

# MR-SafeRing-40.5

## 全绝缘充气式环网开关设备

MR-SafeRing-40.5 Fully insulated inflatable ring switchgear



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## 概述 Summary

SRM16-40.5 系列开关设备系户内 12~40.5kV 三相交流 50Hz，作为接受和分配电能的成套设备，是我公司生产的新一代开关产品。主要用于各类发电厂、变电所、工矿企业、地铁、民用和商用建筑等中压电力系统的变电送电，实行控制、保护、监测之用。具有性能可靠、适应性强、体积小等特点。

SRM16-40.5 series switchgear is indoor 12~40.5kV three-phase AC 50Hz. As a complete set of equipment for receiving and distributing electric energy, it is a new generation of switchgear products produced by our company. It is mainly used for power transformation and transmission of medium voltage power systems such as various power plants, substations, industrial and mining enterprises, subways, civil and commercial buildings for control, protection and monitoring. It is characterized by reliable performance, strong adaptability and small size.

## 使用环境条件 Environmental conditions

### ◆ 周围空气温度

最高温度：40℃；最低温度：-25℃；且 24h 内测得的平均值不超过 35℃。

### ◆ 相对湿度

在 24h 内测得的相对湿度的平均值不超过 95%；

月相对湿度的平均值不超过 90%；

在高湿度期间温度急骤变化时可能出现凝露；

在 24h 内测得的水蒸气压力的平均值不超过 2.2kPa；

月水蒸气压力平均值不超过 1.8kPa；

### ◆ 海拔

设备安装场所的海拔不超过 1000m。

### ◆ 地震烈度不超过 8 度。

### ◆ 在二次系统中感应的电磁干扰的幅值不超过 1.6kV。

### ◆ 周围空气没有明显地受到尘埃、烟、腐蚀性和可燃性气体、蒸气或盐雾的污染。

注：当使用条件超出以上规定时，可与用户协商确定解决方案。

### ◆ Ambient air temperature

Maximum temperature: 40℃; Minimum temperature: -25℃; The average value measured within 24h shall not exceed 35℃.

### ◆ Relative humidity

The average value of relative humidity measured within 24h shall not exceed 95%;

The average monthly relative humidity shall not exceed 90%;

Condensation may occur when the temperature changes rapidly during high humidity;

The average value of water vapor pressure measured within 24h shall not exceed 2.2kPa;

The average monthly water vapor pressure shall not exceed 1.8kPa;

### ◆ Altitude

The altitude of the equipment installation site shall not exceed 1000m.

### ◆ The seismic intensity shall not exceed 8 degrees.

### ◆ The amplitude of electromagnetic interference induced in the secondary system shall not exceed 1.6kV.

### ◆ The surrounding air is not obviously polluted by dust, smoke, corrosive and combustible gases, steam or salt mist.

Note: When the use conditions exceed the above provisions, the solution can be determined through consultation with the user.

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## 符合标准 Compliance with standards

GB3906-2011 《3.6kV~40.5kV 交流金属封闭开关设备和控制设备》

DL/T404-1997 《户内交流高压开关柜订货技术条件》

IEC 62271-200 : 2003 《额定电压 1kV 以上 52kV 及以下交流金属封闭开关设备和控制设备》

1016001/003-0000-00 《国家电网公司物资采购标准 12kV、24kV、40.5kV 高压开关柜通用技术规范》

GB3906-2011 3.6kV~40.5kV AC Metal Enclosed Switchgear and Control Equipment

DL/T404-1997 Technical Conditions for Ordering Indoor AC High Voltage Switchgear

IEC 62271-200:2003 AC metal enclosed switchgear and control equipment with rated voltage above 1kV and below 52kV

1016001/003-0000-00 General Technical Specifications for 12kV, 24kV and 40.5kV High Voltage Switchgear of State Grid Corporation of China

## 开关柜主要技术参数 Main technical parameters of switch cabinet

表 1 Table 1

名称 Name		单位 Unit	参数 Parameter		
额定电压 Rated voltage		kV	12	40.5	
额定电流 Rated current		A	1250~3150	1250~2500	
额定频率 Rated frequency		Hz	50		
额定短时耐受电流 Rated short-time withstand current		kVs	25、31.5		
额定峰值耐受电流 Rated peak withstand current		kA	63、80		
额定短路电流持续时间 Rated short-circuit current duration		s	4		
额定短路开断电流 Rated short-circuit breaking current		kA	25、31.5		
额定短路关合电流 Rated short-circuit making current		kA	63、80		
燃弧持续时间 Duration of arcing		s	0.5		
机械寿命 Mechanical life	断路器 Circuit breaker	次 Times	2000	10000	
	隔离开关 Isolating switch		3000		
	接地开关 Earthing switch		3000		
断路器电寿命 Electrical life of circuit breaker		次 Times	30		
额定充气压力 (20°C表压) Rated inflation pressure (20°C gauge pressure)		MPa	0.05		
最低功能压力 (20°C表压) Minimum functional pressure (20°C gauge pressure)			0.03		
SF <sub>6</sub> 气体年泄漏率 Annual leakage rate of SF <sub>6</sub> gas		-	≤ 0.5%		
额定绝缘水平 Rated insulation level	额定工频 1min 耐受电压 (有效值) Rated power frequency 1min withstand voltage (effective value)	相间, 相对地 Phase to phase 隔离断口、真空断口 Isolation fracture, vacuum fracture	kV	42	95
				48	118
	额定雷电冲击耐受电压 (峰值) Rated lightning impulse withstand voltage (peak value)	相间, 相对地 Phase to phase 隔离断口、真空断口 Isolation fracture, vacuum fracture		75	185
				85	215
辅助控制回路 Auxiliary control circuit	额定电压 Rated voltage	V	DC:110、220 AC:110、220		
	1min 工频耐压 1min power frequency withstand voltage		2000		
柜体防护等级 Cabinet protection grade	柜体外壳 Cabinet shell	-	IP4X		
	充气隔室 Inflatable compartment	-	IP65		



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续表 1 Continued Table 1

名称 Name	单位 Unit	参数 Parameter		
丧失运行连续性类别 Category of loss of operation continuity	-	LSC2B		
温升试验 Temperature rise test	A	1.1I <sub>r</sub>		
主回路电阻 Main circuit resistance	1250	85	100	
	2000		65	
	2500	60	60	
	3150	50		
局部放电 Partial discharge	试验电压 Test voltage	kV	$1.1 \times 12 / \sqrt{3}$	$1.1 \times 40.5 / \sqrt{3}$
	单个绝缘件 Single insulating element	pC	≤ 3	
	整机 Complete machine		≤ 50	
使用寿命 Service life	年 Year	≥ 30		

注：

- a) 40.5kV/2000A 规格额定短路开断电流为 31.5kA；12kV/3150A 规格额定短路开断电流为 31.5kA；
- b) 电流互感器的额定峰值耐受电流和额定短时耐受电流的参数单独考核；
- c) 回路电阻是指从母联器插座外出线（含母联器）测到电缆插座外出线侧（含电流装置）的测量值，当不含母联器和电流装置时表中值减去 20。

Note:

- a) The rated short-circuit breaking current of 40.5kV/2000A is 31.5kA; Rated short-circuit breaking current of 12kV/3150A is 31.5kA;
- b) The parameters of rated peak withstand current and rated short-time withstand current of current transformer shall be assessed separately;
- c) The loop resistance refers to the measured value measured from the outgoing line of the bus coupler socket (including the bus coupler) to the outgoing line side of the cable socket (including the current device). When the bus coupler and the current device are not included, the value in the table is subtracted by 20.

## 充气隔室参数 Inflatable compartment parameters

- 1) 充气隔室压力释放装置的动作压力为 0.2MPa~0.25MPa；
  - 2) 充气隔室充气后静置 38 小时 SF<sub>6</sub> 气体水份含量不大于 250ppm，现场验收 SF<sub>6</sub> 气体水份含量不大于 1000ppm，参考标准见 DL/T 603-20060。
- 1) The operating pressure of the pressure relief device of the inflatable compartment is 0.2MPa~0.25MPa;
- 2) The water content of SF<sub>6</sub> gas shall be no more than 250ppm after standing for 38 hours after inflation of the inflatable compartment, and the water content of SF<sub>6</sub> gas shall be no more than 1000ppm during site acceptance. See DL/T 603-20060 for reference standards.

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## 柜体结构说明 Cabinet structure description

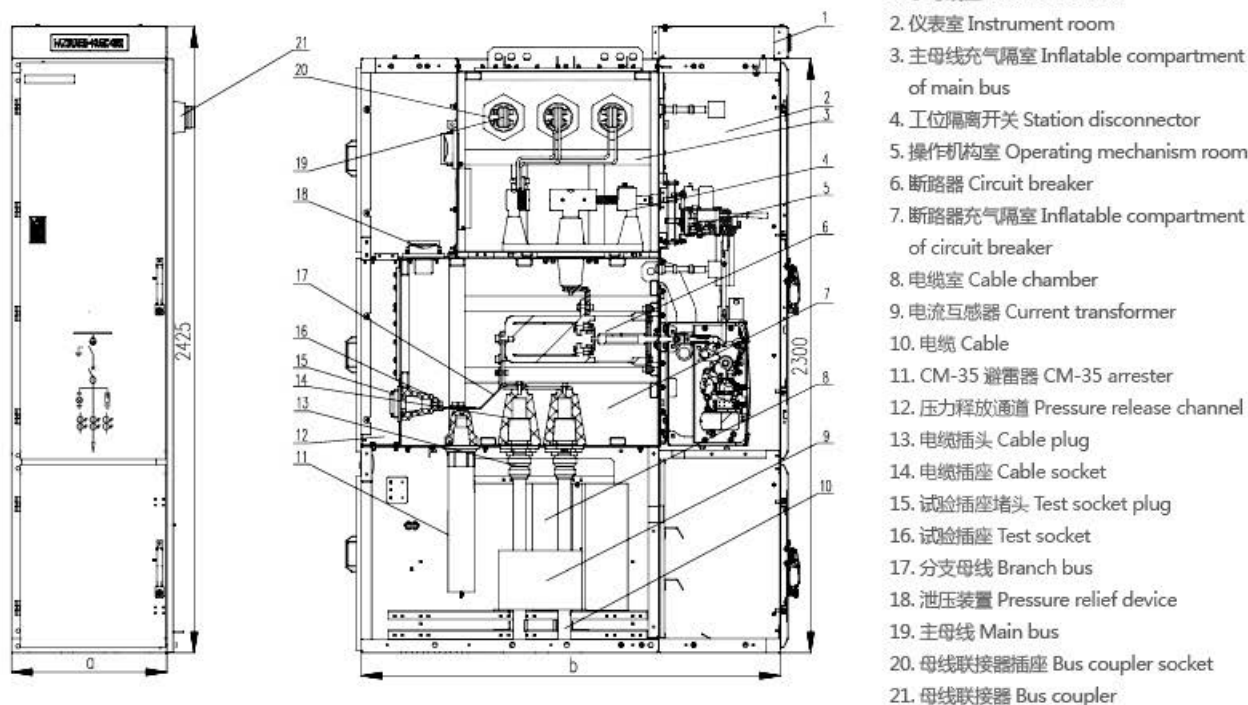
本开关柜是主回路采用低压力 SF6 气体绝缘、主开关为真空断路器的组装型金属封闭开关设备。充气隔室分为两个，断路器隔室和主母线隔室。所有主回路元件（真空断路器，三工位隔离开关）以及主母线及分支母线均装于充气隔室内。开关柜结构按功能可分为断路器充气隔室、主母线充气隔室，电缆室、操作机构室、仪表室、小母线室等。充气隔室和电缆室均设有独立的压力释放通道，最大限度地保证人身安全和设备运行。

开关柜的断路器充气隔室和主母线充气隔室采用薄的优质不锈钢板焊接而成，开关柜壳体采用优质钢板折弯成形后装配而成。

The switchgear is an assembled metal enclosed switchgear with low pressure SF6 gas insulation for the main circuit and vacuum circuit breaker for the main switch. The inflatable compartment is divided into two compartments, the circuit breaker compartment and the main busbar compartment. All main circuit elements (vacuum circuit breaker, three position disconnecter), main bus and branch bus are installed inside the inflatable compartment. The switch cabinet structure can be divided into circuit breaker inflatable compartment, main bus inflatable compartment, cable compartment, operating mechanism room, instrument room, small bus compartment, etc. according to its functions. The inflatable compartment and cable chamber are equipped with independent pressure release channels to maximize personal safety and equipment operation.

The circuit breaker inflation compartment and the main bus inflation compartment of the switch cabinet are welded with thin high-quality stainless steel plates, and the switch cabinet shell is assembled after being bent and formed with high-quality steel plates.

开关柜外形及结构示意图 Outline and structure diagram of switch cabinet



注：a（柜体宽度）：600mm、800mm；

b（柜体深度）：12kV 深度为 1420；40.5kV 深度为 1620。

Note: a (cabinet width): 600mm, 800mm;

b (cabinet depth): 12kV depth is 1420; The depth of 40.5kV is 1620.

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主要技术参数见表 2，断路器装配调整后，其机械特性参数见表 3，二次回路技术数据见表 4，辅助开关的技术数据见表 5。

The main technical parameters are shown in Table 2. After the circuit breaker is assembled and adjusted, its mechanical characteristic parameters are shown in Table 3. The technical data of the secondary circuit are shown in Table 4. The technical data of the auxiliary switch are shown in Table 5.

表 2 Table 2

名称 Name		单位 Unit	参数 Parameter	
额定电压 Rated voltage		kV	12	40.5
额定绝缘水平 Rated insulation level	1min 工频耐受电压 (有效值) 1min power frequency withstand voltage (effective value)	对地、相间 Ground, interphase	42	95
		真空断口 Vacuum fracture	48	118
	雷电冲击耐受电压 (峰值) Lightning impulse withstand voltage (peak value)	对地、相间 Ground, interphase	75	185
		真空断口 Vacuum fracture	85	215
额定频率 Rated frequency		Hz	50	
额定电流 Rated current		A	1250~3150	1250~2500
额定短时耐受电流 Rated short-time withstand current		kA	25、31.5	
额定峰值耐受电流 Rated peak withstand current		kA	63、80	
额定短路电流持续时间 Rated short-circuit current duration		s	4	
额定短路开断电流 Rated short-circuit breaking current	交流分量有效值 Effective value of AC component	kA	25、31.5	
	直流分量百分数 DC component percentage		44%	46%
额定操作顺序 Rated operating sequence			分 -0.3s- 合分 -180s- 合分 O-0.3s-CO-180s-CO	
额定短路关合电流 Rated short-circuit making current			63、80	
额定失步开断电流 Rated out of step breaking current		kA	6.3、8	
额定异相开断电流 Rated out of phase breaking current			21.8、27.4	
额定容性开合电流 (C2 级)	额定电缆充电断开电流 (有效值)		25	50
	额定单个电容器组开断电流 (有效值)	A	800	630
	额定背对背电容器组开断电流 (有效值)		400	400
	额定背对背电容器组关合涌流 (峰值)	kA	20	20
额定主回路电阻 (上、下导电支架间)	1250		≤ 30	≤ 30
	2500	μΩ	≤ 20	≤ 15
	3150		≤ 15	
机械寿命		次 Times	20000	10000
断路器电寿命		次 Times	30	
辅助及控制回路	额定电源电压	V	DC : 110、220 AC : 110、220	
	额定电源频率	Hz	50	



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表 3 Table 3

名称 Name	单位 Unit	参数 Parameter	
额定电压 Rated voltage	kV	12	40.5
合闸时间 Closing time	ms	55±20	55±20
分闸时间 Opening time		27~50	40±15
合、分闸三相不同期 Three phase different periods of closing and opening		≤ 2	≤ 2
合闸弹跳时间 Closing bounce time		≤ 2	≤ 3
分闸反弹幅值 Opening rebound amplitude	mm	≤ 2	≤ 2
合闸速度 (刚合前 6mm) Closing speed (6mm before closing)	m/s	0.8±0.2	
合闸速度 (刚合前 12mm) Closing speed (12mm before closing)			0.9±0.3
分闸速度 (刚分后 6mm) Opening speed (6mm after opening)		1.3±0.3	
分闸速度 (刚分后 12mm) Opening speed (12mm after just closing)			1.7±0.2
超行程 Overtravel	mm	5±1	4±1
触头开距 Contact opening		9±1	19±1.5

表 4 Table 4

名称 Name	单位 Unit	参数 Parameter	
额定电压 Rated voltage	kV	12	40.5
线圈操作电压 Coil operating voltage	V	合闸线圈 Closing coil	DC220、110 AC220/110
		分闸线圈 Opening coil	
线圈功率 Coil power	W	合闸线圈 Closing coil	242
		分闸线圈 Opening coil	
储能电机功率 Power of energy storage motor	W	70	100
储能电机额定电压 Rated voltage of energy storage motor	V	DC:110、220 AC:110、220	
储能时间 Energy storage time	s	≤ 15	
正常工作电压范围 Normal operating voltage range	V	储能电机 Energy storage motor	85% ~ 110%额定电压
		合闸线圈 Closing coil	
		分闸线圈 Opening coil	

表 5 Table 5

名称 Name	型号 Type	规格 Specifications	用途 Purpose
微动开关 S1 Microswitch S1	CSK-AC11	AC 115A/380V	储能位置开关 Energy storage position switch
微动开关 S2 Microswitch S2	F10-16	AC 10A/380V	断路器主触头辅助开关 Auxiliary switch of main contact of circuit breaker

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## 可选配置 Optional configuration

根据不同的单元方案 and 用户要求，可提供下列配置：

- ◇ 预留母线扩展及外部扩展母线；
- ◇ 电容性电压指示器；
- ◇ 短路及接地故障指示仪；
- ◇ 气压指示装置（指针式压力表和密度变送器等）；
- ◇ 三工位隔离开关的电动操作机构；
- ◇ 三工位隔离开关的辅助接点；
- ◇ 避雷器；
- ◇ 电压传感器（带保护用 PT）；
- ◇ 流互感器；
- ◇ 集成式监控单元。

According to different unit schemes and user requirements, the following configurations can be provided:

- ◇ Reserved bus expansion and external expansion bus;
- ◇ Capacitive voltage indicator;
- ◇ Short circuit and ground fault indicator;
- ◇ Air pressure indicating device (pointer pressure gauge, density transmitter, etc.);
- ◇ Electric operating mechanism of three position disconnector;
- ◇ Auxiliary contact of three position disconnector;
- ◇ Arrester;
- ◇ Voltage sensor (with PT for protection);
- ◇ Current transformer;
- ◇ Integrated monitoring unit.

## 柜体安装 Cabinet installation

SRM16-40.5 系列开关设备必须用 4 个 M16x60 的螺栓固定在地面上，所有单元模块的安装方式均相同，开关柜地基示意图如图 11。

开关设备安装基础的施工应符合“电力建设施工及验收技术规范”中的有关条款的规定。

通常在配电室内安装开关柜，采用电焊或螺栓栓接的方式，将开关柜紧固在预置于配电室混凝土地面上的由槽钢预制的基础框架之上。而安装基础一般需通过两次浇注混凝土而完成。第一次浇注时需为开关柜安装预埋件，并铺设基础槽钢框架。第二次的混凝土是地面的补充层，在浇注时，其混凝土地面高度应低于槽钢平面 2-5mm。

开关柜一次、二次电缆沟的形成，视开关设备数量与建筑条件而定，必须严格按照我方提供的地基图施工，以免影响并柜工作在埋设地基框架时，需保证：

- ◇ 基础槽钢的平面度公差不得大于 2mm/m；
- ◇ 基础槽钢的直线度公差不得大于 2mm/m，框架总长度范围内的总偏差不能超过 5mm/m；
- ◇ 基础槽钢的水平度公差不得大于 -2mm/m，框架总长度范围内的总偏差不能超过 5mm/m。

SRM16-40.5 series switchgear must be fixed on the ground with four M16x60 bolts. All unit modules are installed in the same way. The schematic diagram of the switchgear foundation is shown in Figure 11.

The construction of switchgear installation foundation shall comply with the relevant provisions in the "Technical Code for Construction and Acceptance of Electric Power Construction".

The switch cabinet is usually installed in the distribution room, and is fastened on the prefabricated foundation frame of channel steel which is preset on the concrete floor of the distribution room by means of electric welding or bolt connection. The installation of foundation is generally completed by pouring concrete twice. During the first pouring, embedded parts shall be installed for the switch cabinet and the foundation channel steel frame shall be laid. The second concrete is the supplementary layer of the ground. When pouring, the concrete ground height should be 2-5mm lower than the channel steel plane.

The formation of the primary and secondary cable trenches of the switchgear depends on the number of switchgear and building conditions. The construction must be carried out in strict accordance with the foundation drawing provided by us, so as not to affect the consolidation work. When the foundation frame is buried, it is necessary to ensure that:

- ◇ The flatness tolerance of foundation channel steel shall not be greater than 2mm/m;
- ◇ The straightness tolerance of the foundation channel steel shall not exceed 2mm/m, and the total deviation within the total length of the frame shall not exceed 5mm/m;
- ◇ The levelness tolerance of the foundation channel steel shall not exceed - 2mm/m, and the total deviation within the total length of the frame shall not exceed 5mm/m.

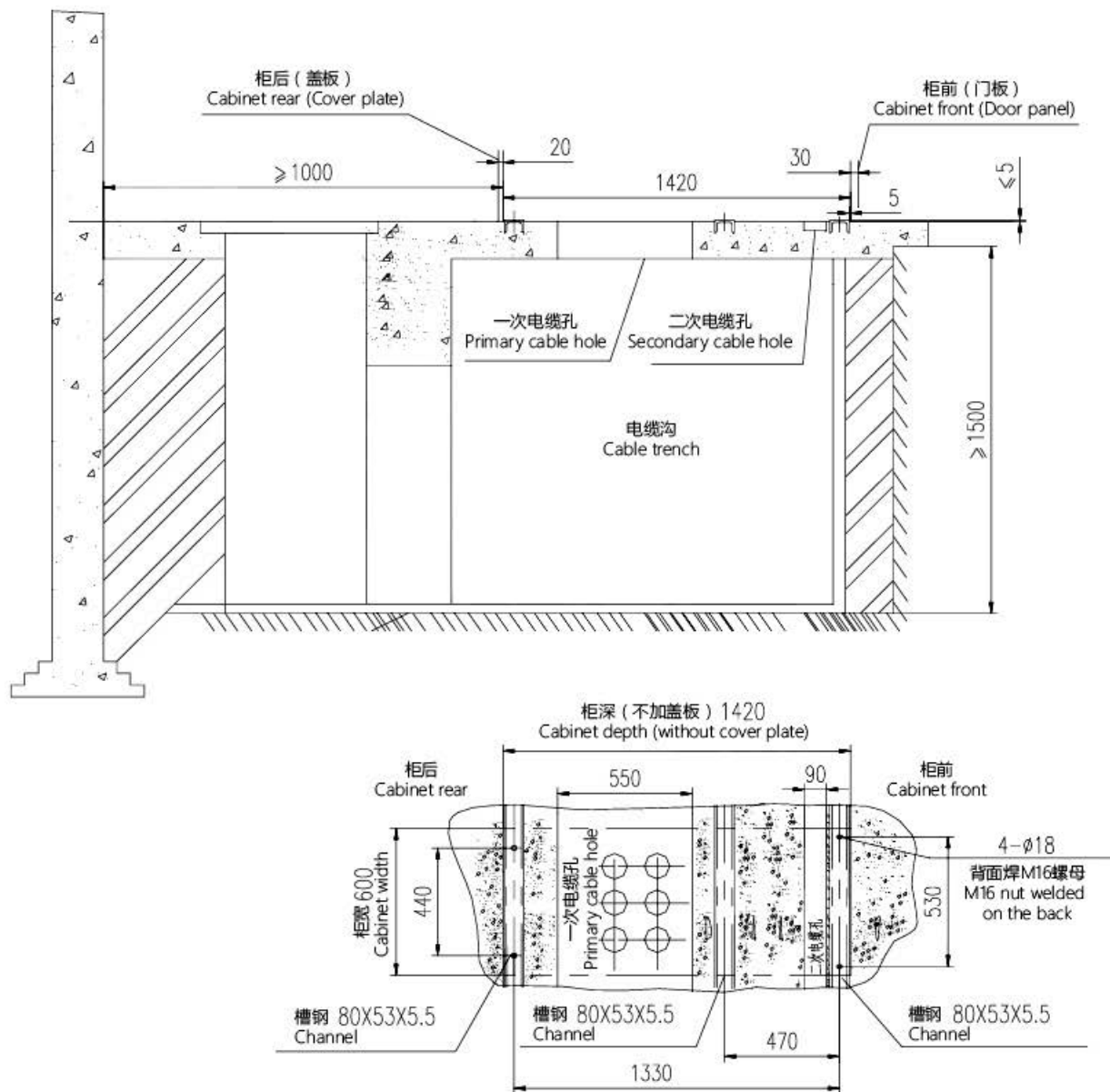


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服务人员在到达现场后,可对安装基础进行观察检测,若不符合上述埋设条件,则应向其负责人员提出,并与公司负责部门进行沟通解决,以免影响开关柜的并柜工作。

After arriving at the site, the service personnel can observe and test the installation foundation. If the above burial conditions are not met, the service personnel shall report to their responsible personnel and communicate with the responsible department of the company to solve the problem, so as not to affect the merging of the switchgear.



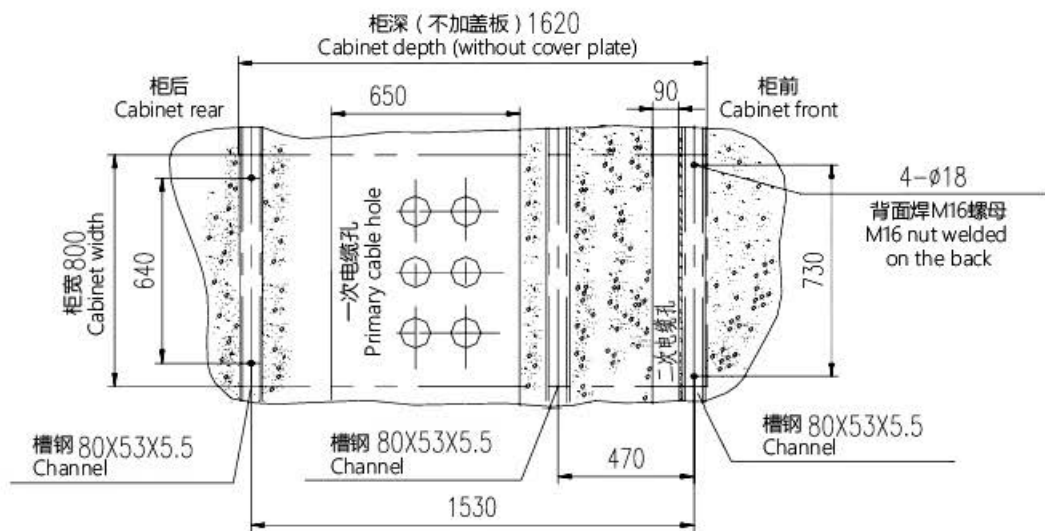
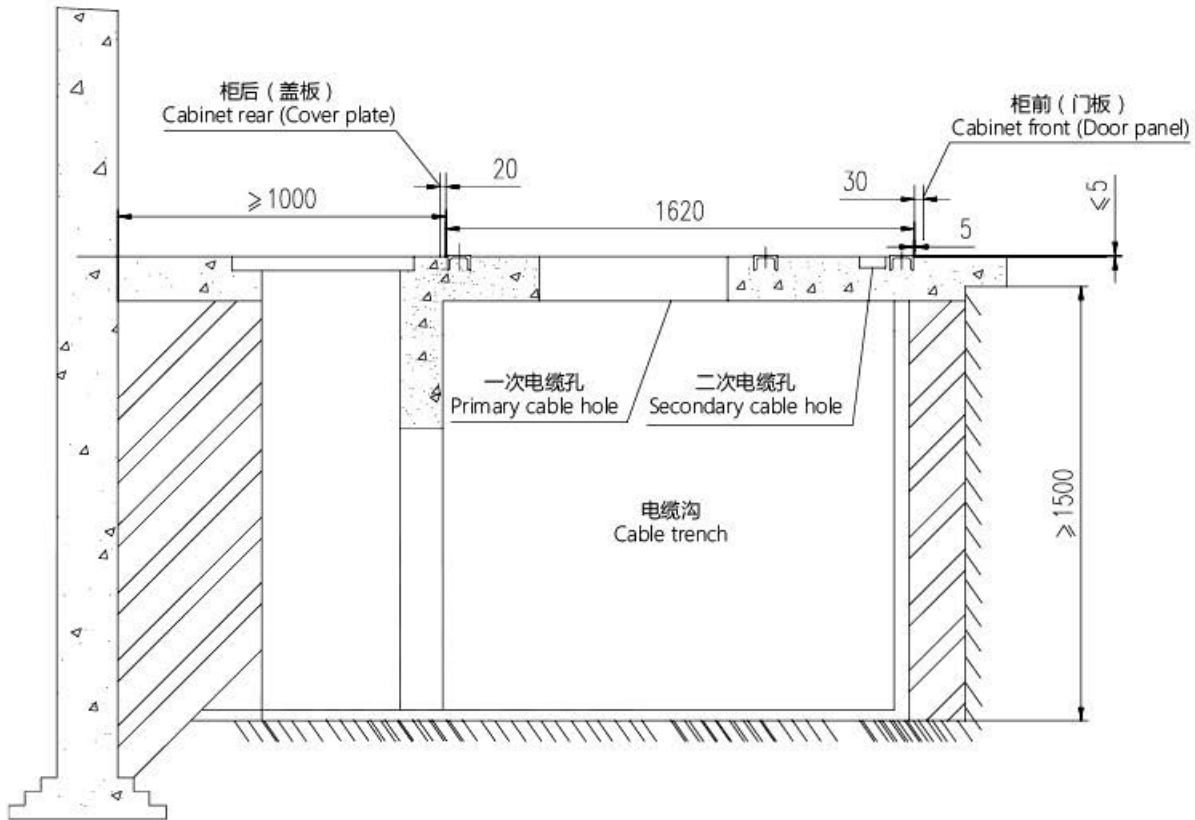
12kV开关柜地基示意图  
Schematic Diagram of 12kV Switch Cabinet Foundation

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明日电气  
MINGRI ELECTRIC



40.5kV开关柜地基示意图  
Schematic Diagram of 40.5kV Switch Cabinet Foundation

图 11 一次、二次电缆进（出）线基础图  
Figure 11 Primary and secondary cable incoming (outgoing) line foundation diagram