9 HANDLING UNDERGROUND WORK

9.1.1 Explanation to Underground Work

Excavation works have to be carried out corresponding to the general valid guidelines and standards for civil underground engineering. Parallel the communal different additional conditions as well as the AGFW-guidelines of the FW 401 regulations - part 12 have to be considered.

The pipe trenches have to be excavated by a competent civil underground engineering company acc. to DIN 18300, DIN EN 805, DIN EN 1610 and DIN 4124 and re-filled again acc. to section 3.09 and 3.11 of standard DIN 18300. Concerning the width of the trench section 5.2 of DIN 4124 has to be considered.

Whether pipe trenches should be scarped and at which depth they have to be constructed is also mentioned in standard DIN 4124 section 4.1 to 4.3, as well as the scarping angles for the different soil characteristics.

The laying depth respectively pipe-crown-covering height according to the projecting work and pipe-static has strictly to be meet. Section DIN EN 1610 will describe the structure of trench-sole. The total length of the sole has to be carried out stable and stone-free.

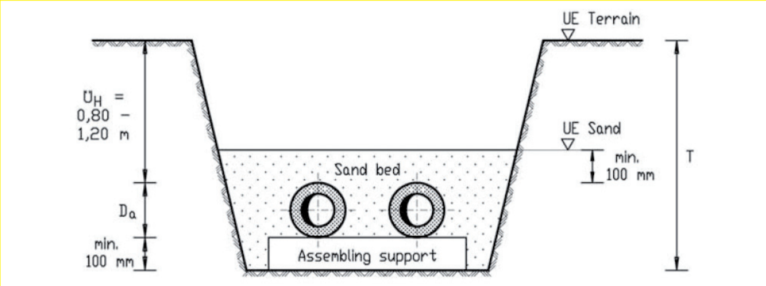
In order to secure the quality of the total system, the pipe layer will be responsible for draining the pipe trenches and to keep them free until all insulation works at the welding spots will be finished, according to DIN EN 1610.

Contracted pipe trenches have to be shovelled free manually. The quality of all works and the expected life time of a district heating line are depending in a high degree from the excavation of the trenches in accordance to the DIN standard.

The measures of length of the **isoplus**-pipeline design are valid as axis measure for the trench excavation. The following described civil underground information has been especially proved practically, without claim for completeness. In case of special situations we ask you to contact the **isoplus**-assembling- respectively design engineers, who will work out special problem-solutions.

9.2.1 Trench Depth Main Line

The soil-depth [T] of the pipe trench will be calculated from the given covering height [$Ü_H$], the PEHD-jacket-pipe diameter [D_a] and the height of the pipe support respectively the sand bed. The standard covering height for pipe construction is 0,80 m (= frost-depth) up to 1,20 m.



Jacket-pipe-Ø **D_a** in mm	65	75	90	110	125	140	160	180	200	225	250	280	315	355
Covering height **$Ü_H$** in m	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80
Soil-depth **T** in m	0,97	0,98	0,99	1,01	1,03	1,04	1,06	1,08	1,10	1,13	1,15	1,18	1,22	1,26

Jacket-pipe-Ø **D_a** in mm	400	450	500	560	630	670	710	800	900	1000	1100	1200	1300	isoplus
Covering height **$Ü_H$** in m	0,80	0,80	0,80	0,80	0,90	0,90	1,00	1,00	1,20	1,20	1,20	1,20	1,20	
Soil-depth **T** in m	1,30	1,35	1,40	1,46	1,63	1,67	1,81	1,90	2,20	2,30	2,40	2,50	2,60	

The value mentioned in the table are valid for the given covering heights and an assembling support of 0,10 m. In case of other covering heights the difference value of the mentioned covering height [$Ü_H$] has to be added or subtracted from the depth [T].

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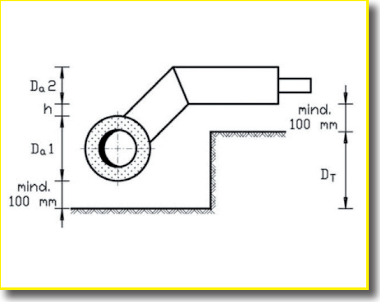
9.2.2 Trench Depth Branch Line

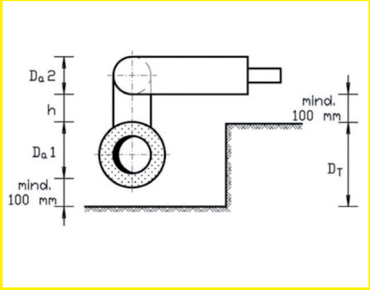
Due to manufacturing technical construction heights [h] at 45° T-branches and at parallel-branches the soil-depth [T] will change at the branch lines in correspondence with the difference measure [D_T]. Depending from installation position of the branch, topside or bottom side the measure D_T has to be added or subtracted from the main line depth [T].

The exact measure [h] can be seen from **chapter 2.2.8**.

45° T-Branch



Parallel-Branch

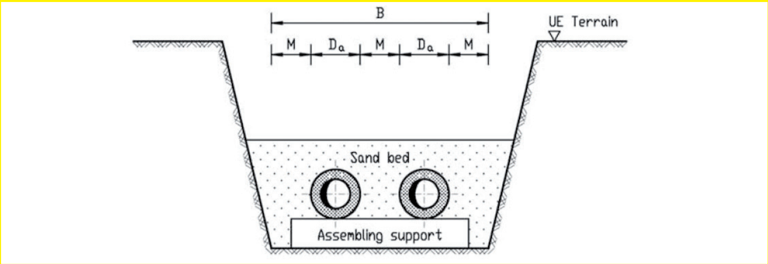


The difference measure [D_T] will be calculated acc. to the following formula:

Exit topside	⇒	$D_T = D_a1 + h$	[m]
Exit downside	⇒	$D_T = D_a2 + h$	[m]

9.2.3 Trench Width Standard

The soil-width [B] will be calculated in trench sections without expansion pads and without additional foreign lines like i. e. a parallel water line, the PEHD-jacket-pipe diameter [D_a] and the minimum assembling distance [M] depending from dimensions.



Jacket-pipe-Ø **D_a** in mm	65	75	90	110	125	140	160	180	200	225	250	280	315	355
Min. assembl. distance **M** in mm	100	100	150	150	150	150	200	200	200	200	200	300	300	300
Soil-width **B** in m	0,43	0,45	0,63	0,67	0,70	0,73	0,92	0,96	1,00	1,05	1,10	1,46	1,53	1,61

Jacket-pipe-Ø **D_a** in mm	400	450	500	560	630	670	710	800	900	1000	1100	1200	1300	isoplus
Min. assembl. distance **M** in mm	400	400	400	500	500	600	600	700	700	800	800	900	900	
Soil-width **B** in m	2,00	2,10	2,20	2,62	2,76	3,14	3,22	3,70	3,90	4,40	4,60	5,10	5,30	

The mentioned width [B] in the table is valid for two pipes of the same PEHD-jacket-pipe diameter. Because of this a sufficient assembling width for post insulation at the connection couplers as well as for the sand bed will be guaranteed. At the areas of the expansion pads the values according to **chapter 9.2.4** will be relevant.

In case that coupler-constructions like i. e. fitted electrical couplers will be installed, which are not included in the **isoplus**-performance range, the conditions of the corresponding supplier will be valid. For other applications, like i. e. in case of several pipes [x] the sole width [B] will be calculated according to the following formula:

$B = x \bullet D_a + (x + 1) \bullet M$ [m]

9.2.4 Trench Width Expansion Pads Area

At the area of expansion pads at L-, Z- or U-elbows as well as at 45° T- and Parallel-branches the sole width [B] and the minimum distance [M] has to be enlarged. The widening is depending from the thickness of the expansion pads [DP_s] mentioned in the **isoplus**-trench-designs. The length of the enlargement is depending from the length of the given expansion pads [DP_L].

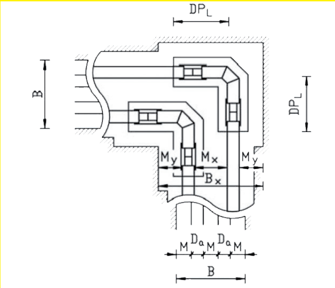
DP_L = Expansion pad length acc. to trench-design [m]

M_x = Minimum distance [M] + 2 • Expansion pad thickness [DP_s] acc. to trench design [mm]

M_y = Minimum distance [M] + 1 • Expansion Pad thickness [DP_s] acc. to trench design [mm]

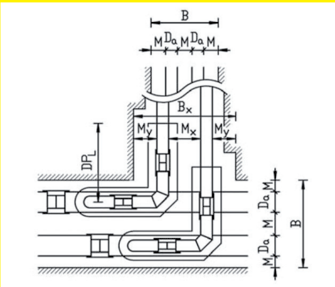
B_X = Total soil-width [m]

L-Elbow



B_X = $2 \cdot (D_a + M_y) + M_x$ [mm]

Parallel-Branch



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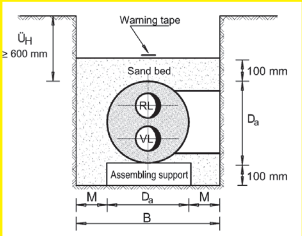
9.3.1 Trench Depth / Trench Width

Trench Depth

The soil-depth [T] of the pipe trench will be calculated from the given covering height [$Ü_H$], the PEHD-jacket-pipe diameter [D_a] and the height of the pipe support respectively the sand bed.



D_a in mm	125	140	160	180	200	225	250	280	315	355	400	450	500	560	630
Soil-depth **T** in m	0,825	0,840	0,860	0,880	0,900	0,925	0,950	0,980	1,015	1,055	1,100	1,150	1,200	1,260	1,330

The value mentioned in the table are valid for the given covering heights of 0,60 m and an assembling support of 0,10 m. In case of another covering height the difference-value to $Ü_H$ = 0,60 m has to be added or to subtract from the depth [T].

Trench Width

The soil-width [B] will be calculated from PEHD-jacket-pipe width [D_a] and the minimum assembling distance [M], depending from dimension.

D_a in mm	125	140	160	180	200	225	250	280	315	355	400	450	500	560	630
Min. assembl. dist. **M** in mm	150	150	150	150	150	200	200	200	200	200	200	300	300	300	300
Soil-width **B** in m	0,425	0,440	0,460	0,480	0,500	0,625	0,650	0,680	0,715	0,755	0,800	1,050	1,100	1,160	1,230

Due to the minimum values a sufficient assembling-width for post insulation at the connection couplers as well as for preparing the sand-bed will be guaranteed. In case that expansion pads will be required at branches or at direction-changes, the soil-width [B] has to be enlarged about 80 mm at a padding thickness of 40 mm as well as about 160 mm at a padding thickness of 80 mm. The values of the table are valid for an **isoplus**-double pipe. In case that more pipes [x] will be laid, the soil-width [B] will be calculated according to the following formula:

$$B = x \bullet D_a + (x+1) \bullet M \quad [m]$$

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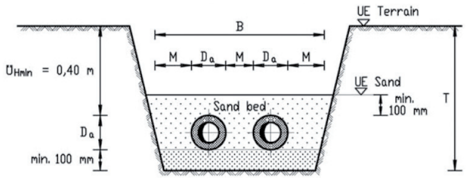
9.4.1 Trench Depth / Trench Width

Trench Depth

The soil-depth [T] of the pipe trench will be calculated from the given covering height [$Ü_H$], the PEHD-jacket-pipe diameter [D_a] and the height of the pipe support respectively the sand bed. The standard covering height for **isoplus** flex pipes is 0,40 m. The frost depth in Central Europe is 0,80 m.



D_a in mm	65	75	90	110	125	140	160	180	225	250
Soil-width **T** in m	0,565	0,575	0,590	0,610	0,625	0,640	0,660	0,680	0,725	0,750

The values mentioned in the table are valid for the given covering heights and a sand-bed respectively assembling support of 0,10 m. In case of other covering heights the difference value of the mentioned covering height $Ü_H$ = 0,40 m has to be added or subtracted from the depth [T].

Trench Width

The soil-width [B] will be calculated in trench sections without expansion pads and without additional foreign lines like i. e. a parallel water line, the PEHD-jacket-pipe diameter [D_a] and the minimum assembling distance [M] depending from dimensions. In case that expansion pads will be required for **isoflex** or **isocu** at alterations of direction or at branches, the distance [M] has to be enlarged about 80 mm.

D_a in mm	65	75	90	110	125	140	160	180	225	250
Min. assembl. dist. **M** in mm	100	100	100	100	100	100	100	100	150	150
Soil-width **B** in m	0,430	0,450	0,480	0,520	0,550	0,580	0,620	0,660	0,900	0,950

The mentioned width [B] in the table is valid for two pipes of the same PEHD-jacket-pipe diameter. For the pipe laying of double pipes this value will be calculated as follows:

$B_{\text{Double pipe}} = D_a + 2 \bullet M$ [m]

For other applications, like i. e. in case of several pipes [x] the sole width [B] will be calculated according to the following formula:

$B = x \bullet D_a + (x+1) \bullet M$ [m]

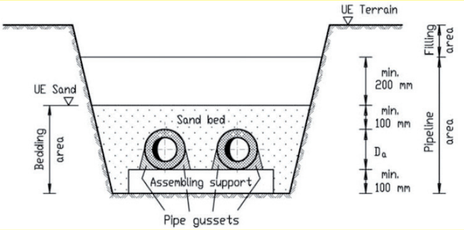
9.5.1 Sand Bed / Sand Structure / Limit of Grading Curve / Grain Size Distribution

Sand Bed

After the insulation and sealing works as well as after assembling of expansion pads, all kind of test procedures which are belonging to the performance range have to be carried out. Especially the following points have to be considered:

⇒ The pipeline guidance corresponds with the **isoplus**-trench-design
⇒ The static calculated covering heights have been strictly considered
⇒ Contracted soil, stones or/and foreign particles have to be removed from the area of the sand-bed respectively from the pipe area
⇒ The expansion pads are assembled in the given length and thickness and against soil an pressure
⇒ All couplers are foamed and recorded, the ducts to the buildings and houses are closed
⇒ In case of a thermal prestressing the given expansion movements and the corresponding temperatures have been reached and recorded
⇒ The monitoring system has been functionally tested and recorded

Before the sand-bed will be established, the trench has to be inspected and approved concerning the mentioned points by a responsible site-manager.



Thereafter the preinsulated jacket-pipe PJP, have to be re-filled carefully with at least 10 cm sand layers with a grain size of 0 - 4 mm (class NS 0/2), **see following page**. After that the sand should be compressed manually. The areas between the pipes and also at the pipe gussets should be especially considered, in order to avoid hollow spaces. These spaces have to be compressed and sealed especially in order to avoid not admissible settlements or movements later on. During these works eventually used supports have to be removed, in case that it will be no sand-sacks, which have to be cut-off, or hard foam supports.

In case that a washing away of the bedded sand cannot be excluded during the underground construction works, due to unfavourable conditions like heavy rain, the bedding area has to be covered by use of geo-textiles. This should be generally considered at locations on a slope respectively at precipitous inclines because of the draining effect of the trench profile. Because of the water quantity the water content of the sand will be above the optimum value of the proctor-curve, and will not fulfill the compressing degree, $D_{Pr} \geq 97$ %.

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Here, the grain sizes are separated so that the target friction values at PJP are not achievable and the so-called „tunnel effect“ kicks in. For this reason, among other things, slurrying the sand is not classified as state-of-the-art in accordance with AGFW FW 401 - Part 12.

In the pipe zone, special requirements are placed on the friction between PEHD material and the quality of the sand. The resulting permanent friction conditions form the decisive basis for verification of the static and dynamic use of the PJP.

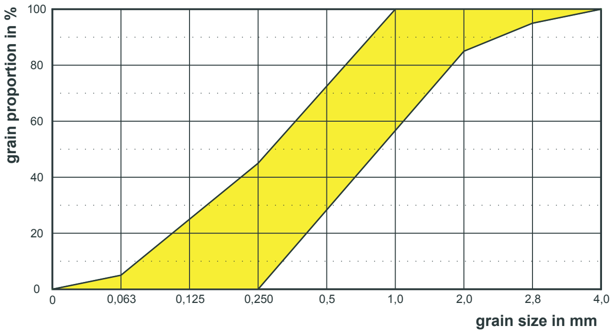
Should flowable bedding materials, such as self-stabilizing sand mixtures, SSM, or soil mortar be used, note that no long-term experience is available in terms of removing these with a simple device. There are no permanent and safeguarded test results available in practice for mechanical characteristics such as long-term friction behavior. General approval of these filling materials as road construction material has not yet been obtained through the German Forschungsgesellschaft für Straßen- und Verkehrswesen, FGSV (Resebend Association for Roads and Transportation). These have not been taken into account in the pipe static basics in accordance with AGFW FW 401 - Parts 10 + 11.

Replacement materials such as foam glass granules, crushed sand, recycled material, etc. are fundamentally not permitted in the pipe zone as bedding material or sand bed material.

Sand Structure in the Bedding Area

Sand bed height	⇒	all sides at least 100 mm
Kind of sand	⇒	Not binding medium up to rough sand
Grainsize	⇒	0 - 4 mm
Kind of Grain	⇒	round edged
Classification	⇒	Nature sand, NS 0/2
Norm	⇒	DIN 12620 resp. TL Min-StB (Technical delivery conditions for mineral materials in the road building)

Limit of Grading Curve acc. DIN EN 12620 of grain class 0/2



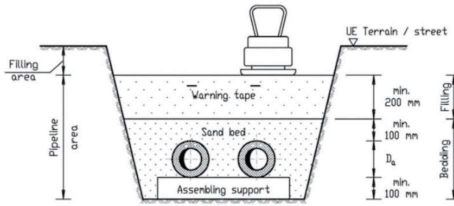
Grain Size Distribution acc. to DIN EN 12620

Rate of passage to 0,063 mm	⇒	± 5 %	Rate of passage to 1,0 mm	⇒	± 20 %
Rate of passage to 0,250 mm	⇒	± 25 %	Rate of passage to 2,0 mm	⇒	± 5 %

9.6.1 Re-Filling

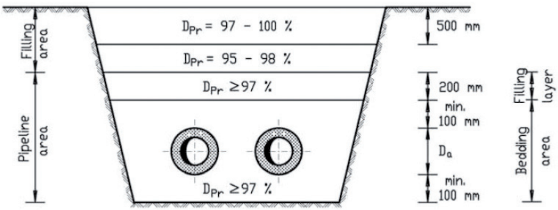
After finishing of the sand bed the trench can be filled with excavation material. The compressing should be carried out in layers. Rough and peaked stones should be removed. According to ZTV E - StB rough-graining soils up to a grain size of 20 mm have to be used as filling soil outside of the line area. Generally re-filling material according to DIN 18196, compressing class V 1 has to be used.

According to ZTV A - StB **in**sensitive soils against water and weather conditions have to be used for the trench filling of the filling area and the 20 cm filling-layer. In connection to this the ZTV E - StB allows also industrial recycling and recycling components, providing that the defined requirements like i.e. environment compatibility regarding water resources policy, compatibility with other building materials etc. as well as the requirements concerning compressing will be meet.



Filling and compressing of the trench has to be carried out simultaneously on both sides of the pipes. After filling of the 20 cm filling layer compressing machines like i. e. a surface compressor or an explosionram (weight up to 100 kg) may be used. The allowed area load is 40 N/cm^2 respectively 4 kg/cm^2 at a cold pipeline. In case that the pipeline should be already in operation, the area load will reduce to maximum 20 N/cm^2 respectively 2 kg/cm^2.

Further layers of 20 - 30 cm will be put on the first layer and a covering layer will finish the filling procedure. The requirements of the “Additional technical contract conditions and guidelines for excavations and soil-works of road constructions”, ZTV A and ZTV E, should additional used. The following degrees of compressing [D_{Pr}] should be reached in correspondence to ZTV E - StB.



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9.6.2 Minimum Covering Height / Bridge Class

The influence of traffic loads on preinsulated jacket-pipes will increase in correspondence with the reducing of the covering height. Therefore the minimum covering heights in dependence of the bridge-classes and dimensions have been investigated and defined by independent material-test-institutes. Theoretically only extreme slight results could be proved.

In case of a secured superstructure at road construction the wheel load will spread over a larger area, as the wheel load will not effect directly on the filled soil, that means the preinsulated jacket-pipe will be less stressed.

The covering heights mentioned in the table have to be meet due to the danger of beaming and buckling of the preinsulated jacket-pipes, the spade-safety, sucking of vehicles in case of not secured surfaces as well as to the possible exceeding of the admissible ring-bending stress.

Bridge class	Single pipe Nominal Diameter in DN										
	20 - 125	150	200	250	300	350	400	450	500	550	600 - 1000
SLW 12	0,40	0,40	0,40	0,40	0,40	0,50	0,50	0,50	0,60	0,80	1,00
SLW 30	0,40	0,40	0,40	0,40	0,50	0,50	0,50	0,60	0,70	0,90	1,10
SLW 60	0,40	0,50	0,50	0,60	0,60	0,50	0,70	0,80	0,90	1,00	1,20

Bridge Class	Double pipe Nominal Diameter resp. type					All flex pipe types and dimensions
	to Dr-80	Dr-100	Dr-125	Dr-150	Dr-200	
SLW 12	0,40	0,40	0,40	0,40	0,40	0,40
SLW 30	0,40	0,40	0,40	0,40	0,50	0,40
SLW 60	0,40	0,50	0,50	0,60	0,60	0,40

Covering height in meter [m]

For big dimensions additional soil mechanical demonstrations respectively underground engineering static calculations are required. This includes the calculation of the circumference-bending-tension for pipes > DN 500 at heavy load traffic SLW 60, for pipes > DN 350 at railway and at road construction works with covering heights < 0,80 m. Calculation will be made according to ATV-working regulation A 127.

Bridge Class acc. to DIN 1072

Heavy-load traffic	Contract breadth the wheel	Wheel-load		Radius load-area	resulting load-area	calculated pressure [p] of load-area		resulting aquivalent surface load	
	in cm	in kN	in to	in cm	in cm^2	in N/cm^2	in kg/cm^2	in kN/m^2	to/m^2
SLW 12	30	40	4,08	18	1.017,88	39,30	4,01	6,70	0,68
SLW 30	40	50	5,10	20	1.256,64	39,79	4,06	16,70	1,70
SLW 60	60	100	10,19	30	2.827,43	35,37	3,61	33,30	3,39

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9.6.3 Maximum Covering Height

The soil-load respectively soil pressure on the preinsulated jacket-pipes will increase in dependence with the increasing pipe-laying depth. Due to the admissible shearing strain respectively transverse stress [τ_{PUR}] between PEHD-jacket and PUR-hard foam respectively carrier pipe and foam, the covering height has to be limited, independent from operating temperature and the medium.

Dimensions carrier pipe			Single pipe						Double pipe			
			Jacket-Pipe Outside-Diameter D_a in mm			Maximum admissible Covering Height $\ddot{U}_H$ in m			Jacket-Pipe Outs.-Diameter-Ø D_a in mm		Max. admissible Covering Height $\ddot{U}_H$ in m	
Nominal Diameter in **DN**	Outside-Ø d_a in mm	W. thick. **s** in mm **isoplus**	Insulation Thickness			Insulation Thickness			Insulation Thickness		Insulation Thickness	
			Standard	**1x reinf.**	**2x reinf.**	**Standard**	**1x reinf.**	**2x reinf.**	**Standard**	**1x reinf.**	**Standard**	**1x reinf.**
20	26,9	2,6	90	110	125	2,10	1,70	1,45	125	140	1,70	1,50
25	33,7	3,2	90	110	125	2,65	2,15	1,85	140	160	1,90	1,65
32	42,4	3,2	110	125	140	2,70	2,35	2,10	160	180	2,10	1,85
40	48,3	3,2	110	125	140	3,10	2,70	2,40	160	180	2,40	2,15
50	60,3	3,2	125	140	160	3,40	3,00	2,60	200	225	2,40	2,10
65	76,1	3,2	140	160	180	3,85	3,35	2,95	225	250	2,60	2,40
80	88,9	3,2	160	180	200	3,90	3,45	3,10	250	280	2,70	2,40
100	114,3	3,6	200	225	250	4,00	3,50	3,15	315	355	2,75	2,40
125	139,7	3,6	225	250	280	4,35	3,90	3,45	400	450	2,60	2,30
150	168,3	4,0	250	280	315	4,70	4,15	3,65	450	500	2,70	2,40
200	219,1	4,5	315	355	400	4,80	4,25	3,70	560	630	2,75	2,40
250	273,0	5,0	400	450	500	4,65	4,10	3,65	---	---	---	---
300	323,9	5,6	450	500	560	4,90	4,35	3,85	---	---	---	---
350	355,6	5,6	500	560	630	4,80	4,25	3,70	---	---	---	---
400	406,4	6,3	560	630	670	4,90	4,25	3,95	---	---	---	---
450	457,2	6,3	630	670	710	4,85	4,50	4,20	---	---	---	---
500	508,0	6,3	670	710	800	5,05	4,70	4,10	---	---	---	---
600	610,0	7,1	800	900	1000	5,00	4,35	3,80	---	---	---	---
700	711,0	8,0	900	1000	---	5,10	4,50	---	---	---	---	---
800	813,0	8,8	1000	1100	---	5,20	4,65	---	---	---	---	---
900	914,0	10,0	1100	1200	---	5,25	4,75	---	---	---	---	---
1000	1016,0	11,0	1200	1300	---	5,30	4,80	---	---	---	---	---
isoflex	20	2,0	75	---	---	1,85	---	---	---	---	---	---
isoflex	28	2,0	75	90	---	2,65	2,20	---	110	---	1,50	---
isocu	22	1,0	65	---	---	2,40	---	---	90	---	2,00	---
isocu	28	1,2	75	---	---	2,65	---	---	90	---	2,50	---
isopex and isoclima	20	2,0	---	---	---	---	---	---	75	---	2,20	---
	25	2,3	75	90	---	2,35	1,95	---	90	110	2,25	1,85
	32	2,9	75	90	---	3,05	2,50	---	110	125	2,40	2,10
	40	3,7	90	110	---	3,15	2,55	---	125	140	2,55	2,35
	50	4,6	110	125	---	3,20	2,80	---	160	180	2,50	2,25
	63	5,8	125	140	---	3,55	3,15	---	180	---	2,75	---
	75	6,8	140	160	---	3,80	3,30	---	---	---	---	---
	90	8,2	160	180	---	3,95	3,50	---	---	---	---	---
	110	10,0	180	---	---	4,30	---	---	---	---	---	---
	125	11,4	180	225	---	4,90	3,90	---	---	---	---	---
	160	14,6	250	---	---	4,65	---	---	---	---	---	---

ATTENTION: The values mentioned in the table are valid for soils with a specific weight of 19 kN/m^3, an inner soil-friction angle [φ] of 32,5° and for steel wall thickness according to **isoplus**, see **chapter 2.2 and 2.3**. Outside of the expansion pad areas respectively expansion branches, according AGFW FW 401, part 10 and EN 253, admissible shearing strain τ_{PUR} = ≤ **0,04** N/mm^2.

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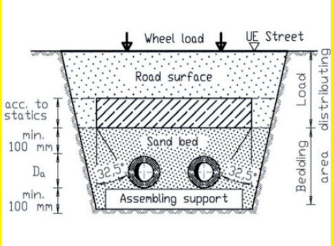
9.6.4 Load Distributing Plate

In case of lowering the minimum covering height respectively exceeding of the maximum covering height, civil underground technical safety measures have to be considered. These should be suitable to secure the preinsulated jacket-pipes against not admissible overloads of the crown-pressure, maximum 20 N/cm^2 respectively 2 kg/cm^2.

As possible load-distributors steel plates which have to be protected against corrosion, or steel-concrete-plates, concrete class B25 can be installed. Both kinds should be at least 100 cm longer as the area of the PJP pipeline which has to be protected. A construction static-engineer has to determine the exact thickness, the reinforcement and the eventual required foundations. Before the execution the approval from the **isoplus**-design engineers will be required.

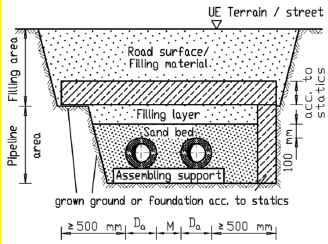
Distributing Plate

These are used for separating of high lumped loads (traffic loads) in case of lowering of the minimum covering height.
Distributing plates should be wide enough to reach with their load-distributing-angle of 32,5° the area outside of the preinsulated jacket-pipe.



Recover Plate

Recovering plates will be suitable for separating of high area-loads (traffic- and soil-loads) in case of exceeding of the maximum covering height. These should bear solid at both sides, that means along the trench length on grown ground. In case that this cannot be guaranteed, additional continuous- or point-footing have to be established. The plate should be at least 50 cm wider than the area which has to be covered.



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9.7.1 Building Site - Quality Assurance

For building site it will be necessary to provide a guideline for a quality performance of the single working steps, in order to reach an optimization of the installing situation for preinsulated jacket pipes. This guideline will be valid in the same manner for civil underground engineering, pipe layer and pipe manufacturer. The most important test parameters are listed chronologically in the following table in accordance with the construction progress:

Working step	Execution and result
Functional check and co-ordination of the tools for the relevant working steps	- Professional work can be only reached with suitable tools
Checking of trench measures: Trench width and trench depth according to pipe dimensions	- Creating of optimal working conditions for pipe layer and coupler assemblers; working clearance at the areas of elbows, expansion pads and coupler connections
Check of trench execution	- Creating of a stone-free and plain laying bottom, with lateral trench security and water and mud-free assembling areas, during the total construction period
Trench filling - Sand filling	- Stone free covering with sand, at least 10 cm thick around of the preinsulated PEHD-jacket-pipe, squared timber have to be removed before filling, Sand grain 0 - 4 mm (class NS 0/2), consider particle-size curve exactly
Trench filling - Filling material	- Stone free not binding compressing suitable material will be filled in layers

See **isoplus**-Assembly-Term - **chapter 11.5.2**