

PRODUCT CATALOGUE

STRU NOBET[®]
MIGACZ

www.strunobet.pl

Production Facility in Kuzki



Production Facility in Lewin Brzeski



Production Facility in Grzybowo

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CHAPTER

1

General**About the Company**

Strunobet-Migacz Sp. z o. o. is the biggest manufacturer of the E pre-stressed concrete electricity poles, EOP light posts, ETG support structures and masts in Poland. The company produces a wide range of pole mount and container transformer stations and a wide selection of accessories and fittings for the power industry.

PRODUCTS FOR ELECTRICAL POWER ENGINEERING

- Pole mount transformer stations



Since February 2006, the company Strunobet Migacz Sp. z o.o. is a manufacturer of fully equipped pole mount transformer stations and power line support structures in any orientation with respect to the MV overhead or cable lines. Basic detailed design documentation of the station is a compilation developed by "Elprojekt" Poznań, which was adopted for general use by the Job Evaluation Workgroup of the Polish Power Transmission and Distribution Organisation. Pole transformer stations include the use of new materials and devices as well as new operational requirements which are aimed at simplifying the operation and enhancing safety of the staff and the outsiders. The production of pre-stressed concrete spun poles of high load capacity with the intention of placing all elements of the transformer station on one pole that can take over even the load of a 630kVA transformer. The company produces stations, poles in any configuration, constructions for the overhead LV and MV lines and fittings for mounting the electric railway tractions on ETG posts. At the customer's request, they are delivered by the company cars, assembled partially or in full.

- E-type spun concrete poles



The selection of spun poles manufactured by Strunobet-Migacz Sp. z o.o. is very wide. Today, it includes over 80 items. As far as the length is concerned, they are items from 9 to 18 meters in length, available at every 1.5 metres and the E spun poles capacity of 2.5 kN to 35 kN. Pole-top diameters from 150 mm to 308 mm depending on the top force, length and kind of construction. All spun concrete poles are characterized by the same taper of 15mm/1m. The company started to produce spun concrete poles in 2001 and in 2002 received the Technical Approval AT15-5733/2002 for the Spun Concrete Poles Produced from the E, EK, EO, EOP and ETO prestressed concrete. In 2008, following the introduction in Poland of the harmonized EN 12843:2008 standard. Precast concrete masts and poles, the Company obtained the Manufacturing Quality Control Certificate for these products. E-type poles are now manufactured in accordance with the above-cited standard and introduced onto the market according to the 2+ attestation of conformity system and marked CE.

Apart from the poles, our offer also includes a selection of footing components like beams type B60, B80, B90, B100, B150, footing plates U85 and U130 and precast footings type FP with plates which are 120, 160 and 200 cm wide. Each type of foundation is accompanied by an appropriate set of clamps needed to attach the stabs to the footing of the column.

- reinforced concrete poles



Reinforced concrete poles type ZN comply with all requirements of the manufacturing quality control system, described in Annexe ZA to the PN-EN12843:2008 standard. After the modernization in 2005, the dimensions of the reinforced concrete poles and the placement and diameters of the mounting holes do not differ from the poles previously produced and commonly used in Poland. Our ZN poles are produced from concrete class C35/45 (in accordance with the PN-EN 2006-1 standard), which guarantees that they have a lifespan of 50 years.

- container transformer stations



The company is the manufacturer of the system of container transformer stations in monolithic reinforced concrete enclosures. A modern production line allows for the production of a wide selection of stations, from the small-sized KSZ stations to large-sized KSW using the SCC self-compacting concrete with the compressive strength of C30/37. The production of enclosures does not involve vibrators and takes place in sealed steel moulds. The reinforced concrete castings are finished with painting and the external plaster in accordance with our customers' requests. Then they are comprehensively fitted with electrical devices, including the transformer as well.

- lamp posts



Strunobet-Migacz Sp. z o.o. has introduced onto the market the following light posts: EOP9, EOP10, 5 and EOP12 which are used, among others, to light railway crossings, platforms, streets and squares. EOP posts have a diameter of 150 mm at the top and a thickened base containing a fuse box. EOP posts have a head which is integrated with the post and to which an outreach arm is attached. The equivalent apical force of the EOP poles is 2.5 kN and allows to install single and multi-arm outreach arms in each wind zone in Poland. Standard components of the EOP poles include an aesthetic cover of the head and a “vandal-proof” composite shield for the junction fusebox with a terminal strip to connect the cable line 2x5x35 mm² with the possibility of installing electrical protection of the fixture. Lighting poles are manufactured according to the conformity system 1 from concrete class C40/50 and marked CE in accordance with the standard PN-EN 40-4:2008. The company offers lighting pole stubs and steel outreach arms made from pipes, which have been galvanized and painted according to a customer’s request.

- ETG poles of railway tractions



Pre-tensioned concrete supporting spun ETG constructions are designed for the construction of railway and tramway tractions installed on foundations with screws properly distributed at their ends.

At the bottom, an ETG pole has a steel head with four mounting holes appropriately spaced, depending on the type of foundation and the function of a pole. Above the head, the pole has a shape of a truncated cone with a ring cross-section. The external diameter of the pole decreases by 15 mm per one meter of length, starting at the base. The hole inside the pole has been used to drop traction bonding cables. At the bottom, the earth wire is connected to the head. The head has holes Ø13 for an external earth wire. An ETG pole is fitted with M8 screwed sleeves for fixing the track axis control signs.

- pre-stressed concrete masts



Pre-stressed spun concrete masts manufactured by Strunobet-Migacz Sp. z o.o. possess high technological parameters and visual aspects thanks to the use of the latest technologies for the production of the pre-stressed spun concrete. In contrast to other solutions, the mould with transverse modulation every 3 meters and an innovative insulation of the mould of the longitudinal joint minimize the number of visible joints. It results in an increased strengths and high resistance to weather conditions, including the aggressive environment.

- MV Switchboards



Prefabrication of MV switchboards by Strunobet-Migacz Sp. z o.o. is the next step in the development of the company aimed at expanding its business on the market of products for the electric power sector. In 2013, new solutions of air-insulated distribution switchboards with the possibility of using them for cable connectors as well as for container stations were introduced.

Switchboards are prefabricated in accordance with the PN-EN 62271-200:2012 standard, and the fields are arc fault protected.

Another MV product of ours enables us to extend the range of our previously offered solutions.



We also know how important the time and logistics solutions are for our customers. Therefore, we have our own modern and professional motor vehicle fleet, the core of which are Volvo cars. Thanks to it, all our customers are guaranteed the "Just In Time" delivery.



High quality of our products and professional management of the company have been recognized by our customers, partners and business institutions. It is best proved by the awards we have received over the past few years. All our products have recommendations of the ASSOCIATION OF POLISH ELECTRICAL ENGINEERS.



We are committed to the continuous development of our company. Therefore, our specialists are constantly improving our products and implementing new technologies. Moreover, our search for innovative solutions for this sector has been supported by our long-term cooperation with the Institute of Civil Engineering at Wroclaw University of Technology.

Today, our latest product catalogue is at your disposal. It will provide you with a full range of our products and contact details. It will certainly prove to be a very useful tool in your everyday work and an efficient source of information concerning different solutions for the power industry.

CHAPTER

2

Poles, posts and masts



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CHAPTER
2

Poles, posts and masts

15 Spun concrete poles type E

18 ŻN reinforced concrete poles

19 EOP lamp posts

28 SK lighting poles

29 SKf lighting poles

30 Ekw composite rods

31 EkwS service composite rods

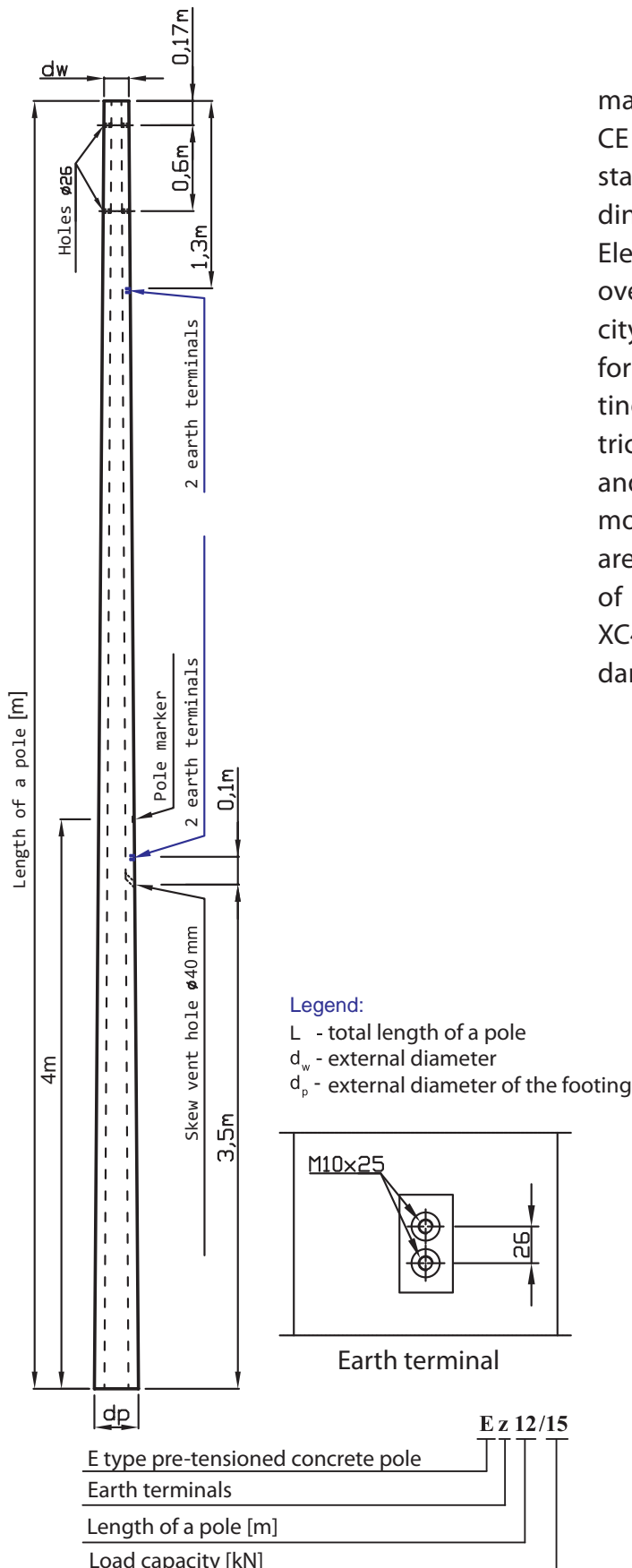
32 ETG railway traction posts

34 Footing elements

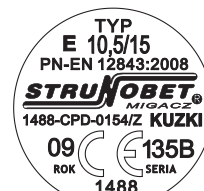
35 ES-type pre-tensioned concrete masts

Spun concrete poles type E

Manufacturing Quality Control Certificate CPD-1488-0154/Z



Prestressed energy poles type E are made of concrete class C40/50, marked CE in accordance with the PN-EN12843:2008 standard and introduced on the market according to the 2+ attestation of conformity system. Electricity poles type E are used as supports for overhead and buried-overhead cable electricity power lines and telecommunication lines, for post-mount transformer stations, as supporting structures for electric rail, tram and electric bus tractions, for lightning and radio masts, and other supporting structures. The most important technical parameters are: frost resistance, planned residual life of 50 years, low water absorption, exposure class XC4, XF2 according to the PN-EN 206-1:2003 standard.



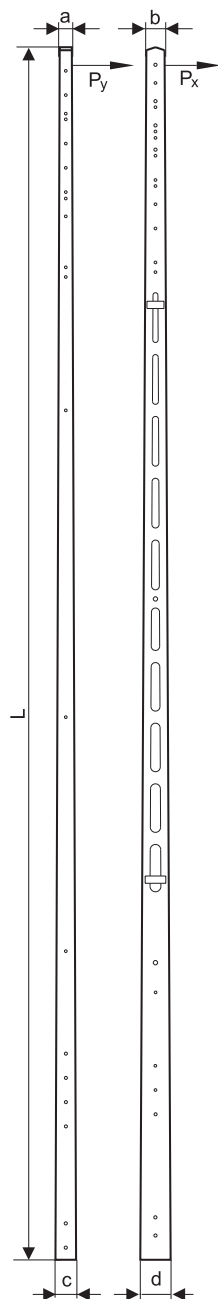
Technical parameters of E poles

Item	Pole symbol	Load capacity [kN]	Dimensions of a pole			Weight catalog [kg]	Weight transport [kg]	Failure load [kN]	Colour	
			L[m]	d _w [mm]	d _p [mm]					
1	E 9/2,5	2,5	9	173	308	755	800	4,5		White
2	E 9/2,5c	2,5	9	150	285	683	700	4,5		White
3	E 9/3,5c	3,5	9	150	285	683	700	6,3		White-Blue
4	E 9/4,3	4,3	9	173	308	845	900	7,7		Blue
5	E 9/6c	6	9	173	308	845	900	10,8		Black
6	E 9/6	6	9	218	353	1058	1200	10,8		Black
7	E 9/10	10	9	218	353	1162	1300	18,0		Red
8	E 9/12	12	9	218	353	1180	1300	21,6		Yellow
9	E 9/15	15	9	218	353	1180	1300	27,0		Green
10	E 9/17,5c	17,5	9	240	375	1305	1400	31,5		Orange
11	E 9/17,5	17,5	9	263	398	1500	1600	31,5		Orange
12	E 9/30	30	9	308	443	1980	2200	54,0		Grey
13	E 9/35	35	9	308	443	2083	2200	63,0		Grey
14	E 10,5/2,5	2,5	10,5	173	330	855	1100	4,5		White
15	E10,5/2,5c	2,5	10,5	150	308	855	1000	4,5		White
16	E10,5/3,5c	3,5	10,5	150	308	855	1000	6,3		White-Blue
17	E10,5/4,3	4,3	10,5	173	330	1055	1100	7,7		Blue
18	E10,5/4,3(218)	4,3	10,5	218	375	1308	1500	10,8		Blue
19	E10,5/6c	6	10,5	173	330	1055	1200	10,8		Black
20	E 10,5/6	6	10,5	218	375	1308	1500	10,8		Black
21	E 10,5/10	10	10,5	218	375	1428	1500	18,0		Red
22	E 10,5/12	12	10,5	218	375	1543	1500	21,6		Yellow
23	E10,5/15c	15	10,5	240	398	1635	1800	27,0		Green
24	E10,5/15	15	10,5	263	420	1823	2000	27,0		Green
25	E10,5/15(218)	15	10,5	218	375	1550	1800	27,0		Green
26	E10,5/17,5	17,5	10,5	263	420	1823	2000	31,5		Orange
27	E 10,5/20	20	10,5	263	420	1823	2000	36,0		Brown
28	E 10,5/25	25	10,5	263	420	2021	2000	45,0		Purple
29	E 10,5/30	30	10,5	308	466	2470	2700	54,0		Grey
30	E 10,5/35	35	10,5	308	465	2585	2800	63,0		Grey
31	E 12/2,5	2,5	12	173	353	1172	1500	4,5		White
32	E 12/2,5c	2,5	12	150	330	1043	1300	4,5		White
33	E 12/4,3	4,3	12	173	353	1298	1500	7,7		Blue
34	E 12/4,3(218)	4,3	12	218	398	1605	1800	10,8		Blue
35	E 12/6c	6	12	173	353	1298	1500	10,8		Black
36	E 12/6	6	12	218	398	1605	1800	10,8		Black
37	E 12/10	10	12	218	398	1763	2000	18,0		Red
38	E 12/12	12	12	218	398	1907	2000	21,6		Yellow
39	E 12/15c	15	12	240	420	2010	2500	27,0		Green
40	E 12/15	15	12	263	443	2225	2500	27,0		Green
41	E 12/15 (218)	15	12	218	398	1950	2500	27,0		Green
42	E 12/17,5	17,5	12	263	443	2225	2500	31,5		Orange
43	E 12/20	20	12	263	443	2225	2500	36,0		Brown
44	E 12/25	25	12	263	443	2472	2500	45,0		Purple

Item	Pole symbol	Load capacity [kN]	Dimensions of a pole			Weight catalog [kg]	Weight transport [kg]	Failure load [kN]	Colour	
			L[m]	d _w [mm]	d _e [mm]					
45	E 12/30	30	12	308	488	3017	3400	54,0		Grey
46	E 12/33	33	12	308	488	2930	3400	59,4		Grey
47	E 12/35	35	12	308	488	3108	3500	63,0		Grey
48	E 13,5/2,5	2,5	13,5	173	375	1495	1700	4,5		White
49	E 13,5/4,3c	4,3	13,5	173	375	1593	1800	7,7		Blue
50	E 13,5/4,3	4,3	13,5	218	420	1813	2300	7,7		Blue
51	E 13,5/6	6	13,5	218	420	1817	2500	10,8		Black
52	E 13,5/10	10	13,5	218	420	2130	2500	18,0		Red
53	E 13,5/12	12	13,5	218	420	2356	2500	21,6		Yellow
54	E 13,5/15c	15	13,5	240	443	2515	2800	27,0		Green
55	E 13,5/15	15	13,5	263	465	2670	3000	27,0		Green
56	E 13,5/15(218)	15	13,5	218	420	2468	2700	27,0		Green
57	E 13,5/17,5	17,5	13,5	263	465	2735	3000	31,5		Orange
58	E 13,5/20	20	13,5	263	465	2775	3200	36,0		Brown
59	E 13,5/25	25	13,5	263	465	3086	3500	45,0		Purple
60	E 13,5/30	30	13,5	308	511	3606	4000	54,0		Grey
61	E 13,5/31	31	13,5	308	510	3585	4000	55,8		Grey
62	E 13,5/35	35	13,5	308	510	3771	4200	63,0		Grey
63	E 15/2,5	2,5	15	173	398	1690	1900	4,5		White
64	E 15/4,3c	4,3	15	173	398	1913	2200	7,7		Blue
65	E 15/4,3	4,3	15	218	443	2140	2600	7,7		Blue
66	E 15/6	6	15	218	443	2141	2800	10,8		Black
67	E 15/10	10	15	218	443	2540	2900	18,0		Red
68	E 15/12	12	15	218	443	2809	3000	21,6		Yellow
69	E 15/15c	15	15	240	465	2925	3300	27,0		Green
70	E 15/15	15	15	263	488	3131	3500	27,0		Green
71	E 15/17,5	17,5	15	263	488	3175	3700	31,5		Orange
72	E 15/20	20	15	263	488	3225	4000	36,0		Brown
73	E 15/25	25	15	263	488	3609	4000	45,0		Purple
74	E 16,5/4,3	4,3	16,5	218	465	2410	3100	7,7		Blue
75	E 16,5/6	6	16,5	218	465	2503	3200	10,8		Black
76	E 16,5/10	10	16,5	240	488	3576	3600	18,0		Red
77	E 16,5/12c	12	16,5	240	488	3170	3650	21,6		Yellow
78	E 16,5/12	12	16,5	263	510	3370	3700	21,6		Yellow
79	E 16,5/15	15	16,5	263	510	3670	4000	27,0		Green
80	E 16,5/17,5	17,5	16,5	263	510	3800	4200	31,5		Orange
81	E 16,5/20	20	16,5	308	555	4178	4600	36,0		Brown
82	E 16,5/25	25	16,5	308	555	4325	4700	45,0		Purple
83	E 18/4,3	4,3	18	218	488	2785	3200	7,7		Blue
84	E 18/6	6	18	218	488	2886	3300	10,8		Black
85	E 18/10	10	18	240	510	3840	4200	18,0		Red
86	E 18/12c	12	18	240	510	3833	4200	21,6		Yellow
87	E 18/12	12	18	263	533	4230	4600	21,6		Yellow
88	E 18/15	15	18	263	533	4640	5000	27,0		Green
89	E 18/17,5	17,5	18	263	533	4900	5500	31,5		Orange
90	E 18/20	20	18	308	578	4944	5500	36,0		Brown
91	E 18/25	25	18	308	578	5114	5600	45,0		Purple

Reinforced concrete poles type ZN

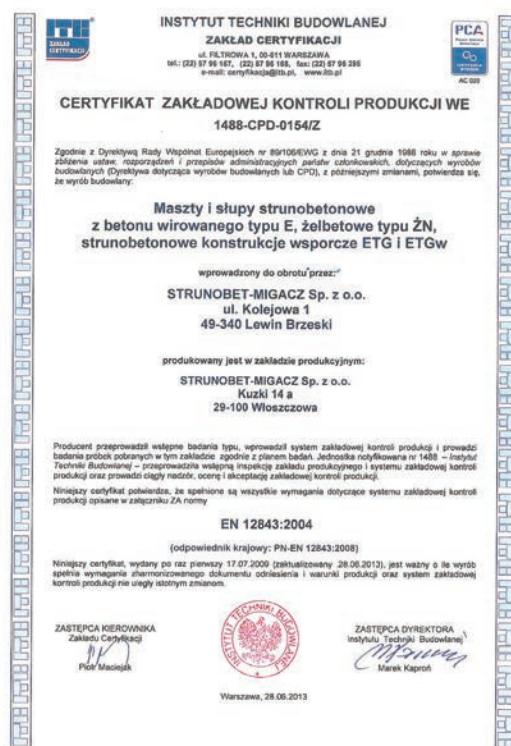
Strunobet - Migacz System



Reinforced concrete poles type ZN comply with all requirements of the manufacturing quality control system, described in Annex ZA of the PN-EN12843:2008 standard.

After the modernization in 2005, the dimensions of the reinforced concrete poles and the placement and diameters of the mounting holes do not differ from the poles previously produced and commonly used in Poland.

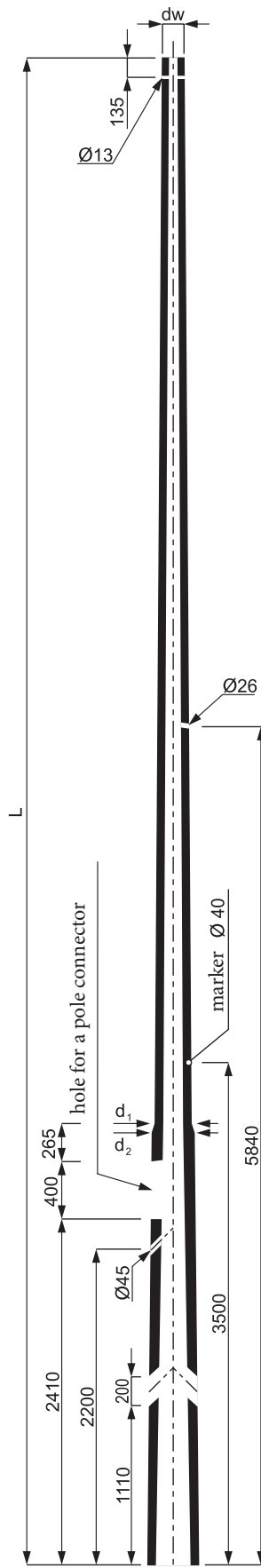
Our ZN poles are produced from concrete class C35/45 (in accordance with the PN-EN 2006-1 standard), which guarantees that they have a lifespan of 50 years.



Type of pole	Load capacity	Length	Cross section dimensions		Failure load [kN]		Weight of a pole
			a'b Peaks	Base c'd	P _{xn}	P _{yn}	
	kN	m	mm		kN		kg
ŽN 9/200	2	9,2	100x150	165x242	4,23	2,32	540
ŽN 10/200	2	10,0		170x250	4,43	2,43	615
ŽN 12/200	2	12,0		184x270	4,70	2,57	840
ŽN 9/300	3	9,2	120x170	185x262	6,91	4,19	710
ŽN10/300	3	10,0		190x270	6,61	4,03	810
ŽN12/300	3	12,0		204x290	6,82	4,16	1060

EOP-type lighting rods

Certificate of Conformity CDP-1488-0118/W

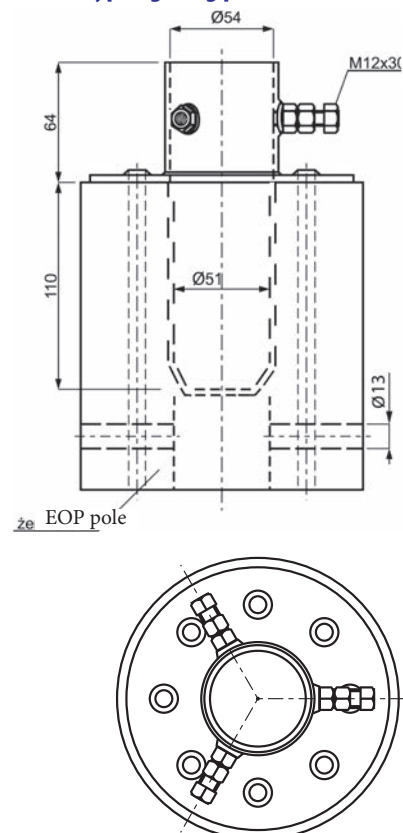


Lampposts are produced from C40/50 concrete and marked CE according to the PN-EN 40-4:2008 standard. An EOP lighting pole is used for lighting: streets, roads, parking areas, industrial plants, railway facilities and tractions powered by cable lines. They have high technical parameters as far as the types of materials used in the process of production are concerned (cement, steel, aggregate). The most important technical parameters include: easy and aesthetic installation of the outreach arm $\varnothing 48$ mm, frost resistance, planned residual life of 50 years, low water absorption, exposure class XC4, XD3, XF1 according to the PN-EN 206-1 standard.

Standard fittings of a pole include the following:

- Head which allows to fix an outreach arm
- Cable connector end with a five-terminal bus bar
- PT-ST/1 connector cover
- Head shield

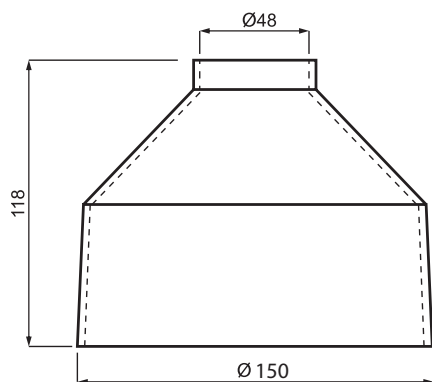
Head of an EOP-type lighting post



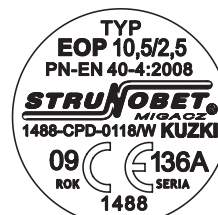
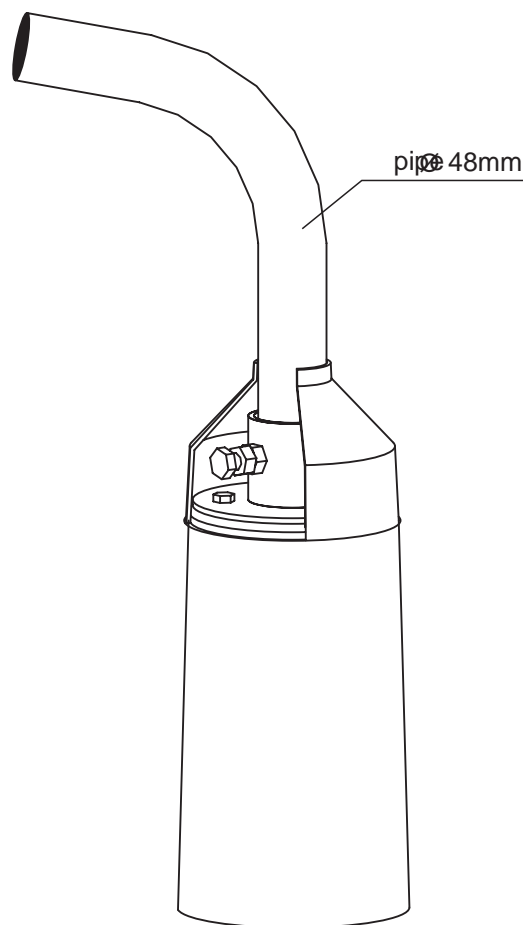
EOP-type lighting rods

Item	Symbol of a pole	Load capacity [kN]	Failure load [kN]	Dimensions					Weight [kg]
				L	d _w	d _p	d ₁	d ₂	
				[m]	[mm]				
1	EOP 9/2,5	2,5	4,5	9,0	150	330	240	285	878
2	EOP 10,5/2,5	2,5	4,5	10,5	150	352	262	285	993
3	EOP 12/2,5	2,5	4,5	12,0	150	375	281	330	1185

Shield of the head of a post

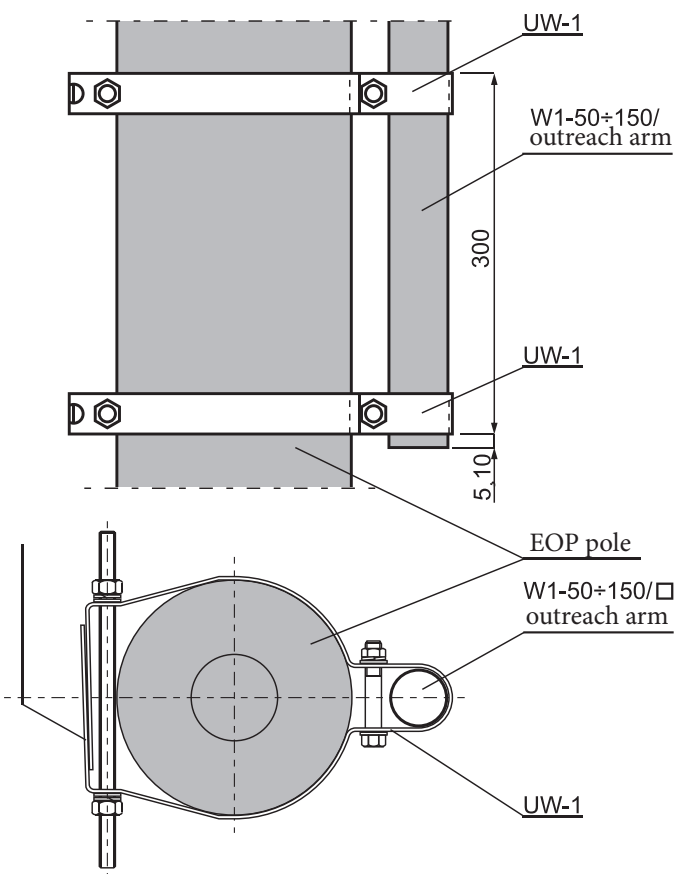


Clamp of an EOP outreach arm

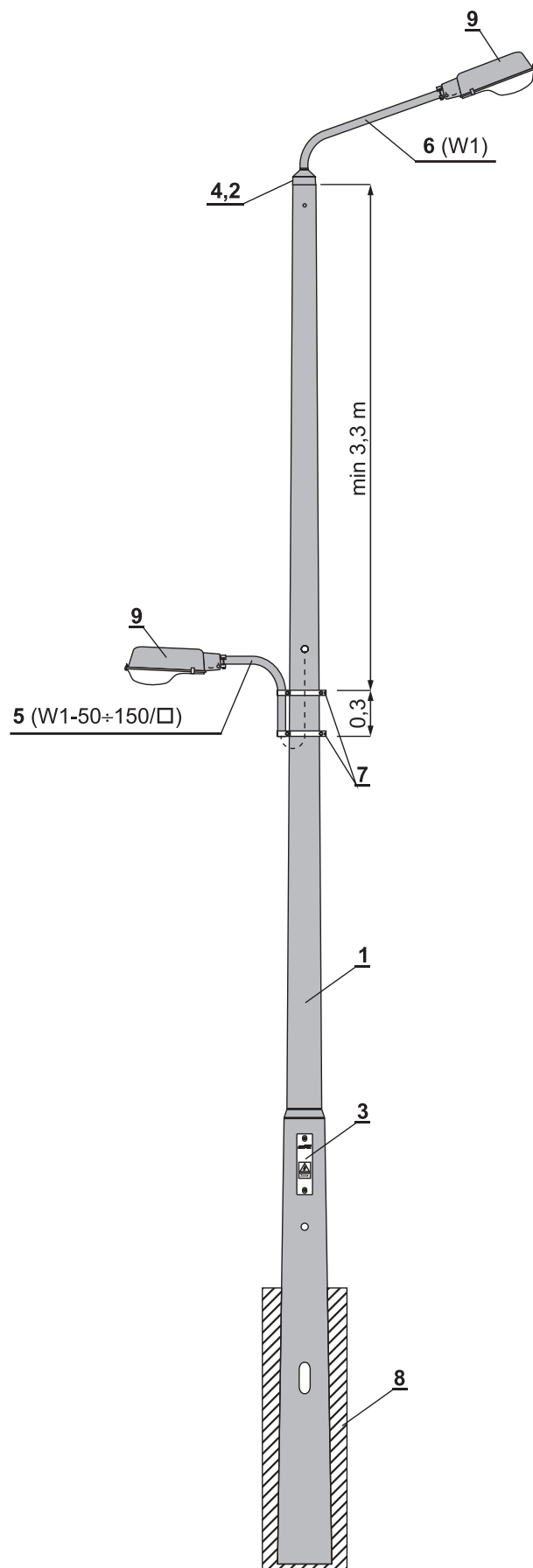
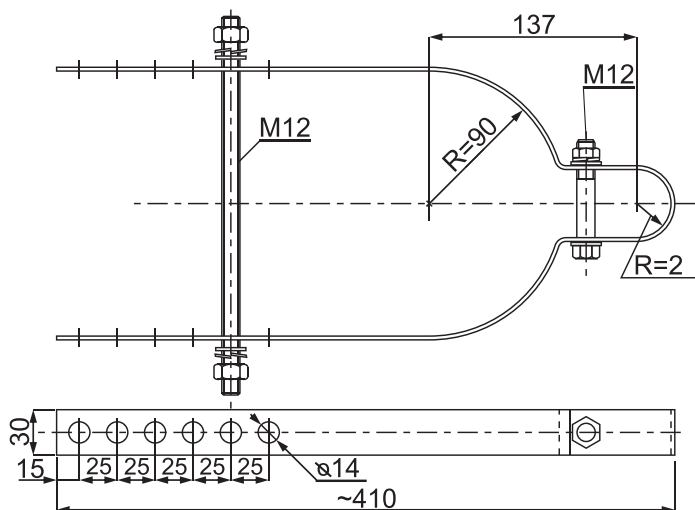


Assembly details

Assembly of an W1-50/150/ outreach arm with the use of a UW-1 holder



Holder of a UW-1 outreach arm



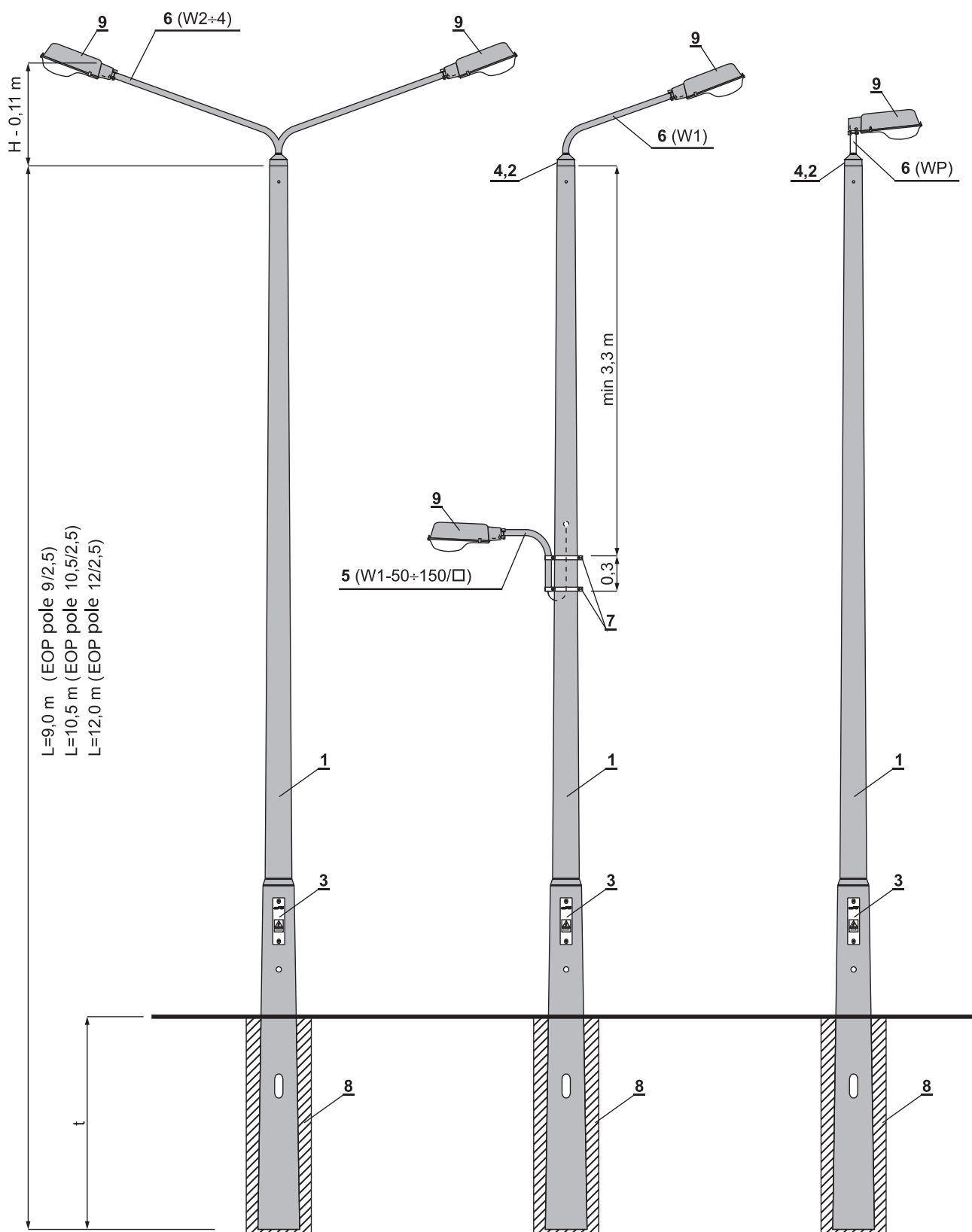
Assembly details

Item	Detailed list	Type	Quantity	Unit	Weight [kg]	Manufacturer
1	Lighting pole	EOP-9/2,5	1	szt.	683	Strunobet
		EOP-10,5/2,5			855	
		EOP-12/2,5			1043	
2	Reduction sleeve	TR	1		0,18	
3	Pole connector with the protections of fittings	ZS -□			□	
4	Shield of the head of a post	OG	1		0,10	
5	Outreach arm for a fixtures	W1-□/□	1		□	
6		W1-□/□	1		□	
		W2-□/□			□	
		W3-□/□			□	
		W4-□/□			□	
		WP-□			□	
7	Holder of an outreach arm	UW-1	2		1,0	
8	Structure	Uo	1		-	
		Uos1			□	
		Up			□	
9	Light fitting	□	□		□	□
10	Round power conductor 450/750v	YDYzo 3x1,5mm ²	□	m	0,59	□
11	Earthing electrode		1	kpl	□	
12	M10x25-4.8-A-Fe/ZnSZ screw with a nut, a round and spring washer	N10x25	1	szt.	0,04	
13	Angular ferrule 90	16x10 KU-L-W	1		□	GPH
		25x10 KU-L-W				
		35x10 KU-L-W				
14	Copper conductor	LY1x16mm ²	0,6	m	□	
		LY1x25mm ²				
		LY1x35mm ²				

Comments:

- The outreach arm in item 5 should have the length of W < 150cm
- Item 11 is to be chosen based on reproducible solutions from the catalogues of overhead LV lines or LV isolated lines published by PTPIREE - Polish Power Transmission and Distribution Organisation
- It is recommended that the weight of the fitting in item 9 be less than 17 kg, and the wind-exposed surface area A < 0.20m

Examples of light posts hardware

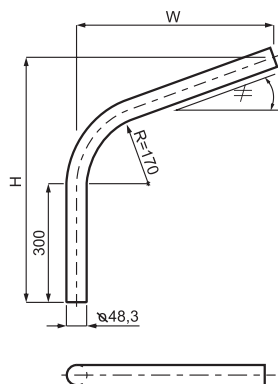


Outreach Arms

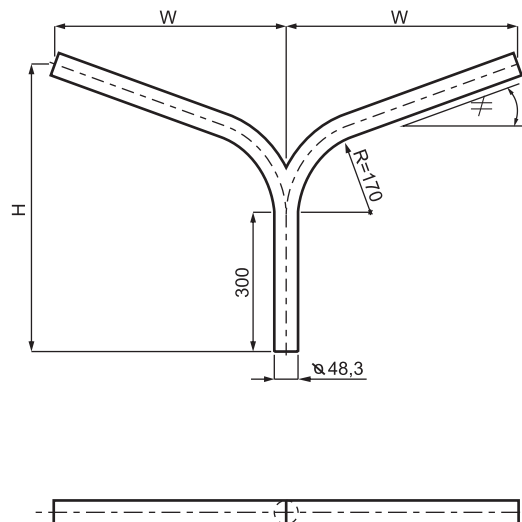
WP-□ simple outreach arm

Type of an outreach arm	Height H [cm]	Total weight [kg]
WP-50	50	1,42
WP-100	100	2,83
WP-150	150	4,25
WP-200	200	6,66
WP-250	250	10,93/9,0

W1-□/□ outreach arm (with one arm)



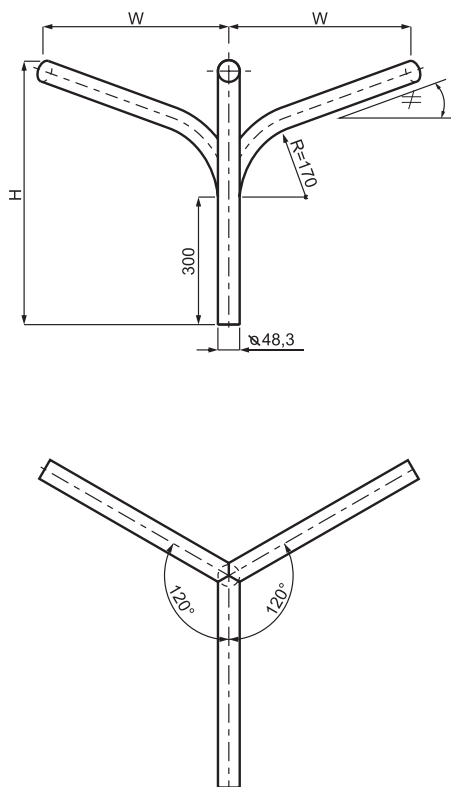
W2-□/□ outreach arm (with two arms)



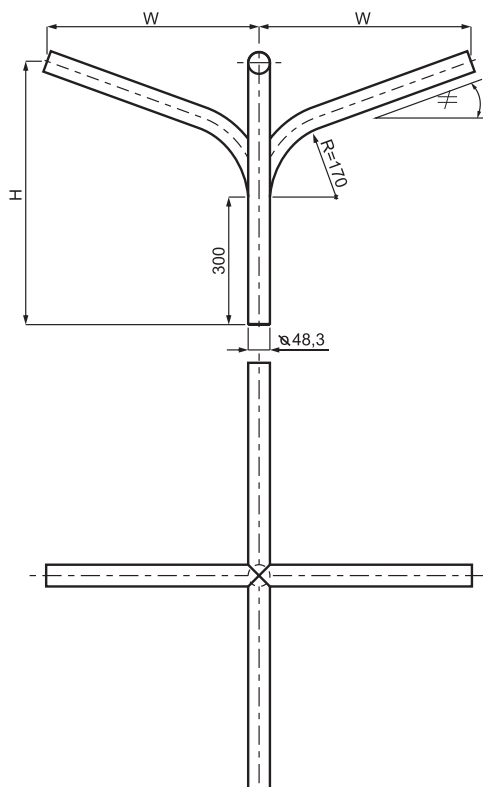
Type of an outreach arm	Length in [cm]	Inclination angle \neq	Height H [cm]	Total weight [kg]
W1-50/0	50	0°	49	2,58
W1-50/5		5°	52	2,58
W1-50/10		10°	55	2,58
W1-50/15		15°	58	2,61
W1-50/20		20°	61	2,64
W1-100/0	100	0°	39	3,99
W1-100/5		5°	57	4,00
W1-100/10		10°	64	4,03
W1-100/15		15°	71	4,08
W1-100/20		20°	78	4,15
W1-150/0	150	0°	49	5,41
W1-150/5		5°	61	5,42
W1-150/10		10°	73	5,47
W1-150/15		15°	84	5,54
W1-150/20		20°	95	5,65
W1-200/0	200	0°	49	8,03
W1-200/5		5°	65	8,05
W1-200/10		10°	81	8,13
W1-200/15		15°	97	8,25
W1-200/20		20°	112	8,43
W1-250/0	250	0°	49	12,72/10,42
W1-250/5		5°	70	12,76/10,46
W1-250/10		10°	90	12,88/10,57
W1-250/15		15°	110	13,08/10,78
W1-250/20		20°	130	13,39/11,08

Type of an outreach arm	Length in [cm]	Inclination angle \neq	Height H [cm]	Total weight [kg]
W2-50/0	50	0°	49	4,31
W2-50/5		5°	52	4,31
W2-50/10		10°	55	4,33
W2-50/15		15°	58	4,39
W2-50/20		20°	61	4,43
W2-100/0	100	0°	39	7,13
W2-100/5		5°	57	7,15
W2-100/10		10°	64	7,21
W2-100/15		15°	71	7,31
W2-100/20		20°	78	7,45
W2-150/0	150	0°	49	9,97
W2-150/5		5°	61	9,99
W2-150/10		10°	73	10,09
W2-150/15		15°	84	10,23
W2-150/20		20°	95	10,47
W2-200/0	200	0°	49	15,06
W2-200/5		5°	65	15,10
W2-200/10		10°	81	15,26
W2-200/15		15°	97	15,50
W2-200/20		20°	112	15,86
W2-250/0	250	0°	49	24,13/19,53
W2-250/5		5°	70	24,21/19,59
W2-250/10		10°	90	24,45/19,83
W2-250/15		15°	110	28,85/20,25
W2-250/20		20°	130	25,47/20,85

W3-□/□ outreach arm (with three arms)



W4-□/□ outreach arm (with four arms)



Type of an outreach arm	Length in [cm]	Inclination angle \neq	Height H [cm]	Total weight [kg]
W3-50/0	50	0°	49	6,04
W3-50/5		5°	52	6,05
W3-50/10		10°	55	6,05
W3-50/15		15°	58	6,15
W3-50/20		20°	61	6,23
W3-100/0	100	0°	39	10,28
W3-100/5		5°	57	10,31
W3-100/10		10°	64	10,39
W3-100/15		15°	71	10,55
W3-100/20		20°	78	10,75
W3-150/0	150	0°	49	14,53
W3-150/5		5°	61	14,53
W3-150/10		10°	73	14,71
W3-150/15		15°	84	14,93
W3-150/20		20°	95	15,27
W3-200/0	200	0°	49	22,09
W3-200/5		5°	65	22,16
W3-200/10		10°	81	22,38
W3-200/15		15°	97	22,75
W3-200/20		20°	112	23,29
W3-250/0	250	0°	49	35,54/28,64
W3-250/5		5°	70	35,66/28,73
W3-250/10		10°	90	36,01/29,09
W3-250/15		15°	110	36,63/29,72
W3-250/20		20°	130	37,53/30,62

Type of an outreach arm	Length in [cm]	Inclination angle \neq	Height H [cm]	Total weight [kg]
W4-50/0	50	0°	49	7,77
W4-50/5		5°	52	7,77
W4-50/10		10°	55	7,79
W4-50/15		15°	58	7,91
W4-50/20		20°	61	8,03
W4-100/0	100	0°	39	13,41
W4-100/5		5°	57	13,45
W4-100/10		10°	64	13,57
W4-100/15		15°	71	13,77
W4-100/20		20°	78	14,05
W4-150/0	150	0°	49	19,09
W4-150/5		5°	61	19,13
W4-150/10		10°	73	19,33
W4-150/15		15°	84	19,61
W4-150/20		20°	95	20,09
W4-200/0	200	0°	49	29,12
W4-200/5		5°	65	29,21
W4-200/10		10°	81	29,50
W4-200/15		15°	97	30,00
W4-200/20		20°	112	30,72
W4-250/0	250	0°	49	46,95/37,75
W4-250/5		5°	70	47,11/37,87
W4-250/10		10°	90	47,27/38,35
W4-250/15		15°	110	48,09/39,19
W4-250/20		20°	130	49,61/40,39

SK lighting poles

Certificate of Conformity PN-EN 40-7

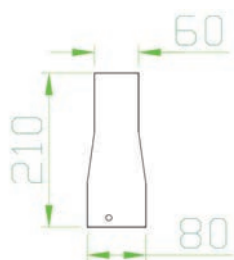
SK

Composite poles, conical, of the SK and SKf type are manufactured using the spin casting technology. This technology allows for dimensional stability and an ideally smooth surface without sharp seams and irregularities. The poles bear the CE marking in accordance with the PN-EN 40-7 standard. Resistance to UV radiation is guaranteed by the application of a special fabric that constitutes the first layer of reinforcement of the pole, thanks to which in case of scratches the protective layer will not get damaged. In addition, the fabric can be printed over with any pattern and dyed with any RAL palette color, depending on the individual needs of the client. The material used for production is a self-extinguishing material. All physical and mechanical properties are described in the table on page 31.

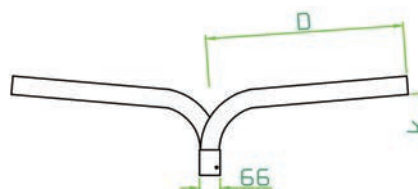
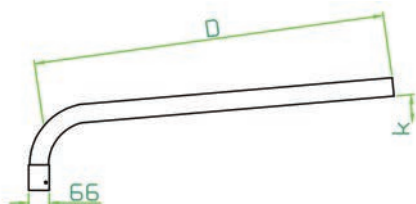
Installation of the SK poles takes place through embedding the pole to an appropriate depth with the use of a stabilizing plate.

Height L [m]	Peak dw [mm]	Basis dp [mm]	Weight [kg]	Wall thickness s [mm]	Peak load [kN]	Hole spacing B [mm]	Head dimension C [mm]
7	76	194	25.6	4	2.5	200	300
8	76	210	39	5	2.5/3	200	300
9	76	225	40.4	5	2.5/3	300	400
10	76	245	46	6	2.5/3	300	400
11	76	260	56	6	2.5/3	300	400
12	76	278	68.2	6	2.5/3	300	400

Table no.1 for SK and SKf poles



Steel booms



The poles are perfect for utilizing standard W1, W2, W3 and W4 booms made of galvanized steel, with D lengths from 0.5m to 1.5m and an angle of inclination from 0° to 20°. The seamless, tight structure of the pole ensures an even distribution of forces, thanks to which the utilization of heavier, and at the same time cheaper steel booms, will not result in its bending.

SKf lighting poles

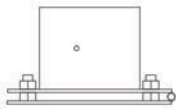
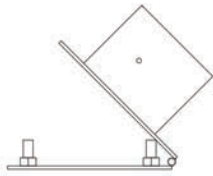


Fig. no.1

The SKf pole has an external mounting head allowing for its installation on a foundation. An innovative utilization of the external head allows for re-using it in case of damage to the pole, or dismantling if the manner of installation is changed. Contrary to heads mounted inside the pole, we have the possibility of a visual assessment of the condition of the mounting basis. The head comes in 2 variants, set (Fig. no. 2) and hinged (Fig. no. 1), allowing for laying the pole down for replacement of the light source, fixture or maintenance. The heads are fully compatible with the prefabricated foundations available on the market.

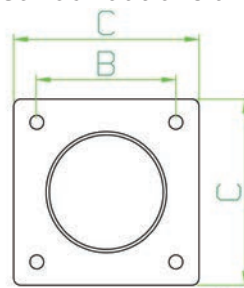
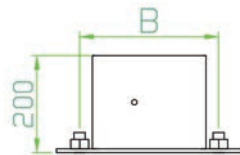


Fig. no.2

Composite booms



A new, innovative solution are composite booms, consisting of 2 elements. The first segment is a stainless mounting sleeve, installed directly onto the composite pole, connected to it using 4 rivets. The second element is a resistant composite pipe with an external diameter of $\phi 60$ mm. The K-type boom is an alternative to aluminum booms, it is characterized by low weight, it does not corrode, and thanks to the use of acid resistant stainless steel and composite it is resistant to adverse atmospheric conditions.



K1



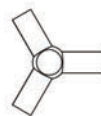
K2



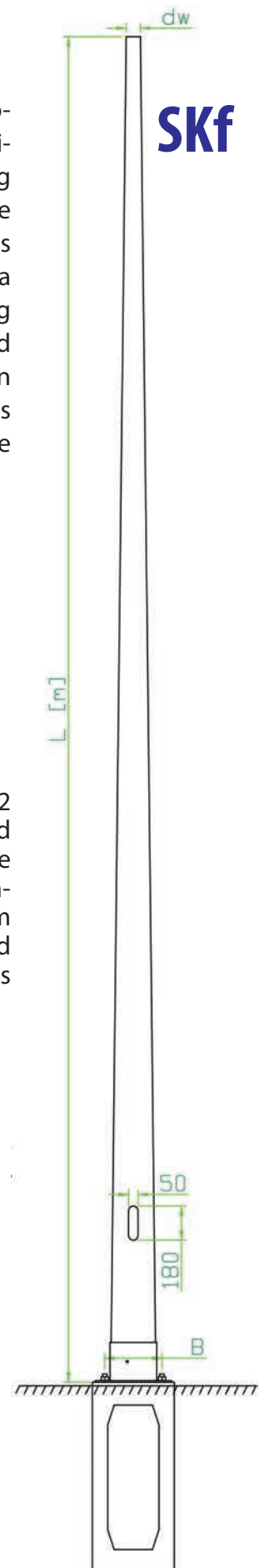
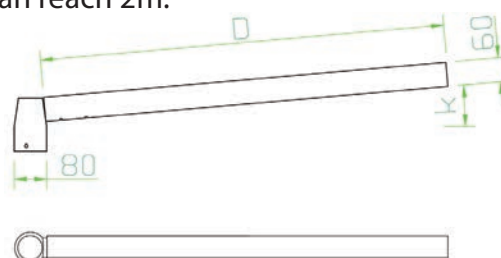
K3



K4



The possible configurations are identical to W-type booms, from a single arm boom to a four arm boom, with the possibility of „k“ inclination angle selection from 0° to 20° , the maximum „D“ length of the boom can reach 2m.



Ekw composite rods

Ekw

Energetic, composite, spun rods of the Ekw type can be used as supports for overhead power and telecommunication lines. Thanks to the use of an identical production methods as with Sk and Skf lighting poles, we obtain a durable, rigid and light pole with a load bearing capacity reaching 10kN. All the physical and mechanical properties of the poles are described in table no. 3 on page 31

Height L [m]	Peak dw [mm]	Base dp [mm]	Peak load [kN]	Weight [kg]
9	120	270	2.5	40
9	120	270	4.5	50
9	120	270	6	60
9	120	270	10	88

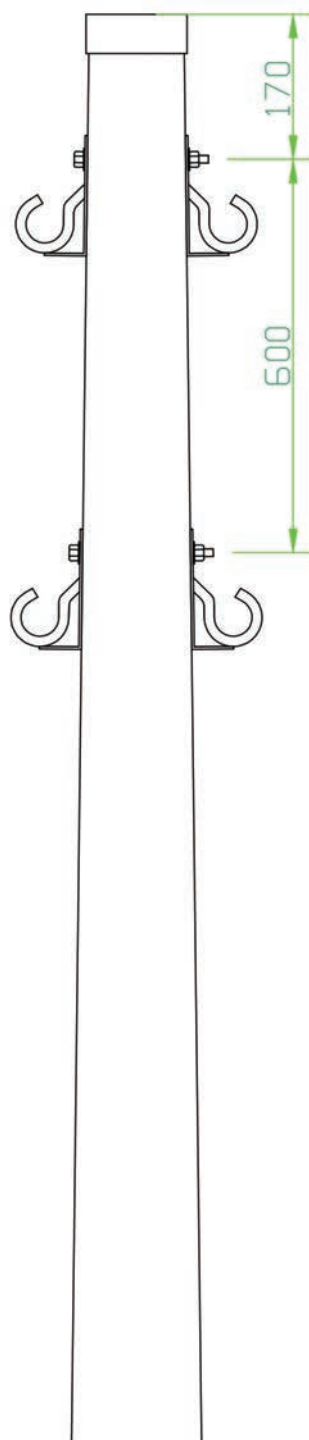
Height L [m]	Peak dw [mm]	Base dp [mm]	Peak load [kN]	Weight [kg]
10	120	288	2.5	45
10	120	288	4.5	56
10	120	288	6	71
10	120	288	10	105

Height L [m]	Peak dw [mm]	Base dp [mm]	Peak load [kN]	Weight [kg]
11	120	304	2.5	51
11	120	304	4.5	64
11	120	304	6	80
11	120	304	10	119

Table no.2. for Ekw and EkwS poles

Thanks to its light weight, the Ekw rod does not require the use of heavy equipment during foundation, two fitters are enough for all installation works. Unloading and loading of the poles can be performed by two people, and a single transport can carry around 150 pieces. This significantly shortens the mounting time and its costs, which as a result lowers the cost of the entire investment.

Holes for the installation of hooks for suspension of lv lines are distributed identically as in the case of making holes in spun poles of the E type. In case of changes, there is a possibility of drilling additional holes depending on the client's needs.



EkwS service composite rods

EkwS The EkwS composite rod is the ideal solution in emergency situations. In the case of line damage, thanks to the use of a temporary service foundation, it is possible to erect a backup line thanks to which the recipients can stay powered during the repair of the damaged line. The foundation presented in figure no. 3 consists of 4 steel elements, which can be put together only at the foundation site of the emergency pole, which greatly facilitates transport. After putting together, the steel structure should be loaded with U-85 stabilizing plates. Their number should be selected depending on the required pole load. Mounting of the pole looks identical to the Skf lighting pole. The EkwS pole is terminated with a head with a hinge that should be connected with the foundation using a bolt (Figure no. 4), the pole should be put in the vertical position and fixed. Mounting of the entire set can be carried out by two people.

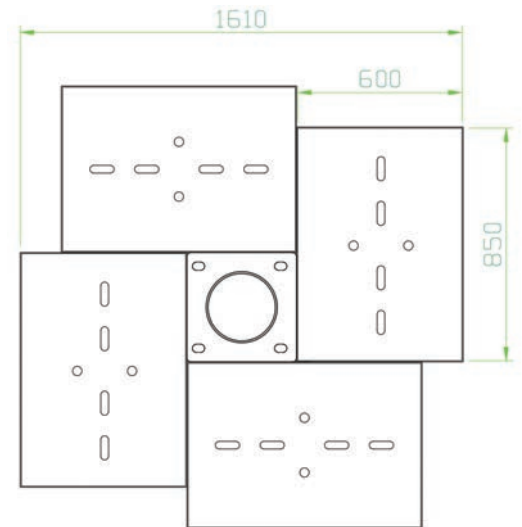


Fig. no.3

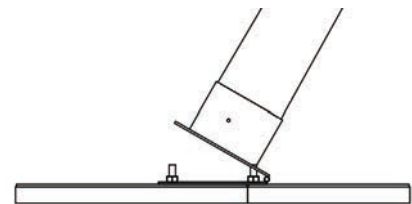


Fig. no.4

Properties	Test method	Unit	Average value
Exact weight	ASTM D792	g/cm ³	1.65
Glass content	ISO 1172	%	45-55
absorptivity	ISO 62	%	0.5
Dielectric strength	ASTM D149	KV/mm	5
Surface resistance	ASTM D149	Ω	10 ¹³
Thermal class	-----	CLASS	F
Longitudinal thermal expansion	ISO 11359-2	K ⁻¹	15x10 ⁻⁶
Thermal conductivity	EN 12667 / EN 12664	W/mK	0.3
Longitudinal bending resistance	ASTM D790	MPa	350
Longitudinal stretching resistance	ASTM D638	MPa	400
Longitudinal modulus of elasticity	ASTM D638	GPa	22
Longitudinal compressive resistance	ASTM D695	MPa	200
Impact force	ASTM D5942	kJ/m ²	180

Table no.3.

Physical and mechanical properties of composite poles manufactured by Strunobet-Migacz

ETG railway traction posts

Approval of the POLISH STATE RAILWAYS Energy Office
[Polish: PKP POLSKIE LINIE KOLEJOWE S.A. Biuro Energetyki] No. IEN2c-5520/41/11

Pre-stressed spun ETG support structures are designed for the construction of railway and tramway tracks mounted on foundations with the bolts properly spaced at their ends.

At the bottom, an ETG pole has a steel head with four mounting holes appropriately spaced, depending on the type of foundation and the function of a pole. Above the head, the pole has a shape of a truncated cone with a ring cross-section. The external diameter of the pole decreases by 15 mm per one meter of length, starting at the base. The hole inside the pole has been used to drop AFL 95mm traction bonding cables.2. At the bottom, the earth wire is connected to the head. The head has holes Ø13 for an external earth wire. ETG poles have M8 screwed sleeves for fixing track axis control signs

Spun technology makes it possible to obtain smooth outer surface of the poles and a high degree of compaction of concrete. It guarantees the lifetime of many years (over 50 years) without routine maintenance, provided concrete class C40/50 is used.

There are three symbols that have been adopted as trade symbols for marking the poles

ETG-1, ETG-2 and ETG-3.

The letters stand for the following:

E- spun electric poles,

T - traction poles,

G - poles with a head.

The numbers denote functions of the poles, and refer to:

1 - intermediate poles,

2 - overlap poles and midpoint anchor poles,

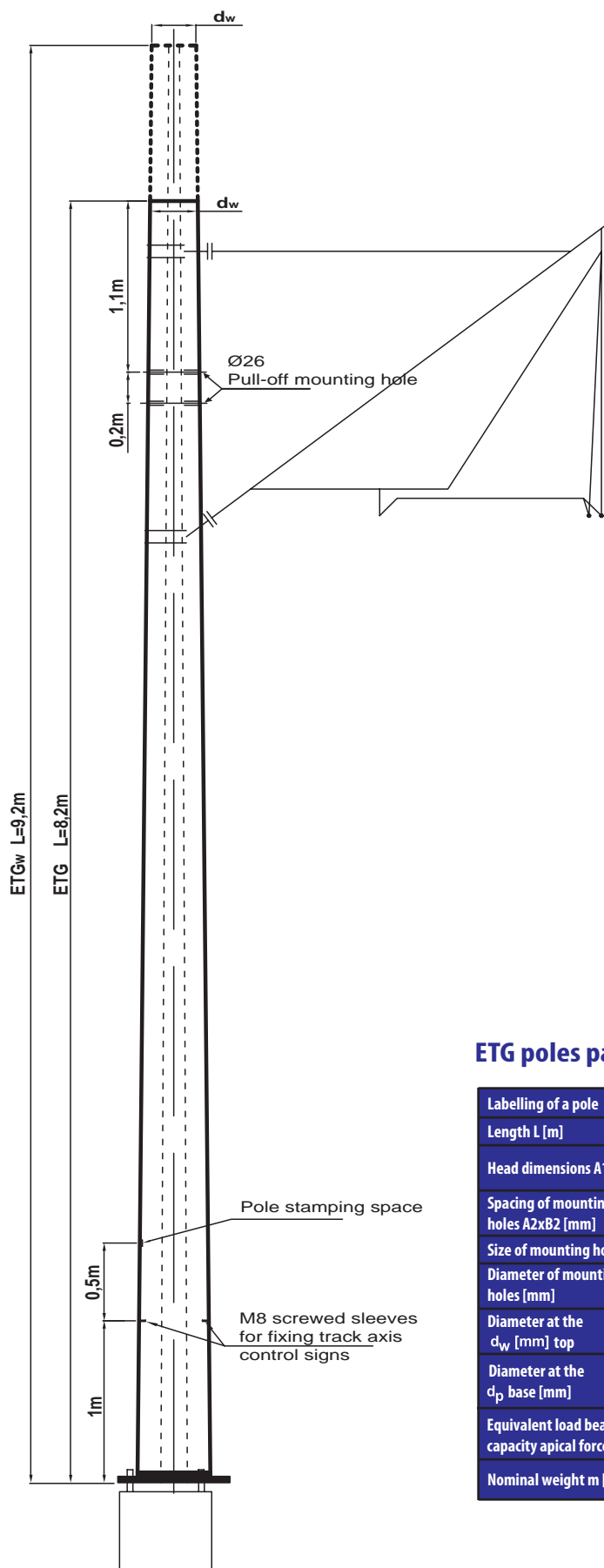
3 - anchor poles.

ETG poles are manufactured according to PN-EN12843:2008 standard and marked CE.

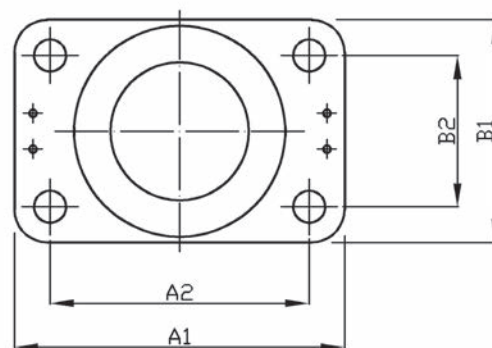
Advantages of pre-tensioned concrete poles type ETG and ETHw:

- Easy and quick erection and dismantling
- Lifetime of many years without routine maintenance (similar to pre-tensioned piles)
- Resistance to deterioration
- Streamline shape (circular cross-section)
- Easy installation of pole hardware (with the use of clamps)
- Two points for the installation of track axis control signs
- Besides mounting traction lines, there is a possibility of simultaneous mounting of other lines (such as trackside power supplies)

ETG poles of a railway traction



Head of an ETG pole



ETG poles parameters

Labelling of a pole	ETG -1	ETGw -1	ETG -2	ETGw -2	ETG -3	ETGw -3
Length L [m]	8,2	9,2	8,2	9,2	8,2	9,2
Head dimensions A1xB1 [mm]	440 x 320	440 x 320	505 x 365	505 x 365	555 x 375	555 x 375
Spacing of mounting holes A2xB2 [mm]	320 x 190	320 x 190	385 x 225	385 x 225	435 x 255	435 x 255
Size of mounting holes	M30	M30	M36	M36	M42	M42
Diameter of mounting holes [mm]	Ø43	Ø43	Ø49	Ø49	Ø55	Ø55
Diameter at the d _w [mm] top	177	162	233	218	233	218
Diameter at the d _p base [mm]	300	300	356	356	356	356
Equivalent load bearing capacity apical force P _k [kN]	6,4	5,7	8	7,1	12,0	10,6
Nominal weight m [kg]	875	940	1150	1240	1200	1310

Footing elements

Footing plates

Type	Dimensions [cm]	Weight [kg]
U-85	85x60x6	77
U-130	130x60x8	156
30x30	30x30x8	14

FP foundations

Component	Dimensions [cm]	Weight [kg]
Component of EF foundation	225x96x55,5	1060
Foundation plate P=120	120x110x12	675
Foundation plate P=160	160x110x12	900
Foundation plate P=200	200x110x12	1125

Kicking blocks

Type	Dimensions [cm]	Weight [kg]
B-60	60x19,5x8	21
B-80	80x19,5x10	36
B-90	90x25x40	72
B-100	100x19,5x10	42
B-150	150x25x40	140








Certyfikat

Zakładowej Kontroli Produkcji
nr **PC - 022 - WB**

Zgodnie z Rozporządzeniem Ministra Infrastruktury z dnia 11 sierpnia 2004r. w sprawie sposobów definiowania zgodności wyrobów budowlanych oraz sposobu oznaczania ich znakami budowlanymi, Dziennik Urzędowy nr 198, poz. 2042

Zaświadczam się,
że wyrób budowlany: płyty ustojowe, belki ustojowe, elementy fundamentu, płyty fundamentowe

zakres zastosowania: wykonywanie ustojów fundamentowych do konstrukcji wsporczych

wprowadzone do obrotu i produkowane przez
STRUNOBET - MIGACZ Sp. z o.o.
Kuzki 14 a, 29 - 100 Włoszczowa

spełniają wymagania określone w:
EN 14991:2007 (odpowiednik krajowy PN-EN 14991:2010)
Płaty betonowe - elementy fundamentu

System oceny zgodności 2+

Niniejszy certyfikat wydany po raz pierwszy w dniu **29.06.2012** przez IMBiTB potwierdza, że spełnione są wszystkie wymagania dotyczące systemu zakładowej kontroli produkcji opisane w załączniku ZA normy PN - EN 14991 i zachowują ważność, o ile ważny jest dokument odświeżenia, warunki i miejsce produkcji nie uległy zmianom i wydany system ZKP nie został zmodyfikowany w istotny sposób. Jednocześnie certyfikat jest potwierdzeniem, że Producent:

- przeprowadził własne badania typu,
- wdrożył i stosuje system zakładowej kontroli produkcji,
- uzyskał pozytywną ocenę wdrożonego systemu ZKP zapewniającego zachowanie deklarowanych właściwości produkowanych wyrobów budowlanych certyfikująca - Instytut Materiałów Budowlanych i Technologi Betonu - przeprowadziła wstępną inspekcję zakładu produkcyjnego i systemu zakładowej kontroli produkcji oraz prowadzi ciągły nadzór, ocenę i akceptację zakładowej kontroli produkcji.

dr inż. Doreta Siemaszko-Lotkiewska
Siemaszko
PION CERTYFIKACJI
PEŁNOMOCNIK DS. JAKOŚCI



dr inż. Grazyna Budyńska-Oracz
Budyńska
DYREKTOR IMBiTB

Stronka IMBiTB | ul. Armii 3 MA 7 | 03-236 Warszawa

WARSZAWA, 29.06.2012

ES pre-tensioned concrete masts

Purpose:

High-voltage power line support structures, telecommunication and antenna masts, lighting masts, lightning protection ground masts, billboard support structures, observation towers, tower monitoring systems and other similar support structures.

Description:

Pre-tensioned masts are manufactured on the basis of the harmonized standard EN-12843:2008 concerning precast concrete products. Masts and poles.

They have the 2311-CPR-055 Manufacturing Quality Control Certificate issued by the notified body Institute of Building Materials and Concrete Technologies in Warsaw.

Pre-tensioned masts are manufactured using the technology of compacted concrete by setting the conical moulds into circular motion. As a result of the centrifugal force, concrete is uniformly spread over the brim of the mould and is favourably compacted, which allows higher technical parameters and smooth surface.

Thanks to the use of reliable materials in terms of their quality and obeying the technological regime, the masts which we produce, as well as the pre-tensioned concrete poles, are characterized by long-term operation without routine maintenance and the lifetime of at least 50 years.

In contrast to other solutions, the mould with transverse modulation every 3 meters and an innovative insulation of the mould longitudinal joint minimize the number of visible joints.

To guarantee proper quality of our products, we have introduced procedures of continuous inspection and surveillance of the products. It has been confirmed by the manufacturing quality control certificate issued by a notified body.

Basic technical specifications:

- Length range: from 18m to 57m
- Convergence 15mm/1m of length
- Max. diameter; 1343mm (without the head).
- Concrete class: minimum C 50/60.
- Exposure class - XC 4, XF 1, XD 1; XS 1 according to PN-EN 206-1:2003 standard, (customers need to ask about other classes).
- Steel for concrete reinforcement (Y1860, BST500S).
- Inlaid screwed sleeves made of stainless steel.
- Steel heads of the masts, hot-dip galvanized with the $\geq 150\mu\text{m}$ coating and finished with a suitable anti-corrosive varnish.

Normally, a pre-tensioned mast has the following components:

- M16 mounting sleeves for an access ladder every 1400mm or 700mm.
- M12 mounting sleeves for cable ducts every 500mm.
- M16 or M20 mounting sleeves to install the lightning rod (at the top of the mast).
- M12 sleeves to install protective earthing in the bottom part, 2 pieces.
- Internal earthing providing connection of each steel element mounted on the mast and permanent connection to earth terminals at the foundation.
- Air escape openings protected with air gratings.

Additionally, each mast can have the following elements:

1. Obstacle markings:

- Daily obstacle markings are red and white stripes of the same width.
- Night obstruction markings are in accordance with the Regulation of the Minister of Infrastructure of 25 June 2003 on Registration and Marking of Aviation Obstacles (Journal of Laws - Dziennik Ustaw - No. 130, Item 1193).

2. Access ladder

The proposed solution of the entrance leading to the antenna mast consists of a rail ladder with fall protection (Soll, Faba).

On the request of the customer, we deal with customized solutions, such as cage ladders with fall protection provided. The access ladder is mounted onto M16 mounting sleeves permanently cast into concrete.

3. Cable duct

It is possible to mount hot-dip galvanized brackets on both sides of the access ladder. These brackets can be spaced every 500mm and are used to install the cable duct.

4. Access walkways

Support structures for antennas, lightning arresters, and platforms for safe operation of antennas mounted on masts are made from hot-dip galvanized steel. Additionally, we can also paint the structure. Bridges and supporting structures for antennas can be on one level or more. Construction and mounting details are set up in the final design of the pretensioned concrete mast.

5. Antenna mounting brackets and billboard support structures.

Support structures for antennas and billboards are manufactured and installed at the customer's request according to their individual projects, with protection by galvanizing and/or painting.

6. High voltage line structures

Crossarms and suspension components of electricity lines are manufactured and mounted in accordance with the project.

We manufacture a wide selection of pre-tensioned concrete masts, depending on their loads and wind zones in which they are installed.

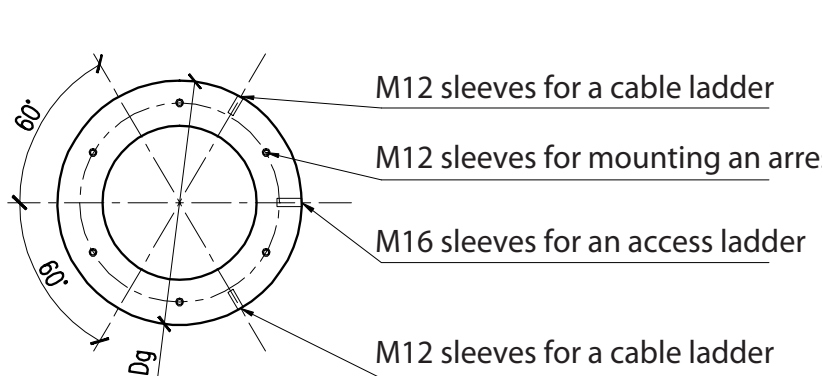
Detailed selection of products manufactured by STRUNOBET-MIGACZ is presented on specification sheets of two- and three-part pre-tensioned concrete masts for wind zones I and II.

Due to a large variety of wind loads and altitudes above the sea level, masts for wind zone III are manufactured on request.

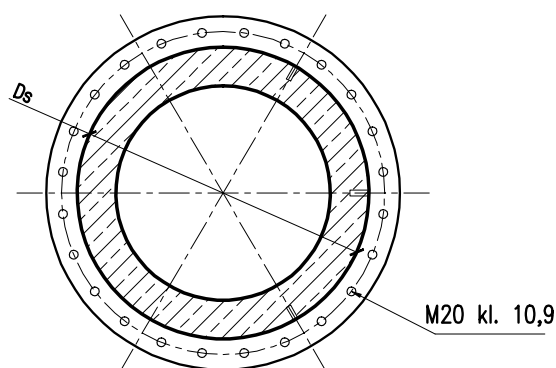
Other elements of our offer include:

- transport by specialist over dimensional vehicles,
- planning permission plans and a plot development plan needed to obtain a building licence as well as working plans and specifications,
- we furnish our customers with all necessary components, such as access ladders with fall protection, cable ladders, working platforms and brackets for mounting antennas, electricity lines support structures, lightning rods, etc.
- construction works connected with foundation and installation,
- technological reinforced concrete container equipped with all installations necessary to supply power and maintain the facilities, which is a separate design.

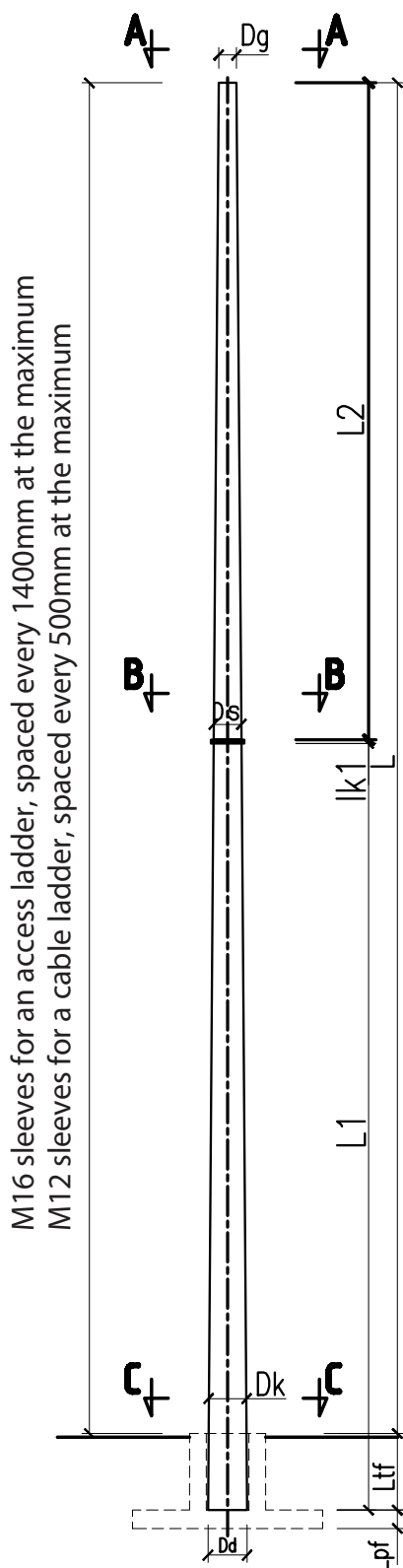
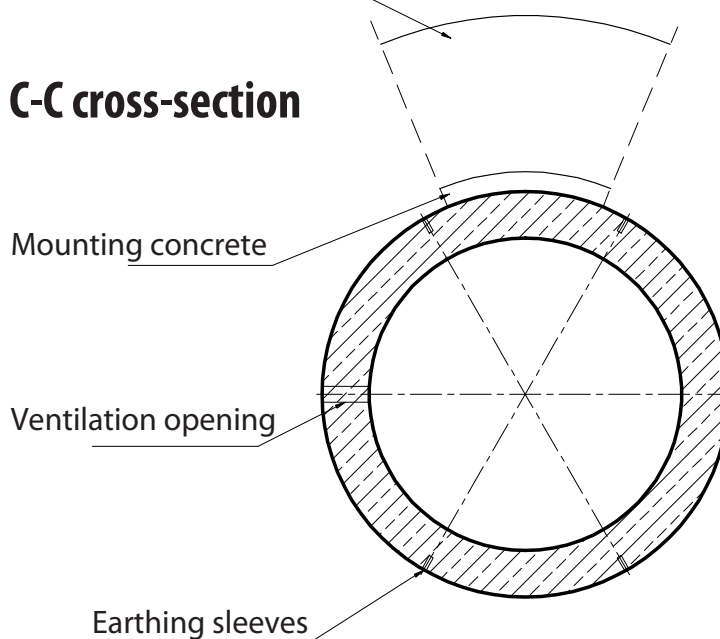
A-A cross-section



B-B cross-section

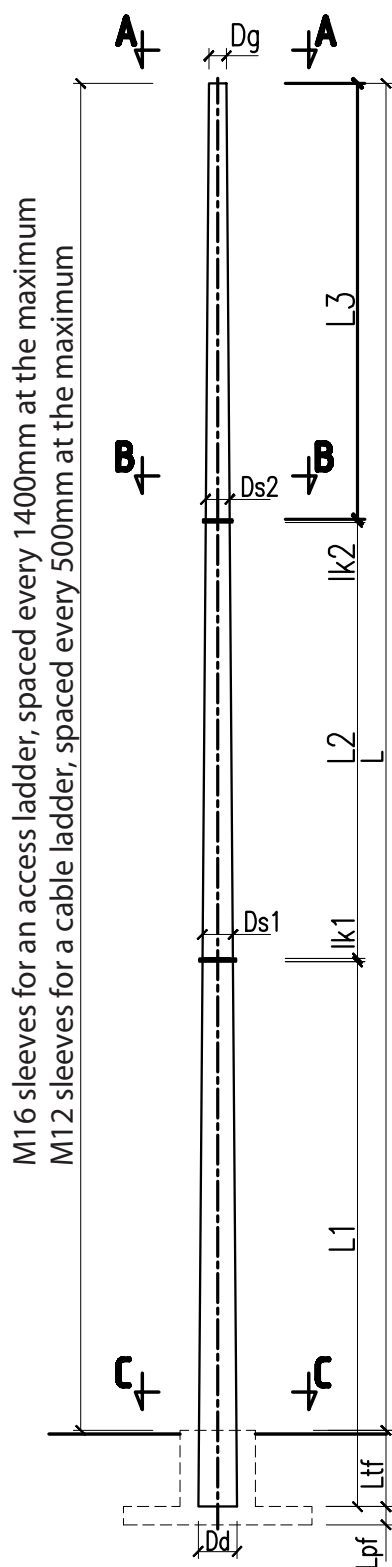


C-C cross-section

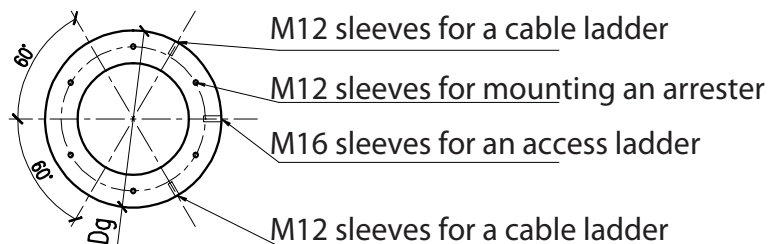


Two-part pre-tensioned concrete mast ES-L/...

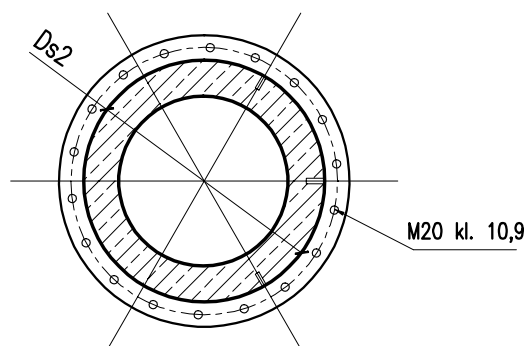
A-A cross-section



M16 sleeves for an access ladder, spaced every 1400mm at the maximum
M12 sleeves for a cable ladder, spaced every 500mm at the maximum

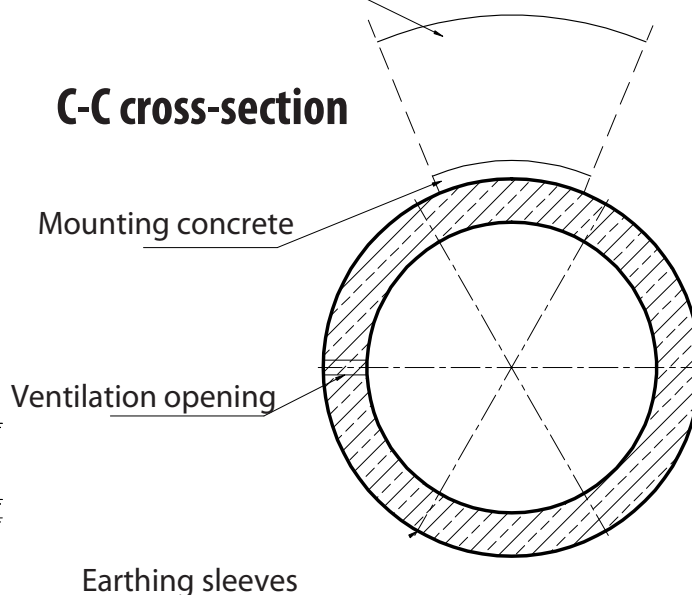


B-B cross-section



Footing socket

C-C cross-section



Two-part PRE-TENSIONED MASTS manufactured on the basis of PN-EN12843:2008 standard Precast concrete components. Masts and poles												
Item	Type of mast	Layout										
		Altitude above ground level	Length of the bottom element	Length of the top element	Diameter of the top	Diameter of the base	Bottom diameter of the top element	Thickness of the joint	Depth of foundation in the socket			
		L	L1	L2	Dg	Dd	Ds1	k1	Ltf			
		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]			
WIND ZONE I												
LIGHT TYPE (load up to 15m2 of the area)												
1.	ES-21/...	19290	12000	9000	488	803	623	90	1800			
2.	ES-24/...	22190	12000	12000	488	848	668	90	1900			
3.	ES-27/...	25090	15000	12000	488	893	668	90	2000			
4.	ES-30/...	28090	15000	15000	488	938	713	90	2000			
5.	ES-33/...	31150	18000	15000	488	983	713	150	2000			
6.	ES-36/...	34150	18000	18000	488	1028	758	150	2000			
7.	ES-39/...	37050	21000	18000	488	1073	758	150	2100			
8.	ES-42/...	40050	21000	21000	488	1118	803	150	2100			
HEAVY TYPE (load over 15m2 up to 25m2 of the area)												
1.	ES-21/...	19190	12000	9000	623	938	758	90	1900			
2.	ES-24/...	22090	12000	12000	623	983	803	90	2000			
3.	ES-27/...	24990	12000	15000	623	1028	848	90	2100			
4.	ES-30/...	28050	15000	15000	623	1073	848	150	2100			
5.	ES-33/...	31050	15000	18000	623	1118	893	150	2100			
WIND ZONE II												
LIGHT TYPE (load up to 15m2 of the area)												
1.	ES-21/...	19190	12000	9000	623	938	758	90	1900			
2.	ES-24/...	22090	12000	12000	623	983	803	90	2000			
3.	ES-27/...	24990	12000	15000	623	1028	848	90	2100			
4.	ES-30/...	28050	15000	15000	623	1073	848	150	2100			
5.	ES-33/...	31050	15000	18000	623	1118	893	150	2100			
HEAVY TYPE (load over 15m2 up to 25m2 of the area)												
1.	ES-21/...	19090	12000	9000	758	1073	893	90	2000			
2.	ES-24/...	21990	12000	12000	758	1118	938	90	2100			
3.	ES-27/...	24950	12000	15000	893	1298	1118	150	2200			
4.	ES-30/...	27850	15000	15000	893	1343	1118	150	2300			
5.	ES-33/...	30850	15000	18000	848	1343	1118	150	2300			
Three-part pre-tensioned concrete masts manufactured based on PN-EN 12843:2008 standard on precast concrete components Masts and poles												
Item	Type of mast	Layout										
		Altitude above ground level	Length of the bottom element	Length of the middle element	Length of the top element	Diameter of the top	Diameter of the base	Lower diameter of the middle element	Lower diameter of the top element	Thickness of the lower joint	Thickness of the upper joint	Depth of foundation in the socket
		L	L1	L2	L3	Dg	Dd	Ds1	Ds2	k1	k2	Ltf
		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
WIND ZONE I												
LIGHT TYPE (load up to 15m2 of the area)												
1.	ES-33/...	31240	12000	12000	9000	488	983	803	623	150	90	2000
2.	ES-36/...	34240	12000	12000	12000	488	1028	848	668	150	90	2000
3.	ES-39/...	37140	15000	12000	12000	488	1073	848	668	150	90	2100
4.	ES-42/...	40140	15000	15000	12000	488	1118	893	668	150	90	2100
5.	ES-45/...	43030	15000	15000	15000	668	1343	1118	893	150	90	2200
6.	ES-48/...	46040										
7.	ES-51/...	49040	15000	18000	18000	578	1343	1118	848	150	90	2200
8.	ES-54/...	52040	15000	21000	18000	533	1343	1118	803	150	90	2200
HEAVY TYPE (load over 15m2 up to 25m2 of the area)												
1.	ES-33/...	31240	12000	12000	9000	578	1073	893	713	150	90	2000
2.	ES-36/...	34240	12000	12000	12000	578	1118	938	758	150	90	2000
3.	ES-39/...	37140	12000	15000	12000	713	1298	1118	893	150	90	2100
4.	ES-42/...	40140	12000	15000	15000	668	1298	1118	893	150	90	2100
5.	ES-45/...	43030	15000	15000	15000	668	1343	1118	893	150	90	2200
WIND ZONE II												
LIGHT TYPE (load up to 15m2 of the area)												
1.	ES-33/...	31140	12000	12000	9000	578	1073	893	713	150	90	2100
2.	ES-36/...	34140	12000	12000	12000	578	1118	938	758	150	90	2100
3.	ES-39/...	37100	12000	15000	12000	713	1298	1118	893	150	150	2200
4.	ES-42/...	40100	12000	15000	15000	668	1298	1118	893	150	150	2200
5.	ES-45/...	43000	15000	15000	15000	668	1343	1118	713	150	150	2300
HEAVY TYPE (load over 15m2 up to 25m2 of the area)												
1.	ES-33/...	31200	12000	12000	9000	803	1298	1118	938	150	150	2100
2.	ES-36/...	34200	12000	12000	12000	758	1298	1118	938	150	150	2100
3.	ES-39/...	37100	15000	12000	12000	758	1343	1118	893	150	150	2200

CHAPTER

3

Stations and Posts



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CHAPTER 3

Stations and Posts

43 Technical description:

STSR transformer stations

STSRs transformer stations

STN transformer stations

STS p (b) transformer stations

52 MV and LV Overhead Lines

MV lines 35(50)

MV lines 70(50)

MV lines 120(70) [240]

LV lines with insulated conductors AsXSn

Technical description:

3.1 Basis and subject of the compilation

The basis of the study is the contract between "Elprojekt" - Poznań and the Polish Power Transmission and Distribution Organisation concerning the specification of the unified MV/LV pole mount transformers and the minutes of the meeting of the Working Party for pole mount transformers of 8 December 1993, as well as the memo from the meeting of the Party herein of 1 March 1994. The study was adopted for general use by the Working Party of the Polish Power Transmission and Distribution Organisation on 12 October 1994. The subject of the study are new generation MV/LV pole mount transformers, which take into account the use of new materials and devices as well as new operational requirements aimed at simplifying the operation and increasing the safety of the staff and the outsiders.

3.2 Pole mount transformers' scope of operation

The stations are designed to supply power to customers in rural, urban and residential areas and small scale industries from overhead or cable medium voltage 15 kV or 20 kV. Overhead power supply can be made from AFL 6-35 (50,70) conductors or insulated conductors with a cross-section of 35 (50-70) mm². Different transformers without an oil expansion chamber and the power of up to 250 kVA, or transformers of 400 kVA can be used at the station. 630 kVA transformers are permitted in new solutions. The support structure of the station is adapted to perform limited functions of a dead end pole for MV and LV power lines.

3.3 Basic Technical Specification:

Rated voltage

- 15/0,4 kV; 20/0,4 kV, 30/0,4 kV

Voltage of insulation:

- 20 kV

Power supply of the MV side:

- bare conductors AFL 6-35; 50;(70)
- isolated cable conductors 35;50;(70)
- with three-core cables
- with single-sheath cables
- with single-core cable in insulation and a small polyethylene sheath

Power of the transformer:

- standard up to 250 kVA
- 400 kVA
- up to 630 kVA-max. power of the transformer 2500 kg

Type of poles:

- E-type spun pre-tensioned concrete poles

Insulation:

- post insulators LWP 8-24, LWP 8-24S, LWZ 8-24
- suspending insulators LP 60/5u, LP 60/8, CS70AA20, CS70AA30, HASDI, SDI

Degree of security level:

- 0°; 1°; 2°; 3°;

Type of soil:

- medium and weak

Type of footing:

- in a bored opening
- excavated, ring well
- slab footings

Climatic zones:

- 1st, 2nd, 3rd and areas of increased hoarfrost

LV circuits:

- overhead with bare or insulated conductors
- cable circuits

LV Switchboard:

- fused load break switches
- distribution panel box on the station
- cable distribution panel box on the footing near the station.

3.4 Type of the station, power and weight of the transformer.

3.4.1 STSR Stations

- STSR-PO -20/25 – 25 kVA - 350 kg
- STSR -20/400 – 250– 400 kVA - 1500 kg
- STSRp -20/400 – 400 kVA - 2000 kg

3.4.2 STSRs Stations

- 630 kVA weight up to 2500 kg

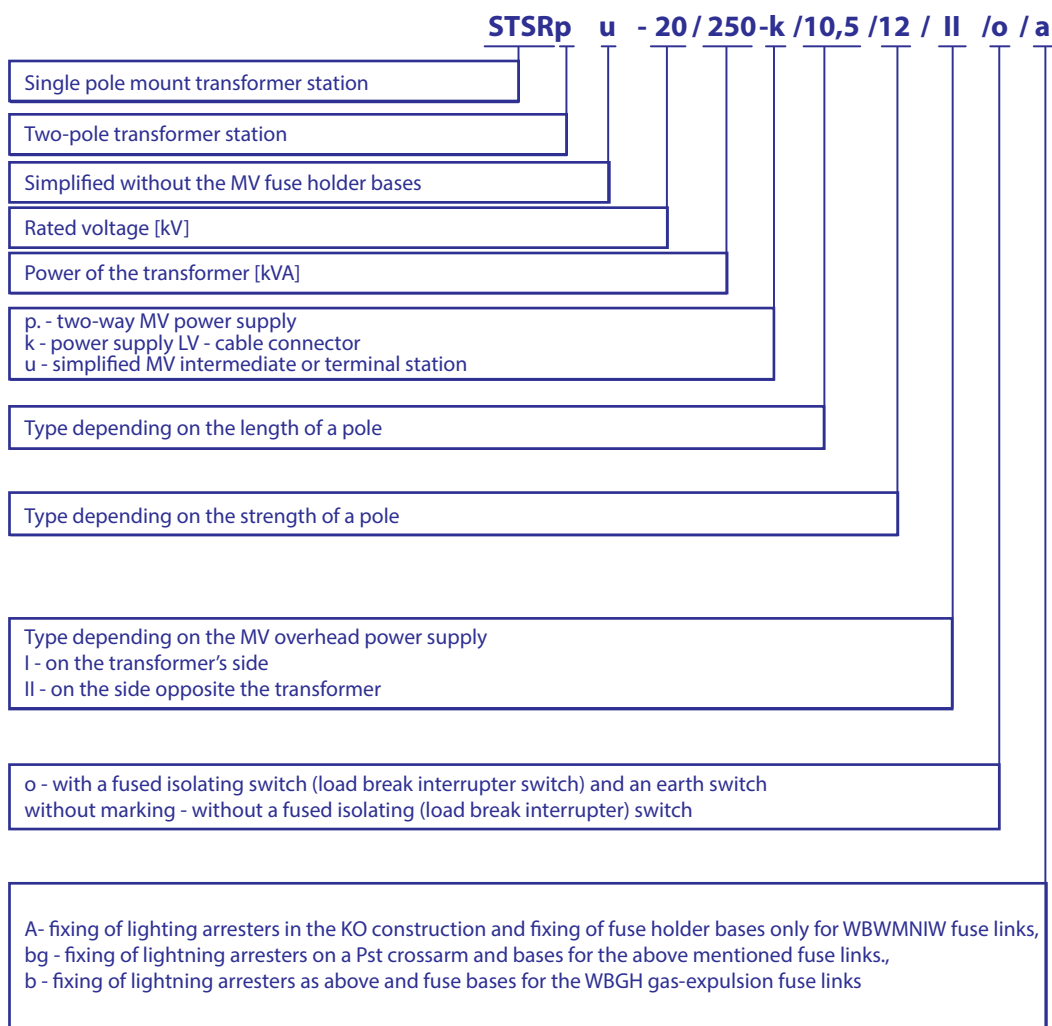
3.4.3 STSp(b) Stations

- STS -20/40 – do 40 kVA - 350 kg
- STS -20/100 – do 100 kVA - 750 kg
- STS -20/250 – 160-250 kVA - 1250 kg
- STS -20/400 – 400 kVA - 1650 kg

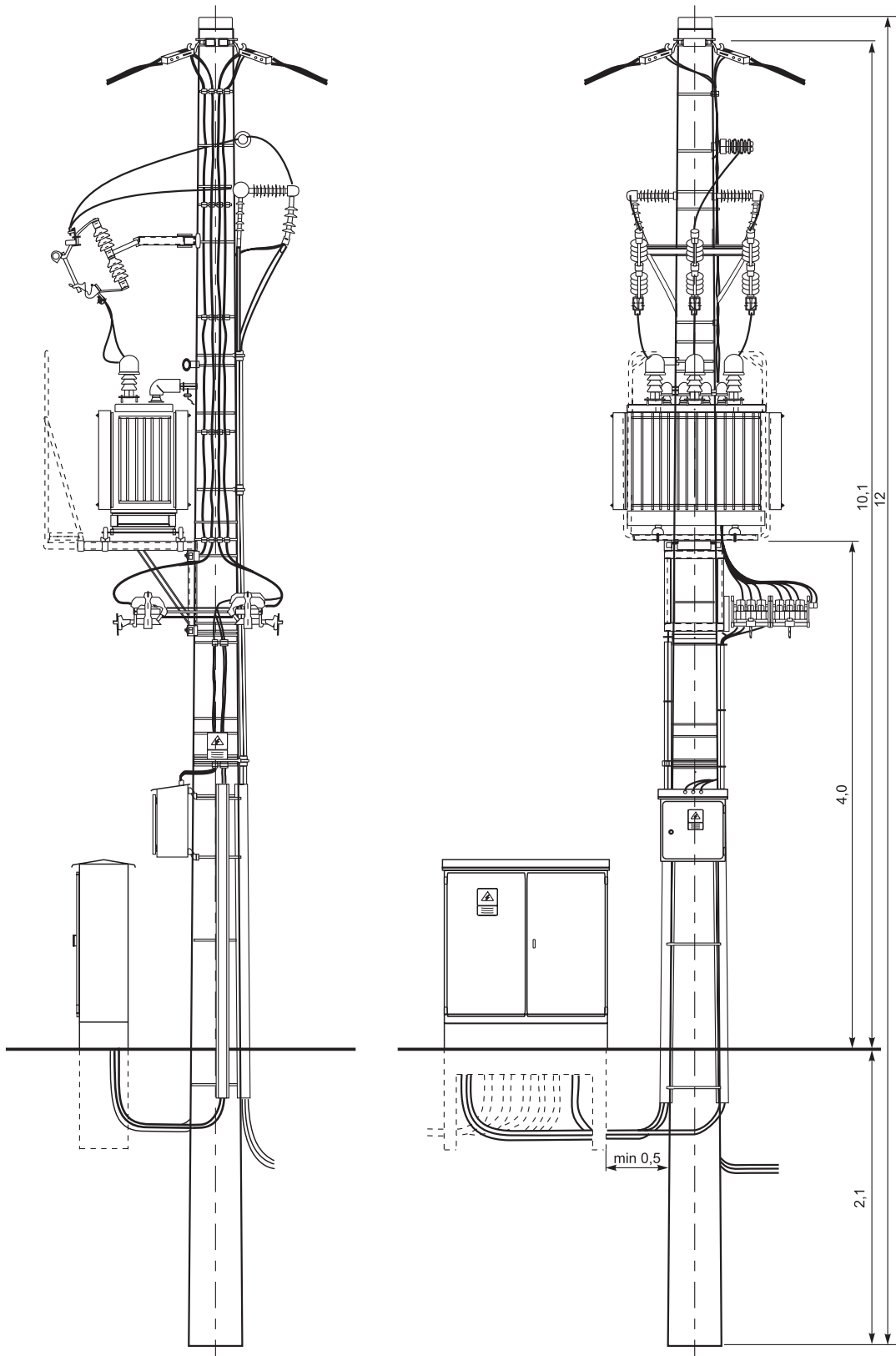
3.4.4 STN Stations

- STN -20/100 - do 100 kVA - 750 kg
- STN -20/250 – 160 – 250 kVA - 1250 kg
- STN -20/400 – 400 kVA - 1650 kg
- STN -20/630 – 630 kVA - 2150 kg

3.4.1 Marking of STSR Stations



Examples of STSR Stations



3.4.2 Labelling of STSRS Stations

Stations have been designed for two major types, depending on the type of the power supply line used for medium voltage:

- overhead [as a terminal post of the overhead line]
- cable [as a post with a cable head for an MV cable line]

ad.a)

STSRS - 20 / 630 - I-12 / 15 - 1 - OP 3

Single Pole Transformer Stations					
MV overhead line branch					
I - on the side opposite the transformer					
II - on the same side as the transformer					
Length of the pole [m]					
Strength of the pole [kN]					
Positions of MV surge arresters					
1 - under MV fuse holder bases					
2 - over MV fuse holder bases					
Additional components:					
	- without additional components				
O	- with a fused isolating or load break interrupter and an earth switch				
P3	- with measuring transformers for the three-phase system of power measurement,				
PA	- with measuring transformers for the two-phase system of power measurement				
OP3	- with a fused isolating/load break interrupter and an earth switch, and measuring transformers for a three-phase system of power measurement				
OPA	- with a fused isolating/load break interrupter and an earth switch, and measuring transformers for a two-phase system of power measurement				

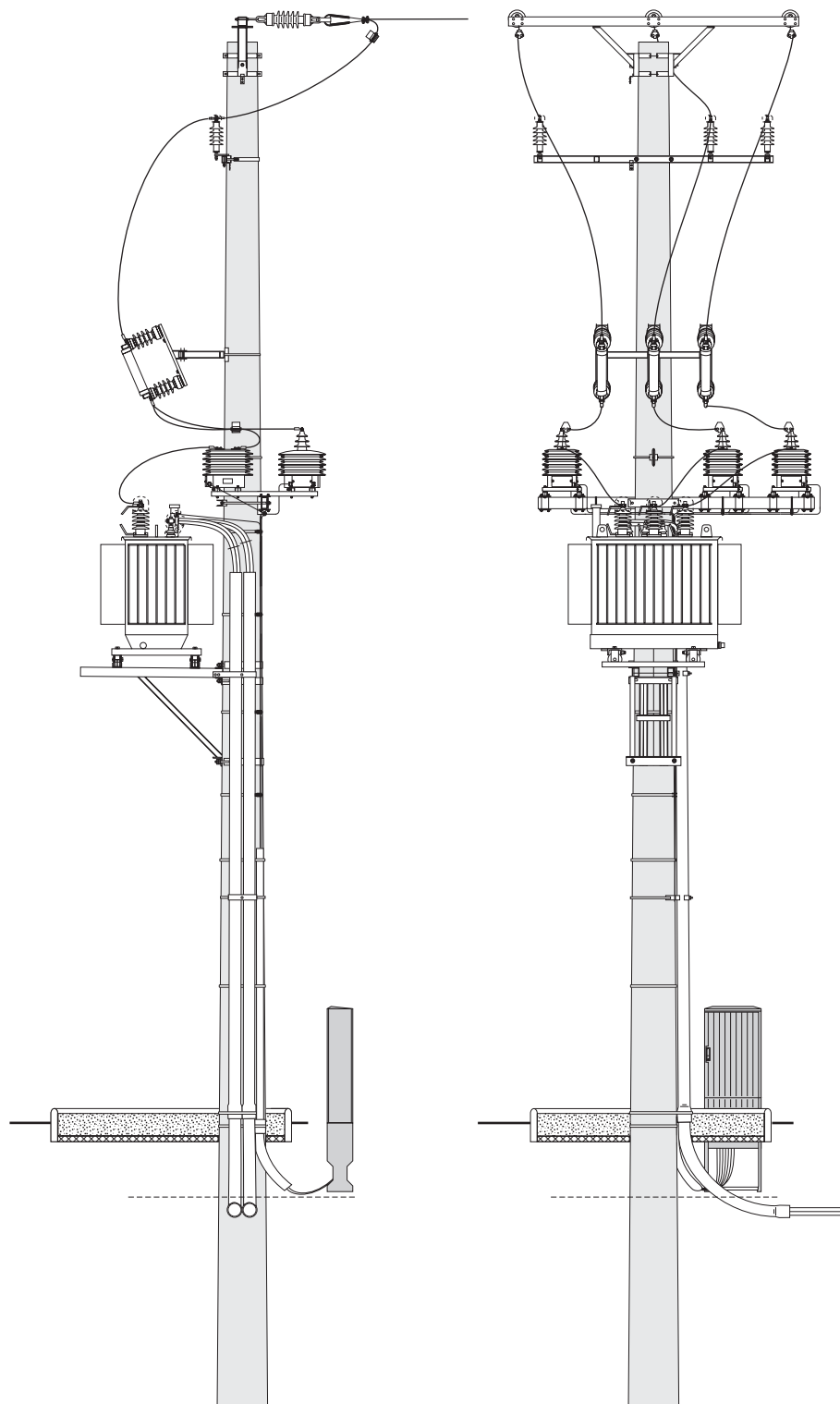
ad.b)

STSRS - 20 / 630 - KK1- 10,5 / 10 - OPA

Single Pole Transformer Stations					
MV cable line branch KK1 - on an 8.2 m post.					
KK2 - on a 9-metre pole.					
K - on a 10.5 m pole.					
Length of a pole [m]					
Strength of a pole [kN]					
Additional components:					
	- without additional components				
O	- with a fused isolating or load break interrupter and an earth switch				
P3	- with measuring transformers for the three-phase system of power measurement,				
PA	- with measuring transformers for the two-phase system of power measurement				
OP3	- with a fused isolating/load break interrupter and an earth switch, and measuring transformers for a three-phase system of power measurement				
OPA	- with a fused isolating/load break interrupter and an earth switch, and measuring transformers for a two-phase system of power measurement				

The presented labelling should be fixed permanently onto the identification board of the transformer station

Examples of STSR Stations



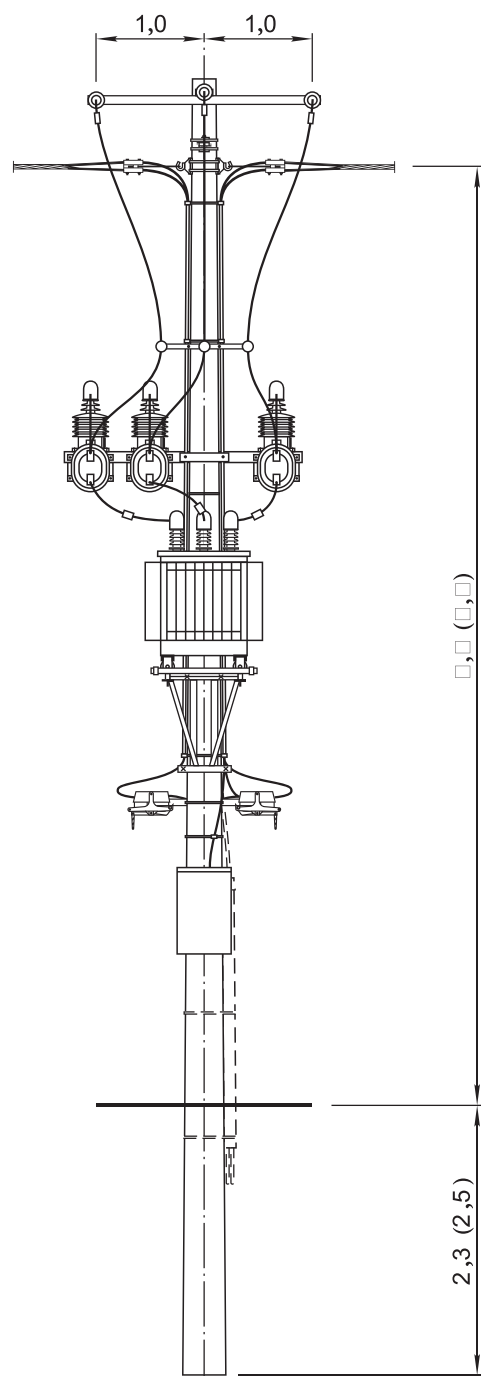
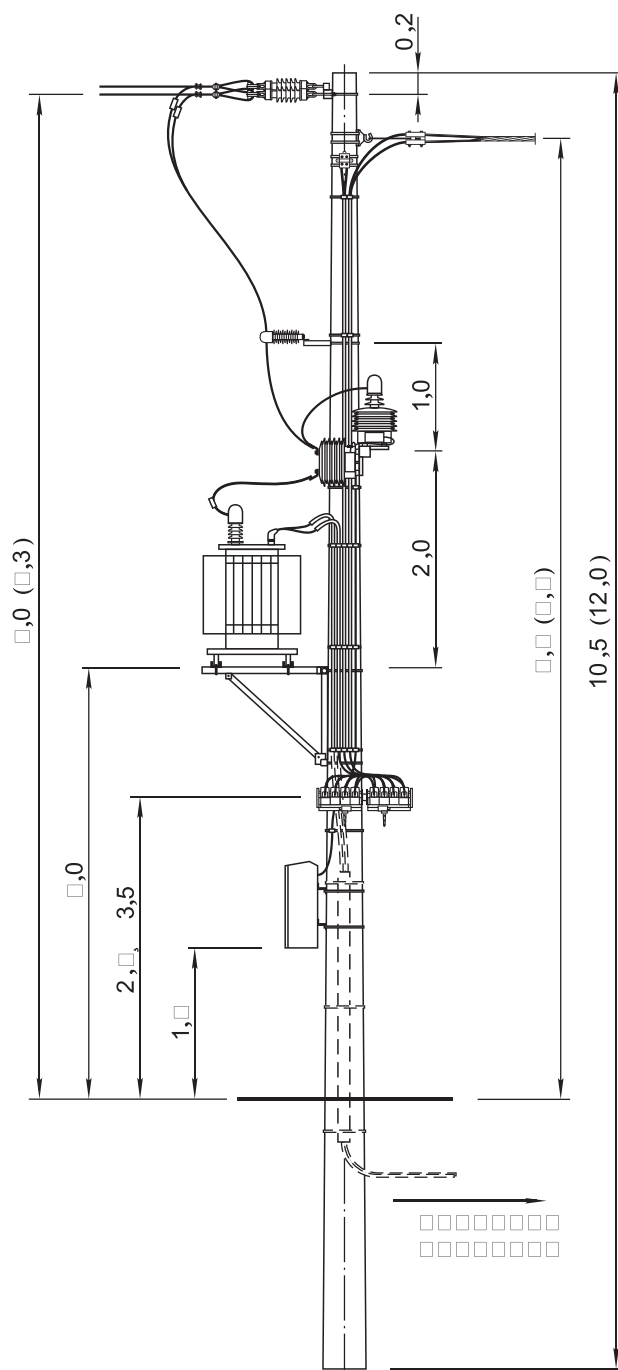
STSRS - 20/630-I-□/□- 2 - P3
With an indirect measurement

* a model solution, a complete album is available on the enclosed CD

3.4.3 Labelling of STN (Overhead Transformer) Stations

STN							- 20/	/	/Pp3
Pole Overhead Transformer Stations									
Types depending on the MV lines used: P - intermediate stations O - small-angle pole stations ON - angle pole stations K - cable stations Ks - with an overhead self-supporting cable Kp - with an overhead festoon cable without a "deadend" label									
u - simplified (without MV fuses) without an "all components" label									
o - with an MV switch without a label without an MV switch									
Type depending on the length of a pole 1 - 10,5 m 3-8,5m 2 - 12 m 4-9m									
Type depending on the strength of a pole 1 - 6 kN 5 - 20 kN 2 - 10 kN 6 - 26 kN 3 - 12 kN 7 - 33 kN 4 - 15 kN									
Rated voltage [kV]									
Power of the transformer [kVA]									
Type depending on the MV overhead power supply I - on the transformer's side II - from the side opposite the transformer or the construction-dependent type: 1 -flat cable system (STNP, STNPu) -MV dead-end cable line, overhead or cable LV joints (STNP, STNKu) 2 -triangle cable system (STNP, STNPu) -MV dead-end cable line, cable LV joints (STNP, STNKu) 3 -MV cable intermediate line, overhead or cable LV joints (STNK, STNKu) 1f - 1-phase transformer (STNPu)									
Stations with an indirect three-phase measurement system									

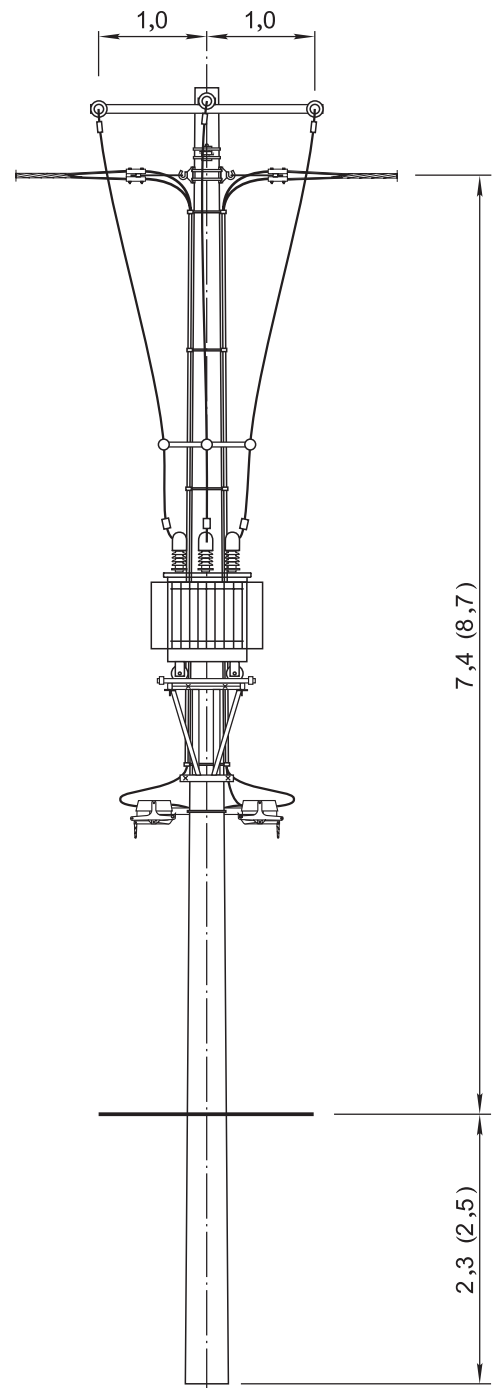
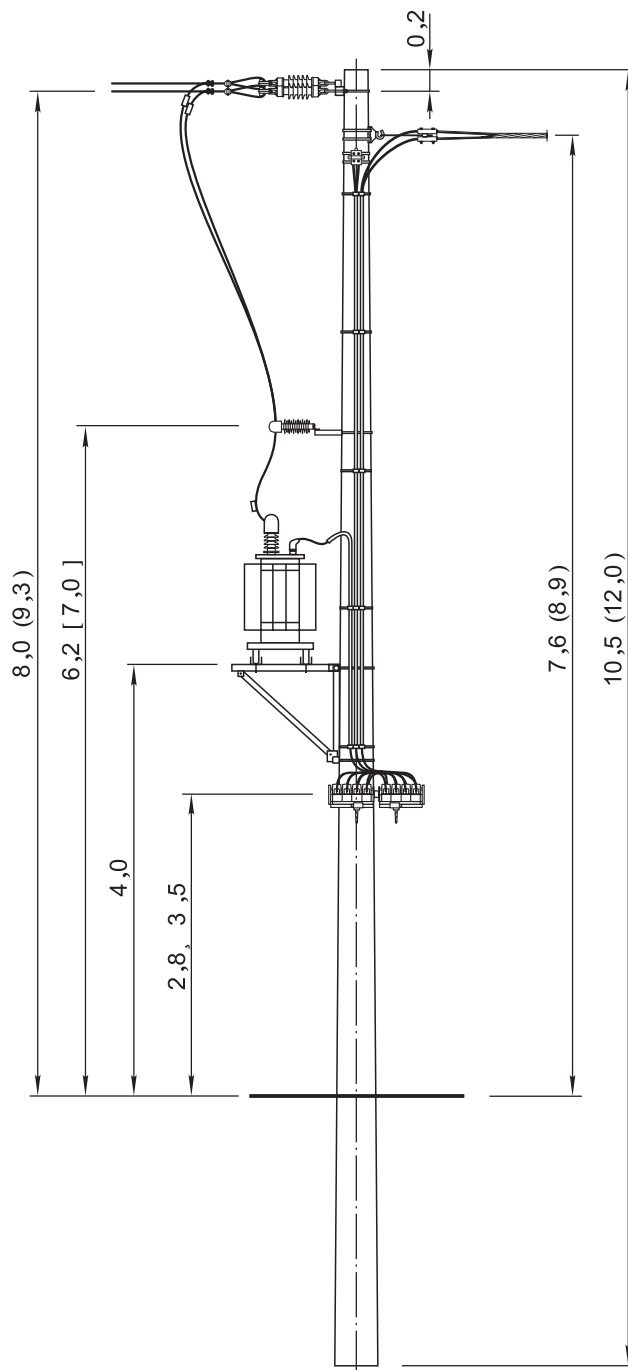
Examples of STN (Overhead Transformer) Stations

STNu -20  //PP3

3.4.4 Labelling of p (b) Pole Mount Transformer Stations

STS							20	/		/	
Types depending on the manufacturer of the fused isolating switch(load break interrupter switch) 1- Centrostal, ZMER, ZPUE, Chimet or 2- ZWAR Type depending on the MV overhead power supply I - on the transformer's side II - on the side opposite the transformer											
Power of the transformer [kVA]											
Rated voltage [kV]											
Type depending on the strength of a pole 1 - 6 kN 2 - 12 kN 3 - 15 kN 4 - 17,5 kN											
Type depending on the length of a pole 1 - 10,5 m 2 - 12 m											
o - with a fused isolating (load break interrupter) switch without the label "no fused isolating (load break interrupter) switch"											
u - simplified (without MV fuses) b - on two spun poles p - on a single spun pole - all components											
K - cable for an MV line P - overhead intermediate for an MV line without the label - "overhead deadend for MV lines"											
E - with the transformer up to 40 kVA without the label - "contains a transformer of up to 400 kVA"											
Pole Mount Transformer Station											

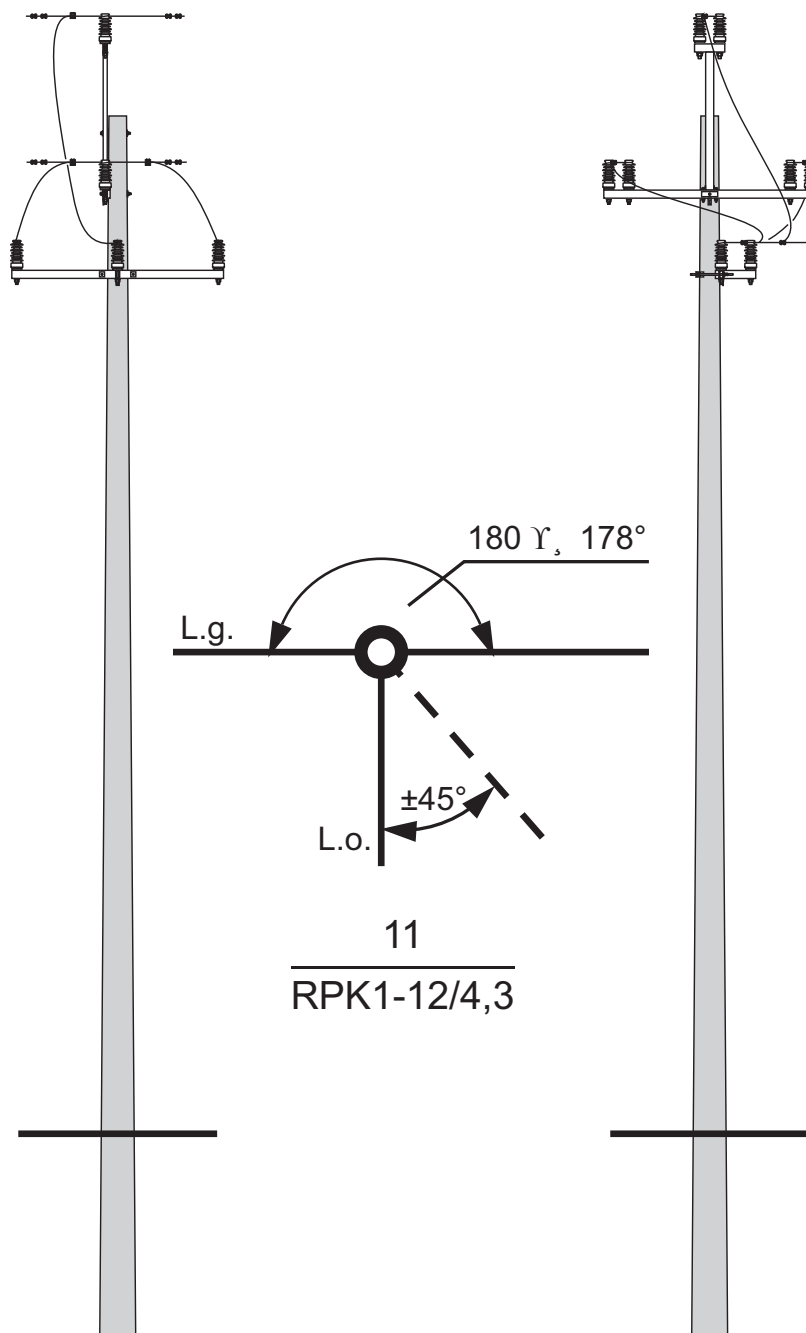
Examples of STS pu Pole Mount Transformer Stations



STS pu-20/□/I

MV Overhead Lines

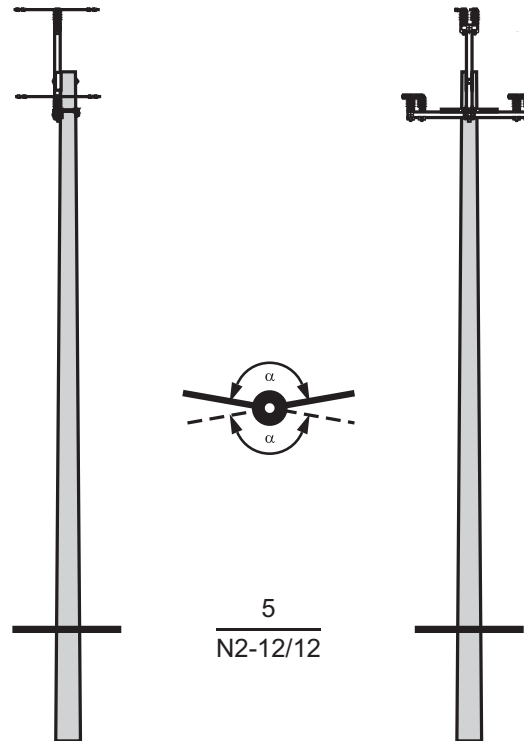
3.5.1 MV Pole Mount Transformer Stations 35(50)



Branch intermediate-deadend poles
RPK1 - □/□□

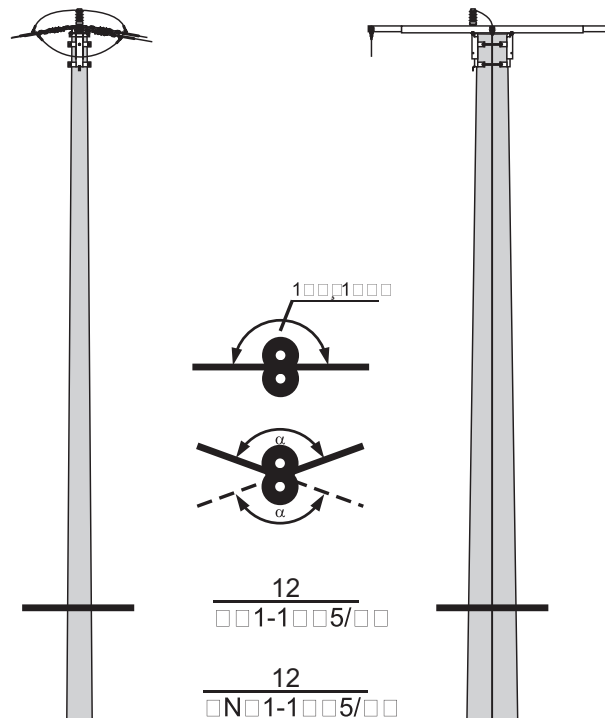
* a model solution, a complete album is available on the enclosed CD

3.5.2 LSNS 70(50)



Corner Poles
N2-□/□□

3.5.3 LSNS 120(70)[240]

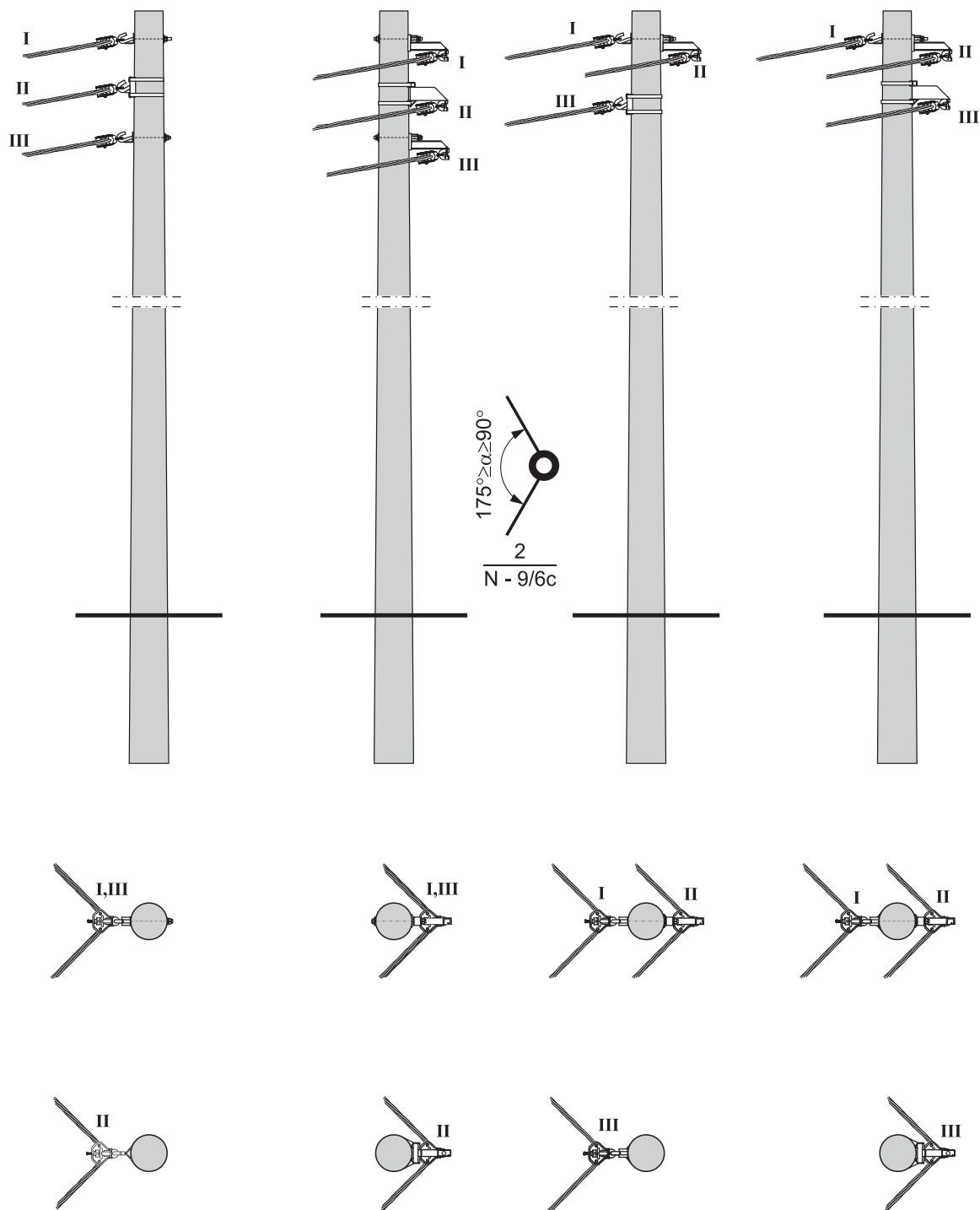


Ob1 - □/□ small-angle poles
and ONb1 - □/□-angle poles
Twin Poles

* a model solution, a complete album is available on the enclosed CD

3.5.4 LV Isolated Lines with AsXSn Cables

Corner Poles
N - □/4,3 ÷ 35



Example 1

Example 2

Example 3

Example 4

* a model solution, a complete album is available on the enclosed CD

CHAPTER

4

**Container Enclosure Systems,
Container Transformer Stations,
MV Switchboards in Air Insulation**



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CHAPTER
4

**Container Enclosure Systems,
Container Transformer Stations,
MV Switchboards in Air Insulation**

57 Systems of Container Enclosures

75 Switchboard

76 MV Cable Connectors

78 Container Transformer Stations

97 MV switchboards in air insulation type RSS and RSSw manufactured by Strunobet-Migacz Sp. z o.o.

Systems of Container Enclosures

In 2006, Strunobet-Migacz Sp. z o. o. launched an innovative technology of manufacturing concrete enclosures with the possibility of a wide range of applications. The enclosures and the transformer stations based on them meet all current production and safety standards.

4.1 Fields of Application

The versatile technology allows the enclosures manufactured by Strunobet-Migacz Sp. z o.o. to be used in a wide range of applications.

The main application fields for reinforced concrete enclosures are::

- **Professional Power Engineering**

- MV cable joints and MV measuring gates
- container transformer stations operated from the inside and from the outside
- PZ and RS delivery-acceptance stations

- **Track Engineering**

- container transformer stations
- track section cabins
- rooms for the supervision and management staff

- **Industrial Power Engineering**

- high power capacity transformer stations
- enclosures of electricity generators
- rooms for the supervision and management staff

- **Individual designs upon customers' requests**

4.2 Innovative Manufacturing Technology

Manufacturing enclosures as monolithic components is a characteristic feature of the technology applied by Strunobet-Migacz Sp. z o.o. The container consists of independent components which are the cable of the basement, the main body and the roof. Depending on the equipment and field of application, the enclosures can be made as compact ones (operated from the outside) or container

ones (operated from the inside).

Main body

The main body of the enclosure of a transformer station is a monolithic system of four walls and a floor. The floor separates the transformer and switchboard compartment from the inner space of the cable basement.

The transformer and the switchboard rooms are separated by a partition made from perforated or solid sheet in an angle frame. There is also an alternative of using a partition made of reinforced concrete slab fixed to external walls and the floor.

The enclosure is made from the SCC self-compacting concrete class C 30/37.

Casting of the enclosure is performed in an inverted position. The walls are cast together with the floor, which forms a solid monolith.

Openings for doors and grates are made in the main body while the openings for cables are made in the floor.

Inside, the walls are covered with white or other bright colour decorative acrylic plaster. Outside, the walls are also covered with acrylic plaster. The colours and types of elevation are offered in a standard version (see manufacturer's catalogue). For the enclosure, it is also possible to use the colours and type of elevation according customer's needs.

Increased degree of REI 120 protection is achieved by the use of PROMATEC plates fixed to the walls on the outside of the enclosure.

Cable Basement

The cable basement is made as a uniform prefabricated component with the dimensions adapted to the freezing zone of the ground, which constitutes the foundation of the station at the same time. The cable basement is made from the SCC self-compacting concrete class C 30/37.

The cable basement has a partition which is 300 mm high and is made in order to section off a part of the basement as a "bath" that can hold the entire (with some margin) oil from the transformer. Upon customer's request, the partition can be as high as the basement and it can be made in the amount specified by them. The surface of the oil pit is covered with 2 layers of an oil-protective paint. The side walls have permanently cast in sleeves, such as plastic ones, which are cable and earthing penetration sleeves. On the surface, the exterior of the cable basement is covered with special bi-directional waterproof and oil-proof agents.

in the form of double-pitched or pyramidal caps covered with tile sheets or ceramic tiles.

Roof

The roof of the enclosures is made as a rectangular reinforced concrete plank with variable thickness needed to form a 2.2% decrease in the direction of the bigger dimension. This edge requires the minimum thickness of the roof plank of 90 mm, and the maximum span in the middle of 130 mm. The roof plank is made from the SCC self-compacting concrete class C 30/37. Intricate components such as the roof verge or the eaves are additionally reinforced.

The roof is mounted directly on the walls. An elastomer background layer between the wall and the roof of the enclosure creates an air space which is a natural draft ventilation of the station. The roof is arranged freely. Therefore, in case of an arc fault it has the ability to go up, forming an outlet for the pressure and the post arc gases and particles, and then it falls freely to its former position.

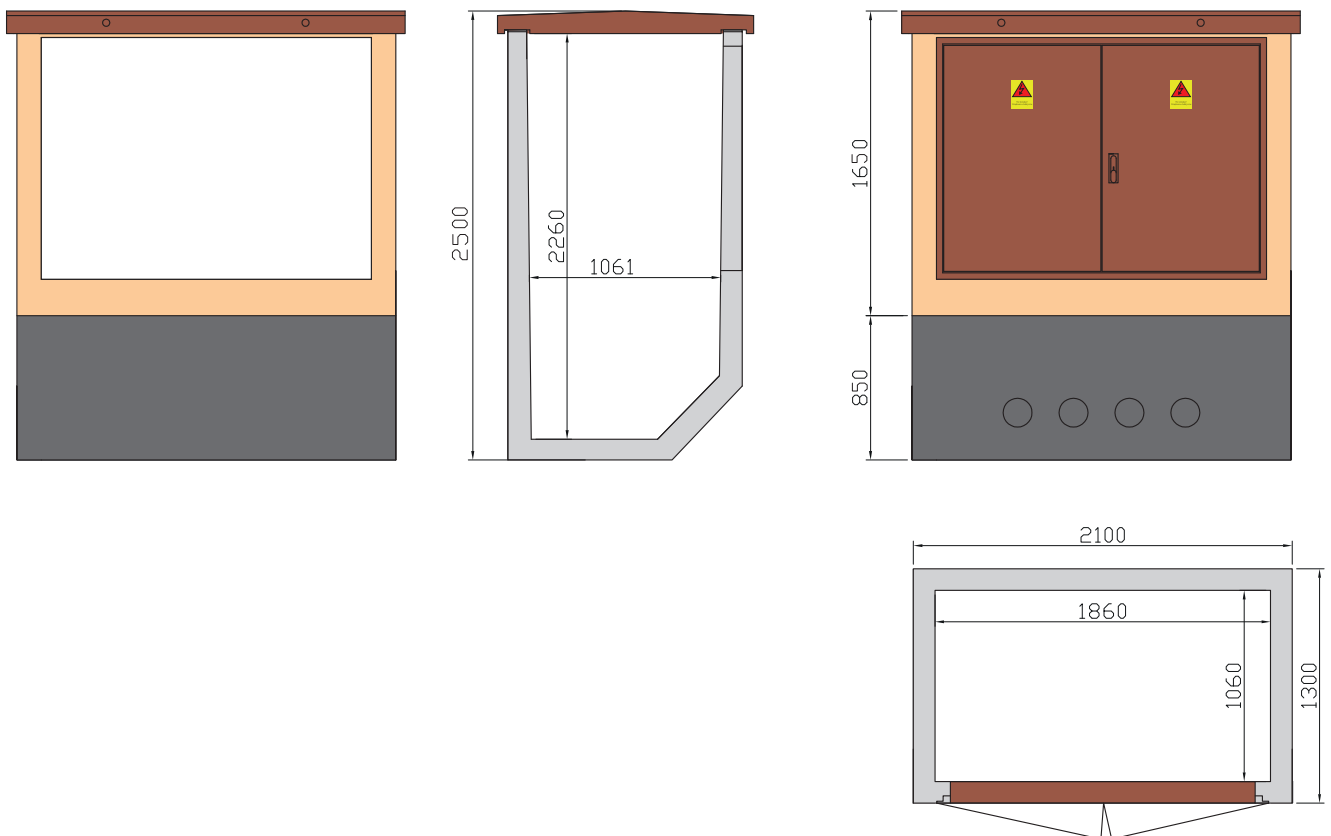
The outer surface of the roof is painted with sun and rainwater resistant paint. Additionally, it can be covered with a layer of roof paper.

In order to adjust the shape of the roof to the architectural requirements, the overlays can be made

4.3 Enclosure ZKSN 130/210

Compact enclosures operated from the outside is mainly used for MV cable joints with an installed switchboard in SF6 or vacuum insulation. The enclosure consists of two components (the main body and the roof). An innovative solution is the possibility to make the cable joint using MV switchboards in RSS air insulation manufactured by Strunobet-Migacz Sp. z o.o.

In the case of one-off solutions it is possible to order additional access doors in the walls.



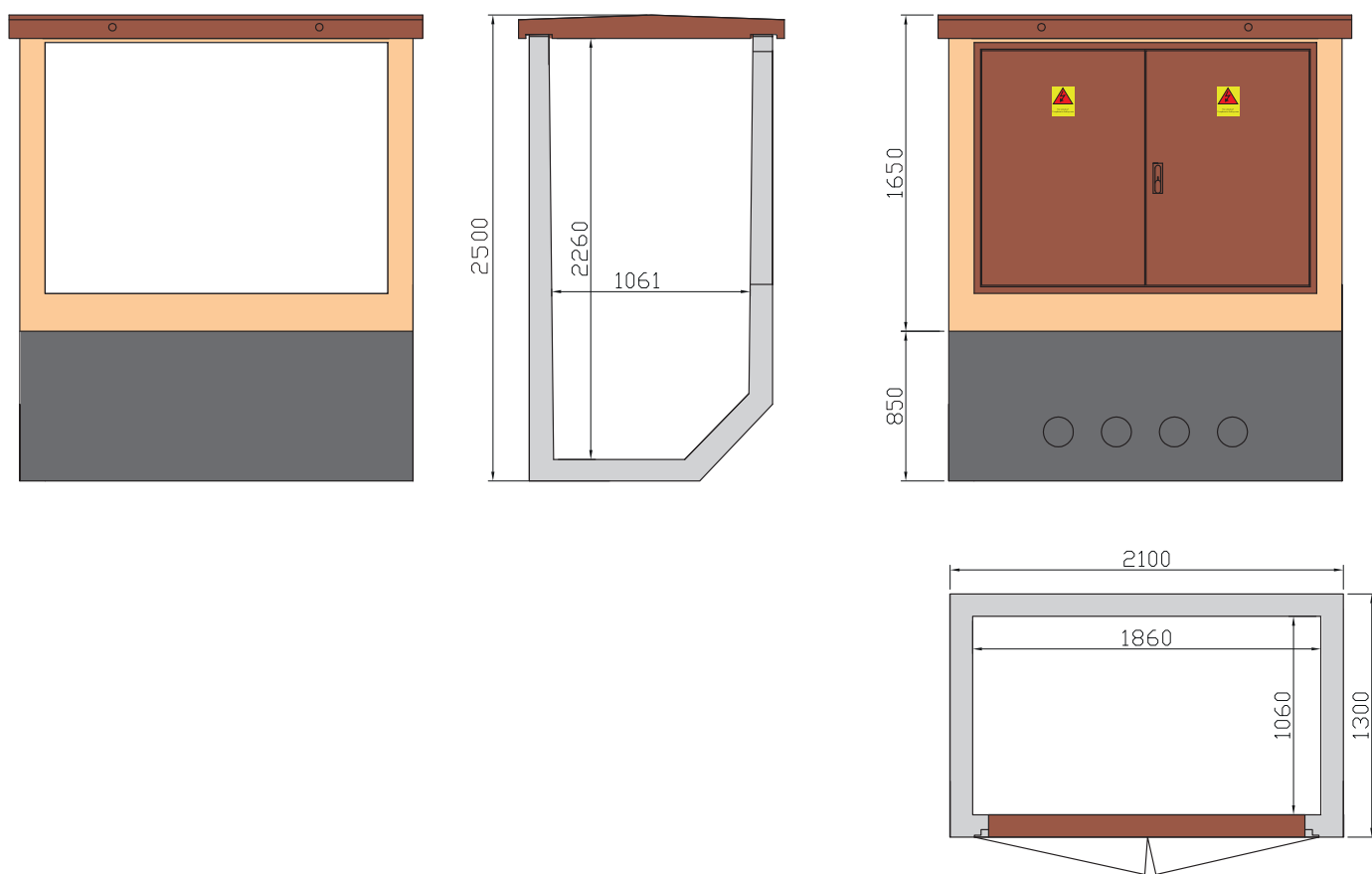
Technical Specifications of Enclosures

Outline Dimensions	External width [m]	1,30
	External length [m]	2,10
	Total height [m]	2,50
	Height after foundation (from the surface of the ground) [m]	1,65
	Gross covered area [m ²]	2,73
	Floor space [m ²]	2,09
Weights	Weight of the main body [t]	4,12
	Weight of the roof [t]	0,88
	Total weight [t]	5,00

4.3.1 Enclosure ZKSN 130/290

Compact enclosures operated from the outside is mainly used for MV cable joints with an installed switchboard in SF6 or vacuum insulation. An innovative solution is the possibility to make the cable joint using MV switchboards in RSS air insulation manufactured by Strunobet-Migacz Sp. z o.o.

In the case of one-off solutions it is possible to order additional access doors in the walls.



Technical Specifications of Enclosures

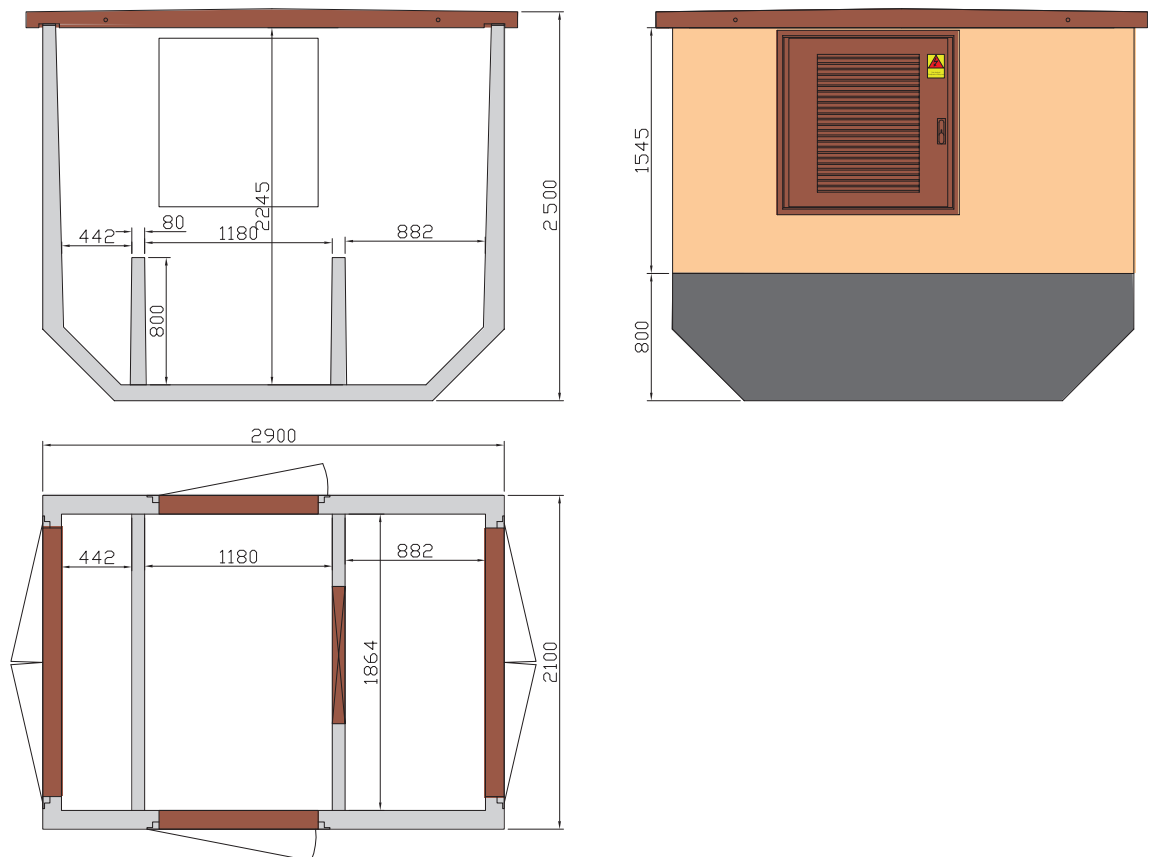
Outline Dimensions	External width [m]	1,60
	External length [m]	2,90
	Total height [m]	2,50
	Height after foundation (from the surface of the ground) [m]	1,65
	Gross covered area [m ²]	4,64
	Floor space [m ²]	3,63
Weights	Weight of the main body [t]	5,74
	Weight of the roof [t]	1,56
	Total weight [t]	7,30

4.4 Enclosure KSZ 210/290

The compact enclosure managed from the outside is mainly used for compact transformer stations with the capacity of 630 kVA and an integrated switchboard in SF6 or vacuum insulation. The enclosure consists of two components (the main body and the roof). Depending on the equipment used and the desired operating side, four options of the enclosure are available (A, B, C and 3P).

In the case of one-off solutions it is possible to order an additional access door.

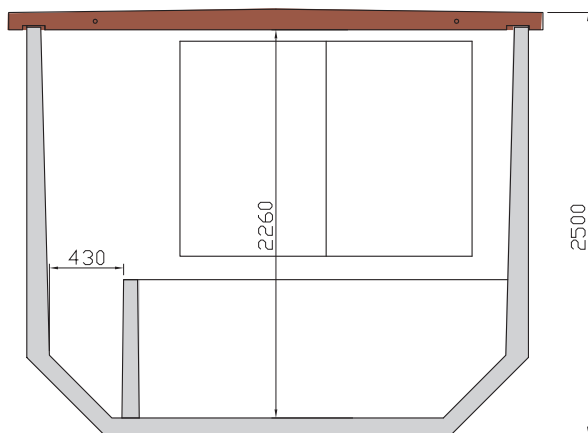
Option A



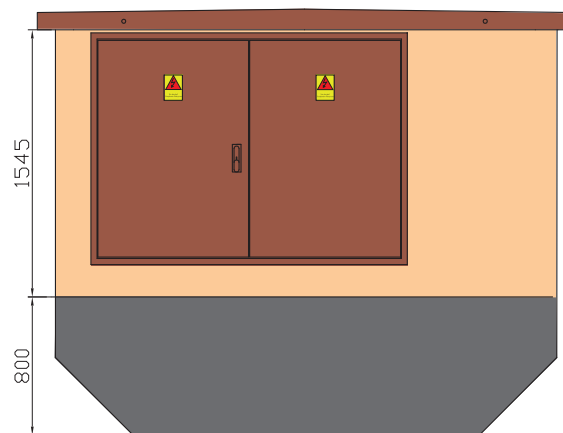
Technical Specifications of Enclosures

Outline Dimensions	External width [m]	2,10
	External length [m]	2,90
	Total height [m]	2,50
	Height after foundation (from the surface of the ground) [m]	1,65
	Gross covered area [m ²]	6,09
	Floor space [m ²]	5,13
Weights	Weight of the main body [t]	6,04
	Weight of the roof [t]	1,95
	Total weight [t]	7,99

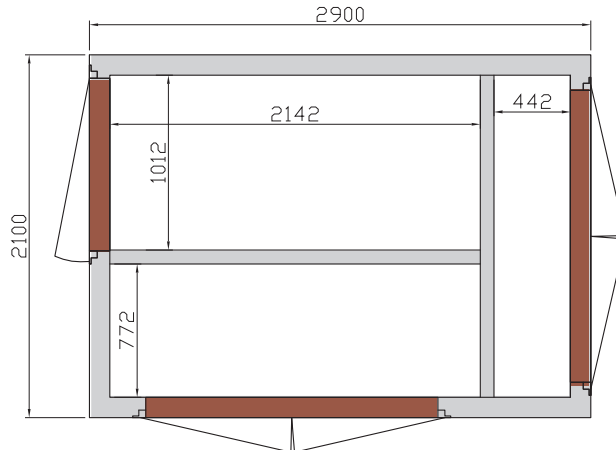
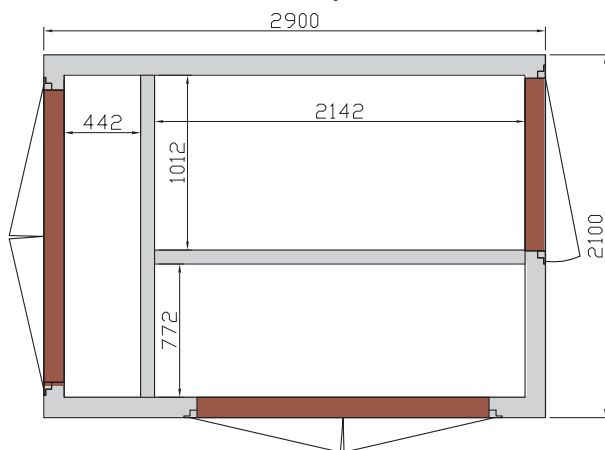
Option B



Basic option



Mirror reflection

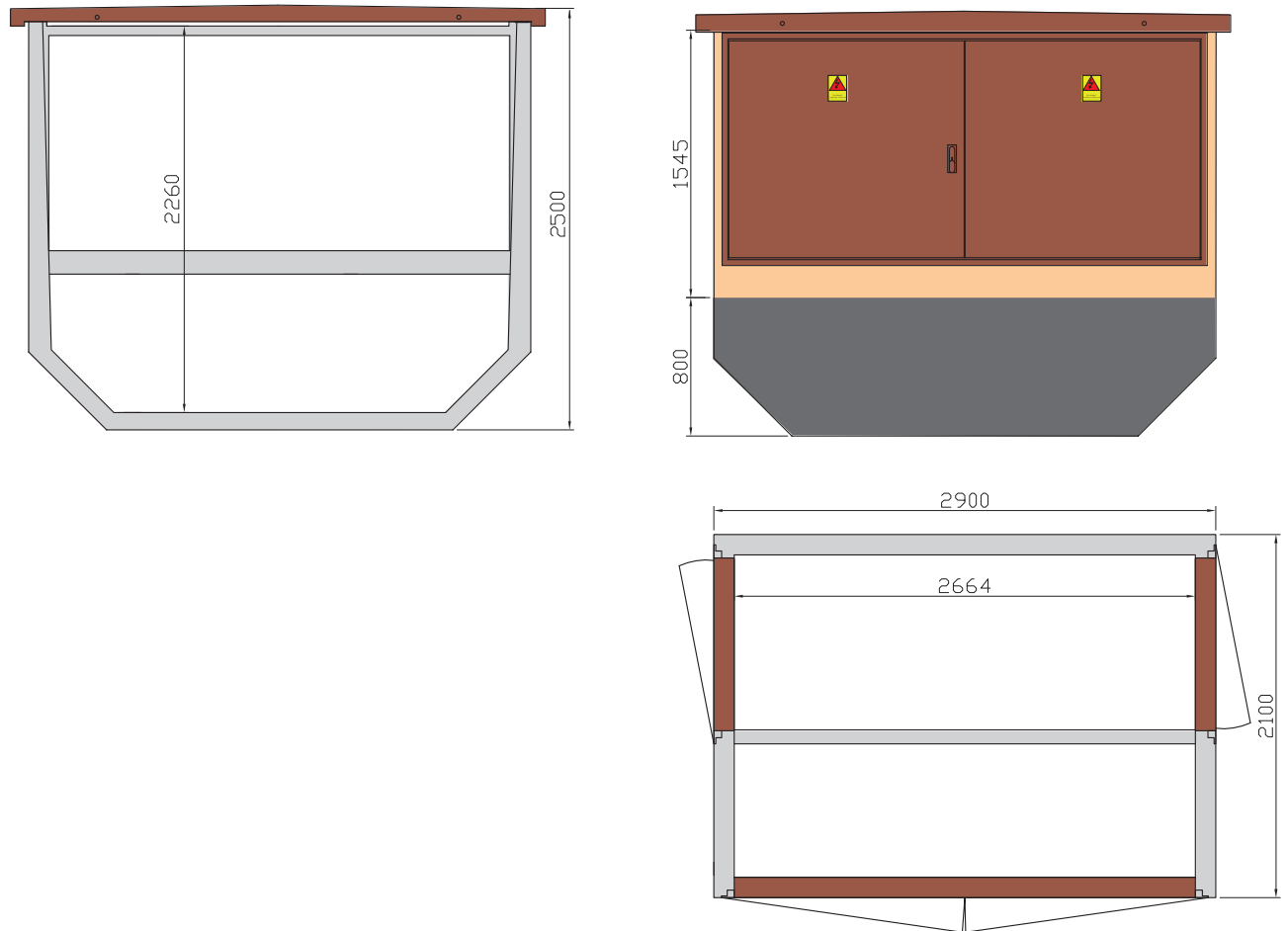


Possibility to manufacture the complete wall as REI120

Technical Specifications of Enclosures:

Outline Dimensions	External width [m]	2,10
	External length [m]	2,90
	Total height [m]	2,50
	Height after foundation (from the surface of the ground) [m]	1,65
	Gross covered area [m ²]	6,09
	Floor space [m ²]	5,13
Weights	Weight of the main body [t]	6,50
	Weight of the roof [t]	1,95
	Total weight [t]	8,45

Option C

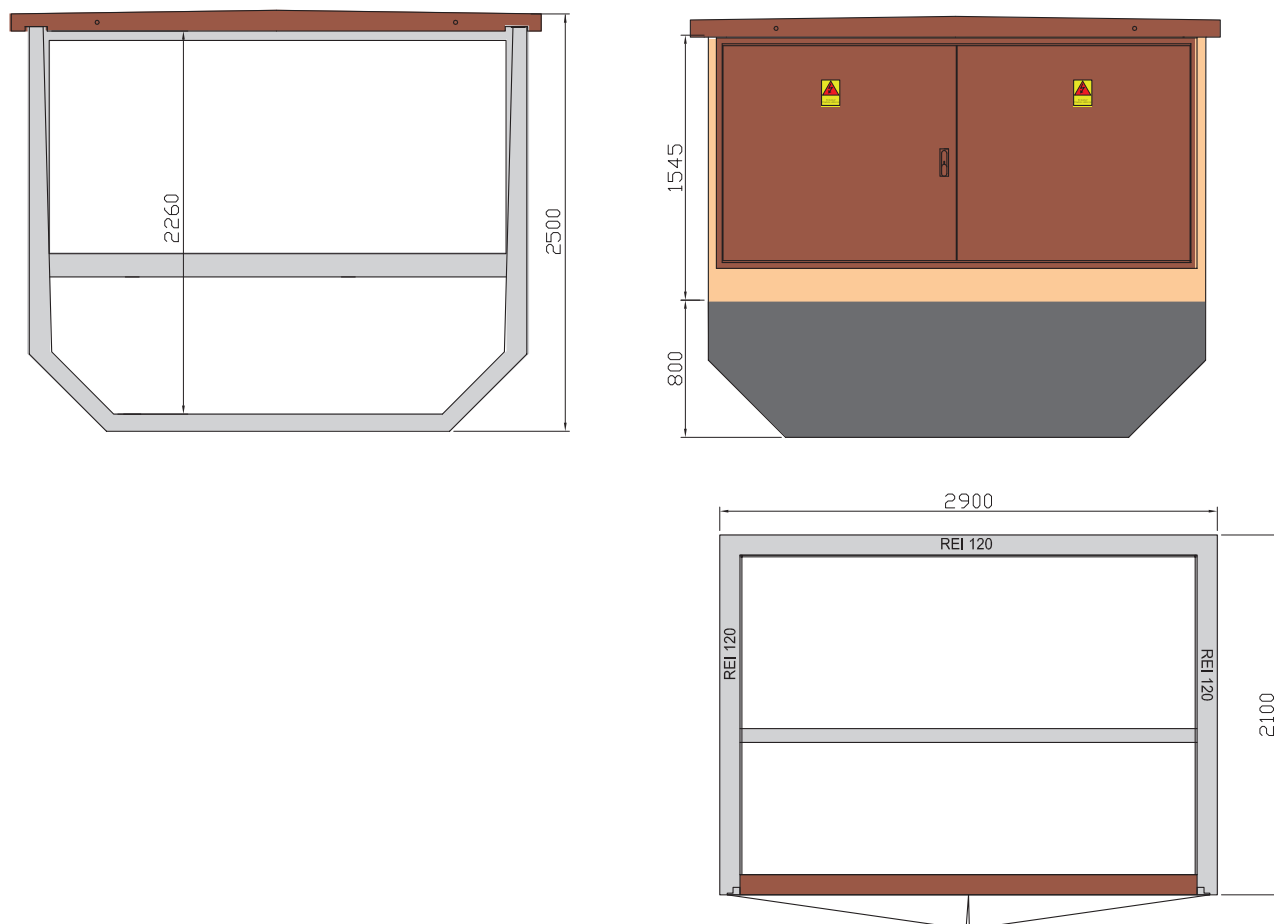


Possibility to manufacture the complete wall as REI120

Technical Specifications of Enclosures:

Outline Dimensions	External width [m]	2,10
	External length [m]	2,90
	Total height [m]	2,50
	Height after foundation (from the surface of the ground) [m]	1,65
	Gross covered area [m ²]	2,73
	Floor space [m ²]	2,09
Weights	Weight of the main body [t]	6,25
	Weight of the roof [t]	1,95
	Total weight [t]	8,20

Option 3P



Model 3P-3 solid walls as REI120

Technical Specifications of Enclosures:

Outline Dimensions	External width [m]	2,10
	External length [m]	2,90
	Total height [m]	2,50
	Height after foundation (from the surface of the ground) [m]	1,65
	Gross covered area [m ²]	6,09
	Floor space [m ²]	5,13
Weights	Weight of the main body [t]	6,25
	Weight of the roof [t]	1,95
	Total weight [t]	8,20

4.5 Enclosure KSW 255

KSW enclosures allow to construct buildings operated from the outside as well as from the inside, which together with a cable basement form one separates monolithic unit.

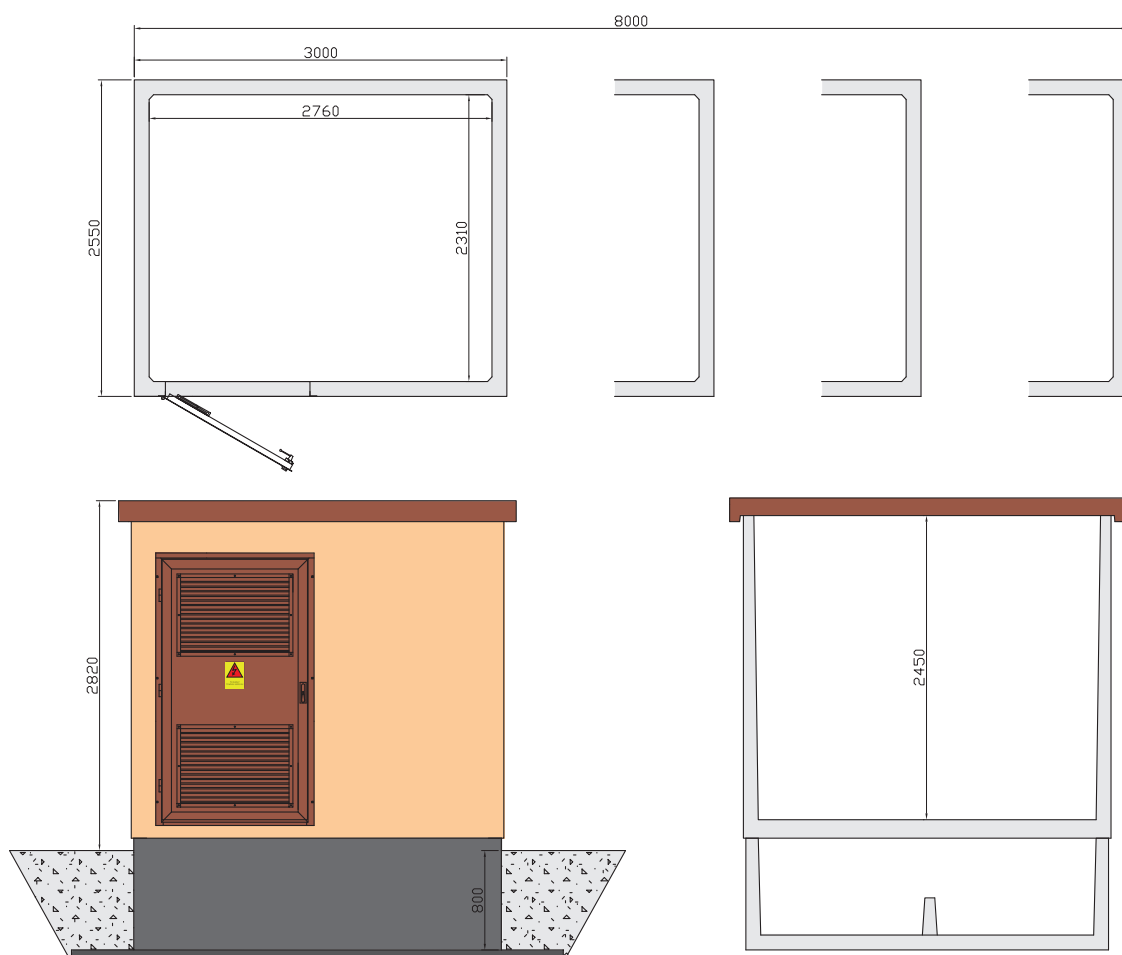
With the variable width of the enclosure from 2550 mm to 2960 mm, there is a wide selection of enclosures that shall meet the customer's needs.

4.5.1 Enclosure KSW 255

Thanks to its movable style, the KSW 255 container enclosure can enjoy many applications. The main areas of application are as follows: professional power transformer stations, industrial stations, track section cabins, compartments for electricity generators and made to order solutions. The width of the

enclosure is 2550 mm and it is possible to adjust its length from 3000 to 8000 mm at every 200 mm. The enclosure consists of three independent uniform components from reinforced concrete (i.e. the cable basement, the main body with the floor and the roof). The height inside the body is 2450 mm. There is a possibility of having steel (or aluminium at the customer's request) door joinery, air grating, door and roof fans or other access elements fitted in the enclosure.

The devices are arranged according to an optimal technical and economic solution.



Technical Specifications of Enclosures:

Outline Dimensions	External width [m]	3 do 8
	External length [m]	2,55
	Total height [m]	3,62
	Height after foundation (from the surface of the ground) [m]	2,82
	Gross covered area [m ²]	7,65 do 20,40
	Floor space [m ²]	6,48 do 18,10
Weights	Weight of the main body [t]	16,8 do 38,30

Weight of individual components of the enclosure*

*- the given data is only of informative nature - openings for doors and air gratings nor the partitions in the basement have been taken into account

		weight [t]			
Depth 2,55[m]	width[m]	enclosure	cellar	roof	total
	3,00	9,80	4,50	2,50	16,80
	3,20	10,20	4,70	2,90	17,80
	3,40	10,70	4,90	3,00	18,60
	3,60	10,90	5,10	2,90	18,90
	3,80	11,50	5,40	3,30	20,20
	4,00	12,00	5,40	3,30	20,70
	4,20	12,50	5,80	3,50	21,80
	4,40	12,90	5,90	3,90	22,70
	4,60	13,40	6,20	4,10	23,70
	4,80	13,80	6,80	4,20	24,80
	5,00	14,30	6,80	4,20	25,30
	5,20	14,70	7,00	4,60	26,30
	5,40	15,20	7,20	4,80	27,20
	5,60	15,60	7,40	4,90	27,90
	5,80	15,90	7,60	5,10	28,60
	6,00	16,30	7,80	5,30	29,40
	6,20	17,00	8,00	5,40	30,40
	6,40	17,50	8,30	5,60	31,40
	6,60	17,90	8,50	5,80	32,20
	6,80	18,40	8,90	6,00	33,30
	7,00	18,80	9,10	6,10	34,00
	7,20	19,30	9,30	6,30	34,90
	7,40	19,50	9,70	6,50	35,70
	7,60	19,60	9,90	6,70	36,20
	7,80	20,60	10,00	6,90	37,50
	8,00	21,10	10,20	7,00	38,30

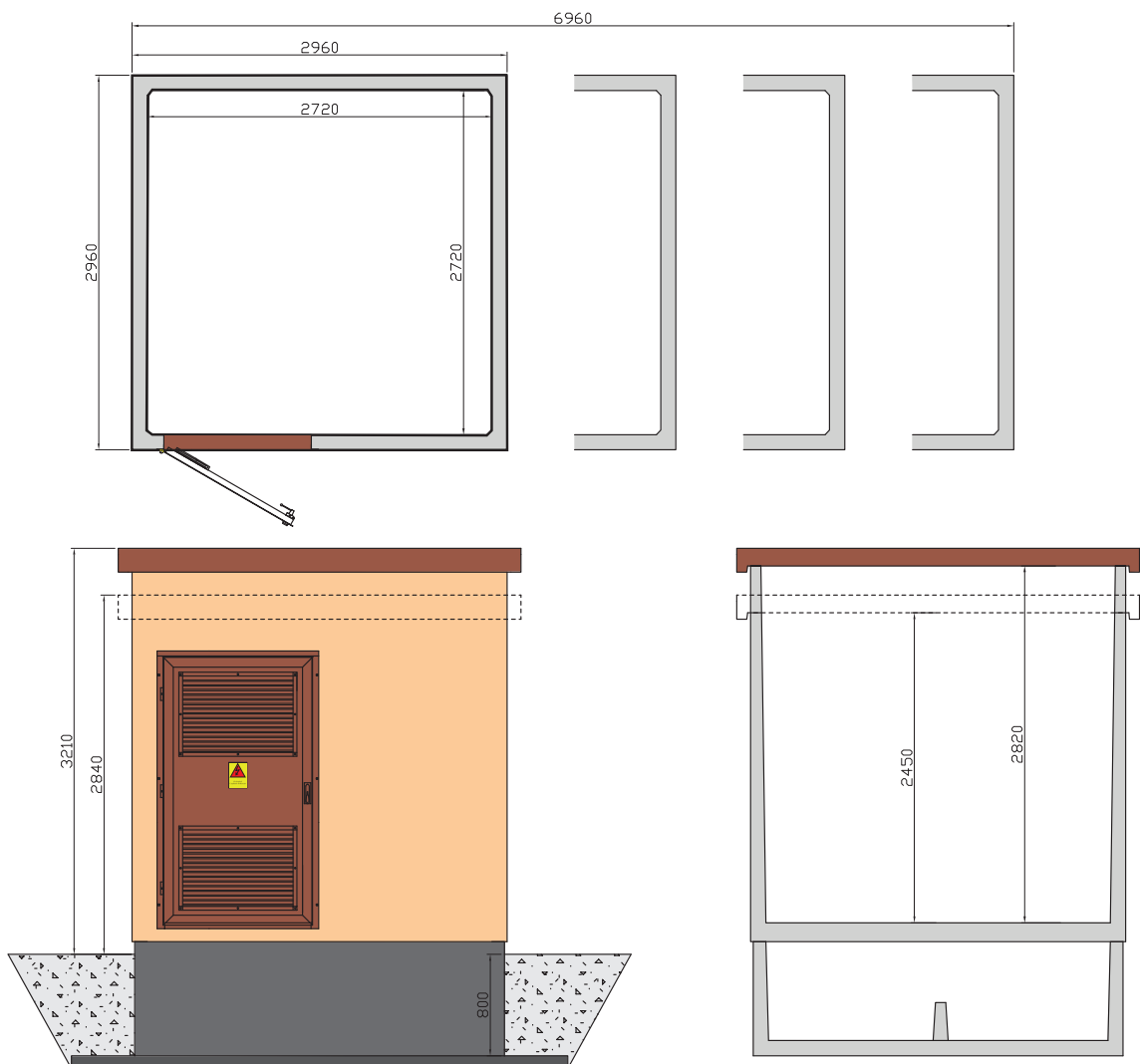
4.5.2 Systems of Container Enclosures

Thanks to its movable style, the KSW 296 container enclosure can enjoy many applications. The main areas of application are as follows: professional power transformer stations, industrial stations, track section cabins, compartments for electricity generators and made to order solutions. The width of the enclosure is 2960 mm and it is possible to adjust its length from 2960 to 6960 mm at every 200 mm. The enclosure consists of three independent uniform components from reinforced concrete (i.e. the cable basement, the

main body with the floor and the roof).

The height inside the main body is 2820 mm. It can be reduced to 2450 mm at the customer's request. There is a possibility of having steel (or aluminium at the customer's request) door joinery, air grating, door and roof fans or other access elements fitted in the enclosure.

The devices are arranged according to an optimal technical and economic solution.



Technical Specifications of Enclosures:

Outline Dimensions	External width [m]	2,96 do 6,96
	External length [m]	2,96
	Total height [m]	3,64 lub 4,01
	Height after foundation (from the surface of the ground) [m]	2,84 lub 3,21
	Gross covered area [m ²]	8,76 do 20,60
	Floor space [m ²]	7,45 do 18,38
Weights	Weight of the main body [t]	20,10 do 40,10

Weight of individual components of the enclosure*

*- the given data is only of informative nature - openings for doors and air gratings nor the partitions in the basement have been taken into account

		weight [t]			
Depth 2,95[m]	width[m]	enclosure	cellar	roof	total
	2,96	11,80	5,20	3,10	20,10
	3,16	12,30	5,50	3,30	21,10
	3,36	12,80	5,80	3,50	22,10
	3,56	13,30	6,10	3,70	23,10
	3,76	13,80	6,30	3,90	24,00
	3,96	14,40	6,60	4,10	25,10
	4,16	15,00	6,90	4,30	26,20
	4,36	15,40	7,20	4,50	27,10
	4,56	15,90	7,40	4,70	28,00
	4,76	16,50	7,70	4,90	29,10
	4,96	17,00	8,00	5,10	30,10
	5,16	17,50	8,30	5,30	31,10
	5,36	18,00	8,50	5,50	32,00
	5,56	18,60	8,80	5,07	32,47
	5,76	19,10	9,10	5,90	34,10
	5,96	19,60	9,40	6,10	35,10
	6,16	20,20	9,60	6,30	36,10
	6,36	20,60	9,90	6,50	37,00
	6,56	21,20	10,20	6,70	38,10
	6,76	21,70	10,50	6,90	39,10
	6,96	22,20	10,79	7,10	40,09

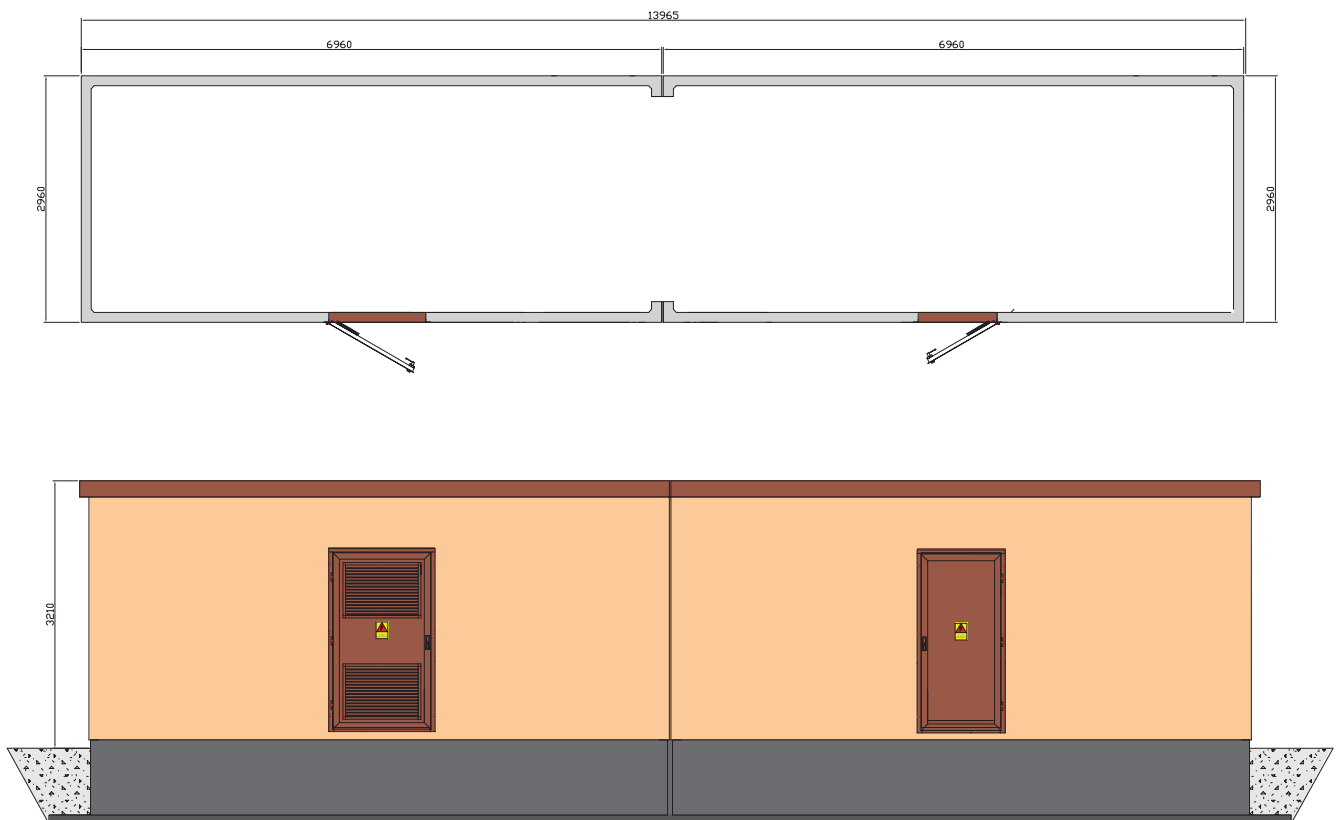
4.5.3 4.5.3 Multi-part enclosures - individual designs

While designing the equipment the dimensions of which make it impossible to fit it into a single enclosure, there is a possibility of a multi-enclosure configuration.

The buildings can be joined with shorter or longer walls. Flashings are provided to join the buildings

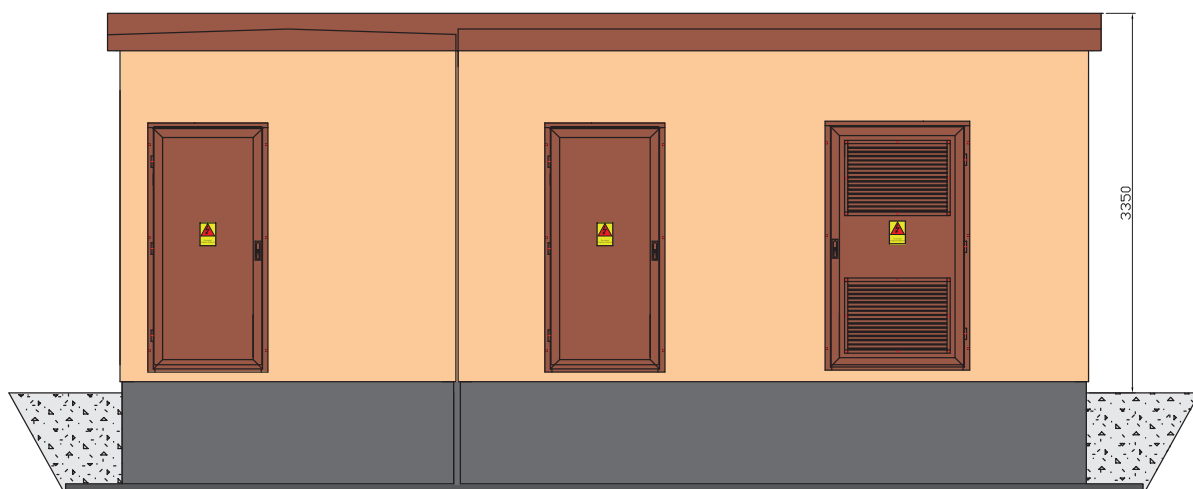
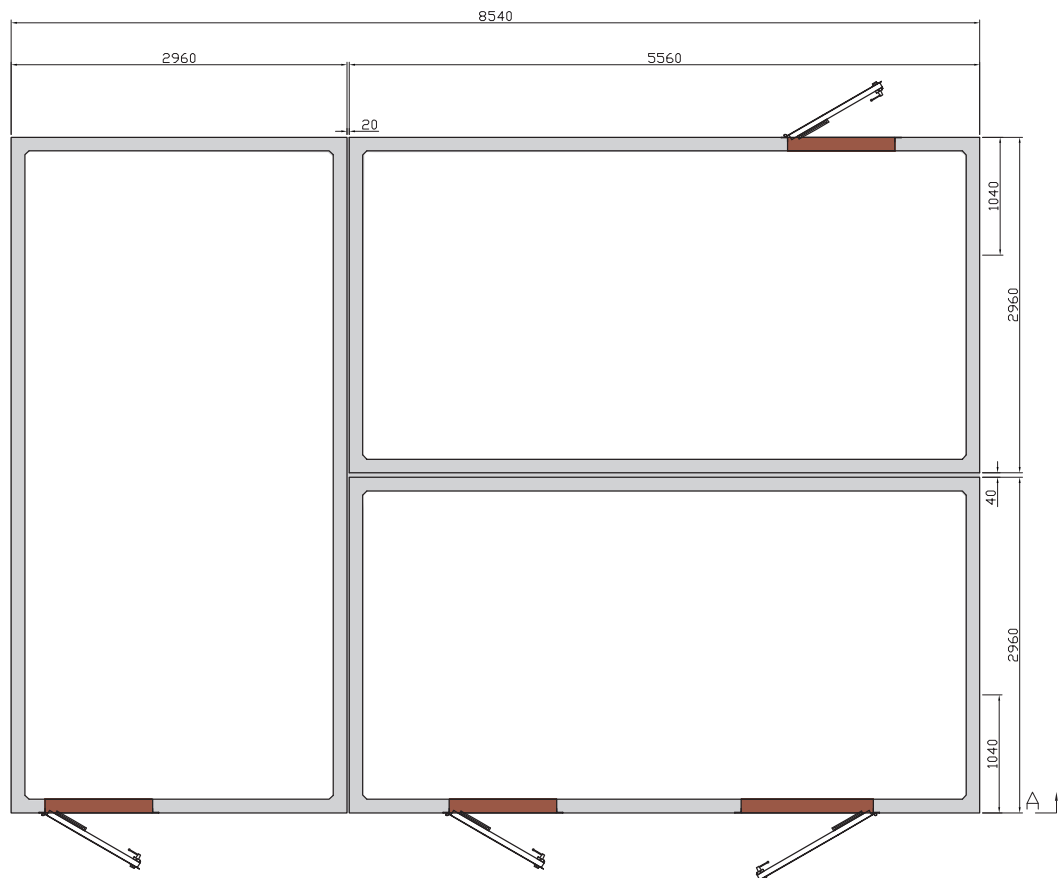
The chosen equipment must be arranged in an

optimal way. Once the arrangements with the customer are made, Strunobet-Migacz Sp. z o.o. submit their proposals of the power scheme.



Technical Specifications of Enclosures:

Dimensions	External width [m]	2,96
	External length [m]	13,96
	Height above the ground [m]	3,21



Technical Specifications of Enclosures:

Dimensions	External width [m]	5,92
	External length [m]	8,54
	Height above the ground [m]	3,35

4.6 4.6 Components of enclosures

4.6.1 Door joinery and ventilation

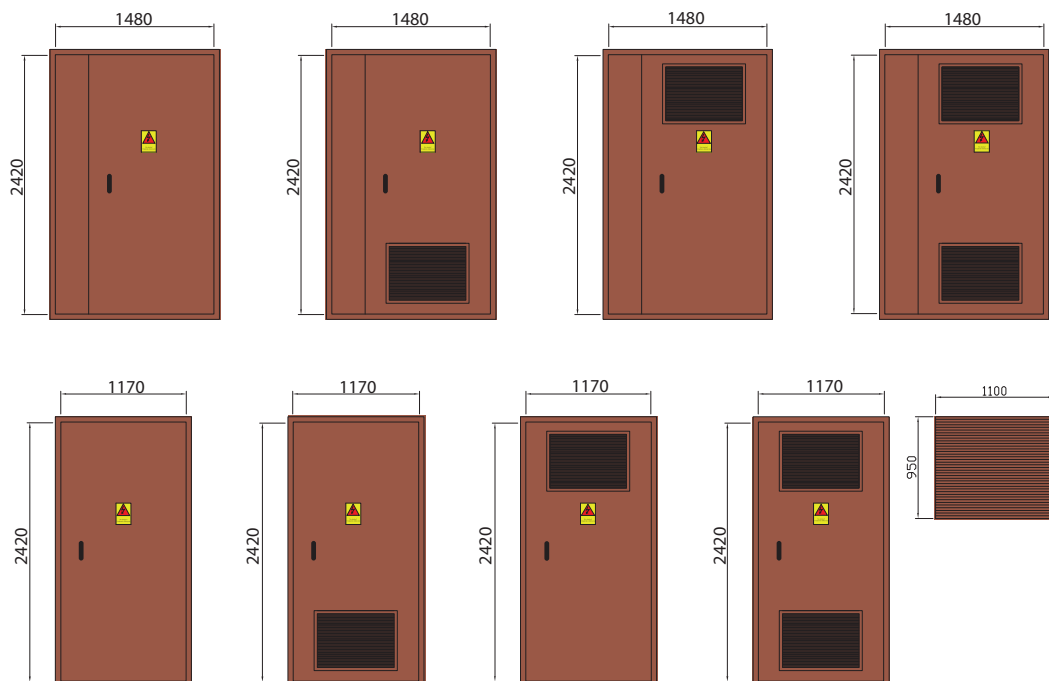
Standard doors and air gratings are made of high quality galvanized steel sheet, powder paint coated with the agreed RAL colour. For individually tailored orders, the joinery can be made of aluminium as well.

Depending on the needs, the doors have air gratings for cooling the equipment and a three-point MasterKey lock.

The drawings below present standard doors and air gratings of KSW enclosures. Other dimensions are available upon customer's request.



Applications in KSW296/.. Transformer Stations with the height of h- 2970 mm



4.6.2 Installation of lighting and protective earthing

The station is equipped with electrical lighting system and the 230V socket system.

They are surface-mounted systems in pipe casings.

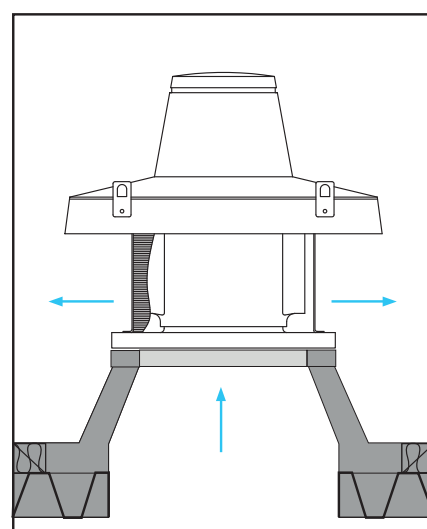
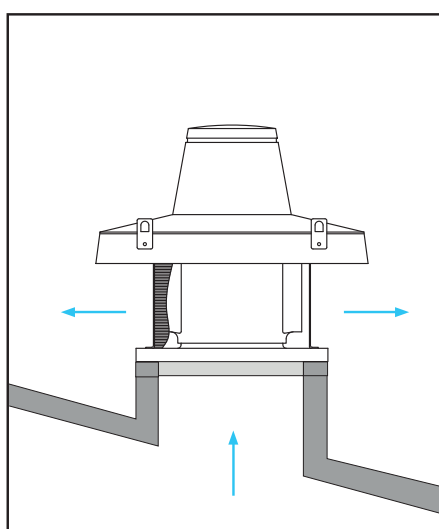
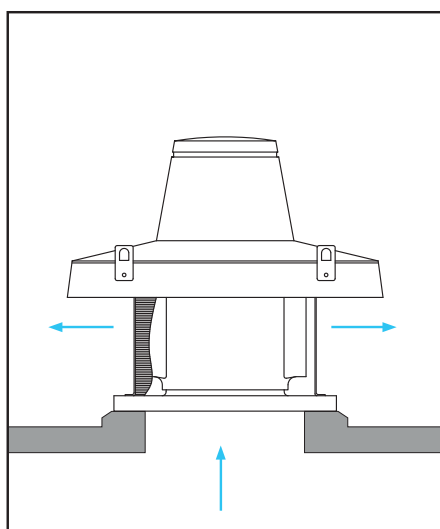
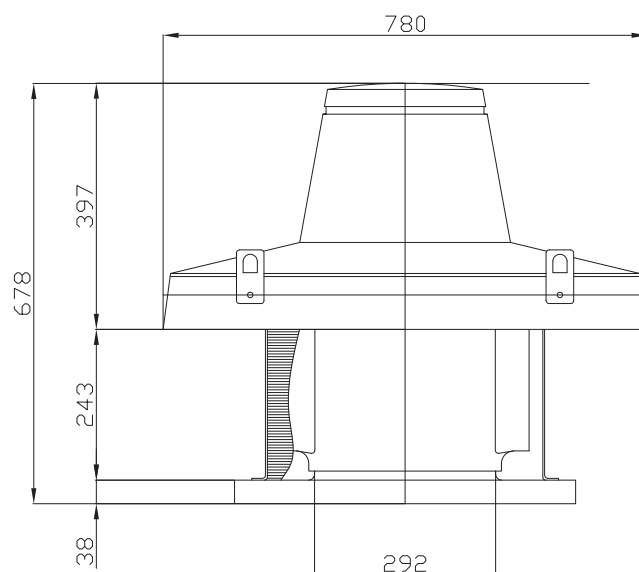
The stations are powered from the auxiliary panel of the LV switchboard or from the outside sources.

The main inner earthing ring is made from a flat hoop iron strip 40x5, marked in yellow and green. Protective earthing inside the station is a copper cable hooked up to a screw terminal on the hoop iron, connected to the foundation earth electrode or the earthing ring. The remaining connections of the earthing system, i.e. metal parts of the substation equipment, metal components of steel construction structures of switchboards and transformers are made in the same way.

4.6.3 Fans

To improve air circulation inside the transformer, mechanical ventilation systems can be used. It is possible to have both door and roof fans fitted.

Roof fan - examples



4.6.4 Draft curtains - transfer dumpers

With transformers requiring simultaneous ventilation in the side or rear walls of the chamber and which must be of REI120 class, draft curtains (in other words transfer dampers by manufacturers like Mercor SA) are used. These dampers consist of a double rectangular enclosure, a movable dividing element which is a falling and folding curtain and a release and control mechanism started up after the heat responsive device has been activated. The cut-off partition is made of stainless steel sheet.

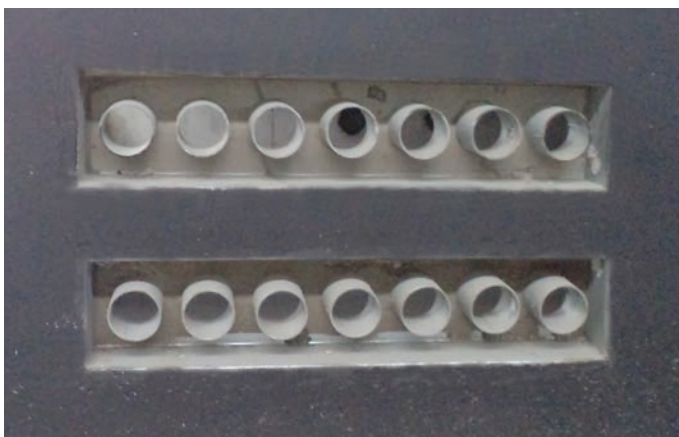
The type of dampers and their operating system are suited to individual solutions.

4.6.5 Sealing Systems

All enclosures and transformer stations can be equipped with sealing systems for LV and MV cables.

In the basic option MV cables are inserted using PVC connectors with a heat-shrink three-fork arm, like AKB5, and in the case of LV cables - battery penetration sleeves produced by Strunobet-Migacz Sp. z o.o., type FeZn, with a heat-shrink pipe.

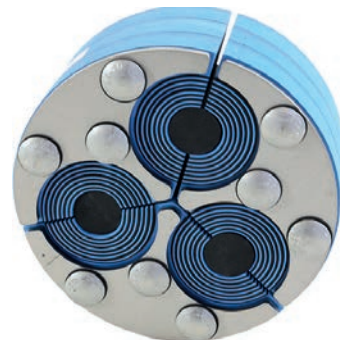
Battery Penetration Sleeves



PVC Penetration Sleeves

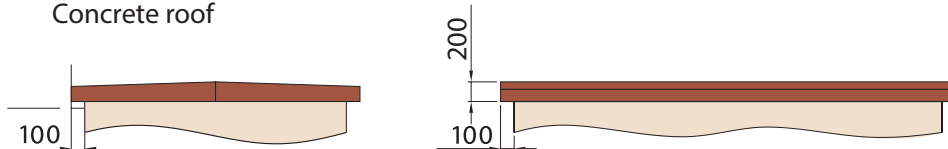


Commercial penetration sleeves by companies like Roxtec or Hauff-Technik are fitted upon customer's request.

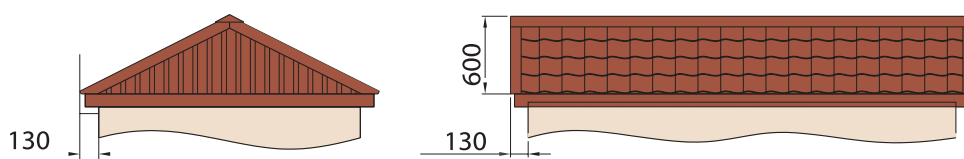


4.7 4.7 Roof options and stations colour schemes

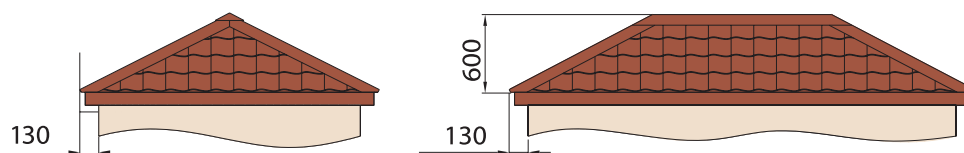
Concrete roof



Double-pitched roof made of metal



Pyramid roof made of metal



Colours available according to the RAL Colour Chart. Colours which do not have to be agreed beforehand include: 1013 (sandy), 7035 (light grey), 8014 (brown), 9006 (white aluminium) and white

RAL 1002	RAL 1012	RAL 1013	RAL 1014	RAL 1015	RAL 1018	RAL 1019
RAL 1023	RAL 3003	RAL 3009	RAL 3012	RAL 3020	RAL 5005	RAL 5010
RAL 5013	RAL 5015	RAL 6010	RAL 6016	RAL 6020	RAL 6021	RAL 6022
RAL 7004	RAL 7032	RAL 7035	RAL 7047	RAL 8011	RAL 8014	RAL 8015
RAL 8017	RAL 8024	RAL 8025	RAL 9002	RAL 9003	RAL 9006	RAL 9010

Equipment used

When offering their solution, the company Strunobet-Migacz Sp. z o.o. take technical and economic optimizations into account. In order to satisfy a wide group of customers and meet their individual needs our stations have approvals for use in the professional power industry with the following types of switchboards.

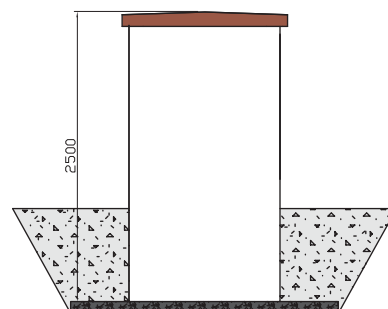
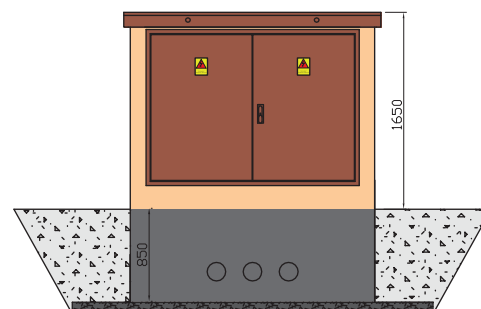
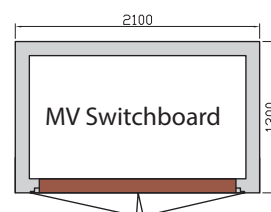
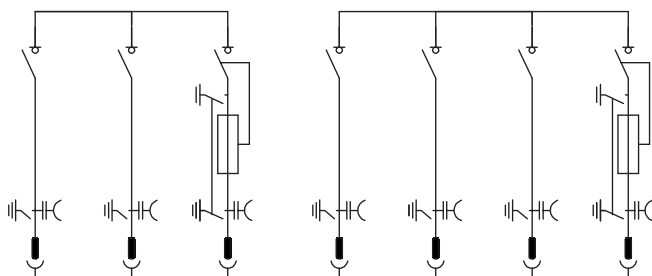
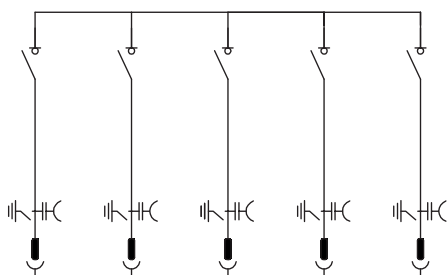
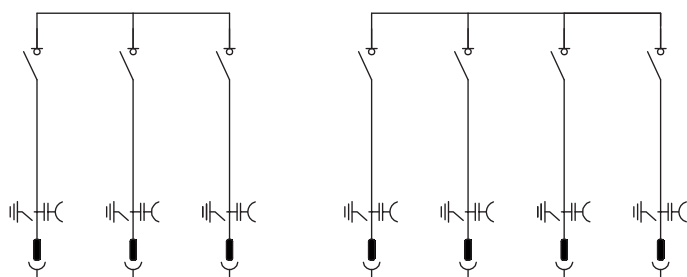
It is also possible to use other equipment with stations manufactured upon a customer's individual request.

Detailed data concerning the products are included in the catalogues and Operation and Maintenance Manuals of individual devices on the websites of their manufacturers.

	Manufacturer	Type
MV Switchboard	Strunobet	RSS/ RSSw
	Schneider	RM6,SM6
	ABB	SafePLus, SafeRing, UniSec
	Efacec	Normafix, Fluofix
	Eaton	Xiria
	Siemens	8DJH
	Elektrospark	System-6, Rsn
LV Switchboard	Elektrospark	Rnn/RNS
	PREBiel	RWT/RWTz
	Emiter	
	Uesa	LTS/LS
	ZENEX	Zenergy

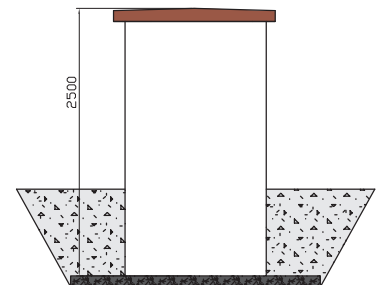
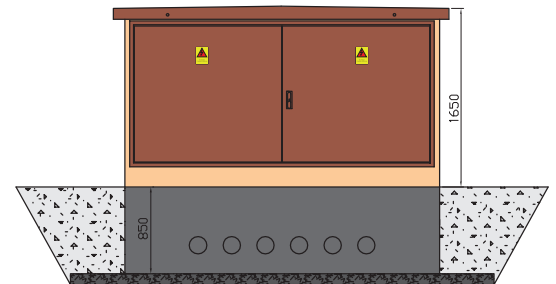
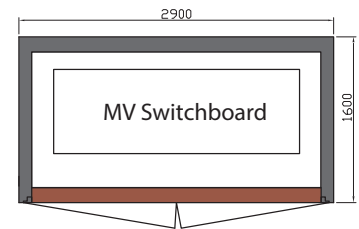
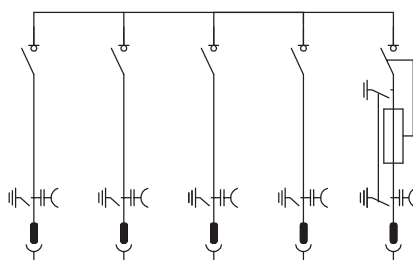
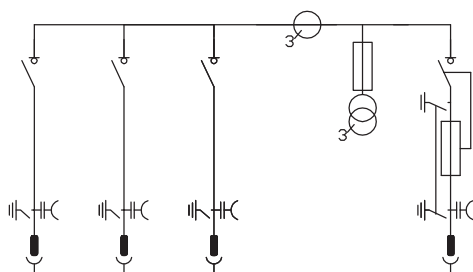
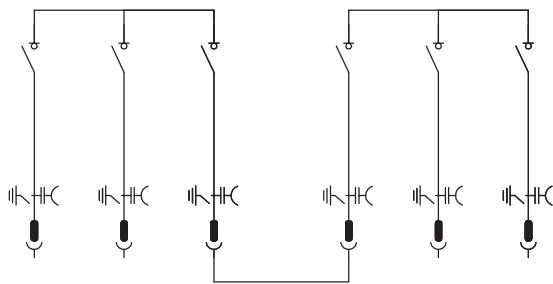
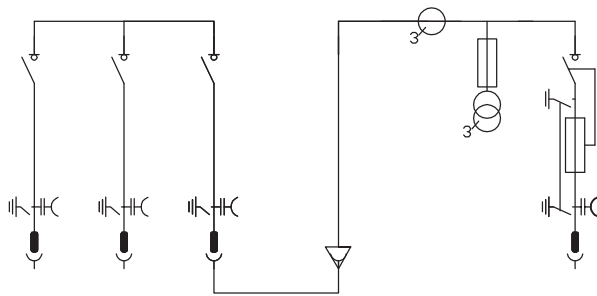
LV Cable Connector

ZKSN 130/210



It is possible to use MV switchboard in RSS air insulation (3 feeder panels) manufactured by Strunobet-Migacz Sp. z o.o.

ZKSN 130/290



It is possible to use MV switchboards in RSS air insulation (4 feeder panels) manufactured by Strunobet-Migacz Sp. z o.o..

Container Transformer Stations

4.8 Container Transformer Stations

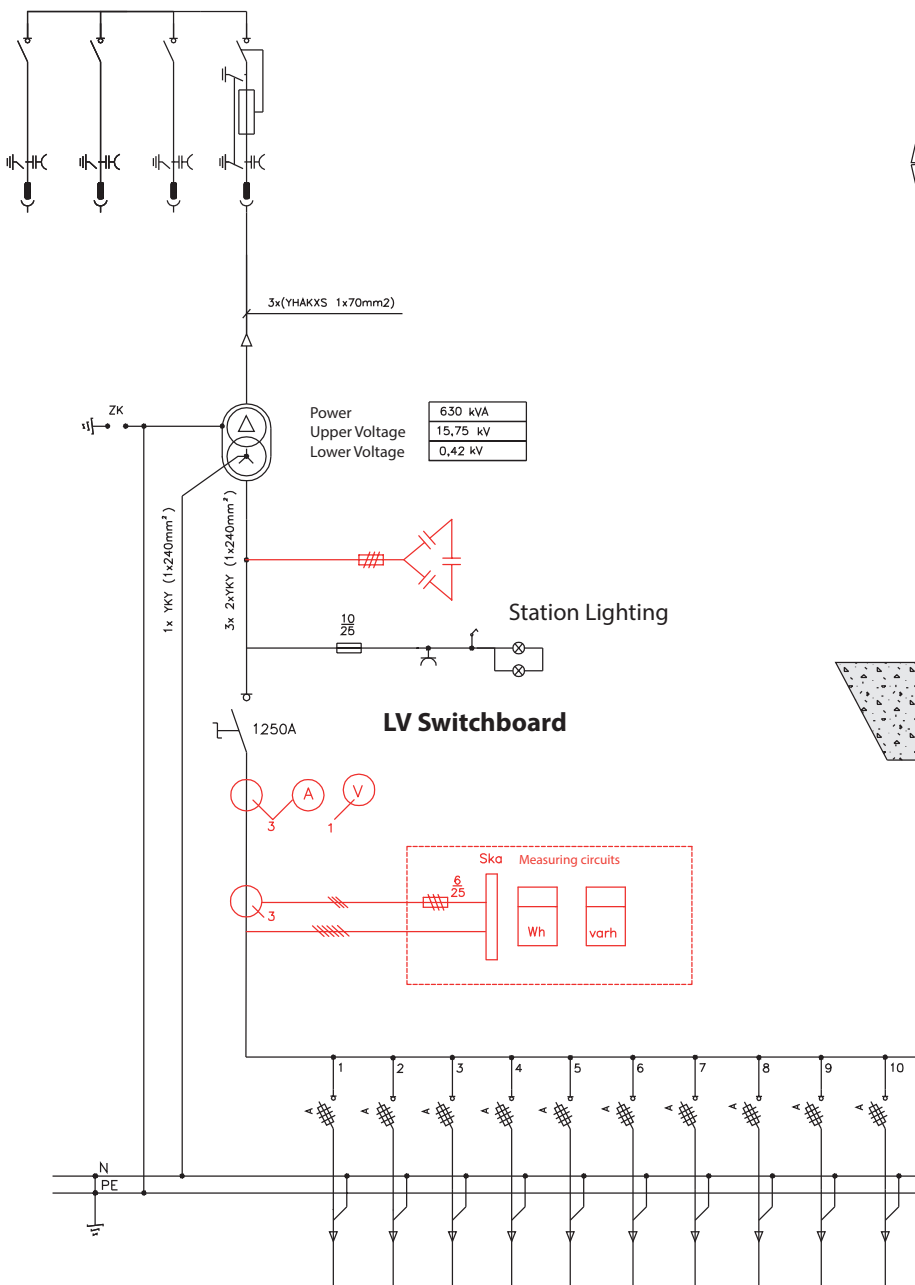
The study contains model transformer stations in KSZ compact enclosures which are operate form the outside as well as container stations in KSW enclosures which are operated form the inside.

If another configuration is required, Strunobet-Migacz Sp. z o. o. offers expert technical advice. The company performs design conversions in the fields of construction and electricity for the approved stations.

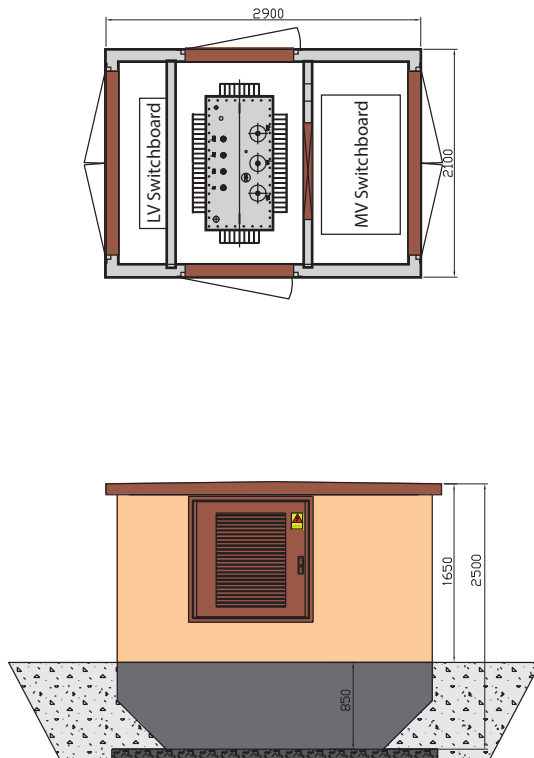
4.8.1 Transformer stations managed from the outside - examples

KSZ-A

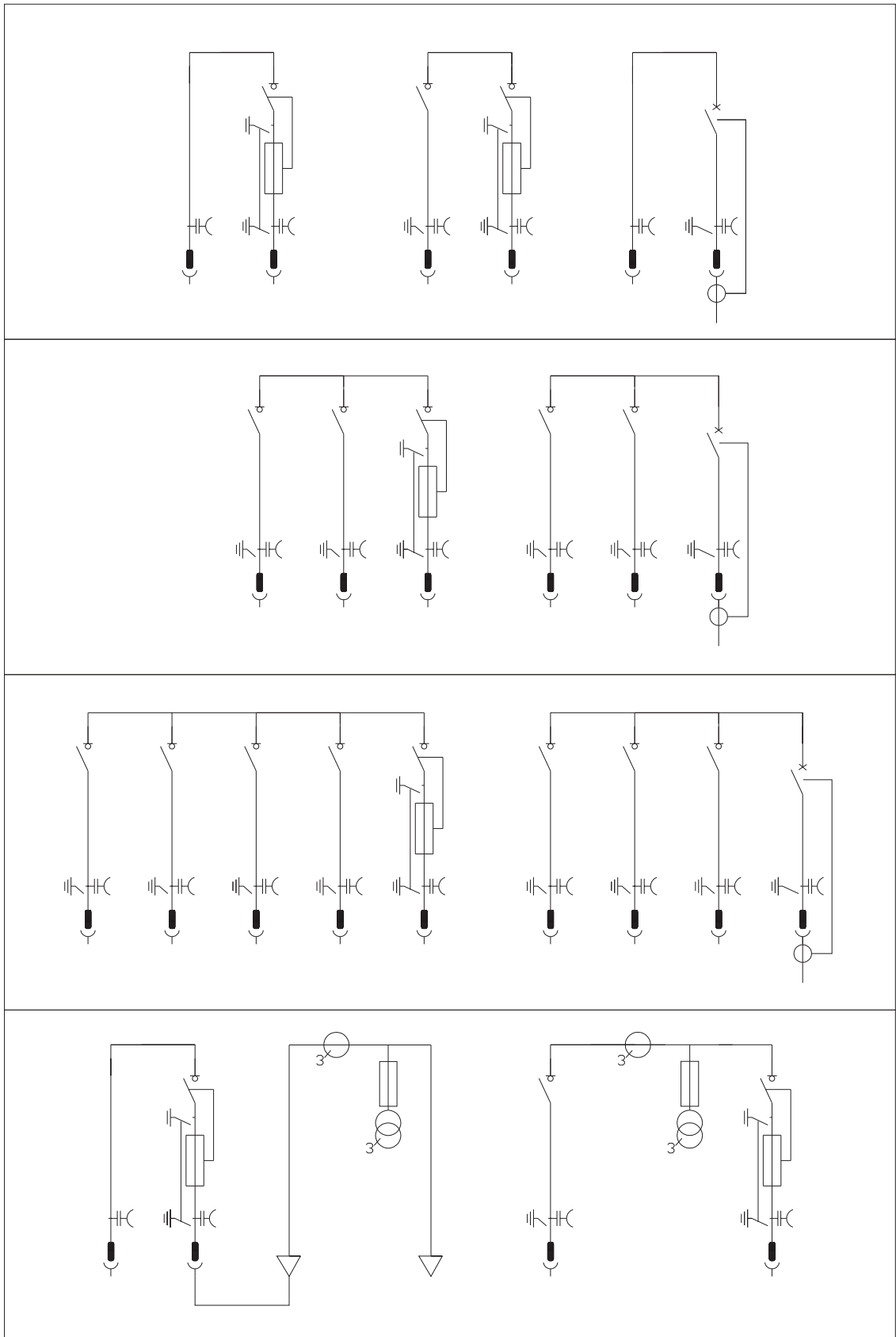
MV Switchboard



*Possibility of manufacturing the wall as REI120

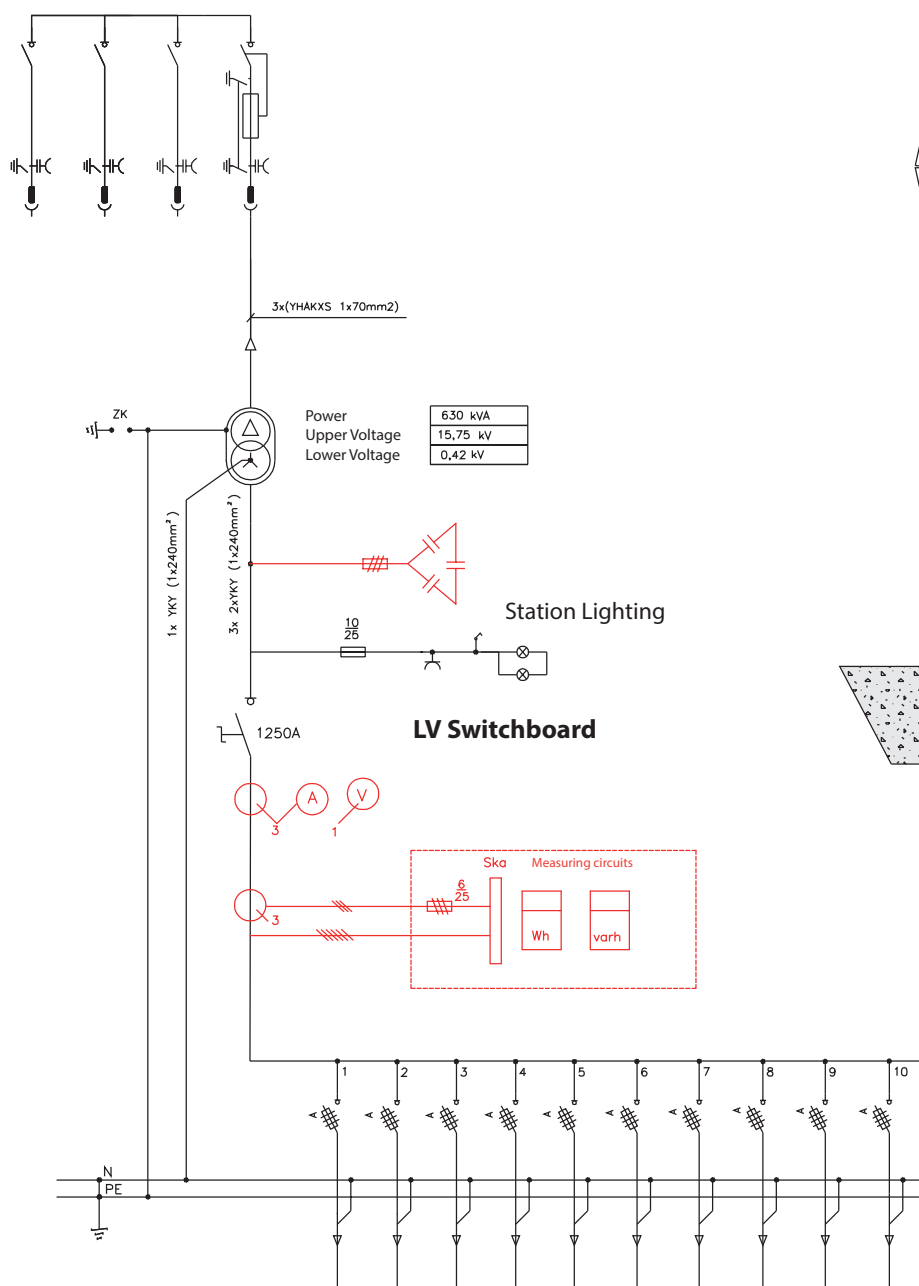


KSZ-A - examples of solutions for MV distribution switchboards

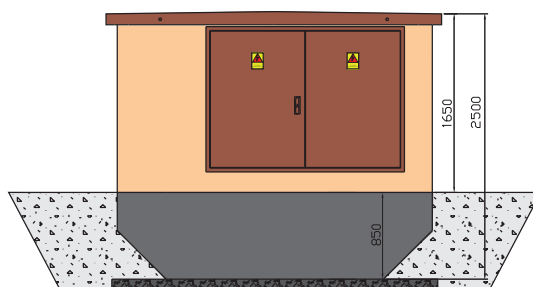
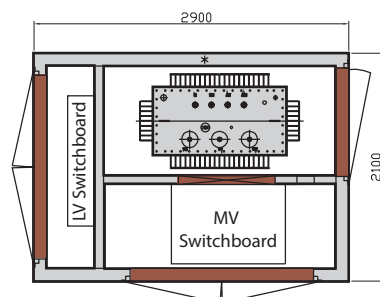


KSZ-B

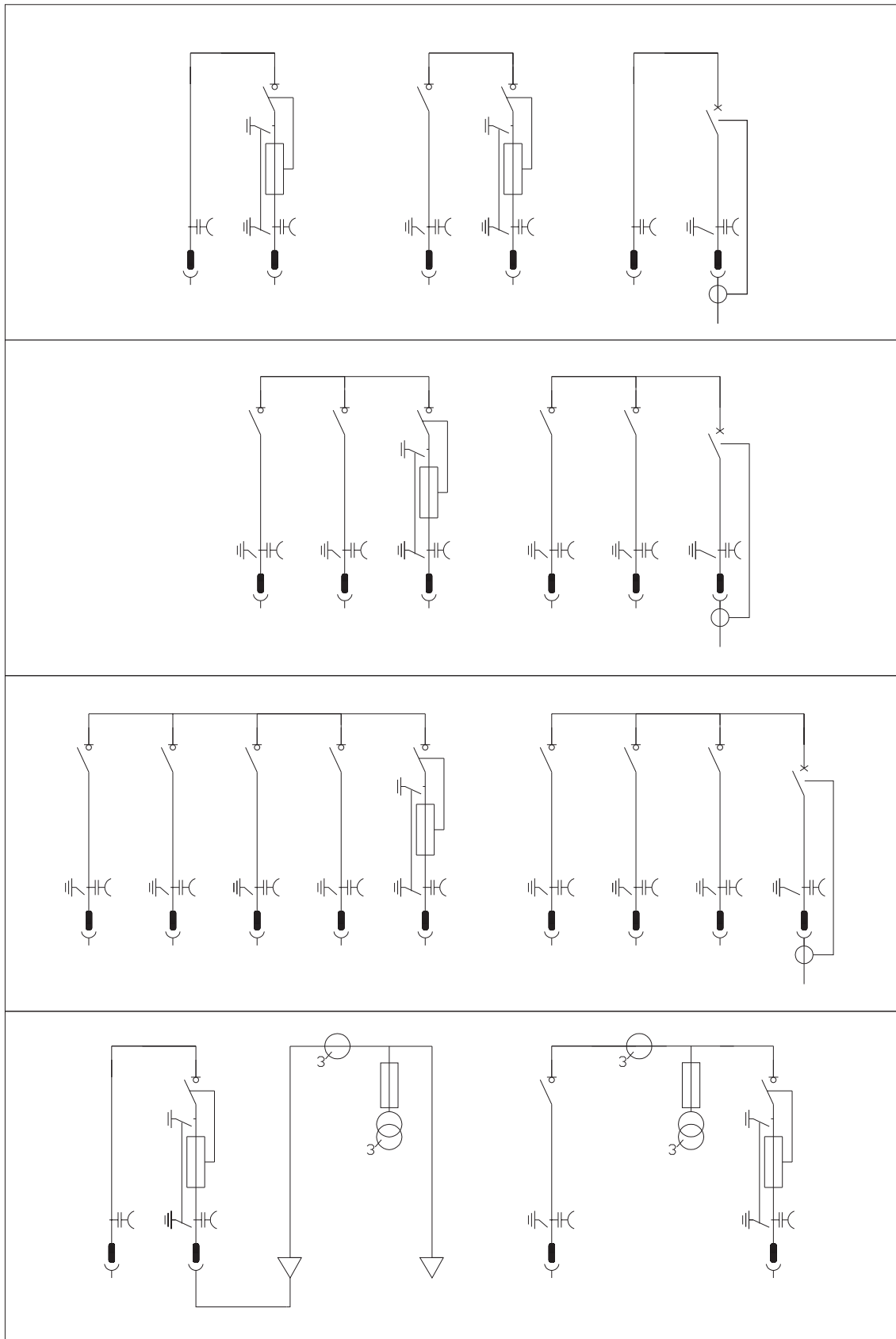
MV Switchboard



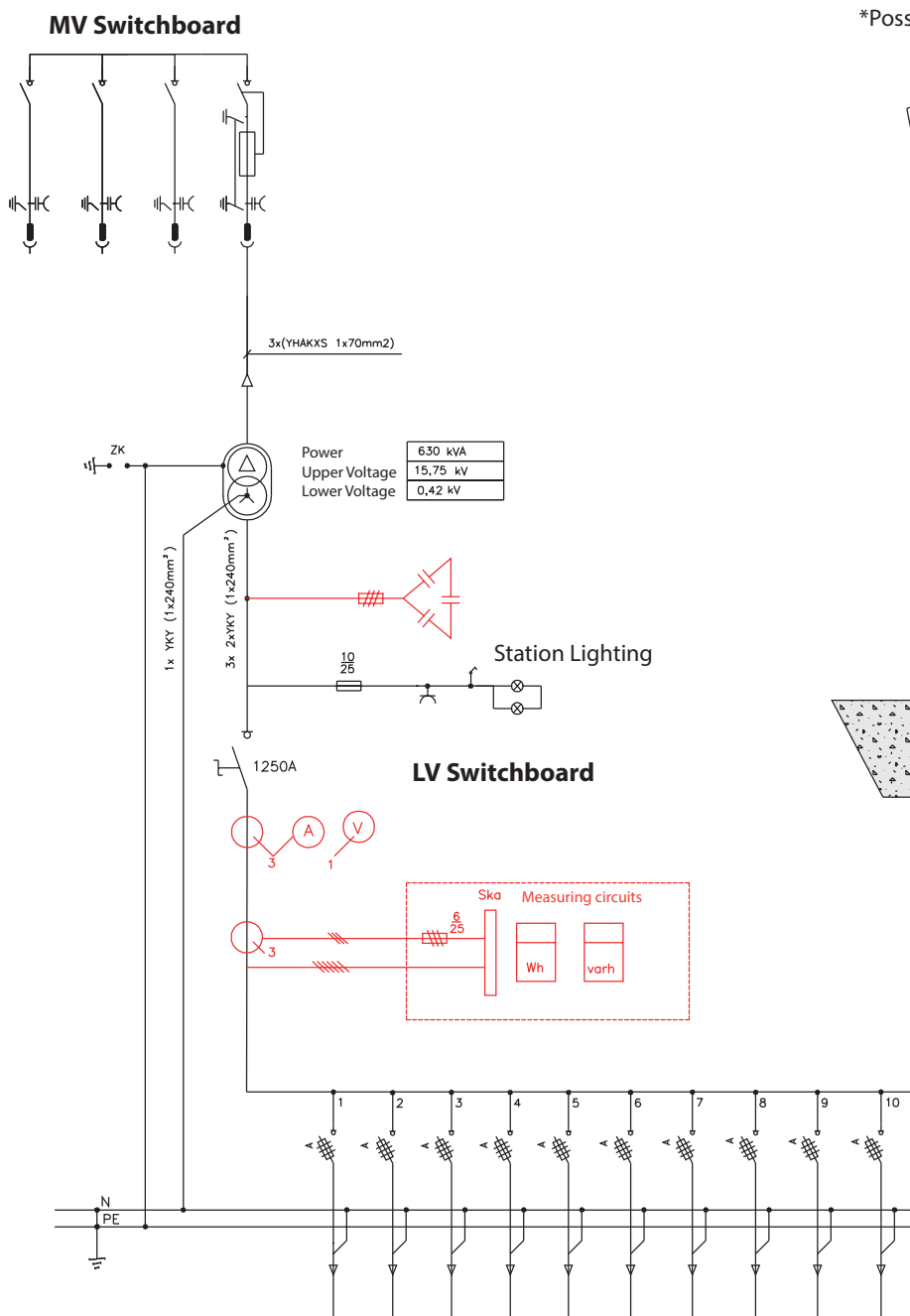
*Possibility of manufacturing the wall as REI120



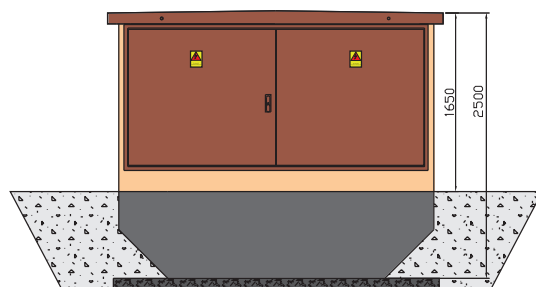
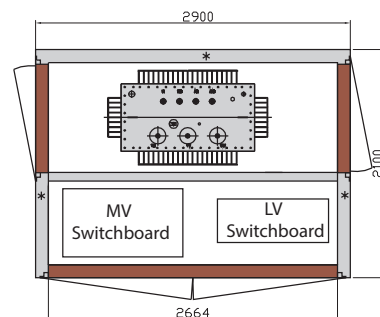
KSZ-B - examples of solutions for MV switchboards



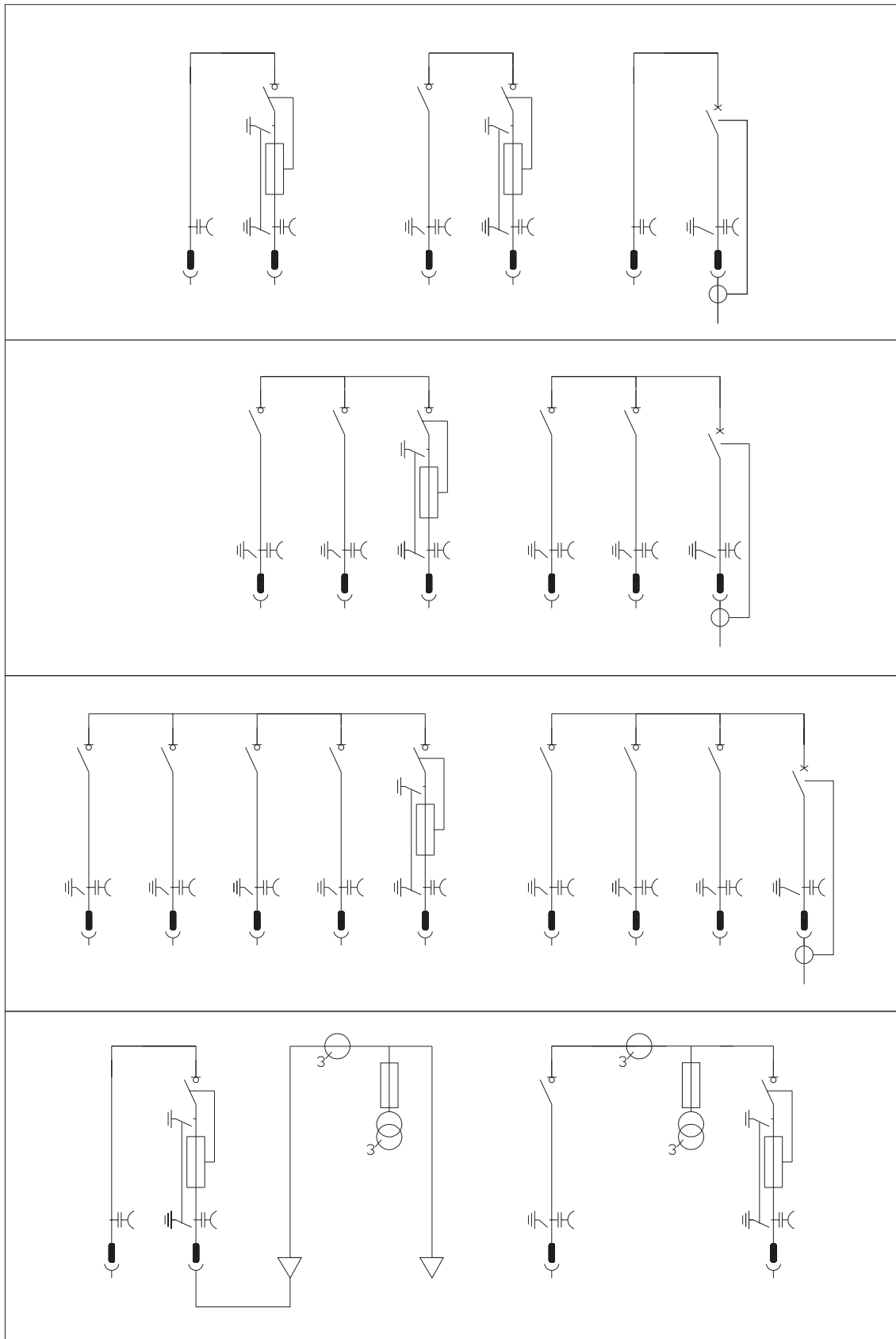
KSZ-C



*Possibility of manufacturing the wall as REI120

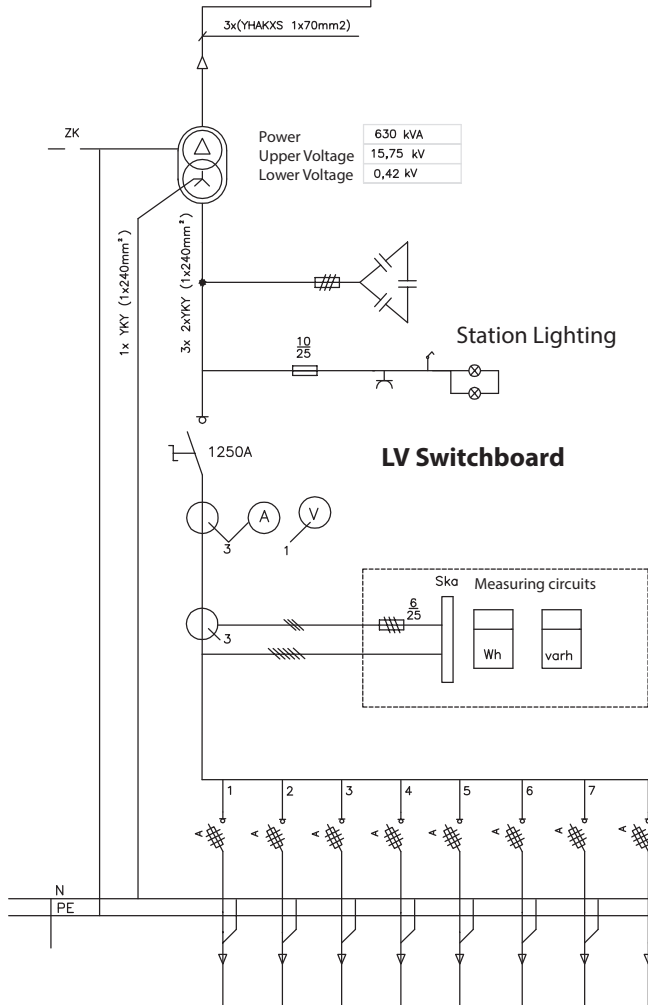
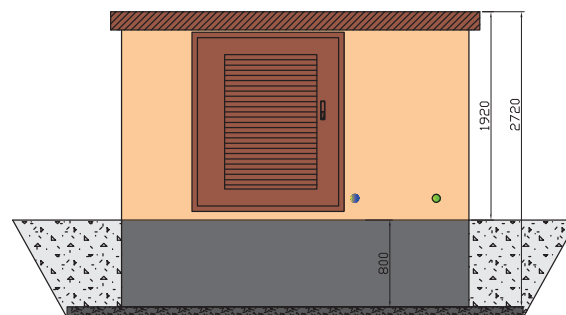
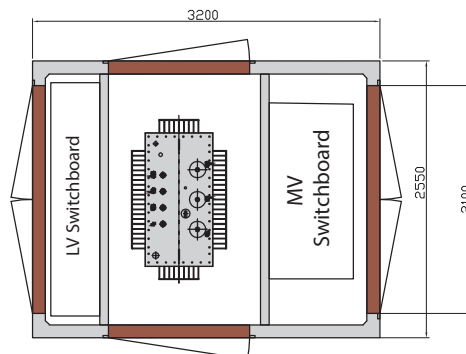
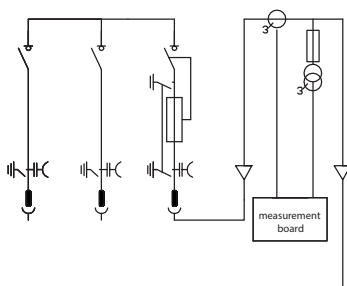


KSZ-C - examples of solutions for MV switchboards



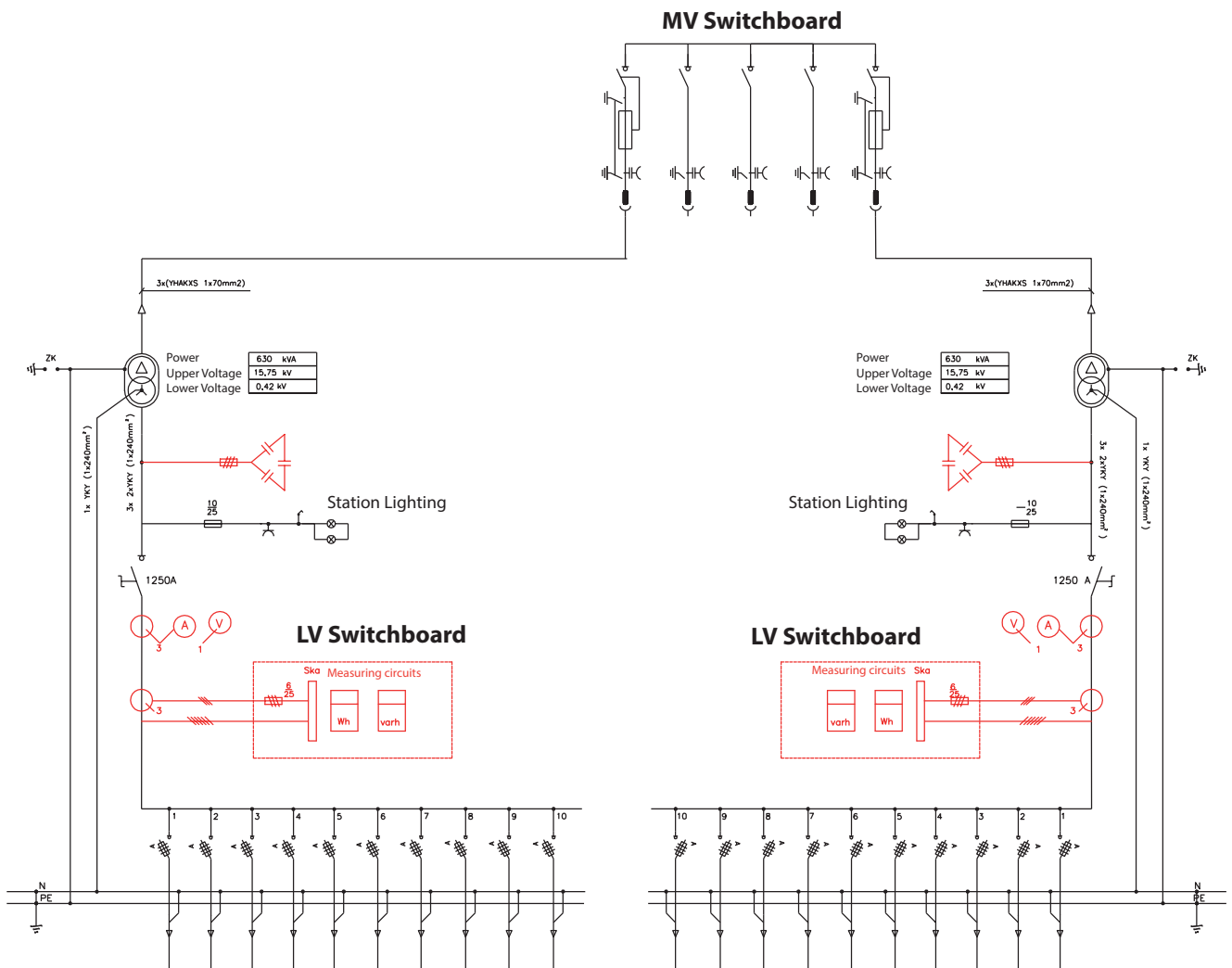
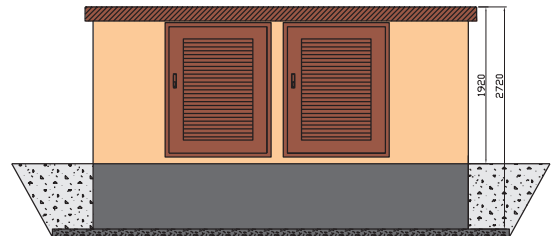
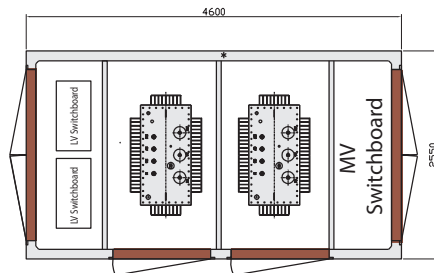
KSWz 255/320

MV Switchboard



KSWz 255/420 (2x630 kVA)

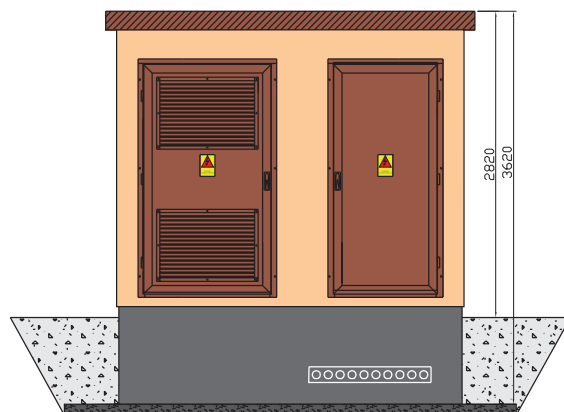
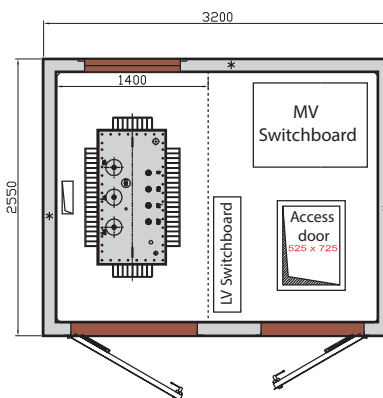
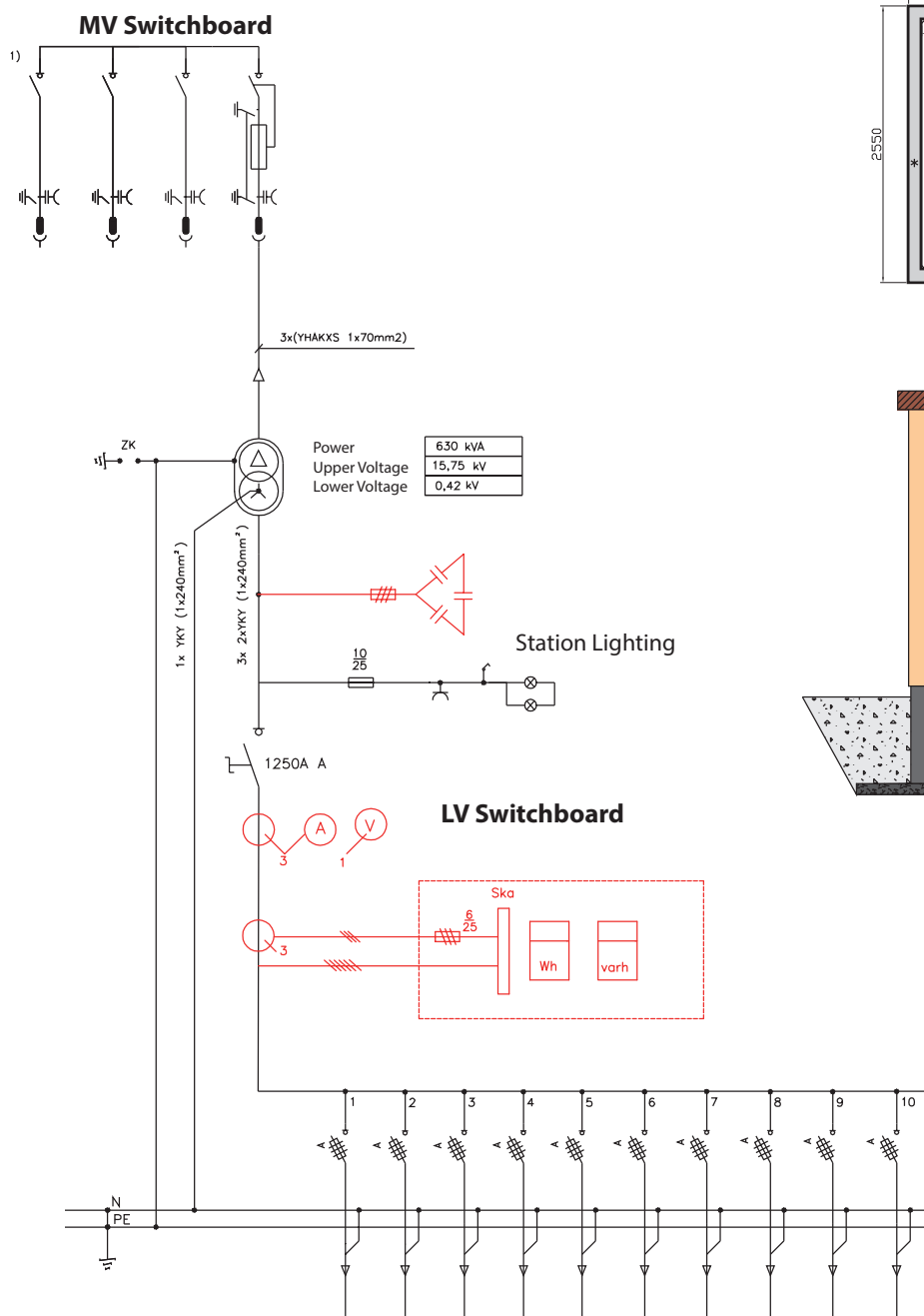
*Possibility of manufacturing the wall as REI120



4.8.2 Transformer stations operated from the inside in KSW 255 enclosures - examples of the types

KSW 255/320

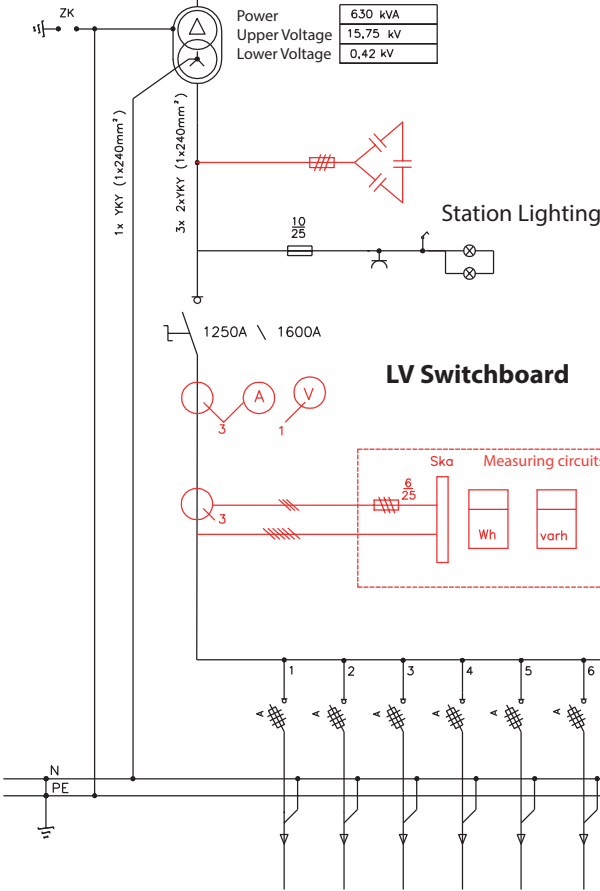
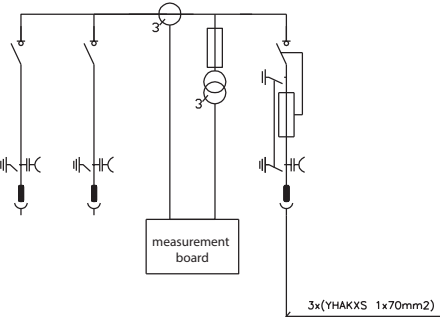
*Possibility of manufacturing the wall as REI120



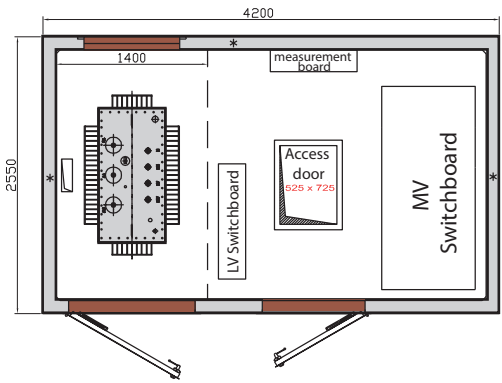
1) manufactured in the LLLT system with an upper transformer terminal

KSW 255/420

MV Switchboard

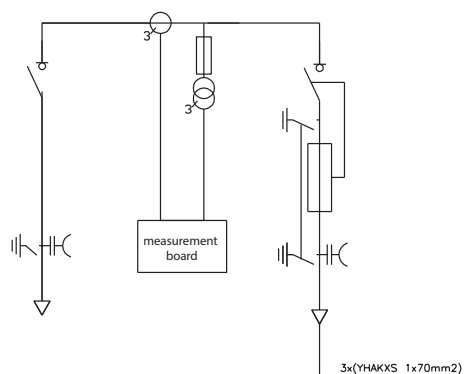


*Possibility of manufacturing the wall as REI120

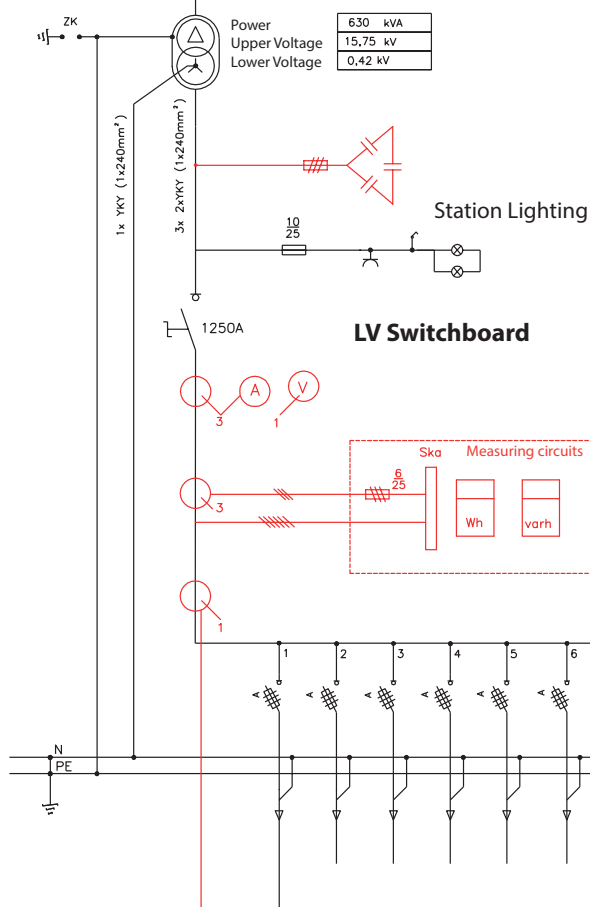


KSW 255/440

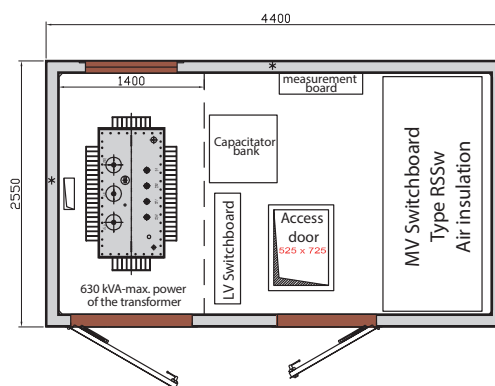
MV Switchboard



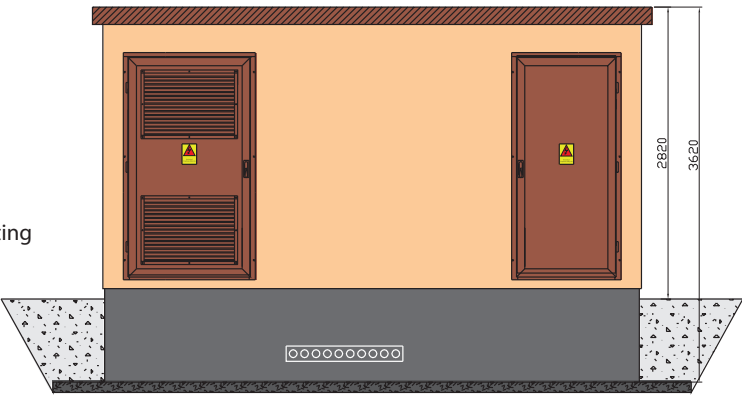
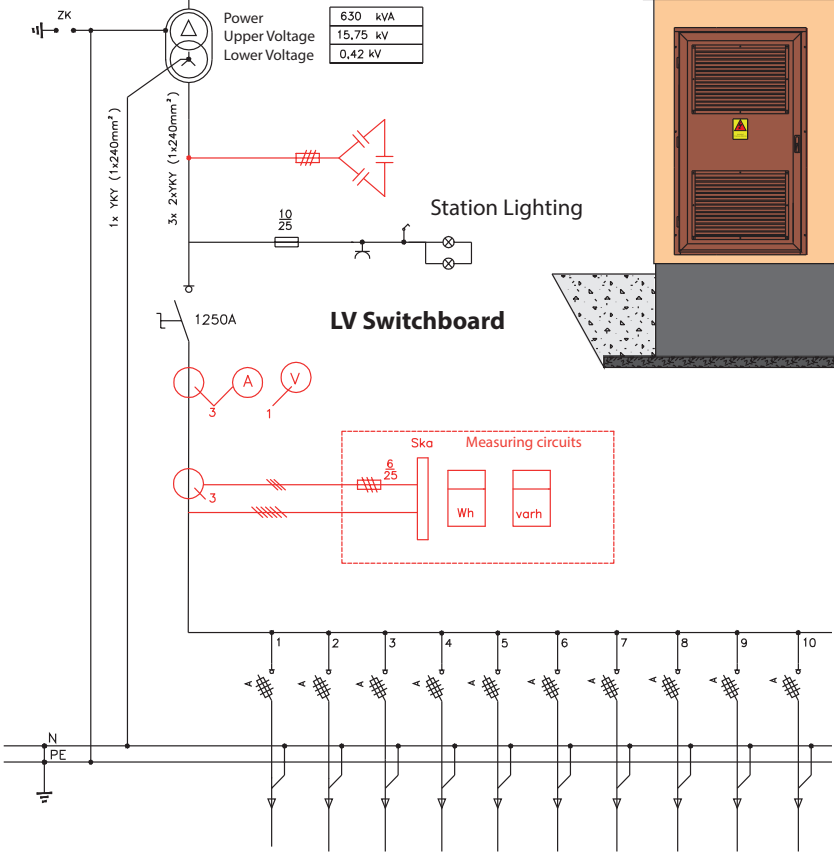
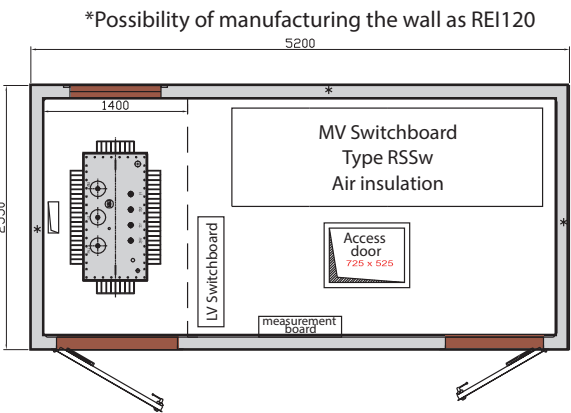
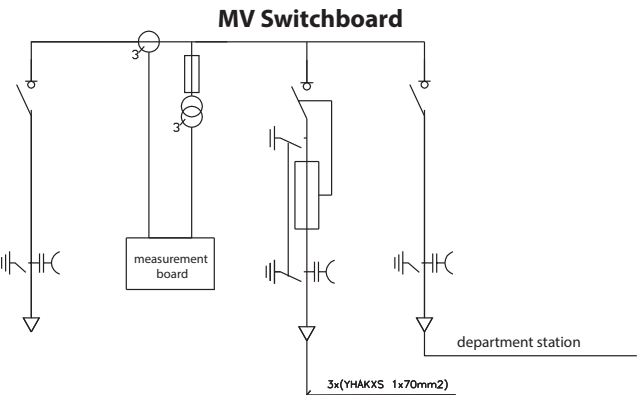
Power	630 kVA
Upper Voltage	15,75 kV
Lower Voltage	0,42 kV



*Possibility of manufacturing the wall as REI120

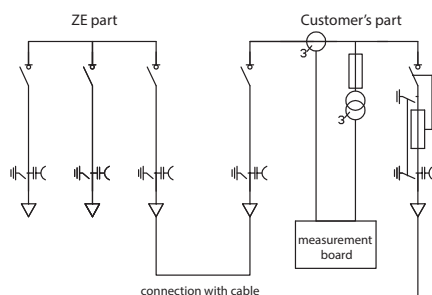


KSW 255/520

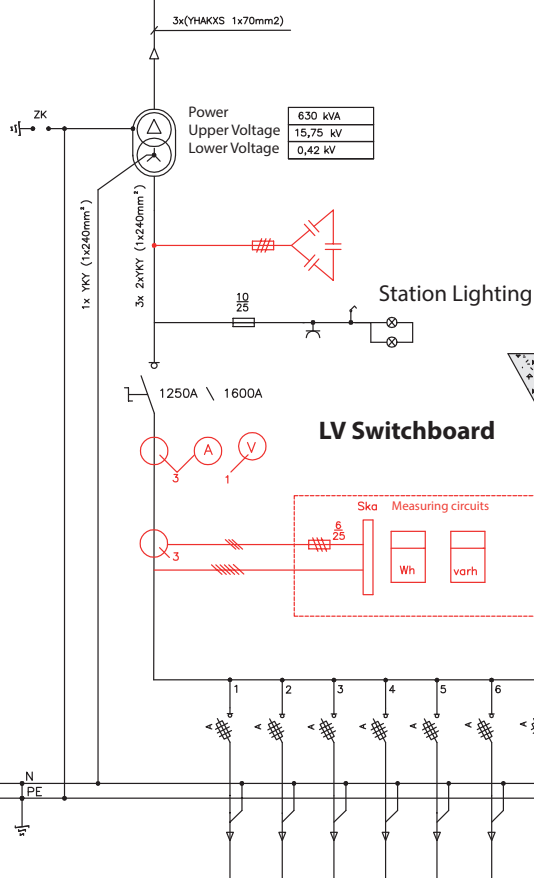
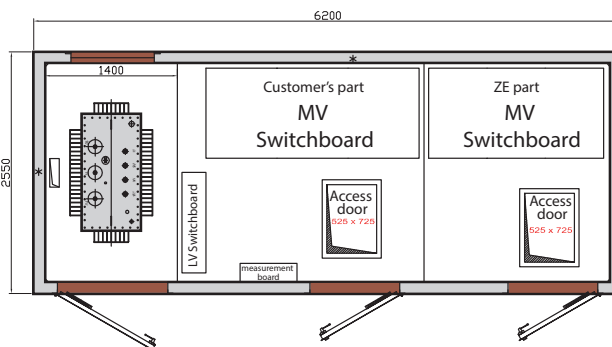


KSW 255/620

MV Switchboard

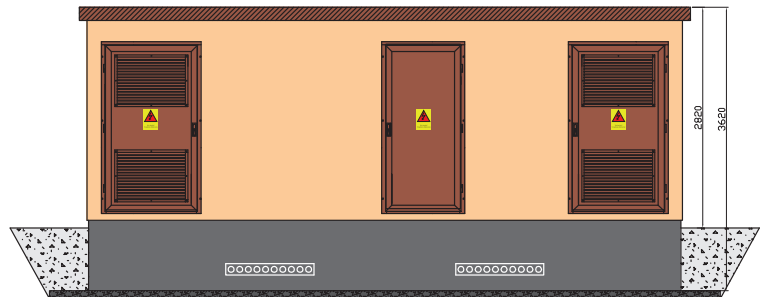
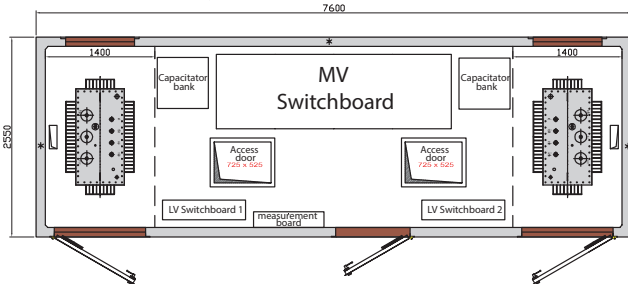


*Possibility of manufacturing the wall as REI120

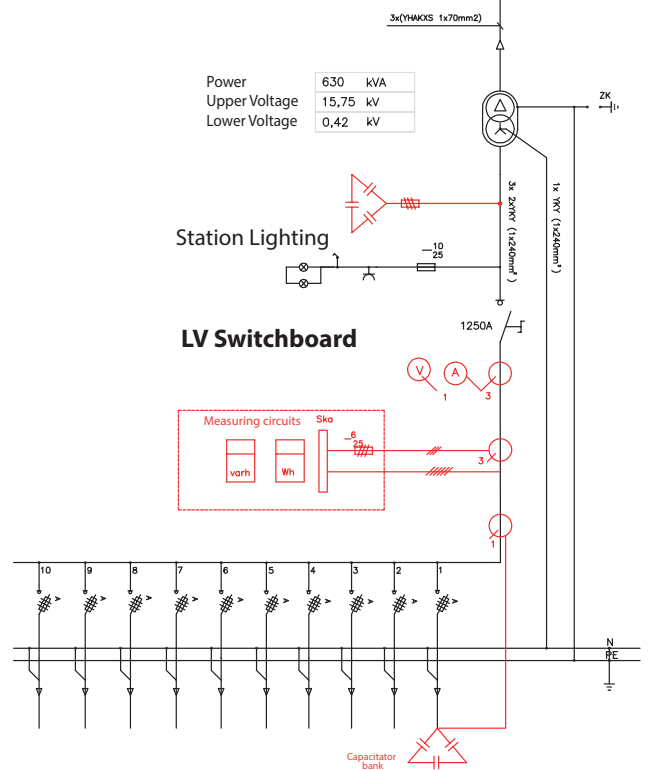
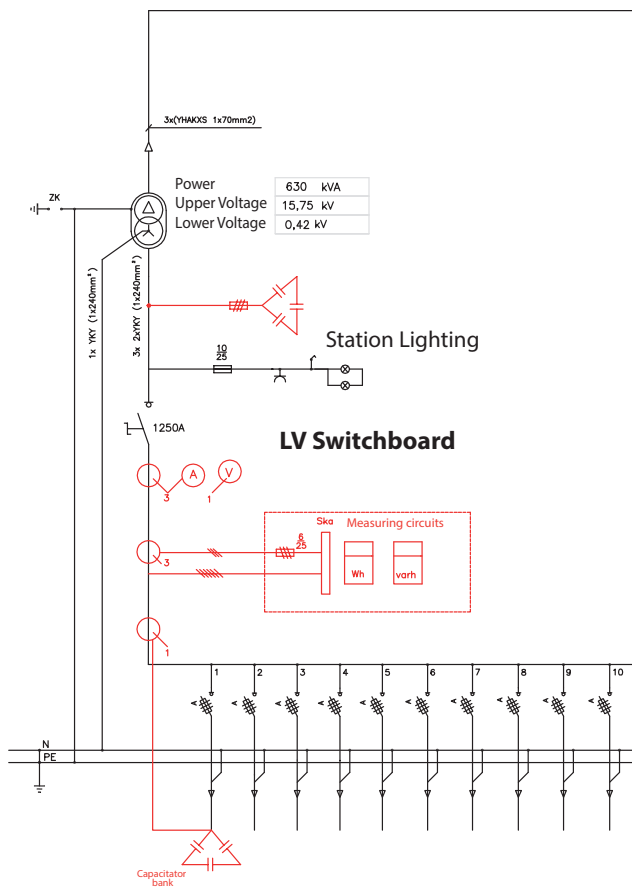
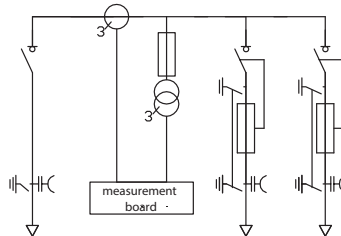


KSW 255/760

*Possibility of manufacturing the wall as REI120

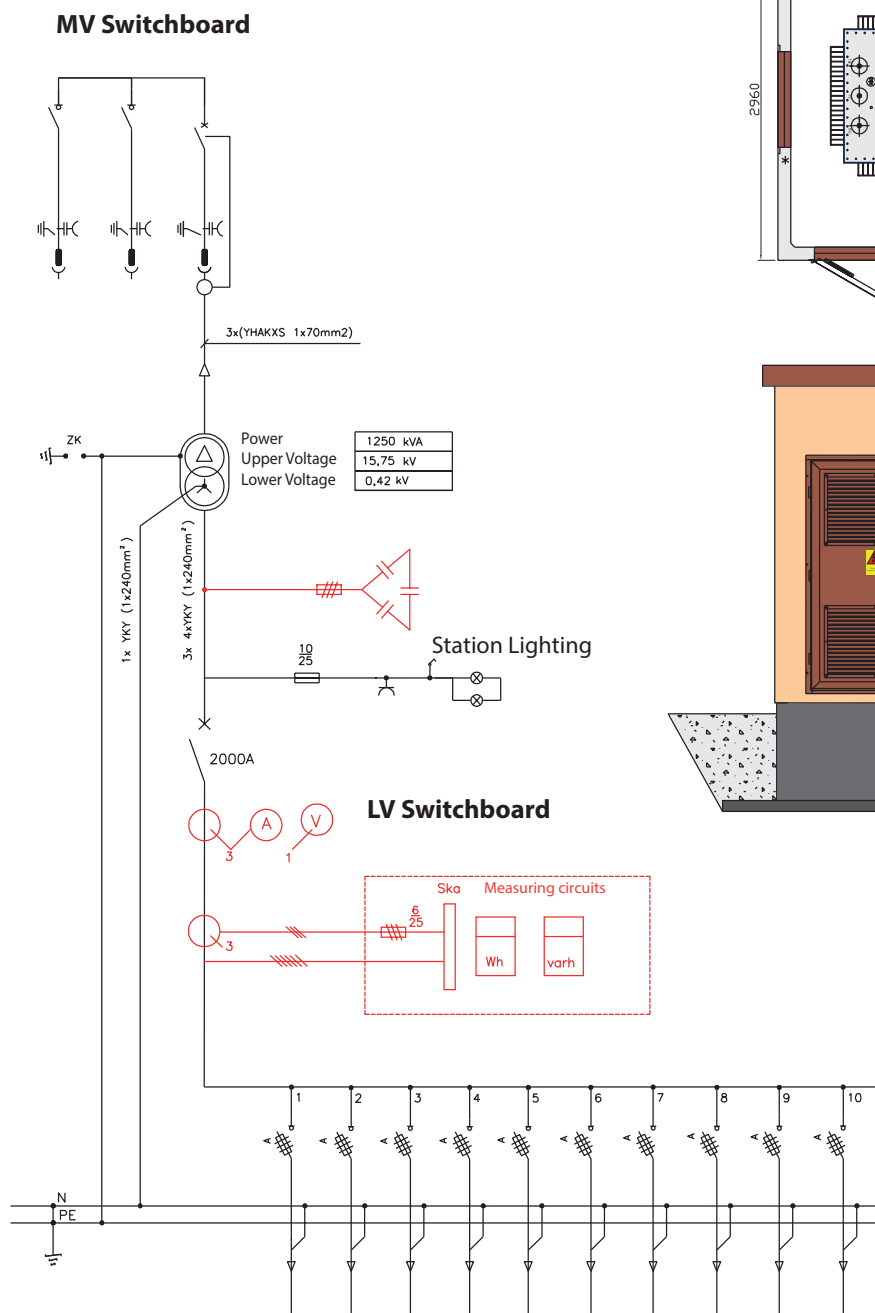


MV Switchboard

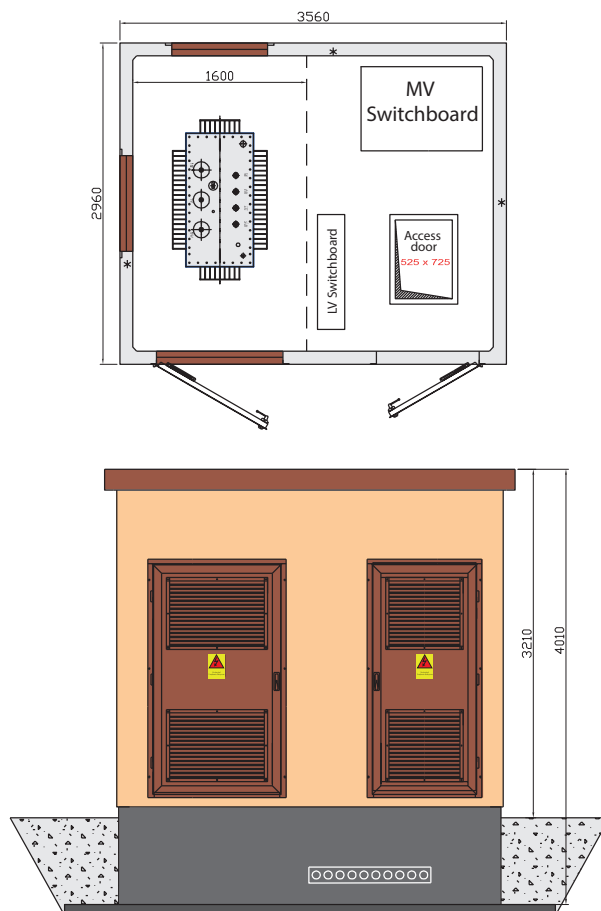


4.8.3 Transformer stations managed from the inside in KSW 296 enclosures - examples

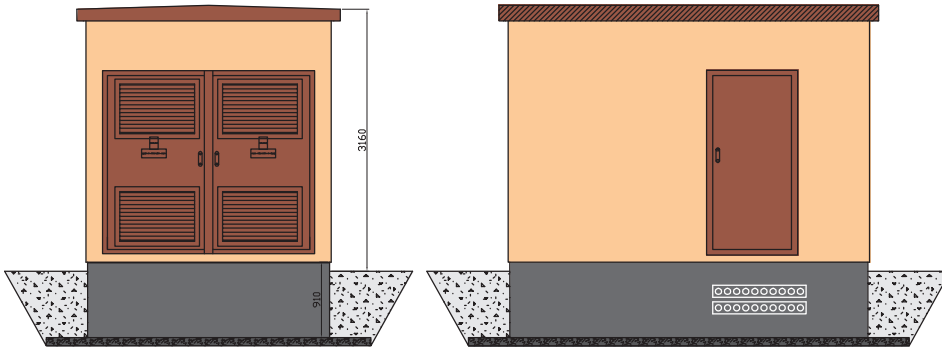
KSW 296/356



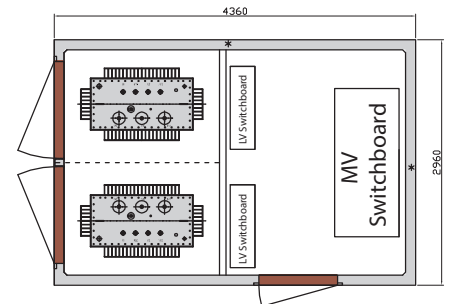
*Possibility of manufacturing the wall as REI120



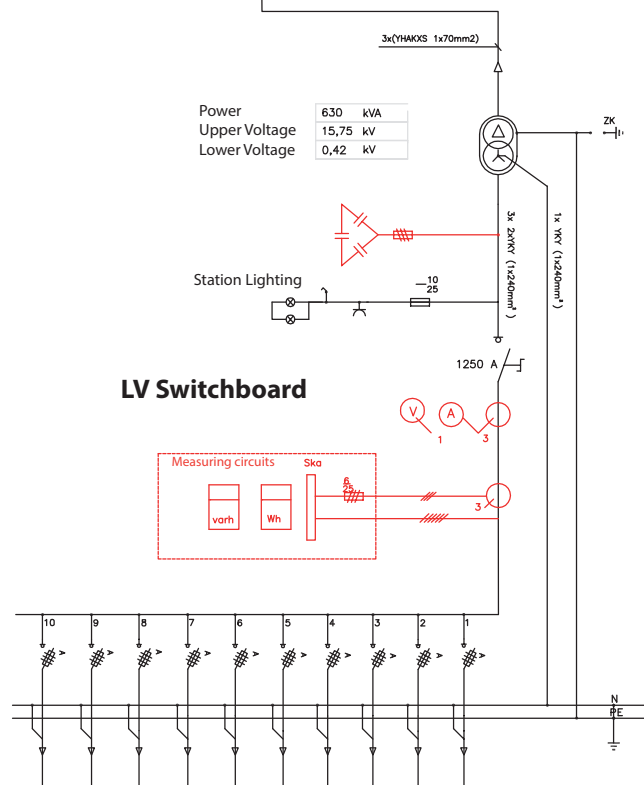
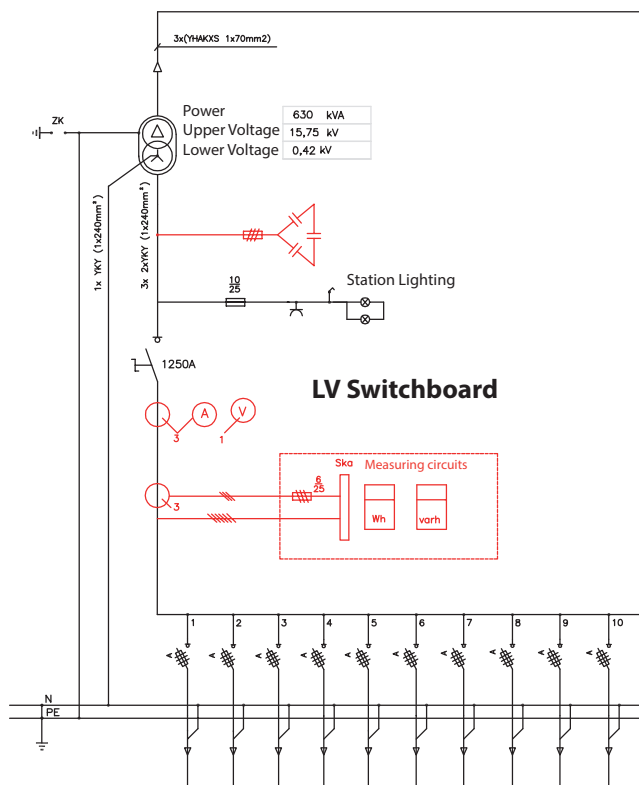
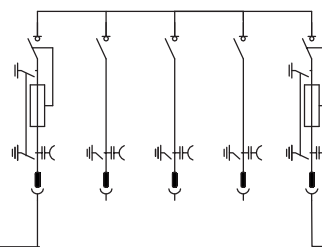
KSW 296/436



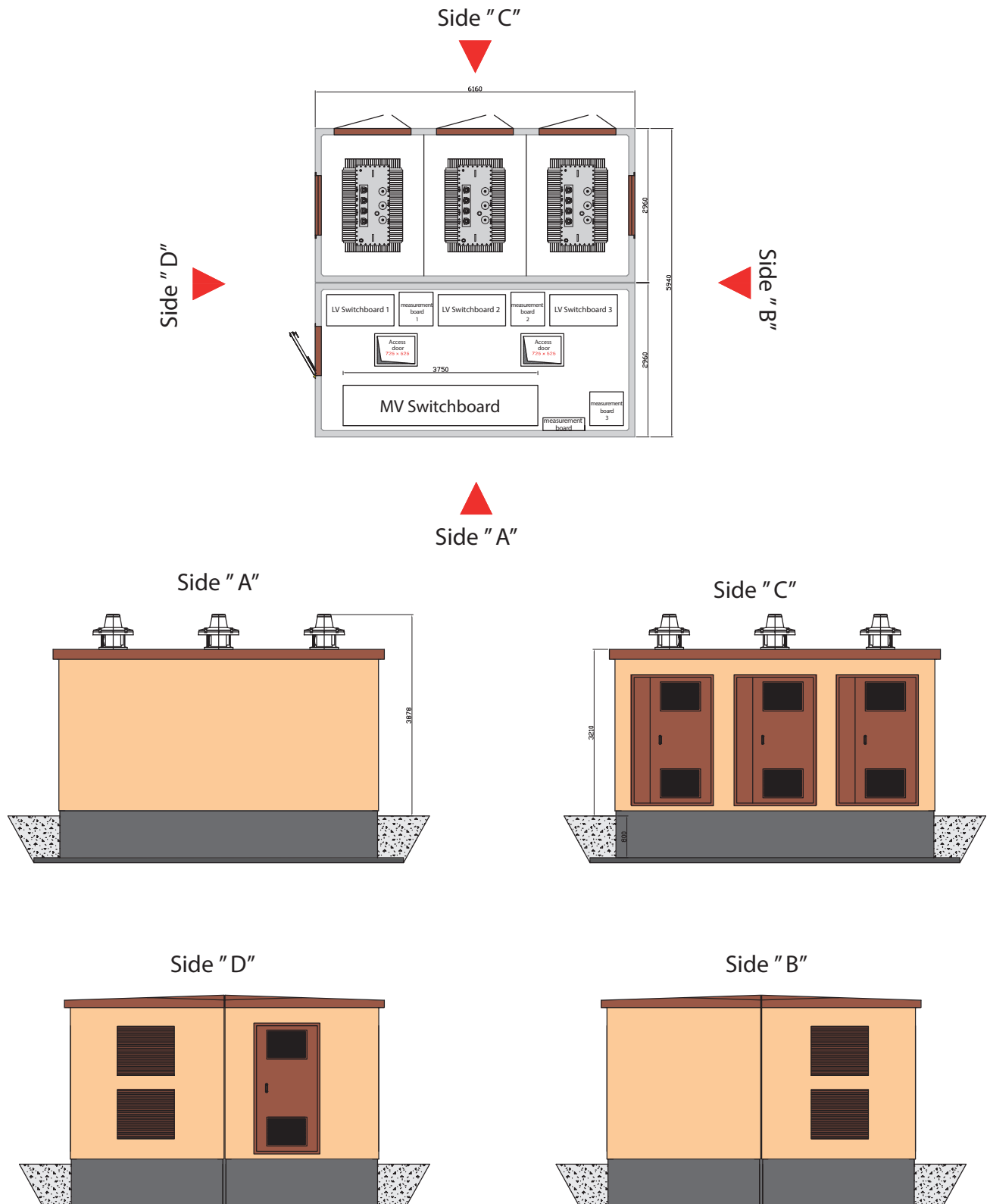
*Possibility of manufacturing the wall as REI120



MV Switchboard

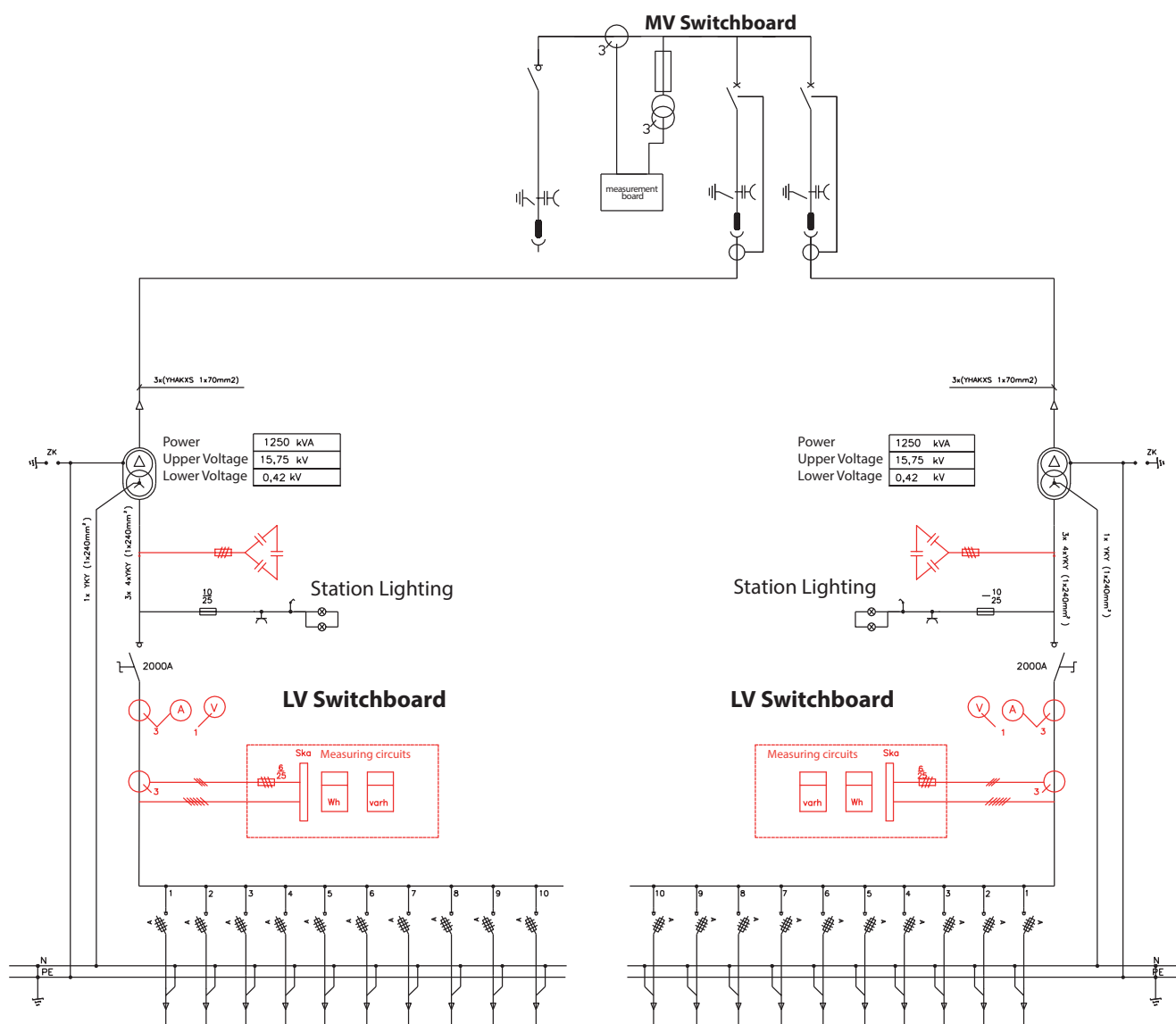
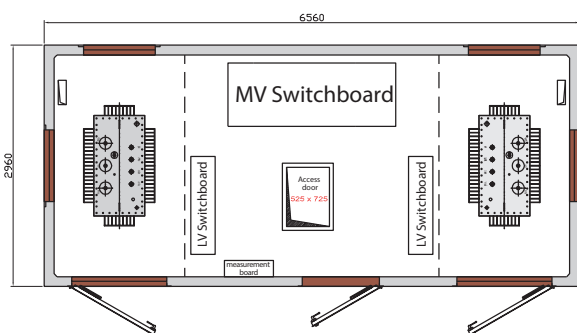






In case of other configuration, please contact the representatives of Strunobet-Migacz Sp. z o.o.

KSW 296/656



MV 24kV switchboards in air-based insulation manufactured by Strunobet-Migacz Sp. z o.o.

4.9 Switchboard type RSS-24/630 in air insulation

The RSS-24/630 switchboard is to be used in transformer stations as well as in MV cable joints, in particular where SF6 insulation solutions are not allowed. This switchboard has been made in accordance with the PN-EN 62271-200:2012 standard. The switchboard set uses NAL 24 load break interrupter switches manufactured by ABB, in air insulation. Switchboard panels are produced as an arc fault protective type. The structure of the panel has components made of aluzinc metal sheet and are joined with blind rivets. The system of mechanical interlocks makes it impossible to perform incorrect switching operations and to remove the guard before switching off the voltage and the earth switch. The basic panel is a feeder panel. Other panel options to be agreed on with the company Strunobet- Migacz Sp. z o. o.



Technical Specification:

Rated voltage	24 kV
Rated frequency	50 Hz
Test voltage with the frequency of a power transmission system	50 kV
Surge lightning test voltage	125 kV
Rated continuous current	630 A
Rated withstand current - 3 sec.	16 kA
Rated peak withstand current	40 kA
Resistance to non-transferred arc / 1 sec.	16 kA
Level of protection	IP 3X

The advantage of the switchboard is its compact system, with minimum panel dimensions for this type of switchboard sets. (width = 615mm, depth = 950mm, height = 1600mm).

Arranging the load break interrupter switches and earth switches one after another allows for a simple system of switching on and switching off, without the need to use the transmission of the drive system.

There are permanent insulating barriers in the switchboard that prevent service staff from access to the components under voltage. In this system, the insulation barrier widely used in the fused load break switch system, which is manually slid between the contacts of this switch in case access to the switchboard is needed, has been removed. It facilitates the operation of the switchboard panel.

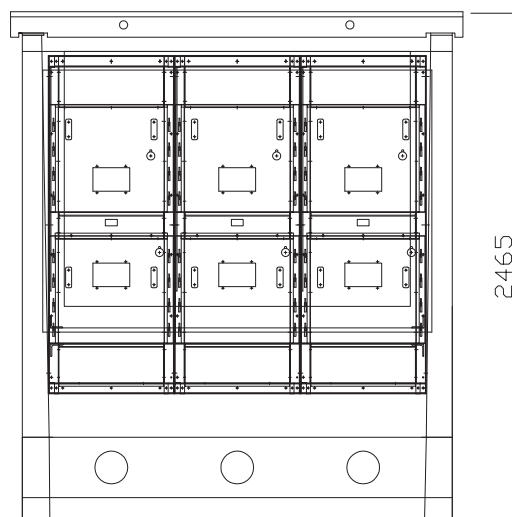
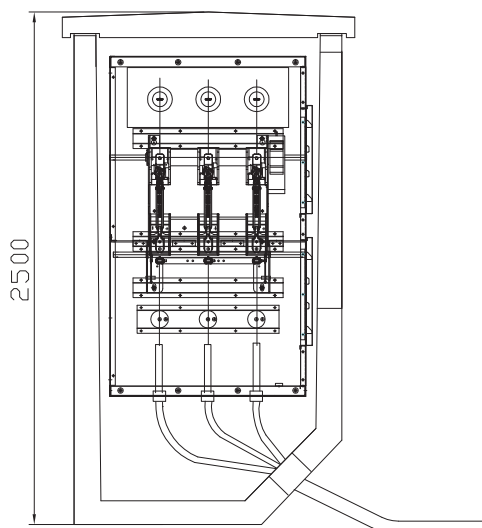
The doors of the fused load break switch compartment and the cable compartment are instal-

led on

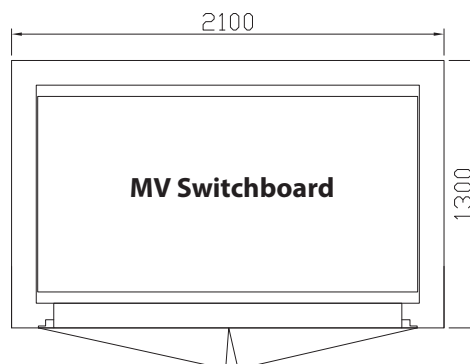
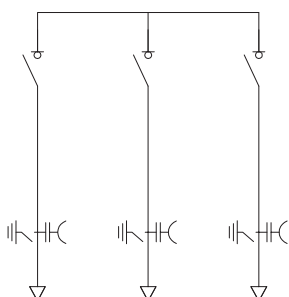
hooks. They are self-adjustable and therefore can be opened in an easy and reliable way. The doors installed on hooks make access to the inside of the switchboard panel easy, especially in the case of cable connectors. Inspection windows in the doors allow unambiguous visual determination of the position of the blades of the load break interrupter switch and the earth switch. The system of mechanical interlocks makes it impossible to perform incorrect switching operations as well as it prevents access to the switchboard panel before the voltage is switched off and the earth switch shut down.

Relatively small overall dimensions of the switchboard panels make it possible to use them as replacements for the switchboard sets which have gas insulation (SF₆), thus eliminating the inspection and disposal of the SF₆ gas.

ZKSN 130/210 cable joint with a 3-panel switchboard in the line system produced by Strunobet-Migacz Sp. z o.o.

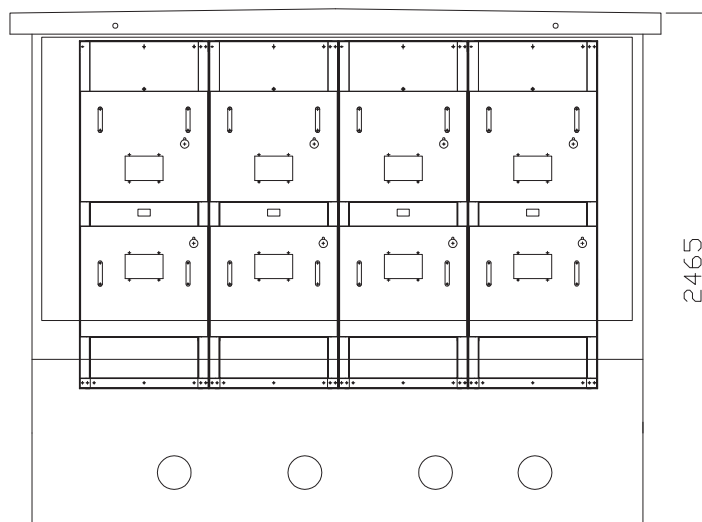
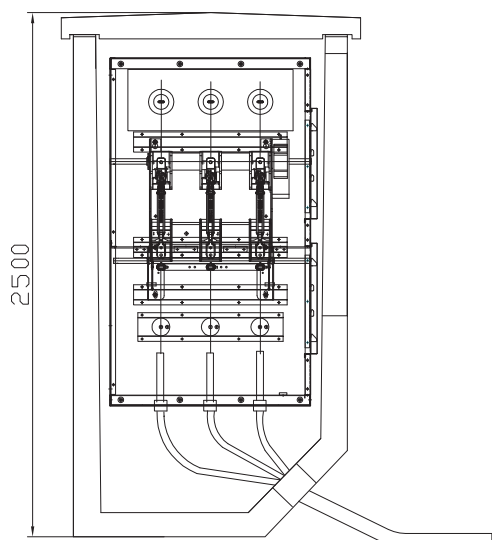


TYP RSS manufactured by Strunobet-Migacz Sp. z o.o.

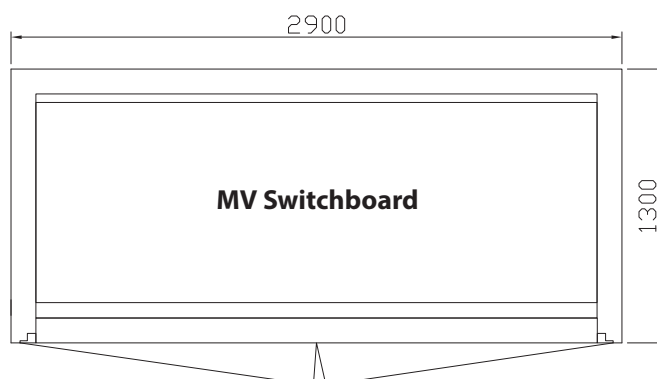
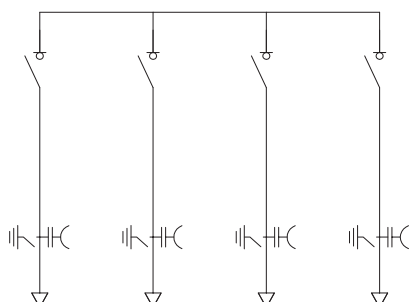


ZKSN 130/290 cable connector end with a 4-field switchboard in the line system

produced by Strunobet-Migacz Sp. z o.o.



TYP RSS manufactured by Strunobet-Migacz Sp. z o.o.



4.10 RSSw-24/630 switchboard in air insulation

The RSSw-24/630w switchboard is designed to be used in container transformer stations which are managed from the inside and all types of internal stations. This switchboard has been made in accordance with the PN-EN 62271-200:2012 standard. The switchboard set uses the KLS 24 and KLSF 24 load break interrupter switches manufactured by UESA. It is also possible to use the equipment manufactured by ABB, types NAL and NALF. Switchboard panels are produced as an arc fault protective type. The structure of the panel has components made of aluzinc metal sheet and are joined with blind rivets. The system of mechanical interlocks makes it impossible to perform incorrect switching operations. Switchboard panels have three separate compartments: for cable service lines, load break interrupter switches and secondary circuits. Configuration and additional components should be agreed upon with the representatives of Strunobet-Migacz Sp. z o. o.

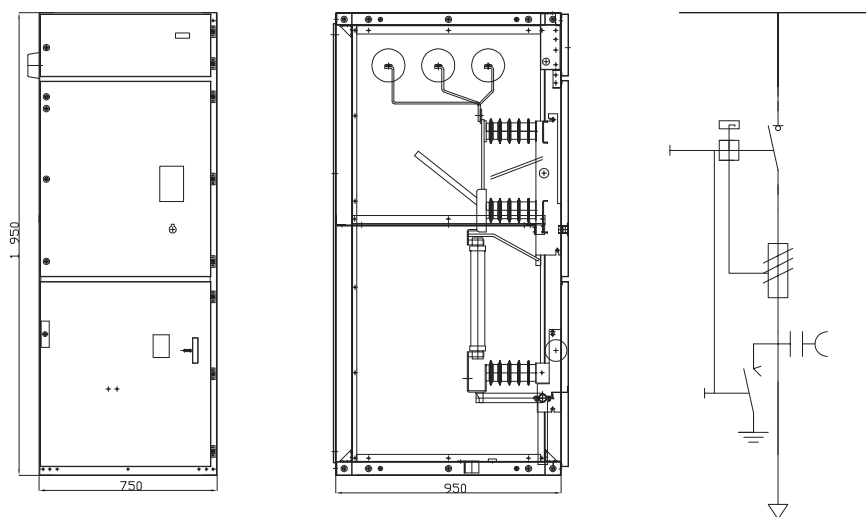


Technical Specification:

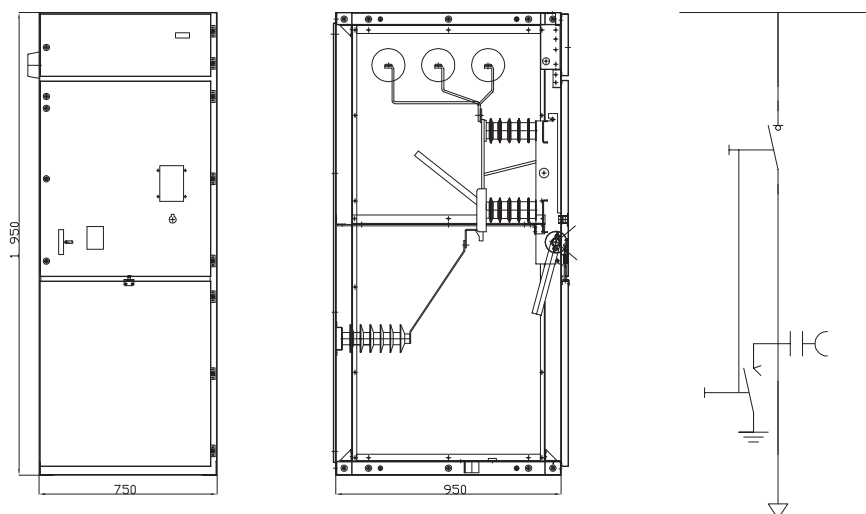
Rated voltage	24 kV
Rated frequency	50 Hz
Test voltage with the frequency of a power transmission system	50 kV
Surge lightning test voltage	125 kV
Rated continuous current	630 A
Rated withstand current - 3 sec.	16 kA
Rated peak withstand current	40 kA
Resistance to non-transferred arc / 1 sec.	16 kA
Level of protection	IP 4X

Basic fields

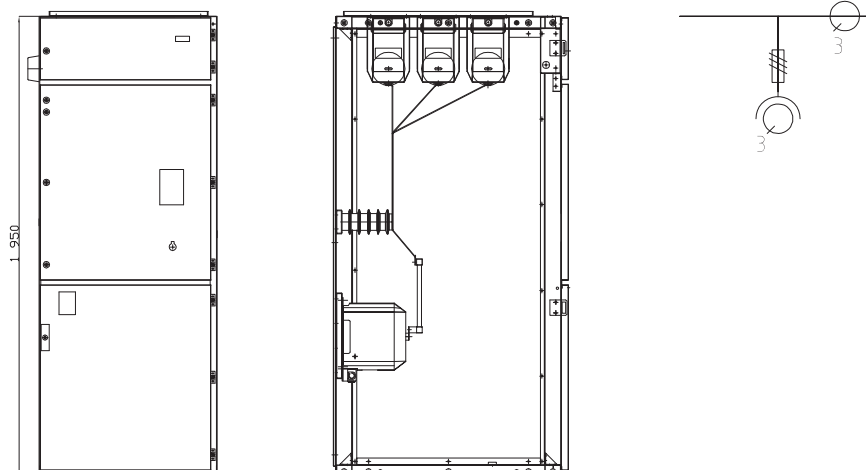
T-transformer panel



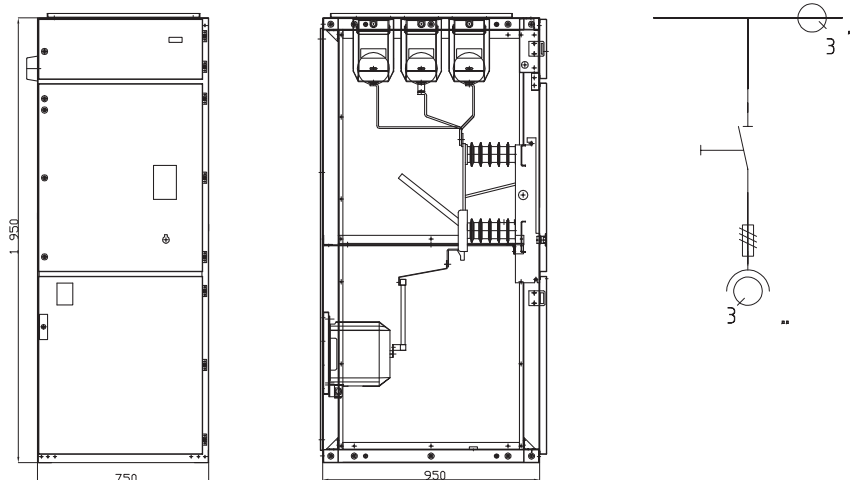
Line field type L



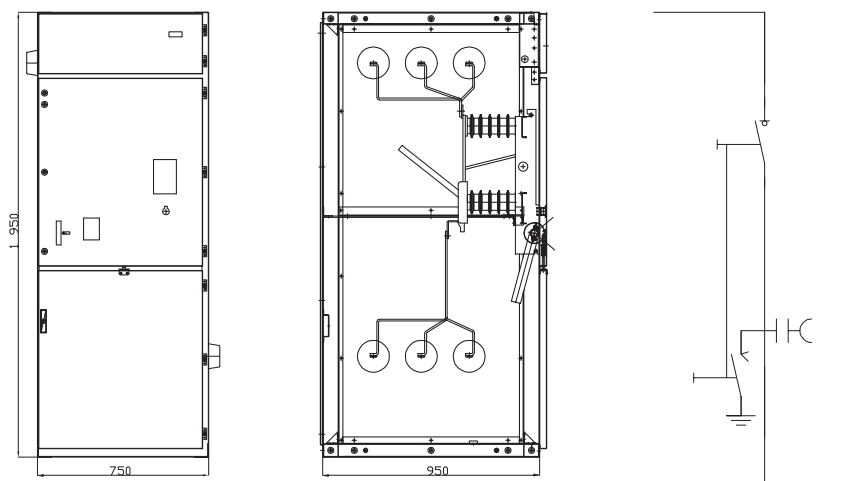
Meter panel type P



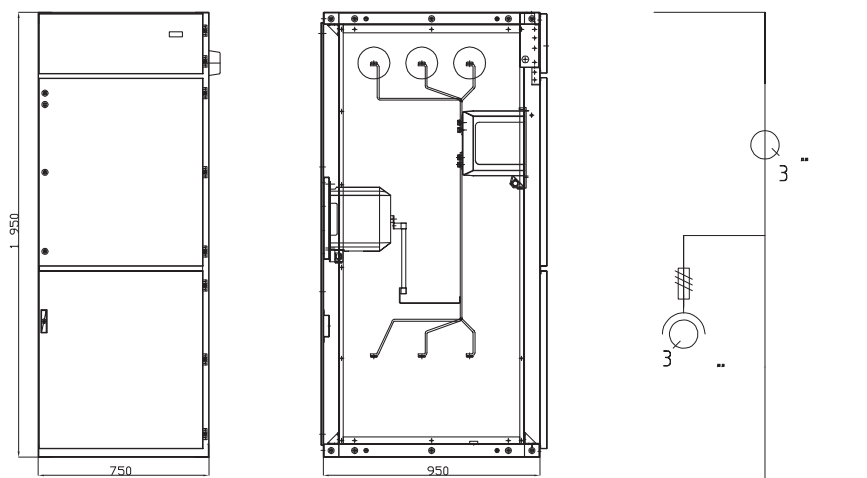
Meter Panel Type Po (with a disconnecter)



Couple panel type S

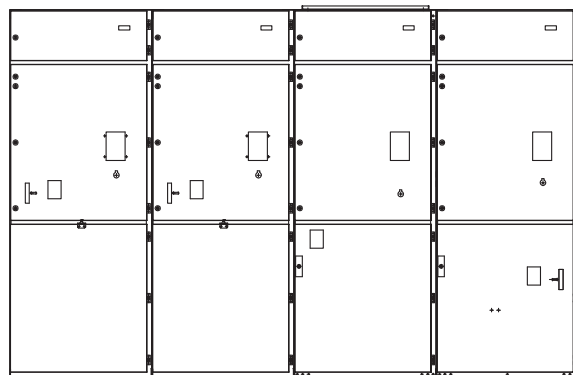


Peak meter panel type PW

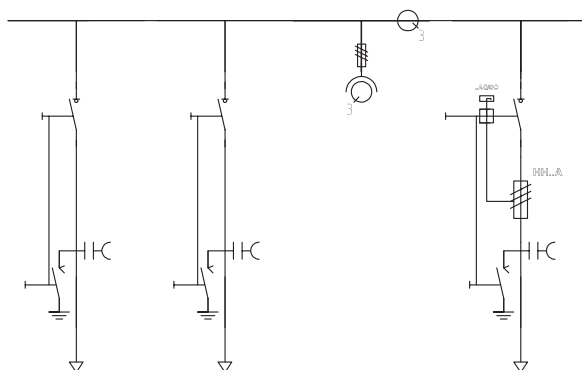


Possible configurations

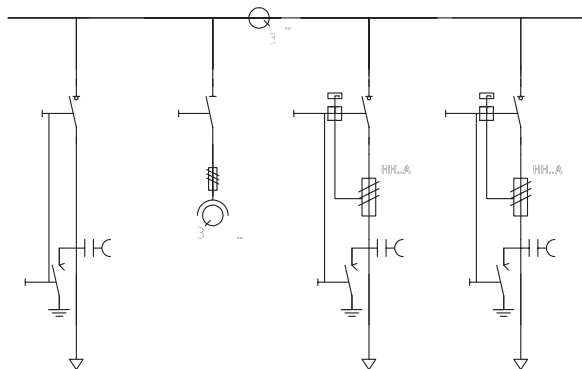
LV switchboard type RSSw manufactured by Strunobet-Migacz Sp. z o.o.



LLPT System



LPoTT System





PRODUCTION FACILITY IN KUZKI

Kuzki 14a
29-100 Włoszczowa

COMPANY'S OFFICE:
tel. +48 41 39 42 113
mobile +48 502 663 613
fax +48 41 39 44 738
e-mail: sekretariat@strunobet.pl

POSTS AND POLES DEPARTMENT:

tel. +48 41 39 41 106
mobile +48 502 663 612
fax. +48 41 39 41 118
tel. +48 41 39 44 571
fax +48 41 39 44 570
e-mail: slupy@strunobet.pl

POLE MOUNT TRANSFORMER STATIONS DEPARTMENT:

tel. +48 41 39 41 116
mobile +48 530 115 881
mobile +48 512 299 833
fax +48 41 39 41 117
e-mail: stacje@strunobet.pl

CONTAINER TRANSFORMER STATIONS DEPARTMENT:

tel. +48 41 39 41 107
mobile +48 512 038 646
Mobile Phones Service Section +48 660 689 727
fax +48 41 39 44 572
e-mail: kontenerowe@strunobet.pl

MARKETING DEPARTMENT:
mobile +48 507 010 886
e-mail: marketing@strunobet.pl

PRODUCTION FACILITY IN LEWIN BRZESKI

ul. Kolejowa 1
49-340 Lewin Brzeski

COMPANY'S OFFICE:
tel. +48 77 552 44 10
fax. +48 77 552 44 11
e-mail: biurolewin@strunobet.pl

SALES DEPARTMENT:
tel. +48 77 552 44 12
mobile +48 502 762 267
fax. +48 77 552 44 13
e-mail: sprzedazlewin@strunobet.pl

e-mail: wieze@strunobet.pl
e-mail: slupyWN@strunobet.pl

PRODUCTION FACILITY IN GRZYBOWO

83-406 Wąglikowice
district Kościerski
tel. +48 58 765 90 10
fax. +48 58 765 90 12
e-mail: biurogrzybowo@strunobet.pl

SALES DEPARTMENT:
tel. +48 58 765 90 13
e-mail: sprzedazgrzybowo@strunobet.pl
e-mail: stacjelewin@strunobet.pl



STRUNOBET-MIGACZ SP. Z O. O.

UL. KOLEJOWA 1

49-340 LEWIN BRZESKI

TAXPAYER ID: 656-21-57-750

POLISH NATIONAL BUSINESS REGISTRY NO. REGON 292831157

E-MAIL: BIURO@STRUNOBET.PL

WWW.STRUNOBET.PL

District Court in Opole,
8th Commercial Division of the National Court Register
National Court Register No. KRS 0000174085
Share capital PLN 6,550,000.00