plugs

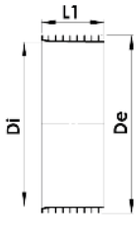
Pipe plugs are made by welding a section of an **InCor®** pipe and an injection-molded cap component.



Dimensions in mm				Weight
DN	De	L1	Z1	kg/pc
160	170	-	-	-
200	227	125	60	0,7
250	283	150	62	1,3
300	340	170	64	2,1
400	453	185	70	3,0
500	567	245	74	6,5
600	680	310	80	9,1
800	906	450	-	15,5
1000	1160	650	-	24,5

4.2.8 Leak-proof sewer pipe connections

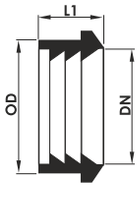
Leak-proof sewer pipe connections for concrete construction partitions (concrete drains) are made of PP joints.



Dimensions in mm				Weight
DN	Di	De	L1	kg/pc
160	172	196	98	-
200	230	252	110	0,4
250	286	312	137	0,6
300	344	375	150	0,9
400	458	498	200	1,7
500	574	624	262	3,1
600	686	748	270	5,4
800	912	924	360	10,5
1000	1166	1190	460	18,5

4.2.9 "IN-SITU" gaskets

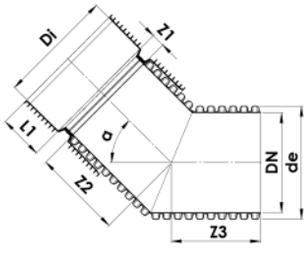
"In-situ" gaskets are made of elastomers and are used for connecting PVC pipes, compliant with PN-EN 1401-1:2019-07, to the existing **InCor®** pipeline without the need to disconnecting it.

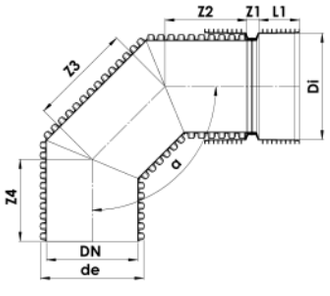


Dimensions in mm			Weight
DN	OD	L1	kg/pc
110	140	68	0,4
160	190	68	0,5
200	234	68	0,6
250	284	80	0,8
315	348	80	1,0

4.2.10 Elbows

InCor® elbows with 15°, 30°, 45°, 60°, 90° angles are made by welding two or three corrugated pipe segments cut at the right angle. Elbows are ended with welded hubs or fitted with double-hub fittings.





Dimensions in mm								Weight
DN	de	Di	a	L1	Z1	Z2	Z3	kg/pc
160	170	172	15°	101	11	68	140	0,6
200	227	230	15°	110	60	180	180	0,8
250	283	286	15°	137	62	210	210	1,5
300	340	344	15°	150	64	252	252	2,5
400	453	458	15°	200	70	314	314	5,7
500	567	574	15°	262	74	423	423	11,8
600	680	686	15°	270	80	528	528	21,1
800	906	910	15°	335	50	720	910	66
1000	1160	1166	15°	435	50	1040	1300	132

Dimensions in mm								Weight
DN	de	Di	a	L1	Z1	Z2	Z3	kg/pc
160	170	172	30°	101	11	80	135	0,63
200	227	230	30°	110	60	202	202	0,9
250	283	286	30°	137	62	236	236	1,7
300	340	344	30°	150	64	283	283	2,8
400	453	458	30°	200	70	354	354	6,4
500	567	574	30°	262	74	475	475	13,3
600	680	686	30°	270	80	594	594	23,8
800	906	910	30°	335	50	720	910	67
1000	1160	1166	30°	435	50	1040	1300	134

Dimensions in mm								Weight
DN	de	Di	a	L1	Z1	Z2	Z3	kg/pc
160	170	172	45°	101	11	110	165	0,73
200	227	230	45°	110	60	225	225	1,0
250	283	286	45°	137	62	262	262	1,8
300	340	344	45°	150	64	314	314	3,1
400	453	458	45°	200	70	393	393	7,1
500	567	574	45°	262	74	528	528	14,8
600	680	686	45°	270	80	660	660	26,4
800	906	910	45°	335	50	720	910	69
1000	1160	1166	45°	435	50	1040	1300	136

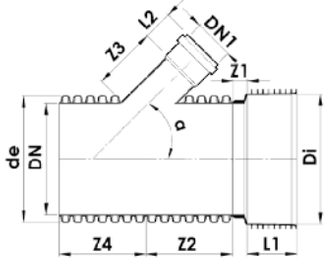
Dimensions in mm									Weight
DN	de	Di	a	L1	Z1	Z2	Z3	Z4	kg/pc
160	170	172	60°	101	50	80	165	140	0,85
200	227	230	60°	110	60	180	202	180	1,6
250	283	286	60°	137	62	210	236	210	2,9
300	340	344	60°	150	64	252	283	252	5,0
400	453	458	60°	200	70	314	354	314	11,3
500	567	574	60°	262	74	423	475	423	23,7
600	680	686	60°	270	80	528	594	528	42,2
800	906	910	60°	335	50	810	910	810	111
1000	1160	1166	60°	435	50	1170	1300	1170	177

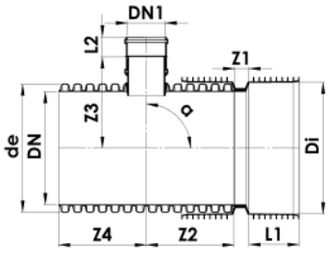
Dimensions in mm									Weight
DN	de	Di	a	L1	Z1	Z2	Z3	Z4	kg/pc
160	170	172	90°	101	11	115	190	180	0,93
200	227	230	90°	110	60	180	225	180	1,8
250	283	286	90°	137	62	210	262	210	3,1
300	340	344	90°	150	64	252	314	252	5,3
400	453	458	90°	200	70	314	393	314	12,0
500	567	574	90°	262	74	423	528	423	25,1
600	680	686	90°	270	80	528	660	528	44,9
800	906	910	90°	335	50	810	910	810	119
1000	1160	1166	90°	435	50	1170	1130	1170	180

4.2.11 Transition tees for PVC pipes

Transition tees with PVC exit pipes at 90° are made by welding the corrugated pipe segment to the exit made of a smooth PP pipe compliant with PN-EN 1852-1:2018-02.

Tees with diameters of DN 400 and smaller can be made by using smooth pipes only. The tees have at the inlet of the hollow passage a welded hub or a double-hub partition fitting, and at the outlet a PP hub butt-welded in compliance with PN-EN 1852-1:2018-02.





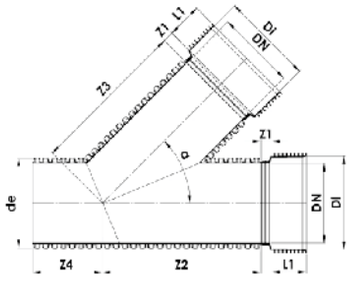
Dimensions in mm									Weight
DN	DN1	α	L1	L2	Z1	Z2	Z3	Z4	kg/pc
200	160	45°	110	98	60	205	418	205	2,2
250	160	45°	137	98	62	228	418	228	2,8
250	200	45°	137	118	62	255	430	255	3,7
300	160	45°	150	98	64	252	418	252	3,6
300	200	45°	150	118	64	283	430	283	4,6
300	250	45°	150	150	64	309	457	309	6,3
400	160	45°	200	98	70	275	418	275	5,5
400	200	45°	200	118	70	314	430	314	6,9
400	250	45°	200	150	70	354	457	354	9,5
400	315	45°	200	170	70	393	515	393	12,0
500	160	45°	262	98	74	318	418	318	9,8
500	200	45°	262	118	74	370	430	370	11,8
500	250	45°	262	150	74	423	457	423	14,6
500	315	45°	262	170	74	476	515	476	18,2
600	160	45°	270	98	80	365	418	365	14,8
600	200	45°	270	118	80	431	430	431	17,5
600	250	45°	270	150	80	497	457	497	22,0
600	315	45°	270	170	80	563	515	563	26,5
800	160	45°	335	98	50	540	160	540	60,8
800	200	45°	335	118	50	585	205	585	64,5
800	250	45°	335	150	50	630	280	630	67,7
800	315	45°	335	170	50	675	350	675	71,2

Dimensions in mm									Weight
DN	DN1	α	L1	L2	Z1	Z2	Z3	Z4	kg/pc
200	160	90°	110	98	60	208	218	208	2,0
250	160	90°	137	98	62	228	247	228	2,2
250	200	90°	137	118	62	242	251	242	2,5
300	160	90°	150	98	64	252	275	252	3,0
300	200	90°	150	118	64	283	280	283	3,8
300	250	90°	150	150	64	309	319	309	4,4
400	160	90°	200	98	70	314	331	314	5,2
400	200	90°	200	118	70	354	336	354	6,2
400	250	90°	200	150	70	380	375	380	7,8
400	315	90°	200	170	70	406	394	406	8,6
500	160	90°	262	98	74	423	388	423	10,2
500	200	90°	262	118	74	475	393	475	12,5
500	250	90°	262	150	74	528	432	528	14,2
500	315	90°	262	170	74	581	451	581	17,3
600	160	90°	270	98	80	365	445	365	14,0
600	200	90°	270	118	80	431	450	431	16,5
600	250	90°	270	150	80	497	489	497	20,3
600	315	90°	270	170	80	563	508	563	24,6
800	160	90°	335	98	50	540	503	540	60,1
800	200	90°	335	118	50	585	515	585	64,1
800	250	90°	335	150	50	630	515	630	66,7
800	315	90°	335	170	50	630	533	630	68,1
800	400	90°	335	200	50	720	673	720	74,8
1000	160	90°	435	98	50	730	610	730	113
1000	200	90°	435	118	50	730	610	730	114
1000	250	90°	435	150	50	795	630	795	118
1000	315	90°	435	170	50	864	660	864	126
1000	400	90°	435	200	50	931	780	931	132

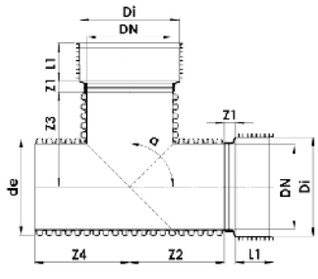
4.2.12 Equal tees

InCor® tees at exit angles of 45°, 90° are made by welding corrugated pipe segments. Tees with diameters of DN 400 and smaller can be made by using smooth pipes.

The tees have at the inlets welded hubs or double-hub partition fitting.



Dimensions in mm									Weight
DN	de	Di	a	L1	Z1	Z2	Z3	Z4	kg/pc
160	170	172	45°	101	11	353	353	165	1,55
200	227	230	45°	110	60	404	404	180	2,4
250	283	286	45°	137	62	471	471	210	4,2
300	340	344	45°	150	64	566	566	252	7,2
400	453	458	45°	200	70	707	707	314	6,3
500	567	574	45°	262	74	950	950	423	34,0
600	680	686	45°	270	80	1188	1188	528	60,7
800	906	932	45°	335	50	1620	1710	540	182
1000	1160	1166	45°	435	50	2345	2520	1064	376



Dimensions in mm									Weight
DN	de	Di	a	L1	Z1	Z2	Z3	Z4	kg/pc
160	170	172	90°	101	11	80	75	280	1,24
200	227	230	90°	110	60	247	248	247	2,0
250	283	286	90°	137	62	288	299	288	3,5
300	340	344	90°	150	64	346	359	346	6,0
400	453	458	90°	200	70	432	462	432	13,4
500	567	574	90°	262	74	581	600	581	28,1
600	680	686	90°	270	80	726	736	726	50,2
800	906	932	90°	335	50	900	540	900	175
1000	1160	1166	90°	435	50	1130	800	1130	234

5. System characteristics

5.1 Pipes and fittings

The physical and mechanical properties of pipes and fittings tested according to the conditions set out in the relevant standards match the requirements shown in the table.

Property	Requirements	Parameters	Standard
thermal dimensional stability	pipe should not have cracks, delamination or bubbles	annealing in oven at 150°C Time for: e4 > 3mm – 30min e4 >10mm - 60min	ISO12091
mass flow rate (MFR)	acceptable change as a result of processing ≤ 0,20g/10min	temp. - 230°C stress - 2,16 kg	PN-ISO1133
circumference stiffness	SN 2 ≥ 2 kN/m2 SN 4 ≥ 4 kN/m2 SN 8 ≥ 8 kN/m2	diameter deformation 3%	PN-EN ISO 9969
pipe impact resistance (drop-weight method)	No cracks, abrasions, permanent bends, kinks or dents and delamination of walls. TIR ≤ 10%	Temp. 0°C, d90 weight dropped from the height of 2.0m weighing kg: DN 200 - 1.6 DN 250 - 2.0 DN≥300 - 3.2	PN-EN ISO 3127
fitting impact resistance (drop-weight method)	No cracks, abrasions, permanent bends, kinks or dents and delamination of walls.	Temp. 0°C, weight dropped from the height of 0.5m onto the outlet	PN-EN ISO 13263
circumference elasticity	- No cracks, abrasions, permanent bends, kinks or dents and delamination of walls. - after releasing the sample, the inner radius of the pipe should not be less than 80% of the original	The deformation of the inner diameter of 30% at the original sample wavelength of min. 5	PN-EN ISO 13968
tightness of connections with elastomeric sealing ring	no leakage	testing temp.: 23°C, angular deviation: DN≤300 - 2° DN≤600 - 1,5° DN>600 - 1° water pressure: 0,5 bar	PN-EN ISO 13259
tightness of fittings mde by joining at least two components	no leakage	testing temp.: 23°C, water pressure: 0.5bar testing duration: 1min.	PN-EN ISO 13254
tensile strength of the weld	no cracks using min. tensile force.	DN ≥ 300 – 360N DN ≥ 400 – 450N DN ≥ 600 – 615N DN ≥ 800 – 800N	PN-EN ISO 13262

5.2 Sealing rings

Sealing rings have no negative impact on the properties of pipes and fittings, and the connections made by using them meet the requirements for tightness of connections.

The materials used for production of sealing rings comply with PN-EN 681-1:2002/A3:2006. Seals made of thermoplastic elastomers (TPE) also meet the requirements for long-term pressure resistance set out in PN-EN 14741:2008.

6. Marking

The marking is embossed directly on the component and is durable and easy to read. Additionally, it is placed on the label so that its legibility is maintained throughout the entire period of storage, transport and during its operation.

The marking does not create cracks or other surface defects, which could adversely affect the properties of pipes and fittings. Marking by embossing may reduce the thickness of walls no greater than 0.25 mm and does not breach the requirements for minimum thickness of walls set out in the standard.

The marking is readable with the naked eye. The pipes are marked at distances no greater than 2 m, but at least once on each pipe. The marking is embossed on each injection-molded component.

The minimum requirements for marking are shown in the table.

Information	Marking or symbol
- producer's identification	InstalPlast Łask
- product name or trademark	InCor®
- type of material	PP
- nominal size	DN200
- series	ID
- angle of the arc (for fittings)	30°
- circumference stiffness	SN8
- application area	U
- reference standard	PN-EN 13476-3:2018-05
- production year and month or batch number	2019/03

Example of the marking of InCor pipes

7. Quality control

InCor® pipe and fitting system is subjected to external control testing and in-house testing to ensure consistent product quality, which in turn ensures the safety of the installation.

Company's quality assurance system has been certified for compliance with the requirements of **ISO 9001:2015** by the German institute of certification **TÜV Management Service GmbH**.

7.1 Acceptance tests (BRT)

BRT (current production control) acceptance tests are done as part of the quality control of the product.

Each batch of the pipes and fittings with the same diameter and made using the same technology and the same type of material on the same technological line from start to finish during 1 week or less is subjected to BRT testing.

The composition and quantity of the batch depends on the testing scheme of the producer.

The scope of acceptance tests performed as part of the current production and the quantity of samples and frequency of testing is shown in the table.

Properties	Sampling	Number of samples
outer appearance	once every 8 hours	1
color	once every 8 hours	1
dimensions of pipes	once every 8 hours	1
dimensions of fittings	once every 8 hours	1
circumference stiffness of pipes	once per batch	3
impact resistance of pipes (drop-weight)	once per batch	3
circumference elasticity of pipes	once per batch	3
impact resistance of fittings (drop-weight)	once per batch	3
marking of pipes and fittings	once every 8 hours	1

7.2 TT tests

These tests are conducted by an external research institute to confirm that the pipes and fittings meet all the requirements set out in the technical standard.

TT tests are carried out for each material, for each diameter and each production line at the start of production of the product and each time changes are made in materials or technology that affect the technical quality of the products and in cases of arbitration in disputes.

The scope of TT tests the **InCor®** system is subjected to is shown in the table.

Property	Sampling scheme	No. of samples	No. of tests
outer appearance	once per size	1	1
color	once per size	1	1
dimensions of pipes	once per size	1	1
dimensions of fittings	once per size	1	1
testing pipes in oven	once per size	1	1
mass flow rate MFR for pipes	once per material	1	3
testing injection-molded fittings in oven	once per size	1	1
mass flow rate MFR for fittings	once per material	1	3
circumference stiffness of pipes	once per size	3	1
impact resistance of pipes (drop-weight)	once per size	3	1
circumference elasticity of pipes	once per size	3	1
circumference stiffness of fittings	once per size	3	1
impact resistance of fittings (drop-weight)	once per size	3	1
elasticity and durability of fittings	once per size	3	1
tightness of connections	once per size	1	1
watertightness of fittings	once per size	1	1
strenght of the weld	once per size	1	1
marking of pipes and fittings	once per size	1	1

7.3 Testing methods

Samples for the testing of technical and functional properties are collected directly from the production line at random, in accordance with PN 83/N-03010, for the tests performed in Poland or by the testing scheme of the producer.

The quality control of pipes tested using BRT is performed according to the testing scheme of the producer which specifies the size of the batch and the type of testing scheme. The test samples are prepared in accordance with the requirements of the reference standards and testing procedures.

The checking of appearance, color and marking is carried out by visual inspection with the naked eye diffused light from a distance of 1 m. Testing methods for other properties are set out in the relevant standards.

The tested products are considered to be good if all test results are satisfactory.

The test results of each batch of products are available in the laboratory of the producer.

8. Application conditions in construction industry

8.1 Placing on the market

In accordance with the Act of 16 April 2004 on construction products (Polish Journal of Laws of 2004, No. 92 Item 881), a construction product can be placed on the market if it is fit for construction applications in the scope relevant to its functional properties and purpose.

A construction product is fit for construction applications provided that:

- **it has the CE marking**, which means that it has been assessed for compliance with the harmonized standard or an European technical approval or a national technical specification of a Member State of the European Union, or
- **is on the list of products** set out by the European Commission and marked with a small health and safety symbol, or
- **marked with the construction mark B**.

Construction products made in accordance with separate technical documentation drawn up by the architect of the building or agreed with him, for which the producer has issued a statement for the compliance of the construction product with the documentation and regulations, are also approved for individual application on the construction site.

The marking of the construction product with the construction mark is permitted if the producer, having its seat in Poland, made a compliance assessment and issued, on their sole responsibility, the national declaration of performance.

The Minister of Infrastructure, by way of regulation, specifies a list of harmonized standards and guidelines for European technical approvals, which material scope includes the construction products subject to the CE marking.

No standard for plastic pipes is mentioned in the said list.

The technical approval is granted for the construction product for which no Polish product standard was drawn up, or for the construction product for which the functional properties related to the basic requirements differ significantly from the properties specified in the Polish product standard.

The technical approval is granted on the basis of assessment of functional properties and life expectancy of the construction product which was properly identified as such and confirmed, as required, by tests, calculations, visual inspection, expert opinions and other documents, using specific technical and construction provisions for products set out in Polish standards.

8.2 Declaration of Performance

The Regulation of the Minister of Infrastructure of 17 November 2016 on **methods of declaring the performance of construction products and the method of marking them with the construction mark** (Polish Journal of Laws of 2016, item 1966) specifies the elements to be included in a national declaration of performance and a template of such a declaration in Appendix 2.

After issuing the national declaration of performance and before placing the construction product on the market, the producer puts the construction mark on the product, which indicates that it conforms with the technical specifications, which was confirmed by assessment of conformity. The construction mark is placed visibly, legibly, indelibly and directly on the construction product or its label.

If it is not technically possible to label the construction product as indicated above, the label is placed on the individual or batch packaging of the construction product or on the commercial documents of the product.

The national declaration of performance is to be made available on the producer's website. Copy of a paper document is delivered to a recipient of a product upon request.

9. Delivery terms and conditions

9.1 Packaging

Structured **InCor®** pipes are packed in bundles/pallets or laid loose depending on the size and transport requirements. Each package is secured by a wooden base and wrapped with tape to allow loading and unloading.

Pipe fittings are packed on pallets and wrapped with foil.

Structured **InCor®** non-hub pipes have at one end a double-hub partition fitting, and at the other end a sealing ring at the final corrugated section of the pipe.

DN	Pallet contents [pc]	Weight of 6m pipe [kg]	Weight of pallet [kg]
160	28	8,5	238
200	14	13	182
250	11	20	220
300	8	30	240
400	3	48	144
500	2	78	156
600	2	114	228
800	2	192	384
1000	2	402	804

9.2 Storing

Structured **InCor®** pipes have to be stored horizontally on even surfaces free of sharp objects, stones or jags to prevent deformation or damage.

InCor® pipes and fittings have to be stored in the original packaging.

Pipes in pallets without side boards can to be stored to a height of up to 2.0 m.

Pipes in pallets with side boards can to be stored to a height of up to 3.0 m. In this case. the pallets have to placed one on another using boards for separation.

Loose pipes may be stored in conical piles to a height of up to 1.5 m.

Loose pipes should be laid on wooden beams of 5x5 cm spaced at a maximum of 2.5 m. Pipes with hubs should be placed alternately.

Pipes of different diameters should be stored in separate piles. If this is not possible, the pipes with largest diameters or thickest walls should be laid on the bottom of the pile.

Pipes are not protected against UV radiation. Pipes and fittings should be stored under roof, which protects against the harmful effects of solar radiation and precipitation.

It is permitted to store structured **InCor®** pipes and fittings in open storage yards, however, the period of storage (including storage on the construction site) should not exceed one year. Fittings should be stored in original packaging.

Pipes stored for over 6 months, especially during the summer, may be discolored by UV radiation. This does not affect their physical and mechanical parameters. For longer storage periods, the pipes should be covered with a tarpaulin or black UV protecting plastic.

Pipes and fittings should be stored away from heat sources and concentrated chemicals such as oils, paints or solvents.

It is recommended to store the pipes and fittings in such a way as to maintain their cleanliness and to avoid contamination of their interior.

The order of building in pipes and fittings should be kept by **FIFO** method ("First-In, First-Out").

9.3 Transporting

Pipes and fittings may be transported by any means of transportation adjusted to their length; they should be stably arranged during transportation. Pipes cannot protrude beyond the vehicle more than 1 m.

The floor of the vehicle should be even and free of sharp edges, screws or jags. If the vehicle has a side, use wooden planks to separate the pipes from it.

Pipes of different diameters and loose pipes should be placed in the vehicle in accordance with section 9.2. Pipes should be protected against contact with the hot exhaust gases, fuel or oil. Pipes have to be secured against movement during transportation by means of straps. Use tapes or straps with smooth surfaces or hemp or polyester ropes to protect the cargo during transportation, loading and unloading. Do not use chains or steel ropes.

Pipes should not be dragged but moved. Do not hitch any hooks to the ends of the pipes. Do not drop or spill out the pipes from the vehicle. Loose pipes of ≤ DN 400 may be unloaded manually.

Keep caution during loading and unloading, especially at temperatures below 0°C. Transporting pipes at temperatures below -15°C may take place only with the consent of the producer.

For loading and unloading, use of appropriate equipment such as forklifts, loaders with accessories for pallets, cranes.

It is permitted to transport pipes pipe-in-pipe. In this case, the pipes should be secured against slipping.

Unloading the pipes transported pipe-in-pipe should be done by gradually removing one pipe from another and placing them in separate piles.

10. Designing pipeline

InCor® pipes are used for non-pressure underground combined drainage and sewerage outside buildings - application symbol "U" - performed in accordance with **PN-EN 752:2017-06** and designed in accordance with PN-EN 1295-1:2019-05.

Pipelines should be designed and laid in accordance with the requirements set out in the Construction Law in terms of functional safety, environmental protection and adequate provision of hygiene and health conditions and energy savings.

10.1 Location of the pipeline

Sewage system lines made of **InCor®** pipes should be located:

- **in built-up areas** - outside roads in separating lanes of existing and planned streets. It is permissible to lay the drainage or combined sewerage under the roadways in the collector, local and access streets if it is used for draining them.
- **outside built-up areas** - off the roads along them.

Sewage system lines made of **InCor®** pipes should be laid along the entire length underground.

In special cases it is allowed to lay the pipes above ground. Individual designs and construction plans are required for such lines. In particular, the lines should be protected against the damaging effects of the environment.

Passages of sewage lines through obstacles should be made using the shortest possible route, perpendicular to the obstacle. Passages of channels under waterways should be made using protective pipes.

Sewage system lines made of InCor pipes can run across railroad tracks in protective pipes under the following conditions:

- the top part of the protective pipe should be buried at a minimum of 1.5 m below the rail head, but not less than 0.5 m below the bottom of the draining ditch
- intersection with the tracks should be at an angle of 60 90°
- the protective should be led out 10 m outside the cross-section of the track and end with drains on both sides.

Passages of lines across the roads cannot undermine the stability and bearing capacity of the subsoil, surface and cross-section of the road, as well as the technical conditions of road facilities set out in the provisions of the law.

Intersections of sewage lines made of **InCor®** pipes with other installations should not disrupt the secure siting of these installations.

As provided by the provisions of the law, minimum distances from buildings, greenery and gas lines laid underground have to be maintained when designing and constructing the pipeline.

The routes of channels made of **InCor®** pipes near buidings should be designed in such a way as to not have a negative impact on the stability of the building's structure. At the some time, the impact of the building on the pipeline has to be considered.

If there is a need to lead the line made of **InCor®** pipes through buildings, the connections made inside the walls of the building should enable to displace both the element of the building and the pipeline.

10.2 Pipeline components

Basic pipeline components include:

- Drains, inspection channels and manholes for connecting channels and inspection
- Sewage chambers for pipelines DN 800 and above
- Sewage gullies draining water to storm water drainage and combined drainage from street surfaces and hardened surfaces
- Vent fans for network ventilation
- Wastewater lifting plants.

Sewage channels made of **InCor®** pipes should be designed and laid straight with the least number of changes in direction and gradient.

Drains and sewage chambers should be designed and used in the following cases:

- change in direction. cross-section and gradient of the channel
- in the start, connections, intersections, branch-offs or ends of the channel
- for longer straight sections at distances not exceeding 60 m
- in places provided for inspection and maintenance.

At the connections between pipes with diameters up to DN400 running at different depths, you should use backdrop manholes with a vertical downpipe outside the manhole for the difference in levels of up to 4 m. For the channels with larger diameters, you have to use appropriately shaped cascade chambers.

The placement of sewage gullies depends on the design of the road. It should be adapted to the shape of the drained surface, size of runoffs and capacity of the gully.

In all the highest points of the network structure, in particular in sewage chambers, vent fans should be installed. Ensuring proper ventilation of the network is essential to achieving proper oxygen conditions inside effluent and preventing the decaying of effluents in the pipes.

10.3 Calculating sewage channels

Sewage channels are designed based on the size of the required wastewater flows, the adopted channel drop, the specified degree of fill-up and the flow velocity, including hydraulic losses.

For the calculation of the turbulent flow in the sewage lines, PN-EN 752:2017-06 recommends the use of **Colebrook-White** and **Manning** formulas.

1. To calculate the flow rate, the following formula is used:

$$Q = \frac{\pi \times D^2 \ v}{4}$$

where:

Q – flow rate [m^3/s],
v – overage flow velocity in the cross-section of the line [m/s]
D – inner diameter of the pipe [m]

2. For the pipes with a circular cross-section at the full flow rate, (v) is given by the **Colebrook-White** formula.

$$v = -2\sqrt{2gDJ_E} \times \log_{10}\left(\frac{k}{3{,}71D} + \frac{2{,}51\gamma}{D\sqrt{2gDJ_E}}\right)$$

where:

v - average flow velocity in the cross-section of the line [m/s]
g – gravitational acceleration [9,80665 m/s^2]
D – inner diameter of the pipe [m]
$\mathbf{J_E}$ – hydraulic gradient [m/m]
k – roughness coefficient of the pipe [m]
γ – kinematic viscosity coefficient of the fluid [*for water at temp. 10 ^0C is 1,308 x 10^{-6} m^2/s*].

If we place v to the formula for Q, we will get:

$$Q = -6{,}95 \times \log\left(\frac{k}{3{,}71D} + \frac{0{,}737}{D\sqrt{DJ_E} \times 10^6}\right) D^2\sqrt{DJ_D}$$

For the lines with partial fill-up or for the channels with non-circular cross-section, the flow velocity is calculated using the above formula by replacing (D) with ($\mathbf{4R_h}$), where ($\mathbf{R_h}$) is the hydraulic radius (the ratio of the cross sectional area of flow and the wetted perimeter).

3. Both for circular and non-circular cross-section, for the lines with full and partial fill-up, flow velocity can be calculated from the **Manning** formula**:**

$$v = KR_h^{\frac{2}{3}} J_E^{\frac{1}{2}}$$

where:

K – Manning coefficient [$m^{1/3}/s$],
$\mathbf{R_h}$ – hydraulic radius [m],
$\mathbf{J_E}$ – hydraulic gradient [m/m]

4. Approximate **Manning** coefficient can be calculated from the formula:

$$K = 4\sqrt{g}\left(\frac{32}{D}\right)^{\frac{1}{6}} \times \log_{10}\left(\frac{3{,}7D}{k}\right)$$

where:

g – gravitational acceleration [m/s^2]
D – inner diameter of the pipe [m]
k – roughness coefficient of the pipe [m]
Applied values of (K) are between 70-90 $m^{1/3}/s$.

Roughness coefficient (k) takes into account the hydraulic losses affected by the material of the pipe, breaks in the connections and sediment on the inner surface of the pipe below the level of effluents.

In the case of deposition of sediments on the surface of the pipe, you have to take into account the decrease of the cross-section of the channel for the calculations.

The hydraulic losses are also found on the connection pieces, changes in channel diameters. drains, curves and other fittings. Therefore, take into account the local losses by adopting higher values of the roughness coefficient.

Commonly used values of (k) are between 0.03- 3 mm.

For new sewage pipes mode of plastics, k = 0.1 is taken. This value does not include the hydraulic resistance of pipe connections, curves, branch-offs, drains, and connections of house sewers and other components.

Recommended (k) for the channel made of InCor® pipes	
mm	**Channel type**
0,25	sanitary without side inflows and components or in small quantities
0,40	sanitary with side inflows and standard components storm water and combined
0,75	storm water and combined with side inflows and components sanitary with side inflows and components in large quantities

10.4 Recommendations for sewage channels

The following recommendations have to be observed each time when calculating the cross-section of channels made of **InCor®** pipes:

1. nominal diameter of sewage lines should not be less than:
- **DN 200** for sanitary channels
- **DN 300** for storm water and combined channels

2. the fill-up of the channel at the calculated flow should comply with the conditions of flow at free level of effluents, prevent the overflow of the channel and provide the ventilation of the network. The ratio of the values of fill-up h to the diameter **D (h/D)** should be:
- **0.5-0.7** for sanitary channels
- **0.7-1.0** for storm water and combined channels
- it is permitted to completely fill the channels of all types of sewage.

3. minimum flow velocities at a completely filled cross-section of the channel should be at least:
- **0.8 m/s** for sanitary channels
- **1.0 m/s** for storm water and combined channels
- lower velocities may result in the decay of effluents in the pipes and the formation of H_2S, which is a highly unfavorable phenomenon. It is then necessary to enable the network to be flushed.

4. minimum gradients for sewage lines to enable proper flow velocities should be:
- **0.5%** for sanitary channels DN 200
- **0.3%** for storm water channels DN 300
- in each case the gradients should not be lower than **1/DN**.

5. maximum gradients of sewage channels result from the decrease of flow velocities of effluents. It is recommended not to exceed the velocity of **5.0 m/s**.

6. when larger gradients of the lines are required, the following consequences of high velocities have to be taken into account:
- air suction
- H_2S released into the environment
- increased erosion of the line
- increased risk of maintenance.

10.5 Recommendations for house sewers

House sewers as section of the sewage channels which connect the sources of effluents with the sewage network should be designed in accordance with PN-EN 752:2017-06.

House sewers may be mode of **InCor®** pipes as well as PVC-U pipes with smooth walls produced by InstalPlast Łask.

A. House sewers for sanitary channels starting from the first drain off the building should meet the following requirements:

1. the route of the house sewer should perpendicularly to the channel with a uniform gradient
2. the connection with the channel is achieved by using a drain
3. it is permissible to use a tee, a saddle junction or an in situ gasket
4. nominal diameter of the house sewer should not be less than **DN 150**
5. minimum gradient of house sewers should be:

DN	spadek
150	**1.5%**
200	**1.0%**
250	**0.8%**
300	**0.6%**

6. maximum gradient for the house sewer made of **InCor®** pipes is **25%.**
7. drains for house sewers should be used:
- at the boundary of the property
- when there is a change of direction, diameter or gradient
- at the straight lines each 35 m for DN150 or each 50 m for DN 200.

B. House sewers running from storm water channels to street rain drums should meet the following requirements:

1. the route of the house sewer should be straight with a uniform gradient
2. the length of the house sewer running from the floor drain to the channel or drain should not be longer than 20 m
3. nominal diameter of the house sewer should not be less than DN200, and from a single floor drain for the house sewer no longer than 12 m – **Dn150**
4. minimum gradients for the house sewers should be **2.0%**
5. maximum gradient for the house sewer made of **InCor®** pipes is **40%.**

10.6 Depth of the pipeline

The depth of the sewage network should take into account:
- he ground freezing depth (**0.8-1.4m**) set out in PN-EN 1997-1:2008
- the requirements for necessary channel gradients
- physical properties of the ground, the presence of groundwater
- protection against the damage to the pipeline by external loads
- the proximity to technical infrastructure and other buidings
- terrain layout
- the distance of the source of effluents from the channel
- economic aspect of the construction and operation of the network.

Under average conditions, the minimum depth of the sanitary channel is **2.5 m**, and the storm water channel is **2 m**. It is recommended to adopt a minimum thickness of the covering layer of **1.4 m** in order to prevent any possible damage to the pipeline by external loads.

The maximum allowable depth of the pipeline is **8-10 m**. For practical as well as technical and economic reasons related to the construction and operation of the network, the recommended depth of the pipeline made of **InCor®** pipes should be no more than **4-6 m**.

If the terrain layout prevents the placing of lines under recommended gradients or if the depth of the channel exceeds the maximum permitted depth, it may be necessary to use a sewage pumping station.

In the case of storm water and combined networks. a gravity system for effluent run-off has to be used. In the case of the sanitary network, it is often unavoidable to use a pumping station, but you should always carry out a feasibility study before introducing it.

11. Completion of the pipeline

11.1 Groundworks

The trench for the sewage lines has to be in accordance with the technical requirements set out in PN-B-10736:1999 and PN-EN 1610:2015-10.
Trenches for pipelines made of **InCor®** pipes should meet the following requirements:

1. the bottom of the trench should be leveled to the required gradient and shape in order to ensure a uniform support for the pipes. At the bottom of the trench dips should be made for the joints.

2. the trench should be drained and protected against water pouring in, the pipeline should be protected against surfacing.

3. the trench width depends on the terrain and hydrogeological conditions and the depth should be included in the design each time. The trench width should provide a working space on both sides of the pipeline.

DN	Working space
200 - 300	0,25 m
400 - 600	0,35 m
800	0,45 m

4. depending on the soil type, use the following methods to prepare the surface:
- without sand bed, directly on the leveled and shaped bottom of the trench in a uniform, relatively soft fine-grained soil
- with sand bend of **10 cm** in normal soil conditions
- with sand bend of **15 cm** in the rocky or hard soil.

5. when the bearing capacity of the soil is insufficient; in unstable soils such as peat or quicksand, it may be needed to replace the native soil with reinforced bedding such as sand, gravel, concrete footing, etc.

6. the backfilling should be made across the entire width of the trench up to the top of the **InCor®** pipe.

7. the backfilling has to be thoroughly compacted with layers of 1/3 of the thickness of the diameter of the pipe.

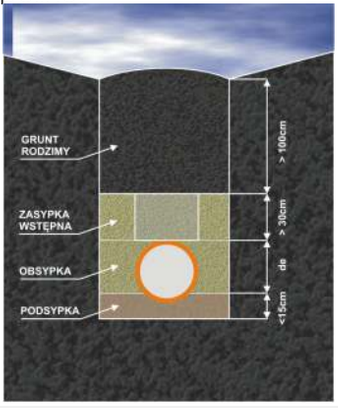
8. the minimum thickness of the initial backfill over the top of the pipe should be:
- **15 cm** for pipes with diameter **< DN 300**
- **30 cm** for pipes with diameter **≥ DN 300**.

9. the initial and final backfilling of 30 cm over the pipe should be compacted manually.

10. use only light equipment for mechanical compacting of the final backfilling of 1 m over the pipe.

11. use the native soil or the soil delivered especially for this purpose to make the backfilling and the initial backfilling of the pipeline made of **InCor®** pipes. For example:
- loose, compactable material such as sand, gravel, breakstone and a mixture of sand and gravel
- it cannot contain lumpy or frozen materials or garbage and rubble
- it cannot contain grains with sharp edges and sharp rocks or stones
the thickness of the grains cannot exceed 75% of the width of the groove of the pipe.

12. the final backfilling of the pipeline made of I**InCor®** pipes can be done using the native soil if this will not have an adverse impact on the pipeline.



11.2 Installation of pipes and fittings

InCor® pipes are connected using hubs or double-hub fittings and elastomeric seals installed in the last groove of the spigot end of pipe. The installation of the pipes in the trench is easy owing to their lightness and flexibility.

To ensure a proper laying of the pipeline, use the following recommendations:

1. PP pipes are far more resistant to low temperatures than PVC pipes. However, we do not recommend to lay them in temperatures below -20°C.

2. the pipes should not be thrown into the trench but placed manually or using equipment in accordance with the guidelines for loading and unloading.

3. before connecting pipe sections, they should be checked for damage

4. the end of the pipe, especially the seal and the inside of the hub should be cleared of any contamination. If necessary, remove the seal and reinstall it after clearing.

5. the pipes should be laid with hubs in the opposite direction to the flow of effluents

6. measure the depth of the hub and mark on the pipe the necessary depth of insertion

7. apply lubricant to the seal - do not use grease or oil as it may damage seals.

8. insert the pipe into the hub and push all the way until you reach the depth you marked; if necessary, use a hand lever or proper equipment, but take extra caution not to damage the end of the pipe

9. do not strike or hammer the pipes with metal tools. However, if you need to use such tools, secure the end of the pipe by placing pieces of wood before striking or hammering.

10. the pipe can be cut to any length with a hand fine tooth saw or a fine tooth chainsaw. The cut has to be made in the groove perpendicular to the pipe's axis. Clear the cut surface of any chips. There is no need for beveling.

11. fittings should be connected with **InCor®** pipes just like pipes with pipes, but care should be taken when pushing the pipe into the hub so as not to damage it. It is different with elbows since the pushing force does not typically work along their length.

11.3 Connecting pipes and drains

InCor® pipes can be connected to typical plastic drains.

If the drains are connectable with PVC pipes with smooth walls in accordance with PN-EN 1401-1:2019-07, use our transition fittings.

InCor® pipes can also be connected to any other types of sewage wells and concrete sewage chambers, prefabricated or completed on the construction site.

The connection can be made in two ways:

1. by embedding the **InCor®** leak-proof sewer pipe connection in the cavity of the wall of the well or chamber by means of cement mortar; the cavity for embedding the fitting should be as close to its diameter as possible.

The remaining free space has to be filled with cement slurry to ensure proper tightness.

Take care when embedding the fitting as it may deform, which may have an adverse impact on the tightness of the connection or in extreme cases make it impossible.

After embedding the fitting, the pipe can be connected to the well or chamber inserting the spigot end with a seal into the hole of the fitting.

2. by embedding the connecting piece made of the **InCor®** pipe with the length of protruding outside the wall no longer than 0.5 x DN or 0.5 m in a similar way as the leak-proof sewer pipe connection.

When embedding the connecting piece in the concrete wall, ensure its proper support by compacting the soil under so that a full joint strength of the concrete with the pipe can be achieved.

Having completed the concrete well or chamber in this manner, you can connect the **InCor®** pipe by means of the double-hub fitting or elastomeric seals.

12. Symbols and Abbreviations

12.1 Symbols

A :	hub depth
C :	sealing area depth
DN :	nominal size
ID :	nominal size of inner diameter
OD :	nominal size of outer diameter
de :	pipe outer diameter
di :	pipe inner diameter
De :	hub outer diameter
Di :	hub inner diameter
e2 :	hub wall thickness
e3 :	wal thickness in sealing area
e4 :	wal thickness between waves
e5 :	wal thickness of inner layer
e6 :	wal thickness of outer layer
L:	pipe length
L1 :	length of fitting
R :	deviation radius of fitting
Z1, Z2, Z3, Z4 :	length of (the part) of fitting
a :	angle of fitting

12.2 Abbreviations

MFR :	mass flow rate
OIT :	oxidation induction time
PP :	polypropylene
SDR :	standard dimension ratio
SD :	stiffness designed
SN :	stiffness nominal
TIR :	true impact rate

13. Compilation and DTP

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