RZVA

Vacuum Circuit Breakers
Type BPC-110

Technical Information

НКАИ.670049.042 ТИ

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CONTENTS

Introduction

The following technical information is provided for the professionals of instates, engineering and operating companies which deal with developing and modernisation of packaged transformer substations and units of factory-assembled switchgears of railway substations.

We have deliberately avoided the framework of typical catalogues and have provided a wider range of technical characteristics and peculiarities of circuit breakers.

1 General Information

BPC-110 vacuum circuit breakers for outdoor installation are the first single break vacuum circuit breakers. The poles have solid-cast silicone insulation. Circuit breakers are produced with spring actuator. The following circuit breakers meet the requirements of GOST P 52565-2006 and technical specifications ТУ 3414-021-95799595-2010. BPC-110 circuit breakers are used for switching of electric high-voltage circuits under normal and emergency modes in three-phase alternating current networks with rated voltage of 110 kV and the frequency of 50 Hz with grounded neutral and earth fault quotient of 1,4.

BPC-110 circuit breakers are used as components for 110 kV open switchgears of packaged transformer substations КТПБР-110/35/10(6).

Circuit breakers have earthquake resistant design and can be operated at an altitude of 0 – 1,2 m with ductility level event (DLE) of 9 points according to MSK-64 scale.

Due to a number of their advantages BPC-110 circuit breakers can also be used for the enhancement of current substations or the replacement of obsolete air circuit breakers.

Main advantages are:

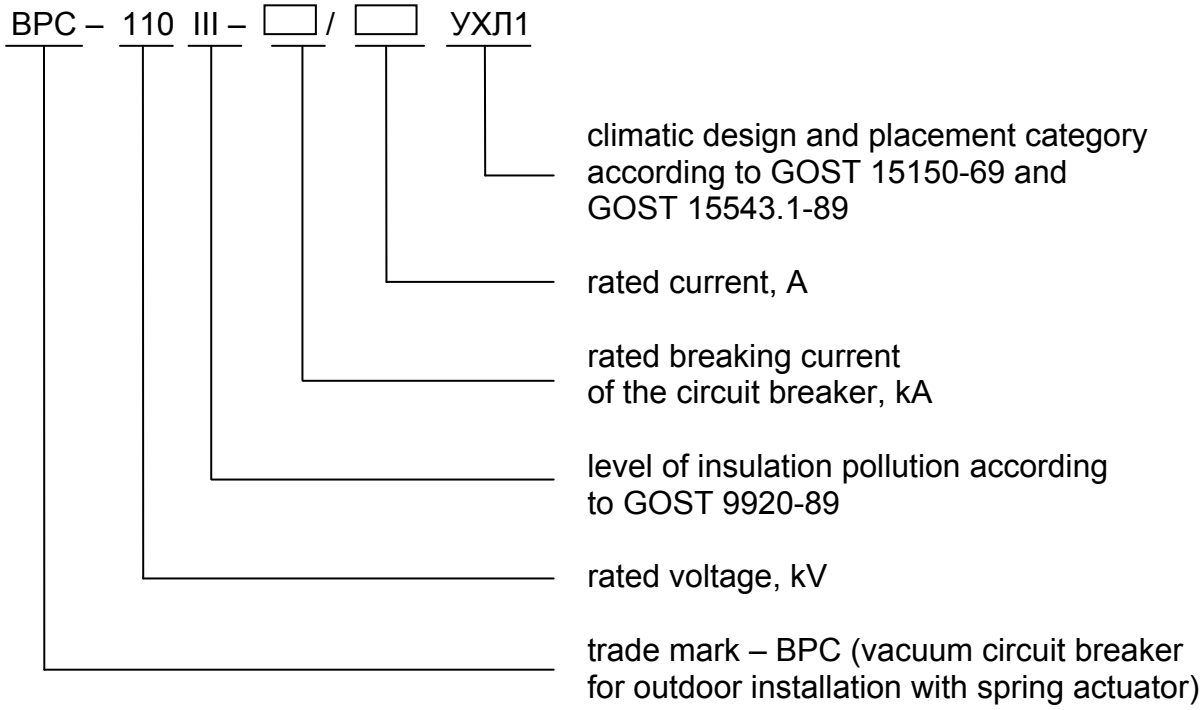
- minimum level of maintenance;
- minimum amount of installation works because circuit breakers are delivered completely assembled and adjusted. The customer only has to install the supports and to add the actuator (without adjusting);
- mechanical durability is up to 10000 cycles BO (“O” – opening operation, “B” – closing operation);
- commutation durability is 25 O (“Open”) operations at rated breaking current;
- commutation durability is 10000 cycles BO at rated current (“O” – opening operation, “B” – closing operation);
- solid-cast silicone insulation of the poles as compared to ceramic cover reduces weight and dimensions of the circuit breaker and significantly increases the reliability of insulation;
- warranty period is 2 years commencing from the day of putting into operation.

Besides, the design of BPC-110 circuit breakers provides:

- lateral position of spring actuator of the circuit breakers which provides good access to the spring actuator;
- possibility of operation within wide range of temperatures from -60°C to +50°C;

According to electrical diagram of the actuator, external connections of secondary circuits and the amounts of current consumption BPC-110 circuit breakers are compatible with previously installed circuit breakers in the substations.

2 Conventional Symbols Representing Circuit Breakers



The following conventional symbols represent ВРС-110 circuit breakers with spring actuator for rated voltage of 110 kV with level III of insulation pollution, rated breaking current of 31,5 kA, rated current of 2500 A with УХЛ1 climatic design and placement category:

ВРС-110 III-31,5/2500 УХЛ1 ТУ 3414-021-95799595-2010.

Main Technical Parameters

The following are the rated values of climatic factors for circuit breakers according to GOST 15543.1-89 and GOST 15150-69:

a) altitude above sea level – not exceeding 1000 m;

b) upper working value and effective value of air temperature surrounding the circuit breaker is +50°C and +40°C;

c) lower working value of air temperature surrounding the circuit breaker is -60°C;

d) standard slick thickness is 25 mm at an altitude of 10 m above ground level with recurrence interval of once in 25 years;

e) standard wind load is 80 kgF/m^2 (800 H/m^2) under the conditions of ice slick at an altitude of 10 m above ground level with recurrence interval of once in 25 years;

As far as earthquake resistance is concerned the circuit breakers can be operated at an altitude of 0 – 1,2 m with ductility level event (DLE) of 9 points according to MSK-64 scale according to GOST 17516.1-90.

Electric strength of insulation of the circuit breaker meets the requirements of GOST 1516.3-96 for the devices with voltage of 110 kV and with standard insulation.

External insulation under the conditions of pollution meets the requirements of level III of insulation pollution according to GOST 9920-89.

The circuit breakers work in operations “O” and “B” and in cycles O-0,3sec-BO-180sec-BO, O-0,3sec-BO-20sec-BO and O-180sec-BO-180sec-BO (“O” – opening operation, “B” – closing operation).

The circuit breakers belong to the class C1 according to ГОСТ Р 52565-2006. Circuit breakers are capable make and breake in this circuit the no-load currents of overhead lines up to the rated values of the breaking currents of unloaded overhead lines specified in Table 1 of this technical information, with a low probability of restrike.

Main technical parameters of BPC-110 circuit breakers are shown in Table 1.

Table 1

Parameter	Requirements for the modification	
	ВРС-110 III-31,5/2500 УХЛ1	ВРС-110 III-40/3150 УХЛ1
1 Rated voltage, kV	110	
2 Maximum operating voltage, kV	126	
3 Rated current at frequency of 50Hz, A	2500	3150
4 Rated breaking current, kA	31,5	40
5 Standard parameters of making current, kA: a) initial active value of periodic component b) maximum peak	 31,5 81	 40 102
6 Standard parameters of short-circuit steady leakage current, kA: a) maximum peak (electrodynamic endurance current) b) root-mean-square value of the current during its flowing (thermal endurance current for the period of 3 sec) c) initial active value of periodic component	 81 31,5 31,5	 102 40 40
7 Standard breaking current of unloaded overhead line, A, not exceeding	31,5	

Table 1 continued

Parameter	Requirements for the modification	
	ВРС-110 III-31,5/2500 УХЛ1	ВРС-110 III-40/3150 УХЛ1
8 Standard percentage of aperiodic component, %, not exceeding	40	
9 Intrinsic turn-on time, msec, not exceeding	80	
10 Intrinsic turn-off time, msec, not exceeding	32	
11 Total turn-off time, msec, not exceeding	47	
12 Dead time of auto reclose, sec, not less than	0,3	
13 Test voltage of internal and external insulation of full lightning impulse, kV	450	
14 Test short-term voltage of internal and external insulation in dry condition with partial discharge absence check, kV	200	
15 Test short-term alternating voltage of internal and external insulation in the rain, kV	200	
16 Absolute pressure of gas flushing (N2) at the temperature of 20°C of internal insulation plates of the circuit breaker, kPa	115	
17 Absolute pressure of alarm actuation of gas pressure reduction (N2) at the temperature of 20°C of internal insulation plates of the circuit breaker, kPa	100	
18 Gas weight (N2) at the temperature of 20°C of internal insulation plates of the circuit breaker, kg	0,17	
19 Potential annual gas leak (N2), %, not exceeding	0,1	
20 Volume ratio of water vapour in nitrogen, %, not exceeding	0,004	
21 Mechanical durability, number of cycles BO (“O” – opening operation, “B” – closing operation)	10000	
22 Commutation durability: - at rated current, number of cycles BO	10000	
- at rated breaking current, number of operations O (“O” – opening operation, “B” – closing operation)	25	
23 Weight of the circuit breaker, kg	1645	1700

Main parameters of the secondary circuits of BPC-110 circuit breakers are shown in Table 2.

Table 2

Parameter	Requirement
1 Rated voltage of the circuit of closing spring charging motor (M) of the actuator: - at direct current, V - at alternating current, V	 220; 110 230; 120
2 Operating voltage range of the circuit of closing spring charging motor (M) of the actuator in percentage to rated voltage at direct or alternating current	85-110
3 Current consumption of the circuit of closing spring charging motor (M) of the actuator measured at the moment of maximum shaft load: - at direct voltage of 220 V and alternating voltage of 230 V, A, not exceeding; - at direct voltage of 110 V and alternating voltage of 120 V, A, not exceeding	 4,6 9,2
4 Initial starting current of the circuit of closing spring charging motor (M) of the actuator: - at direct voltage of 220 V and alternating voltage of 230 V, A, not exceeding; - at direct voltage of 110 V and alternating voltage of 120 V, A, not exceeding	 30 60
5 Time of the circuit of closing spring charging motor per one closing operation at minimum voltage, sec, not exceeding	15
6 Rated voltage of the circuit of closing electromagnet (YAC) at direct current, V	220; 110
7 Rated voltage of the circuit of tripping electromagnet (YAT) at direct current, V	220; 110
8 Rated voltage of circuit of independent power tripping electromagnet (YAV) at direct current, V	220; 110
9 Operating voltage range of the circuits of control electromagnets at direct current in percentage to rated voltage: - YAC - YAT and YAV	 80-110 70-110
10 Current consumption of control electromagnets (YAC, YAT, YAV): - at direct voltage of 220 V, A, not exceeding; - at direct voltage of 110 V, A, not exceeding;	 1,5 3,0
11 Heating capacity of the actuator box at alternating voltage of 230 V, kW	0,5

Interlock contacts of circuit breaker position Q1 are installed in the actuator box of the circuit breaker.

Technical parameters of interlock contacts are shown in Table 3.

Table 3

Parameter	Requirement
Rated voltage, V	220
Test voltage, kV	2,0
Thermal endurance current for the period of 2 sec., A	10

According to electrical diagram interlock contacts of circuit breakers have 6 normally closed contacts and 6 normally opened contacts.

Overall, installation and fitting dimensions of circuit breakers are shown in supplement A.

Electrical diagram of circuit breakers is shown in supplement B.

Note: Subject to previous agreement, circuit breakers can be produced according to customer's climatic, mechanical and electrical requirements which may differ from those indicated in the following chapter.

4 Construction and principles of operation

Circuit breaker BPC-110 type consists of the following basic parts: unit pole, box with the spring actuator and bearing metal constructions (bars).

Unit pole consist of:

- three poles with vacuum chambers, made with a unit-cast silicone insulation and filled with nitrogen;
- frames, with poles installed on it, adjustable tractions and conditional nitrogen pressure indicator installed in it;

Pole of circuit breaker type BPC-110 consist of vacuum arc-quenching chamber (VBC), bearing envelope, insulation traction, upper and lower contacts, champs and components of compression for the pole sealing. Upper and lower pole parts are made of glass-plastic pipe, covered outside with silicone insulation. For ensuring the insulation strength inside of the pole: space between upper envelope and vacuum chamber is filled with polymeric insulation, inner surface of lower envelope covered with silicone insulation. Insulation pole traction is covered with silicone insulation as well. Current traction insulation is accomplished with ribbing in order to augment leakage path. To prevent dampness occurrence and influence, inner pole hollows are filled with nitrogen with absolute pressure of 115 kPa at 20°C. Current pole hollows are connected with communicating pipes. And nitrogen pumping is performed through the clapper, installed on the one last pole, and conditional pressure indicator is installed on the other last pole. Conditional nitrogen pressure indicator (SP) has temperature compensating mechanism and control nitrogen density point in all circuit breaker's temperature range. It always at every temperature range of the circuit breaker displays the excess of nitrogen pressure 0,015 MPa on default (indicators scale in the green sector – 0,15 Bar), which corresponds to the absolute pressure of the nitrogen load in the amount of 115 kPa at temperature 20°C. In case if the absolute nitrogen pressure reduces to 100 kPa at 20°C, the indicator of the nitrogen pressure on default the normally open signalizing contact will close, the

point on the indicators scale will be in the red sector – 0,6…0 Bar, which indicates on the necessity for execution of the additional nitrogen loading of the poles.

The spring actuator of the circuit breaker type BPC-110 is installed in the actuator's box and kinematically connected through tractions with circuit breaker's poles.

The controlling by circuit breaker's activator is performed through the chain of the electro engine (M) with starting of the closing spring and through the controlling chain and protections, exactly through electromagnet's tripping chain (YIT), through the closing electromagnet chain (YAC) and through the tripping electromagnet's chain which disconnects from the independent power supply (YAV).

All chains of controlling, protection and heating of the actuator are lead out to the clamp row XT, which is installed in the actuator's box. Two slugs are installed for connection to the external secondary chains on the bottom of the actuator's box, through which two lead wires can be installed for connecting clamp row XT.

Turning off of the circuit breaker is performed due to energy of the closing actuator's spring. Starting of the actuator's closing spring can be performed automatically with the help of electro engine (M) or manually with lever for starting of the closing spring.

After the starting of the closing spring, the operation "B" can be performed, which is executed by voltage supply in the electro magnet's closing chain (YAC) or by pushing the button "On". After the execution of the operation "B" the automatic starting of the closing spring will be performed for possibility of executing of Automatic power supply of circuit breaker.

The circuit breaker in the working position can be turned off by power supply in the closing electro magnets' chain (YAT), closing electro magnets chain from independent power supply (YAV) or with the help of button "Off". Turning off is executed due to the energy of spring constriction mechanisms of the poles and closing spring which are started during the turning on of the circuit breaker. In the control scheme of circuit breaker type (BPC-110) there is the blocking relay against the repeated turning on (KBS).

The switch SACY which is installed in the actuator's box and designed for the selection of circuit breakers mode of control. The switch has two fixed positions: "local", "distant". The control of the circuit breaker is turned off in the neutral position (commands are not active), and only the contact of signalization, which indicates this position, is closed.

In the actuator's box also the switch SA is installed for giving of commands "ON" and "OFF" designed for the local control. The switch is with self-back function in the neutral position.

5 The complete set of delivery

The complete basic delivery set for the circuit breakers BPC-110 execution includes:

- pole unit, piece……..……..…1
- box with spring actuator, unit…….....1
- bar НКАИ.301421.273, unit……..1
- bar НКАИ.301421.273-01, unit……....1
- grounding bus НКАИ.685614.013, unit……..4
- protecting screen НКАИ.301421.269 with fixing elements, unit……..…1

- lever designed for starting of actuator's closing spring, unit……....1
- list of manual usage documents of electric circuit breaker, copy……....1
- complete set of the manual usage documents with the list of electric circuit breaker (registration certificate passport, operating manual list of spare parts and equipment, etc.), set……..…….……..1
- complete set of spare parts, instruments and equipment in accordance with a list of single list of spare parts and equipment, set……..…..……...1
- the complete set of spare parts , instruments and equipment in accordance with a list of repairing spare parts and equipment, set…….....…...1

Attention:* delivered in accordance with separate order and payment.

6 ORDERING OF CIRCUIT BREAKERS

During the ordering of circuit breakers (look supplement C), besides the structure of indication of the type execution of the circuit breakers and Technical Conditions current type, voltage in volts frequency have to be indicated additionally:

a) chains of the electro engine (M) of actuator's closing spring starting

b) closing electromagnet's chains (YAT);

c) closing electromagnet's chains (YAC);

d) closing electromagnet's chain design for disconnecting from the independent power supply (YAV).

Besides the aforementioned, it is necessary to indicate the usage sphere of circuit breaker: in case of replacement it is necessary to indicate the type of the replaced circuit breaker and in case of fundamental building indicate the usage of basic execution.

In case of absence of the additional indications in the order, circuit breaker type BPC-110 is produced with the electro engine chain (M) of starting of the closing actuator's spring, closing electromagnet's chains (YAT) and closing electromagnet (YAC), chains of closing electromagnet designed for disconnection from independent power supply (YAV) for direct current voltage 220 volts with scheme of the electrical connections in accordance with supplement B and to support bar and protecting screen in accordance with Figure A1.

Contact information

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Bielaya St., 16, City of Rivne
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Telephone: (+38 0362)61-72-94
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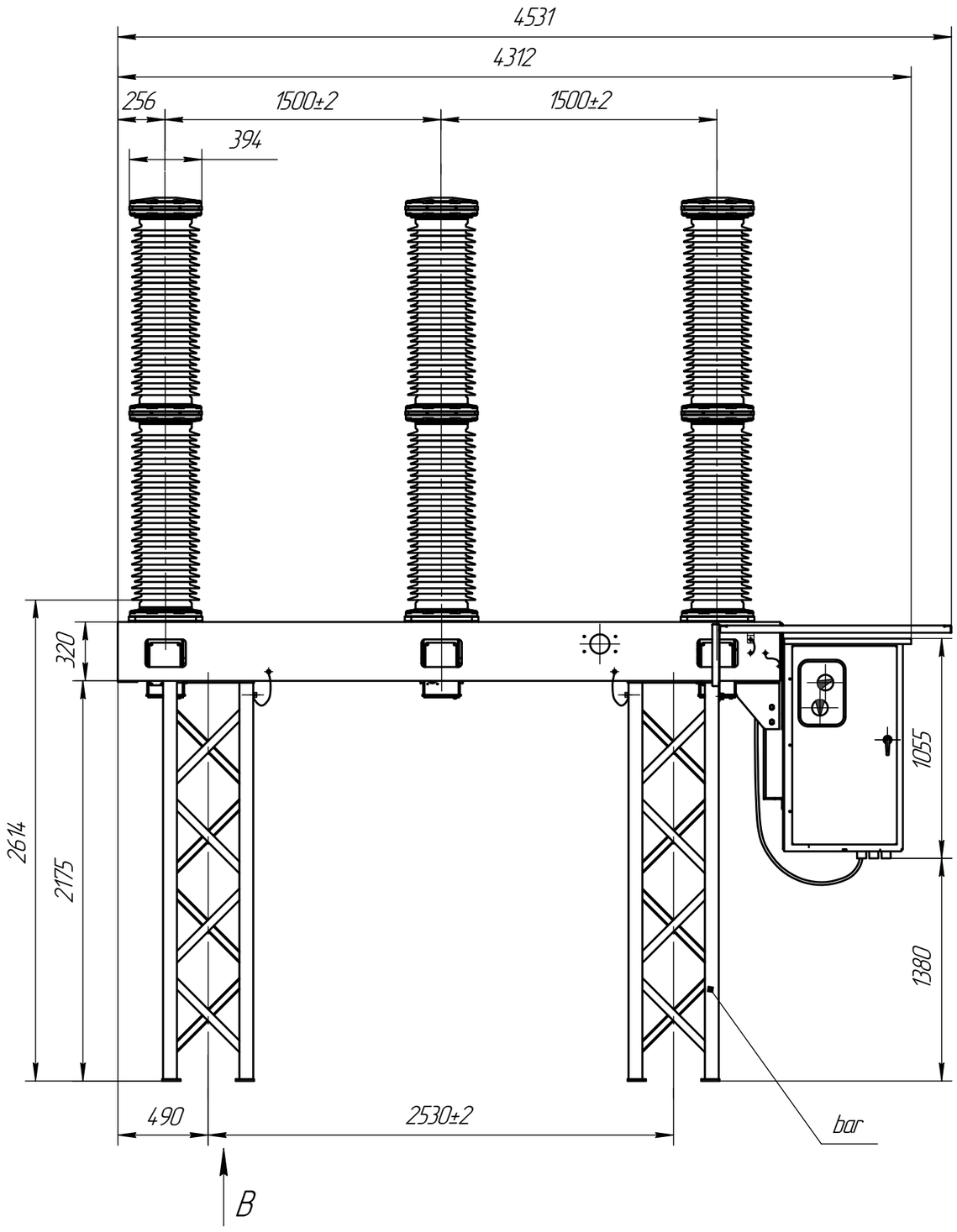
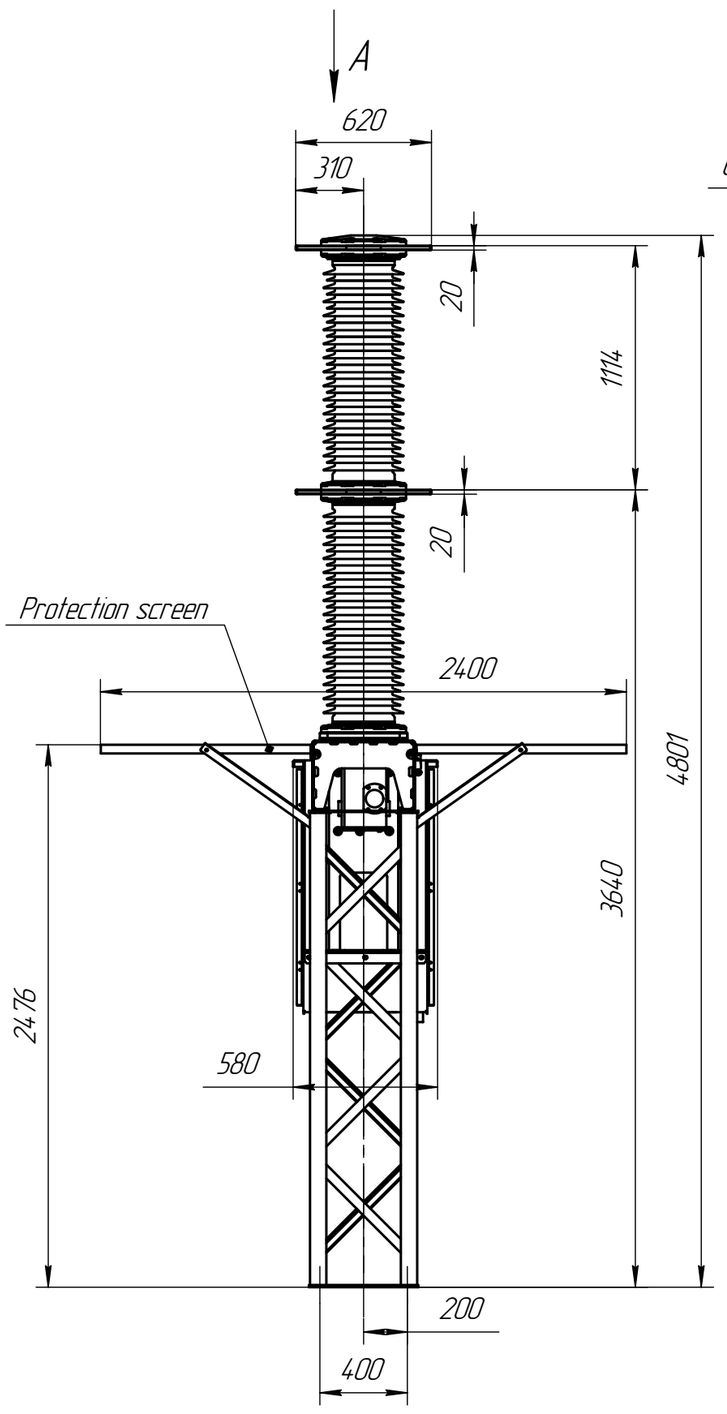
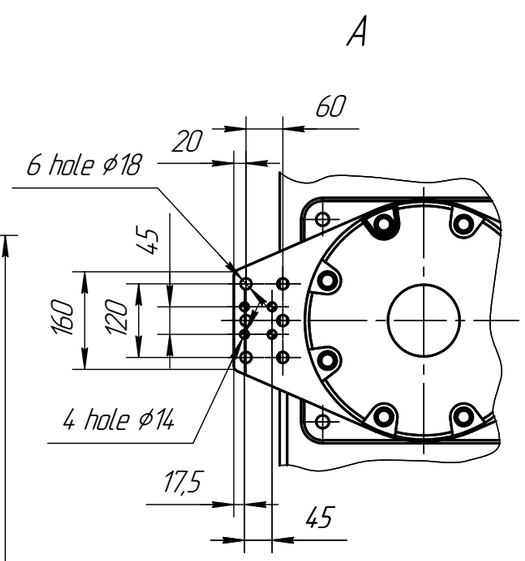
Supplement A







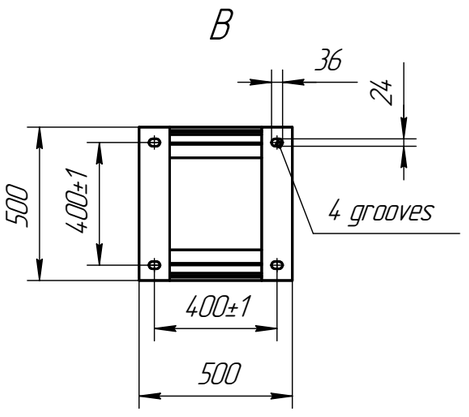


Figure A.1 – Overall, adjusting and adjoint dimensions of the vacuum circuit breakers tupe BPC–110 III–31,5/2500 УХЛ1

Continue of the supplement A

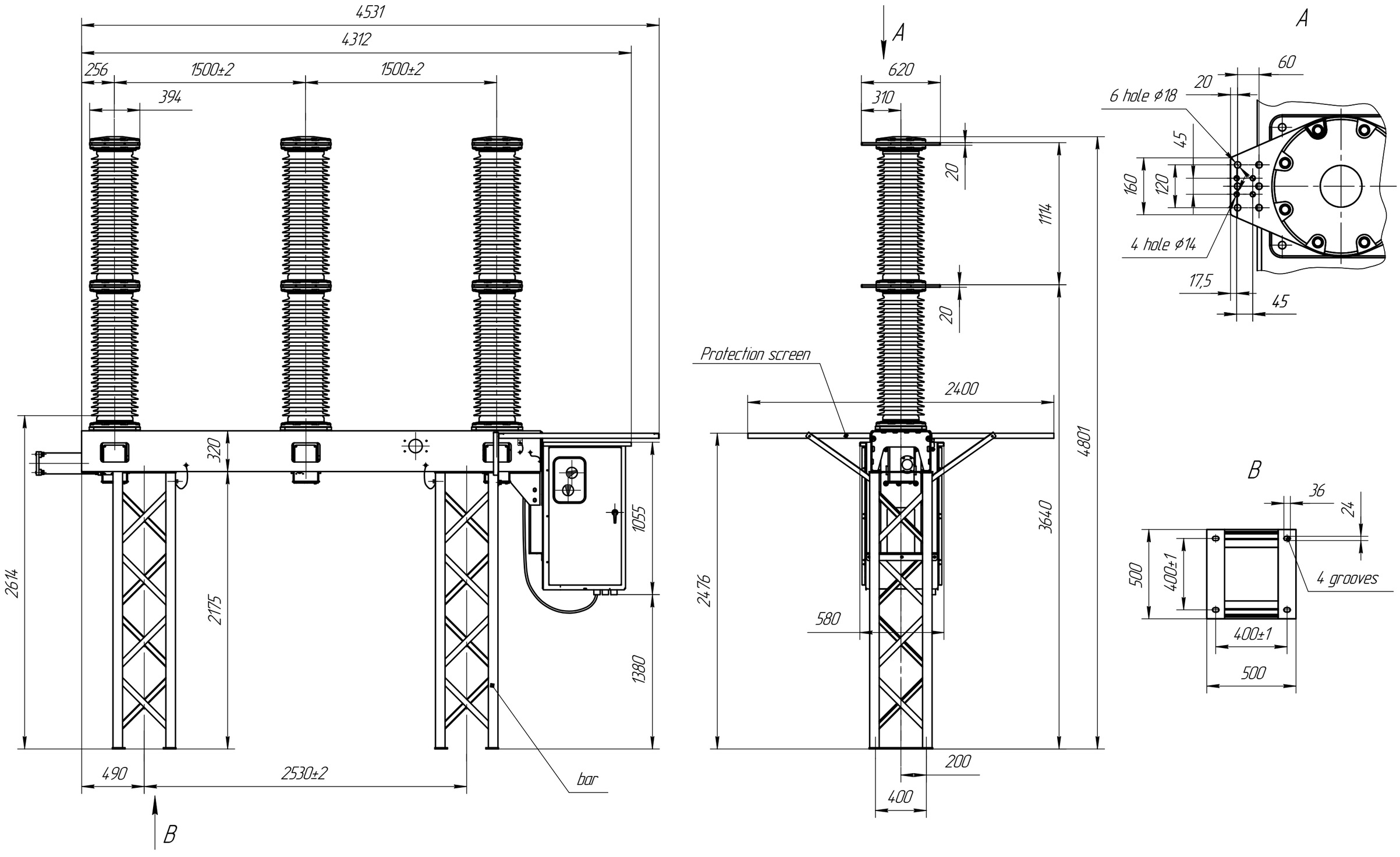


Figure A.2 – Overall, adjusting and adjoint dimensions of the vacuum circuit breakers tupe ВРС–110 III–40/3150 УХЛ1

Continue of the supplement A

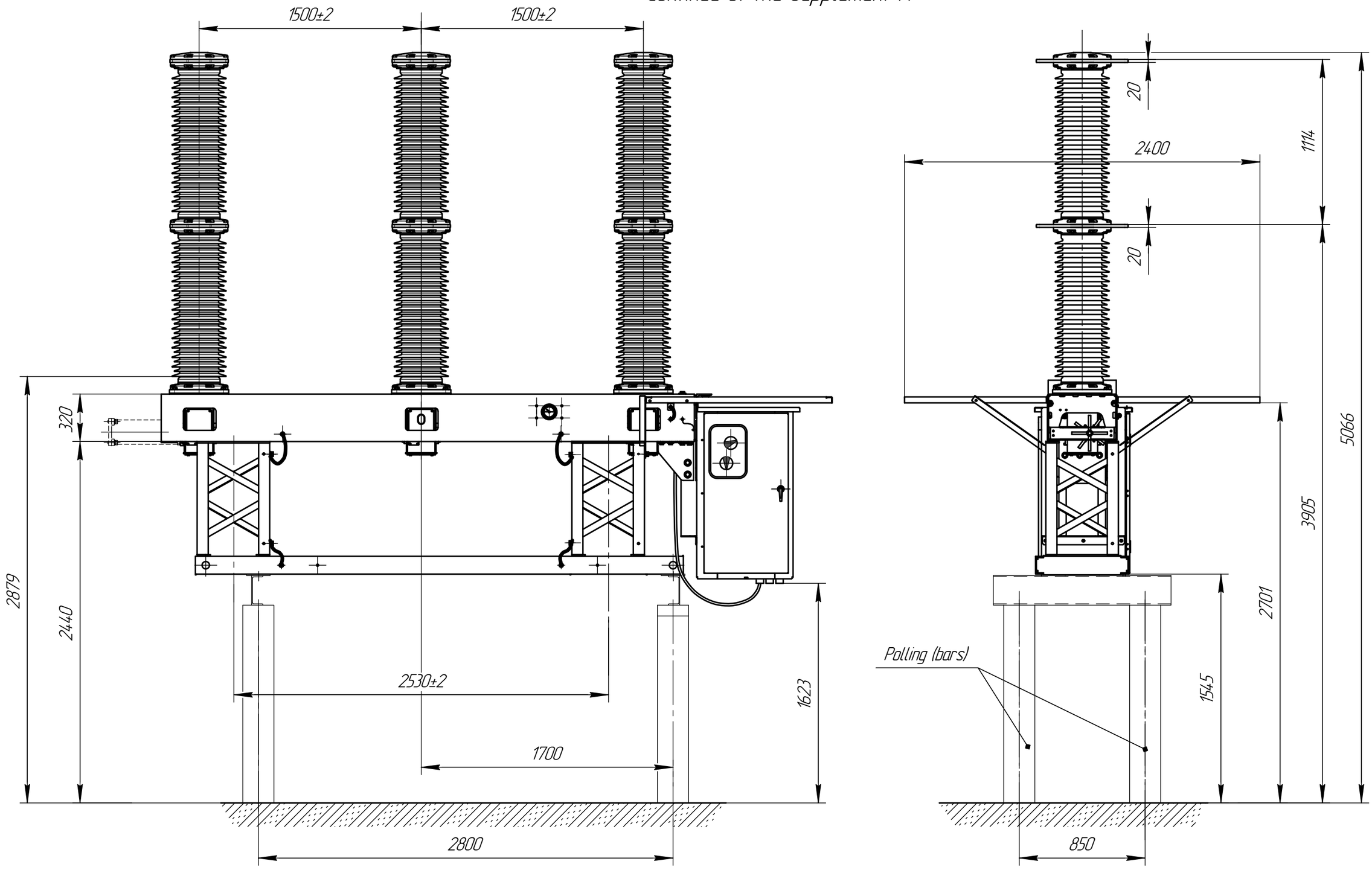
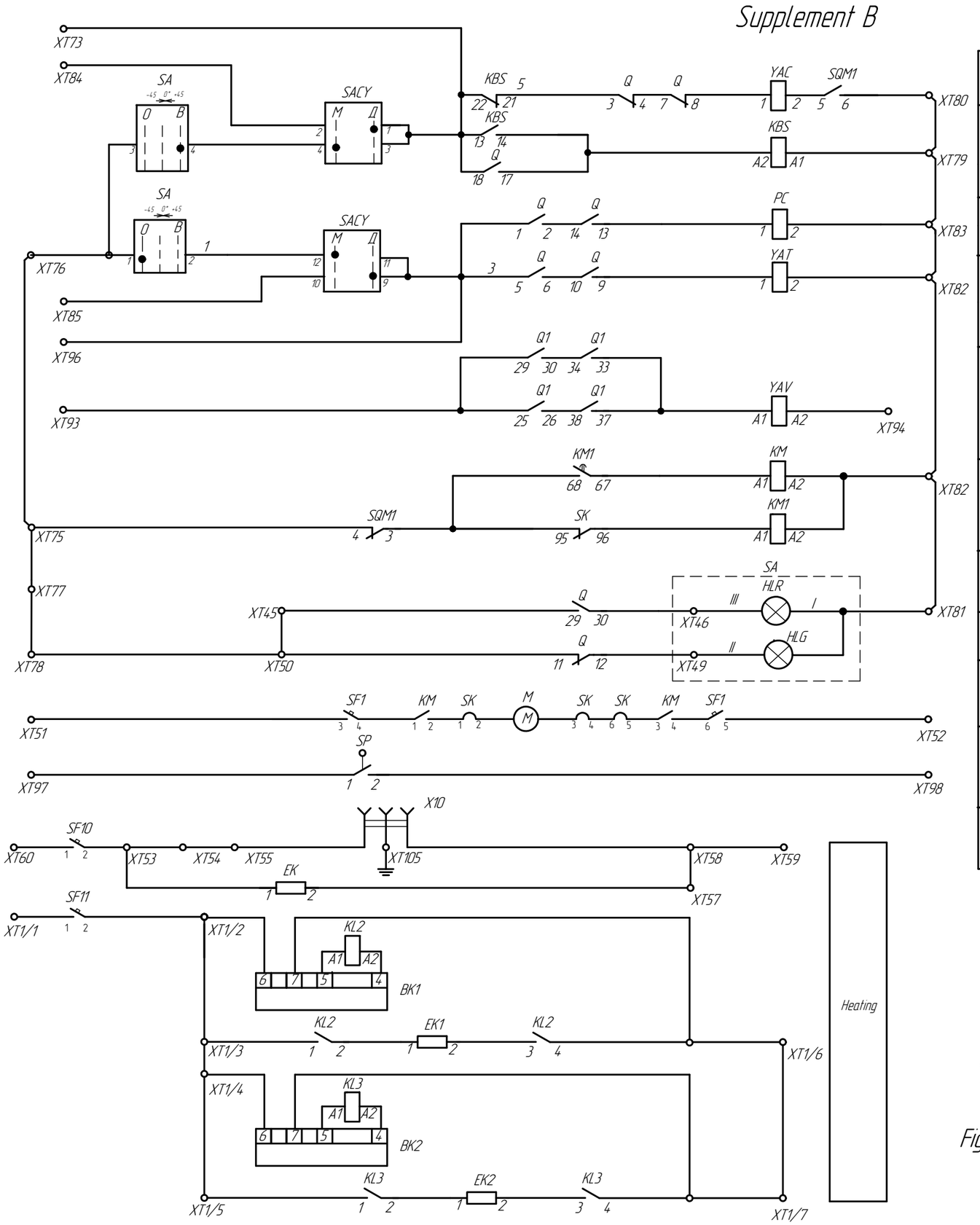
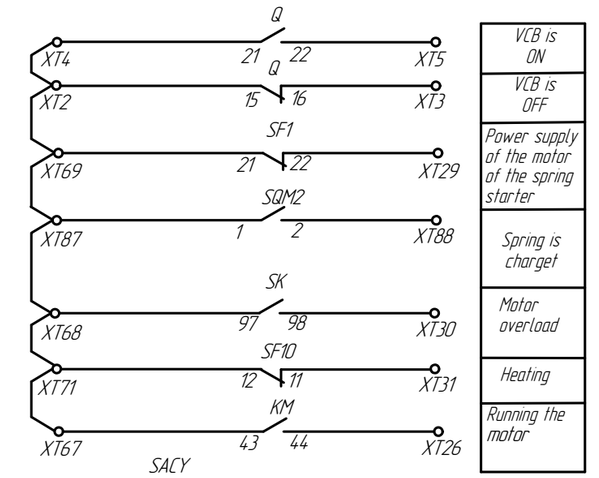


Figure A.3 – Overall, adjusting and adjoint dimensions of the vacuum circuit breakers tupe BPC–110 (for replacement of circuit breakers BMT–110)

Supplement B

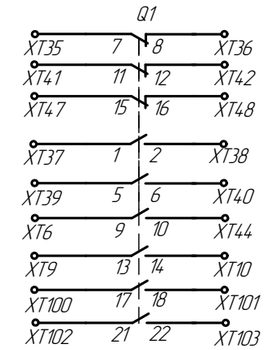


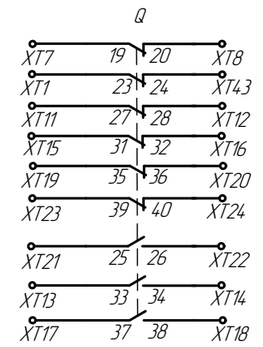
Closing electro-magnet
Blocking relay against the repeated turning on
Counter
Tripping electro-magnet
Tripping electro-magnet from the independent power supply
Contactor of the engine control
VCB is ON
VCB is OFF
Motor of the spring starting
Siglization of the gas pressure in circuit breaker's poles
Plug



VCB is ON	
VCB is OFF	
Power supply of the motor of the spring starter	
Spring is charget	
Motor overload	
Heating	
Running the motor	

"Distant"	Signalization of the switch position SACY
"Local"	





Indication	Description	Number
YAT	Tripping electromagnet	1
KBS	Relay KBS	1
YAV	Tripping electromagnet from the independent power supply	1
SQM1, SQM2	Blocking contacts of the actuators position (signalization of the spring starting	2
M	Motor	1
Q, Q1	Blocking contacts of the circuit breakers positions	2
HLR	ON indicator	1
EK, EK1, EK2	Heater	3
SF1, SF10, SF11	Automatic	3
YAC	Closing electromagnet	1
PC	Counter	1
KM, KM1	Contactor	2
KL2, KL3	Intermediate relay	2
SA, SACY	Switch	2
HLG	OFF indicator	1
SP	Contact of monostat	1
SK	Thermal release	1
BK1, BK2	Temperature indicator	2
X10	Socket	1
XT	Connecting clamps	46
XT1	Connecting clamps	7

1. The position of the scheme elements corresponds to the circuit breakers position "Turnet off", drive is discharged.
2. Contact SP of monostat is opened while working gas pressure of gas in poles.

Figure B – Electrical principal scheme of the circuit breakers type BPC-110

Supplement C.1
How to fill
Interrogatory list №_____

Of the order of the vacuum circuit breakers type BPC-110

IS FILLED BY THE CUSTOMER					
1	Customer	**LLC "Promet"**			
2	Object name	**p/c "Horenichi"**			
Circuit breaker technical data					
3	Characteristics of the main chains	Rated voltage		кВ	**110**
4		Closing rated voltage		кА	**31,5**
5		Rated voltage		А	**2500**
6	Climatic execution and the category of placement according to GOST 5150		УХЛ1		**УХЛ1**
7	Characteristics of the secondary chains	Current type and chain rated voltage of the electro engine (M) of starting closing actuator's spring		В	**= 220**
8		Current type and chain rated voltage of the closing electromagnet (YAC)		В	**= 220**
9		Current type and chain rated voltage of the electromagnet (YAC)		В	**= 220**
10		Current type and chain rated voltage of the closing electromagnet with independent power supply (YAV)		В	**= 220**
11	The sphere of usage	- for a circuit breaker change:ВМТ-110 [-] ; ВГТ-110 [-]; LTB [-] ; _____ [-].			
		- for the fundamental building (basic execution of the circuit breaker BPC110) [X].			
Order of the necessary equipment					
12	Number of the ordered circuit breaker's of one type = N				**5**
13	Structural (on default) indication of the circuit breaker in accordance with technical maintenance (or technical instruction)			**BPC-110 III-31,5 / 2500 УХЛ1**	
Full name and position of the person responsible for the order **Chief engineer of p/c "Horenichi"** _____ Contact telephones, fax **+38 064 4331840** Date and signature **17.07.2012**_____					
Note: For circuit breaker's with different parameters and sphere of usage fill in the separate interrogatory lists					

FILLED IN BY THE MANUFACTURING ENTERPRISE					
Specification for the order executing					
14	Circuit breaker	Breaker's code	Number		5
15		Structural (on default) indication		BPC-110 III-31, 5/2500 УХЛ1	
16		Indication of the drawing on default		НКАИ.674153.021	
17		Principal electrci scheme		НКАИ.670209.319 ЭЗ	
Equipment concerning the order					
	Name	Indication	Number	* for the basic execution. The documentation set must include the installment drawing НКАИ.674153.021 МЧ	
18	*Set of parts of the Montagnais*	*НКАИ.674153.021 Д**			
19					
20					
21					
22					
23					
24					
Specification is concluded by:_____ Date and signature:_____					

Supplement C.2

Interrogatory list №_____

Of the order of the vacuum circuit breakers type BPC-110

IS FILLED BY THE CUSTOMER					
1	Customer				
2	Object name				
Circuit breaker technical data					
3	Characteristics of the main chains	Rated voltage		кВ	
4		Closing rated voltage		кА	
5		Rated voltage		А	
6	Climatic execution and the category of placement according to GOST 5150		УХЛ1		
7	Characteristics of the secondary chains	Current type and chain rated voltage of the electro engine (M) of starting closing actuator's spring		В	
8		Current type and chain rated voltage of the closing electromagnet (YAC)		В	
9		Current type and chain rated voltage of the electromagnet (YAC)		В	
10		Current type and chain rated voltage of the closing electromagnet with independent power supply (YAV)		В	
11	The sphere of usage	- for a circuit breaker change:ВМТ-110 ☐ ; ВГТ-110 ☐; LTB ☐ ; _____ ☐.			
		- for the fundamental building (basic execution of the circuit breaker BPC110) ☐.			
Order of the necessary equipment					
12	Number of the ordered circuit breaker's of one type = N				
13	Structural (on default) indication of the circuit breaker in accordance with technical maintenance (or technical instruction)				
Full name and position of the person responsible for the order Contact telephones, fax Date and signature					
Note: For circuit breaker's with different parameters and sphere of usage fill in the separate interrogatory lists					

FILLED IN BY THE MANUFACTURING ENTERPRISE				
Specification for the order executing				
14	Circuit breaker	Breaker's code	Number	
15		Structural (on default) indication		
16		Indication of the drawing on default		
17		Principal electrci scheme		
Equipment concerning the order				
	Name	Indication	Number	
18				
19				
20				
21				
22				
23				
24				
Specification is concluded by: _____ Date and signature:_____				