

<b>Unipetrol RPA, s.r.o.</b>	<b>Insulation – assembly, inspection and takeover</b>	N 11 019
Maintenance department		

The standard is binding on all entities (physical persons and legal entities) that participate in assemblies, repairs of thermal and cold insulated equipment of ORLEN UNIPETROL RPA, s.r.o. as an operator. Does not apply to the Litvínov and Kralupy refinery unit.

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<b>Replaces:</b>	<b>Standard administrator:</b>	<b>Valid from:</b>
	Maintenance Support Section	12.7.2017 (Validity verified 7.9.2020)

## **Initial provisions**

This standard determines and specifies in more detail the procedures for the assembly and repairs of thermal and cold insulation under the conditions of UNIPETROL RPA, s.r.o.

The purpose of the standard is to achieve the highest quality and standard of each type of insulations described in this standard.

Maintenance and repairs of insulations at the company are secured in a contractual manner based on contracts concluded between UNIPETROL RPA, s.r.o. and a qualified service company (contractor).

### **1. Scope of validity**

This standard is valid for the entire UNIPETROL RPA, s.r.o.

The procedure includes installation of insulations, handling of disassembled material and storage of removable insulations installed on the equipment of UNIPETROL RPA s.r.o.

The procedure also defines the rules and parameters of insulation inspections when they are taken into use.

The obligation of external companies to accept and comply with this standard must be stated in the corresponding contracts for work or other similar contracts concluded between UNIPETROL RPA, s.r.o. and the given contractor.

### **2. Terminology and definitions**

Company - UNIPETROL RPA, s.r.o.

User	- unit manager (for example, section director, plant director, department manager or production facility or section manager) to whom the operator entrusted assets for use. He/she is responsible for compliance with the conditions for a safe and reliable operation pursuant to the instructions and regulations designated for its use, operation and service
Care taker	- director of the technical unit or the service unit, maintenance department manager or manager of the premises and asset management department or another authorized employee who is responsible for the technical condition of the designated individual groups of tangible assets, including maintenance, repairs, revisions and tests
Client	- employee responsible for the activities associated with work orders
Contractor	- authorized physical person or legal entity, technically capable to assemble and repair flange joints, i.e. including dedicated technical devices, which holds the appropriate TICR authorization pursuant to Section 6, Paragraph 1, Letter b) of Act No. 174/1968 Coll., and which has a valid trade license

### **3. Scope of insulation**

#### **Insulation is required for:**

- Heat storage in equipment and pipeline.
- Temperature control of processes and products, e.g. to prevent condensation, solidification or too high viscosity.
- Protection of workers if higher surface temperatures pose a danger.
- Prevention/reduction of damage to equipment or pipelines under freezing conditions.

### **4. Thermal insulation of pipelines**

#### **4.1. Insulation from pre-formed parts (tube, plate and block)**

Rigid mineral fibre insulation materials will be mounted on the pipeline in pre-formed sections or segments and must be fixed to the pipe with a tie wire. Min. two wires for 0.5 m length of pre-formed section and max. three wires for 1 m length of pre-formed section are required to be used. All connections will be maximally tight. Perimeter connections between segments of adjacent lengths must be alternated. Welded or clamped support rings at the bottom end and above each flange shall be used for vertical pipes of nominal size 100 mm or greater. The additional rings can be prescribed in the range of approximately 4 - 6 m. For pipe bends, the pipe sleeve is cut into oblique pieces so that the outer contour of the insulation follows the shape of the elbow. Each piece is fastened with one ring of wire. There must be no gaps between the pieces and they must be close to each other.

#### **4.2. Insulation of the pipelines with lamellar strips**

The lamellar strip of the length corresponding to the circumference after insulation is applied to the pipeline and tightly wrapped. The fastening is carried out with a steel wire in a spiral manner. The distance between the rings must be max. 20 cm.

##### **The following is used for pipeline diameter including insulation:**

up to 200 mm, Ø 1.25 mm steel wire  
up to 400 mm, Ø 1.60 mm steel wire  
up to 600 mm, Ø 1.80mm steel wire  
over 600 mm, Ø 1.80 mm steel wire

The fastening of lamellar strips with steel wire cannot be done in a spiral manner. Alternatively, the lamella strip can be fastened with aluminium strips and cyclop clamps. The maximum distance of aluminium strips is 20 cm. The second layer is fixed similarly and must overlap the joints (both longitudinal and vertical) of the first layer. In the case of insulation with reinforcing structure, only longitudinal joints overlap. The bends are wrapped in the same way as straight sections with pre-cut pieces. Each individual piece must be fixed to the bend by at least one ring of steel wire or aluminium tape. In the case of sheet metal surface

treatment, the bending insulation can be done by stuffing with the fibrous material behind the metal package. If a reinforcing structure (temperature above 300 °C) from spacer rings is used, the lamellar strips must be tightly fitted to the spacer ring.

#### 4.3. Pipeline insulation with mats on wire mesh

After cutting off the required length, the mat on the mesh is tightly wound on the pipeline. Contact surfaces should be in close contact to avoid gaps. In the multilayer design, the contact joints are overlapped. Individual mats are connected with a binding wire of min. Ø 0.7 mm with an overlap of at least three meshes on both sides. Alternatively, the mats can be fastened with wire hooks or stainless steel strips with min. 10 mm wide. If the wire hooks are used, they must not be more than 150 mm apart. Each hook should extend over at least three meshes on both sides. Adjacent parts are also connected by wire or hook at least in six places per meter.

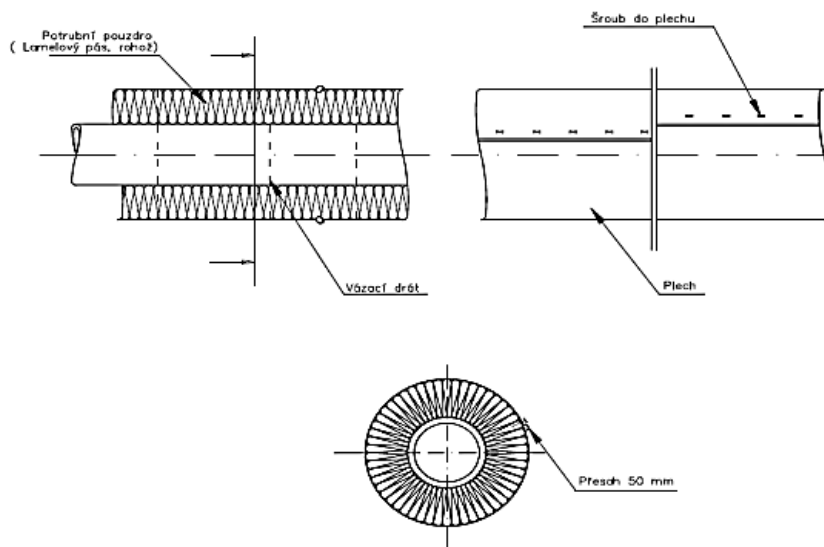
#### 4.4. Sheathing

##### Sheet metal thicknesses for sheathing

Perimeter [mm]	Galvanized [mm]	Stainless [mm]	Aluminium [mm]	Lacquered (Platal) [mm]
<b>Below 400</b>	0.5	0.5	0.6	
<b>400 – 800</b>	0.6	0.5	0.8 (1.0)	0.63
<b>800 – 1 200</b>	0.7	0.6	0.8 (1.0)	0.75
<b>1 200 – 2 000</b>	1.0	0.8	1.0	1.00
<b>Above 2 000</b>	1.0	0.8	1.2	

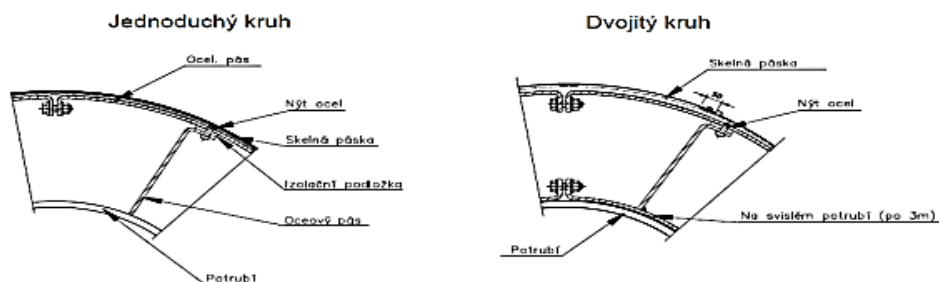
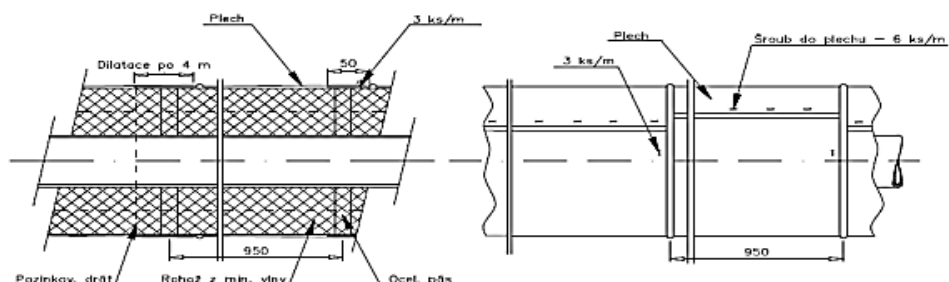
When assembling the sheet, it is proceeded from the lowest point on the route or riser and then against the slope so that the overlaps are sufficiently wide (ca 50 mm). The twisted and marked sheet is slid and pulled onto the insulated pipe so that the longitudinal joint is alternately mounted at the top of the perimeter. The connection is made with self-tapping screws at a maximum distance of 200 mm. For pipeline hangers or supports, the sheet must be cut so that the device can dilate and the sheathing cannot be damaged. Sheet metal joints will be sealed with silicone.

Pipeline diameter in mm	Marking wheel no.
pipeline up to Ø 140	0
pipeline up to Ø 240	1
pipeline up to Ø 400	2
pipeline up to Ø 600	3
pipeline up to Ø 1000	4
pipeline over Ø 1000	5



#### 4.5. Supporting and load-bearing structures, fixation

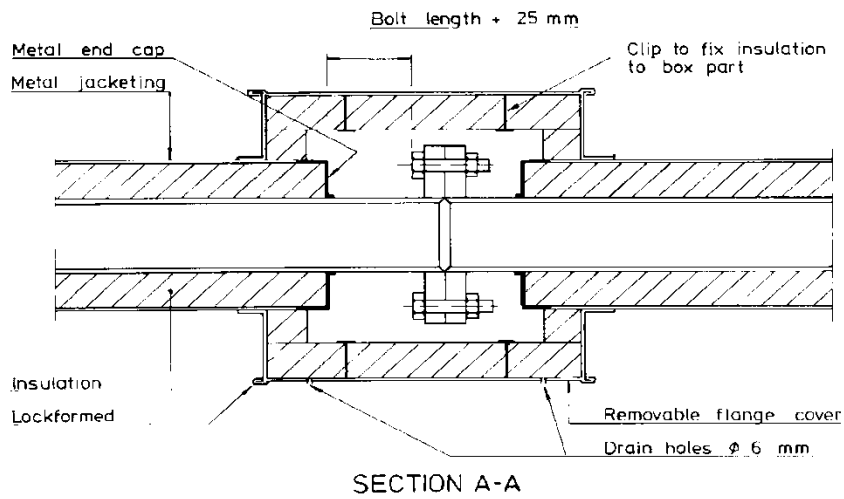
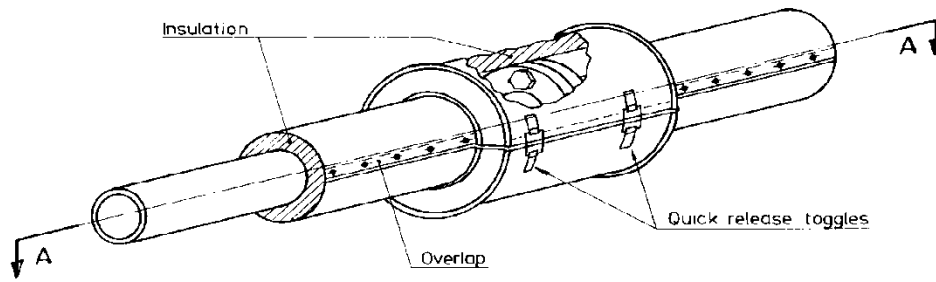
Insulations with low compressive strength and operating temperatures above 250 °C require support structures. These must be placed with a maximum spacing of 1000 mm. For arches, the supports are at the beginning and at the end at a support distance of up to 700 mm (measured along the outer circumference); if the support distances are longer, intermediate supports are necessary. Vertical and inclined pipelines should be equipped with supporting structures up to 4 m.



#### 4.6. Valves, flanges and fittings

If valves, flanges and fittings must be insulated, they must be provided with removable insulating covers/casings. The seal cover must be kept away from the insulating casing. The covers/casings will be made of two halves of sheet metals, lined with a rigid insulating plate and secured in hinges with clamps, self-tapping screws or tightening belts. The insulating lining will be secured, for example, by hooks of metal strips riveted to the inside of the metal cover. The protruding ends of the casing will be grooved and placed as rain protection. The insulation thickness around the flanges will have the same thickness as the insulation around the pipeline – at least 25 mm.

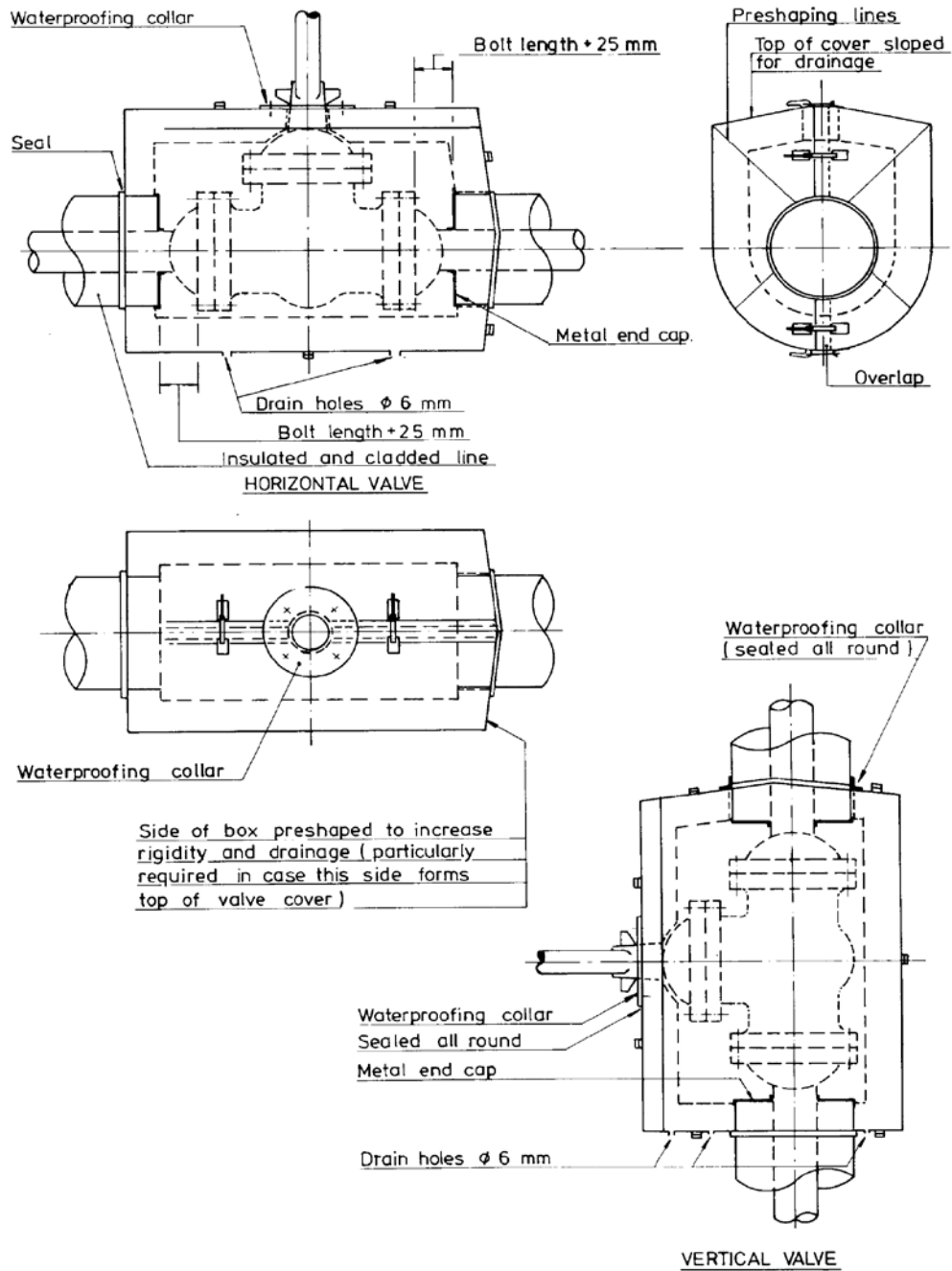
### REMOVABLE CASINGS FOR FLANGE



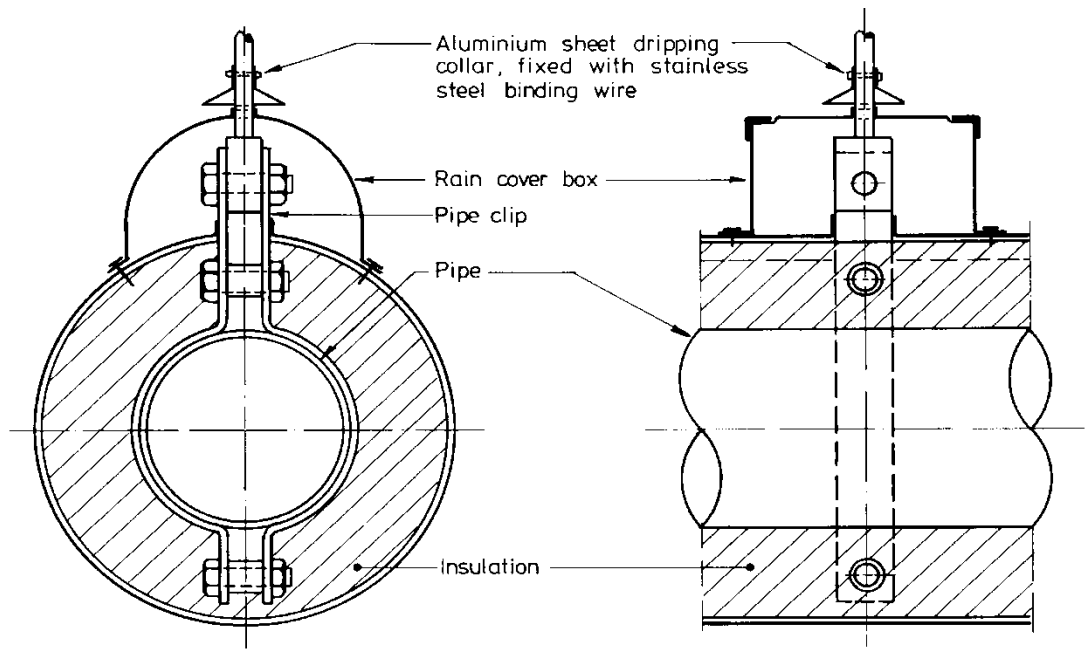
NOTE: Insulation to be fixed to box parts for easy removal and replacement

**REMOVABLE CASINGS OF FITTINGS**



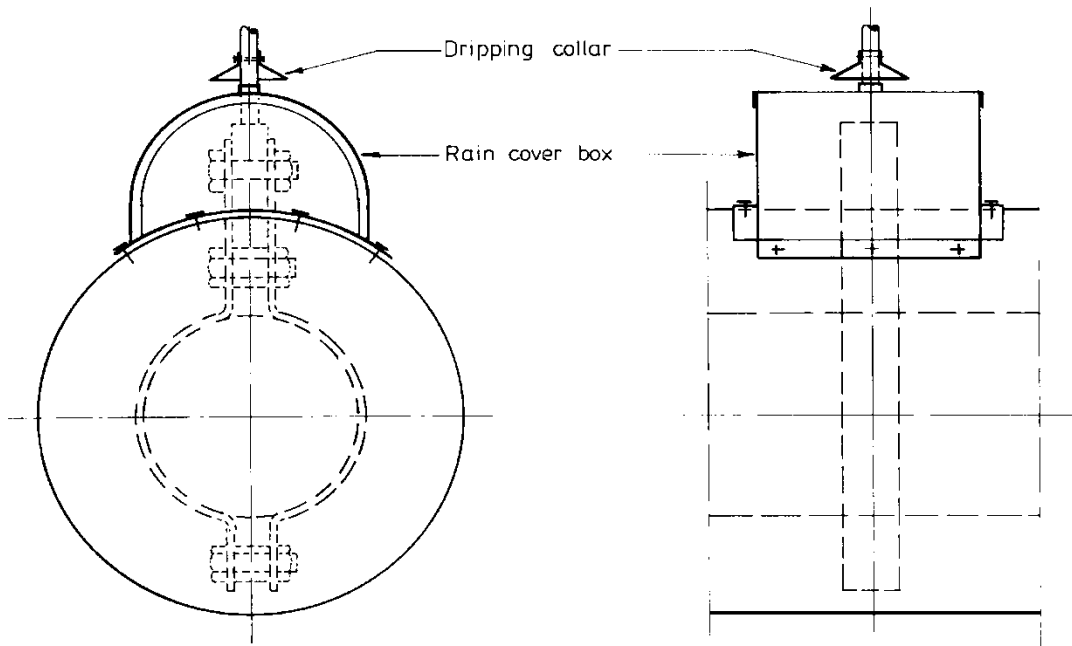


**COVER AGAINST RAIN AND DRIPPING COLLAR AROUND SUSPENSIONS**



CROSS SECTION

LONGITUDINAL SECTION



EXTERNAL VIEWS

## 5. Thermal insulation of apparatuses

### 5.1. Insulation of apparatus by plates or mats on wire mesh of mineral fibre

Plates or mats on the mineral fibre mesh are stabbed onto a welded construction of steel rod spikes  $\varnothing$  5 (4) mm and they are pressed against the insulated equipment. The maximum spacing of spikes is 300 x 300 mm. Plates or mats are secured with spring clips in each layer. For multi-layer insulation, the plates or mats of the next layer must fully cover the joints of the previous layer. If joints (e.g. shaped bodies, fronts, etc.) arise between plates or mats, it is necessary to fill them in and seal the cut-offs of the insulation material. For mats, longitudinal and transverse joints can be joined (stapled) with a binding wire of min diameter of 0.7 mm with a minimum of three meshes overlap on both sides. Alternatively, the mats can be fastened with wire hooks. If the wire hooks are used, they must not be more than 150 mm apart. Each hook should extend over at least three meshes on both sides. The hook connection should be at least at six locations per meter.

All covers, such as heat exchangers and manholes that are frequently removed, must be provided with removable sheet metal casings filled with an insulation plate with min. thickness of 50% of the vessel insulation. Each casing will be made of one or more pieces; each piece of size and shape so that two people can easily handle it. Locking in position will be done by snap fasteners.

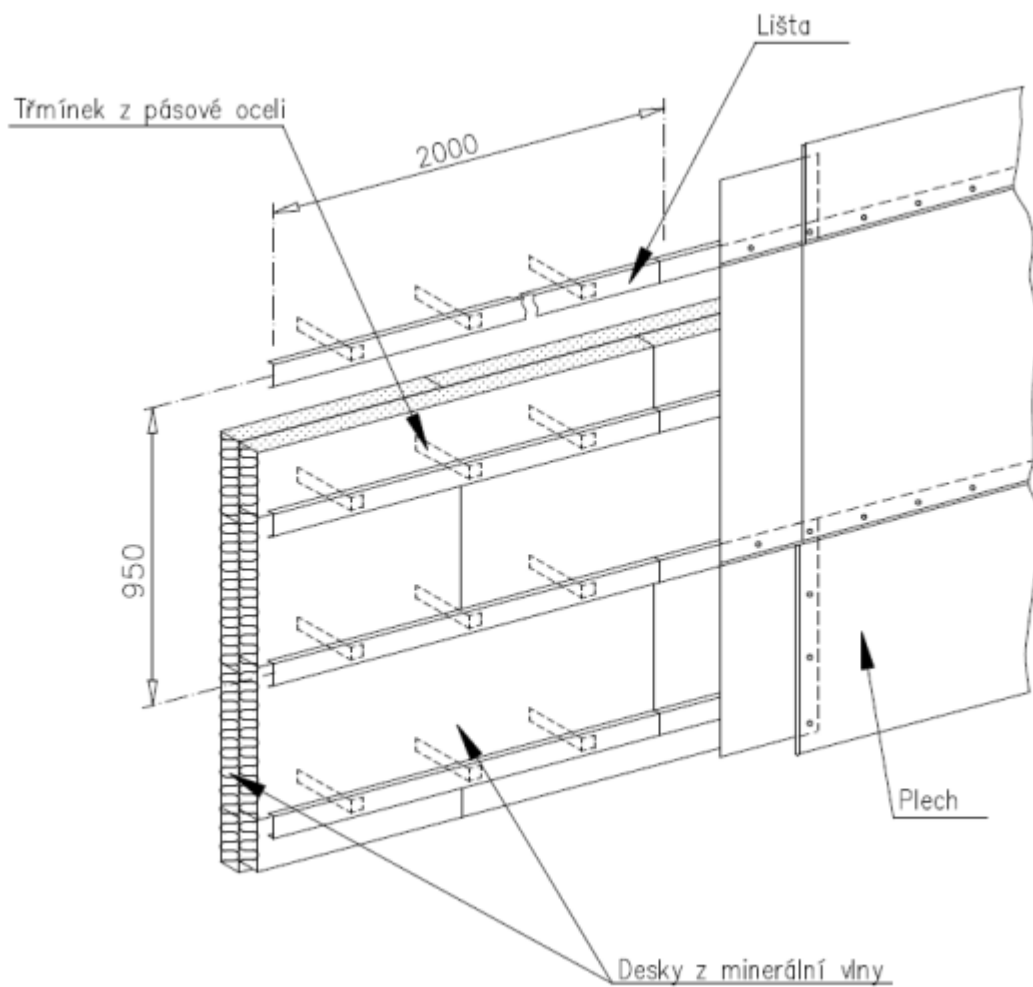
## 5.2. Sheathing

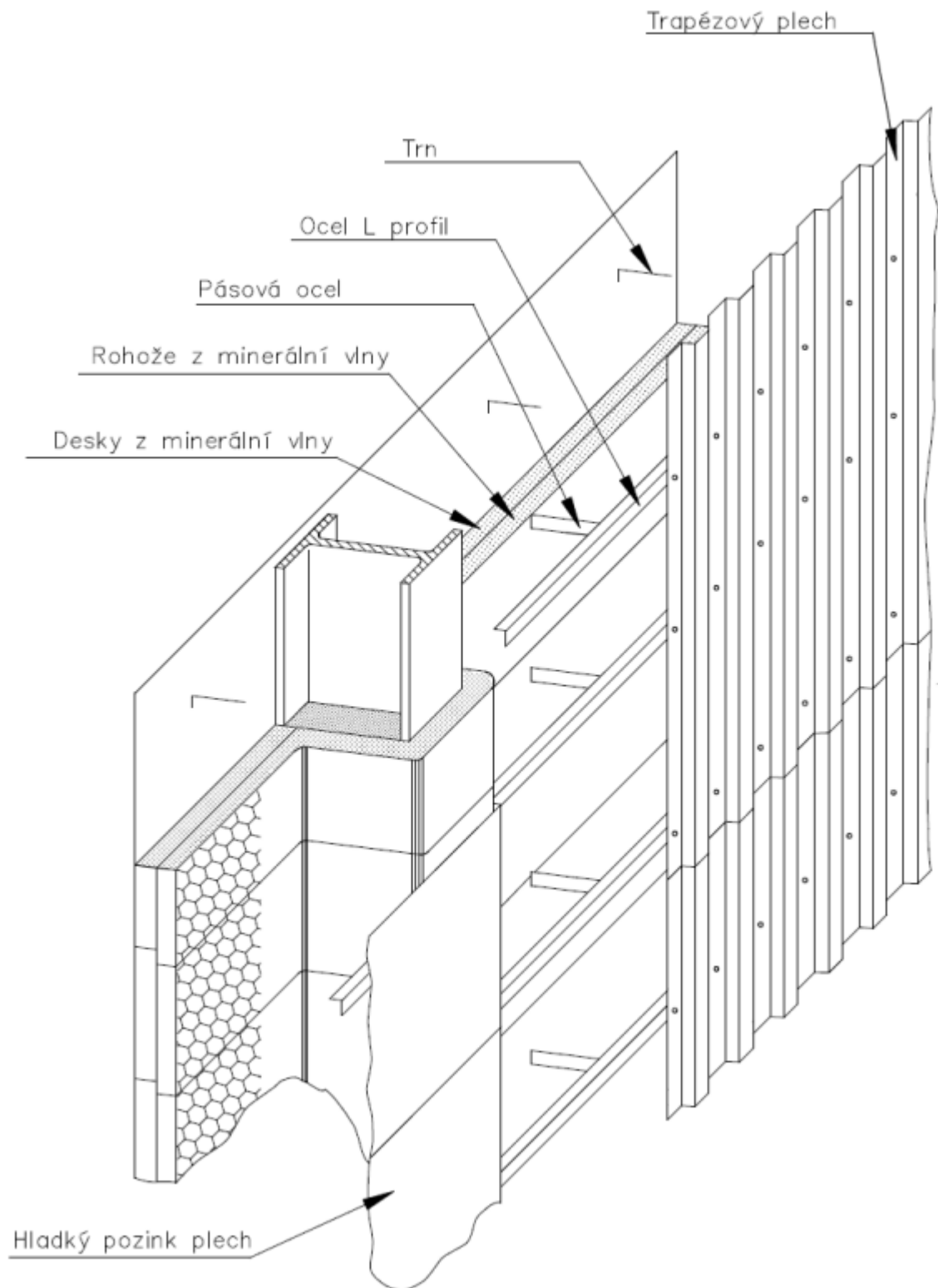
### Sheet metal thicknesses for sheathing

Galvanized [mm]	Stainless [mm]	Aluminium [mm]	Trapezoidal [mm]
0.7 -1.0	0.6 - 0.8	0.8 -1.2	0.65 - 0.75

Sheathing is made of smooth sheets, diagonally broken (letter shape) or trapezoidal. The type of sheet and fasteners is chosen according to the type of environment and stress (e.g. outdoor environment, alkaline, acidic etc.) Sheet metal fastening is performed on a structure made of galvanized sheet metal rails, steel "U" profiles or strip steel rings depending on the shape of the insulated equipment. Rails or circles are fixed to the device by means of  $30 \times 3$  mm clamps (1 m of rail = 2 clamps, 2 m of rail = 3 clamps, circle – clamp spacing 250 mm). For small installations, sheathing may be self-supporting. The spacing of the substructure is usually 950 mm, for trapezoidal sheets ca 1 500mm. The connections are made by sheet metal screws or rivets with a spike in distance of 200 mm for longitudinal joints and 500 mm for circumferential joints. The sheathing overlapping is 50 – 80

mm for both longitudinal and circumferential joints. In places where the formation of macro cells can be expected on contact of various metals (e.g. aluminium – steel) it is necessary to create an intermediate layer to eliminate them.





The dished, spherical segmented faces are made as dished faces from segments. The sheathing follows the shape of the face. The following data must be measured for manufacturing:

Diameter and height of the dished face, thickness and circumference of the insulation, rounding of the dished face with respect to the insulation thickness.

The width, length and number of segments are calculated based on the measured data. The number of segments for the selected diameters is shown in the following table:

∅ mm	obv. mm	šíře seg.mm	počet ks	rozt.šroubů	poč.šroubů	počet ks
D 1	čelo	D 1	segmentů	mm	spoj seg.	cca šroubů
600	1 885	105	18	65	5	83
800	2 513	126	20	80	5	100
1 000	3 142	131	24	95	5	126
1 100	3 456	144	24	100	6	132
1 200	3 770	157	24	100	6	144
1 300	4 084	146	28	100	7	182
1 400	4 398	157	28	100	7	196
1 500	4 712	168	28	100	8	210
1 600	5 027	180	28	100	8	224
1 700	5 341	167	32	100	9	272
1 800	5 655	177	32	100	9	288
1 900	5 969	187	32	110	9	276
2 000	6 283	196	32	110	9	291
2 200	6 912	192	36	120	9	330
2 400	7 540	209	36	120	10	360
2 600	8 168	204	40	130	10	400
2 800	8 796	220	40	130	11	431
3 000	9 425	214	44	140	11	471
3 200	10 053	228	44	140	11	503
3 400	10 681	223	48	150	11	544
3 600	11 310	236	48	150	12	576
3 800	11 938	249	48	150	13	608
4 000	12 566	242	52	160	13	650
4 200	13 195	254	52	160	13	683
4 400	13 823	266	52	160	14	715
4 600	14 451	258	56	170	14	758
4 800	15 080	269	56	170	14	791
5 000	15 708	280	56	170	15	824
5 200	16 336	292	56	170	15	856
5 400	16 965	283	60	180	15	900
5 600	17 593	293	60	180	16	933
5 800	18 221	294	62	180	16	999
6 000	18 850	304	62	180	17	1 033

The assembly of the sheathing of the dished face begins with the placement of a circular target in the centre of the face of  $\varnothing$  ca 200 mm. It is attached either directly to the body or to insulation. At the point of transition of the face to the cylindrical part, a strip of sheet metal ca 200 mm wide is fastened to the finished insulation on the circumference of the body, which serves to attach the widest part of individual segments. For vertically placed faces, the segments are fitted symmetrically on both sides from bottom to top. The segments must be assembled in direction of the water fall. When the segments are assembled, the centre of the face is covered with a rosette. Sheet metal joints will be sealed with silicone.

## **6. Cold insulation**

Insulation thickness depends on economic criteria and allowed surface temperature to prevent condensation. As insulation thickness increases, cold losses are reduced. As climatic and economic conditions vary for each insulation project, thicknesses cannot be standardized. They are calculated individually for each project.

### **6.1. Technological process of polyurethane insulation – PUR foam**

PUR foam has a closed cell structure, bulk density of 45 kg/m<sup>3</sup> +/- 5 kg (according to ČSN EN 1602), compressive strength ca 100 kPa (according to ČSN EN 826), measured thermal conductivity coefficient  $\lambda = 0.020$  W.m-1.K-1 (according to ČSN EN 12 664, ČSN 72 7012, ČSN 72 7014), calculation coefficient of thermal conductivity  $\lambda = 0.030$  W.m-1.K-1 (according to ČSN 73 0540-3). The product certificate was issued under no. 100 – 1018584 by Technický a zkušební ústav stavební Praha, s.p. (Technical and Testing Institute of Construction Prague, public enterprise), Notified Body 204. Hard PUR foam is cast in accordance with Arbeitsblatt Q 138 and DIN 18159.

### **6.2. Sheathing**

#### **Metal sheathing requirements for PUR foam insulation system**

- Absorption of foam pressure during PUR foam production
- Insulation protection against mechanical reactions and weather conditions
- Functions as vapour barrier

- Positive influence on fire behaviour

Sheet metal joints will be sealed with silicone and PUR foam filling holes will be closed with plastic plugs.

## **7. Handling of dismantled material**

Before commencing work, within the framework of issuing work permits, the operating personnel shall designate a collection point in the operational set for the storage of dismantled material. This material will be handled in such a way as to prevent contamination of the operating areas. It will be further stored in suitable closable large-volume bags in order to avoid the influence of weather conditions and with regard to work safety. The disposal will take place during the work performed, but no later than after the completion of the work. In case of dismantling of removable insulations, which will be re-mounted on the equipment, they will be stored in such a way that they cannot be degraded by soaking of the insulation wool due to weather conditions.

## **8. Inspection**

The inspections are conducted by the given device administrators during the implementation period and after the work completion.

### **The parameters of insulation inspection are:**

- Visual inspection of insulation performance and completeness according to this standard.
- Visual inspection of insulation of joints for leaks to prevent damage due to weather conditions and possible leakage under the insulation.
- Thermovision inspection after completion of the work.



## 9. List of related and other legal regulations

ČSN EN 1602	Thermal insulating products for building applications – Determination of bulk density
ČSN EN 826	Thermal insulating products for building applications – Compression test
ČSN EN 12664	Thermal performance of building materials and products - Determination of thermal resistance by methods of protected heating plate and heat flow meters - Dry and wet products with medium and low thermal resistance
ČSN 72 7012	Determination of coefficient of thermal conductivity of materials in thermal steady state.
ČSN 72 7014	Determination of coefficient of thermal conductivity of materials in thermal steady state. Evaluation of tests
ČSN 73 0540-3	Thermal protection of buildings - Part 3: Design values of quantities
DIN 18159	Cellular plastics as in-situ cellular plastics in building - In- situ polyurethane (PUR) foam for thermal and cold insulation - Application, properties, execution, testing.
DEP 30.46.00.31-Gen.	Thermal insulation in higher temperature operations
Act no. 174/1968 Coll.	On state professional supervision of work safety