



BTTZ 系列矿物绝缘电缆

BTTZ Series Mineral Insulated Cable

PRO 胜宇 胜宇电缆 胜用70年
SHENGYU CABLE 70 YEARS DURABILITY

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BTTZ SERIES MINERAL INSULATED CABLE



一、矿物绝缘电缆简述

Instruction for Mineral Insulae diagram

矿物绝缘电缆又称防火电缆或铜芯铜护套氧化镁绝缘电缆，国外简称MI电缆。该电缆最早于1895年瑞士人研制开发，并取得专利，1934年法国率先将该项新技术转化为生产。矿物绝缘电缆的出现是对传统电缆的创新，特别是在一些重要场所和关键电气线路中发挥的作用，使塑料电缆望尘莫及。因而英国、澳大利亚、加拿大等工业发达国家均开始生产矿物绝缘电缆，但主要仅用于建筑业及重要的工业设施。而中国涉及较迟，直至1968年开始由上海电缆研究所对该产品进行研制开发。由于该产品用材和结构的特殊性，使得其具有传统有机绝缘电缆所无法比拟的电气性能、机械性能、耐环境性能和环保性能。随着该产品不断推广人们对安全要求越来越高，矿物绝缘电缆也越来越为人们所认同，现已广泛应用于基础工业及民用建设中。BTTZ系列电缆执行国家标准GB/T 13033.1-2007。

Mineral insulated cable is manufactured from completely inorganic material. The copper sheath and conductors, insulated with magnesium oxide ensure that the cable is able to withstand the effects of fire and is fully usable afterwards. The m.i. cable system provides a simple solution to many difficult wiring problems and makes for a dependable and permanent installation for virtually all types of electrical circuits. The copper cable sheath meets NEC grounding requirements. Suitable for 300 and 600 volt applications. Pressure tested to 2000 psi. Mineral insulated cable complies with Articles 330, 500 and 501 and all other applicable provisions of the National Electric Code.

To produce assemblies, the cable is cut to the desired length, pigtails brazed on and terminat-ed with union type glands with male NPT threads.

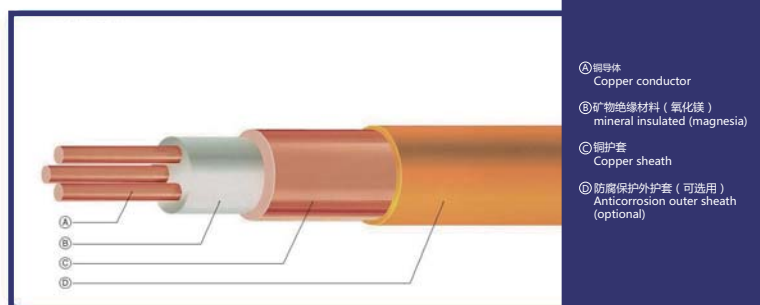
二、矿物绝缘电缆结构图

MI cable structured Cable (MI Cable)

矿物绝缘电缆以高导电率的铜导体、矿物（氧化镁）绝缘、无缝铜管护套为基本结构组成，当电缆用于对铜有腐蚀的场合时，最外层可加一层塑料外套（可选择）。

裸电缆连续工作温度可达250℃，在950℃~1000℃时可持续供电3小时，短时间或非常时期可接近铜的熔点1083℃工作（氧化镁熔点为2800℃）。

MI cable is composed of high-conductivity copper conductor, mineral (magnesium-oxide) insulator and seamless copper-tube sheath, if the cable is used in the locations where the copper will be eroded, it may be added with plastic sheath (optional) at the outermost layer. The continuous working temperature of bare cable reaches 250 °C, it can supply the power for 3 hours continuously at 950°C-1000°C, in addition, it can work at copper melting point of 1,083 °C in short time or unusual time (melting point of magnesia: 2,800°C)



三、电缆主要性能 Main performance of cable

1 耐火性能 Fire-resistive performance

电缆不但自身无法燃烧，更不会引发火源。即使在着火的情况下，电缆仍可正常工作。而且只要火焰温度低于铜的熔点温度，火情消除后，电缆无需更换，仍可继续使用。更换护套和芯线材料耐火更佳，可在油气环境下使用。

Never does the cable bum by itself, or does it cause the source of fire. Even in fire condition, it can still work normally. And , as long as the flame temperature is lower than the melting point of copper, the cable can be used continuously without change after the fire is removed. It would have better fire-resistive performance if the sheath and conductor material are changed , it can be used in oil gas environment.

2 过载保护能力强 Strong overload protection

线路过载时，塑料电缆会因过电流或过电压而引发绝缘发热老化或击穿；而对于矿物绝缘电缆，只要发热达不到铜的熔点温度，电缆不会受损。即使瞬间击穿，击穿点处氧化镁即便熔化仍为氧化镁，过载消除后，电缆性能不会发生变化，仍可继续使用。

When the circuit has the over load the plastic cable will come across the aging of insulation or breakdown for heat due to the over current or over voltage; while , MI cable has no loss only the heating temperature is not higher than the copper melting point. Even if the instantaneous breakdown occurs, the magnesia at the breakdown point still is magnesia after being melted at a high temperature. After the over load is removed , the cable has no change in performance,

3 载流量大 Large current carrying capacity

由于电缆绝缘材质及结构的特殊性，使得矿物绝缘电缆具有较大的载流能力。传输相同的电流量，若选用矿物绝缘电缆可比塑料类电缆减小1到2个截面等级或更大。

Because of the particularity of insulated material and structure , MI cable has a quite large current carrying capacity. If transmitting the same current capacity, MI cable could be one to two or more cross sections less than plastic cable.

4 工作温度高 High working temperature

由于绝缘层氧化镁的熔点温度远高于铜的熔点温度，因而裸电缆最高正常工作温度可达250℃，短期可在接近铜的熔点温度1083℃下运行。

Because the melting point of magnesia at the insulating layer is far higher than the melting point of copper , the max normal working temperature of bare cable can reach as high as 250 °C , and , it can work continuously under the copper melting point of 1,083°C in a short time.

5 防水、防腐、防爆 Waterproof , anticorrosion and explosion-proof property

由于电缆采用无缝铜管作护套，导体、绝缘及护套三者间是致密压实体。因而使其不但具有防止水、潮气、油及一些化学物质的侵害，而且具有阻止可燃性油蒸汽、气体和火焰的蔓延。

The cable adopts the seamless copper tube as the sheath, it is very compact among the conductor , insulation and sheath, so, the cable not only has the function of resisting the water , dampness, oil, chemical substance, etc. , also can prevent the spreading of combustible oil vapor, gas and flame.

6 屏蔽性能优越 Excellent shielding property

电缆铜护套是最佳的屏蔽保护层，既可防止电缆本身对其它线缆的干扰，又可阻止外界电磁场对自身的干扰。

The cable copper sheath is the best shield , it not only can prevent other cables being interfered by this cable , but also can prevent this cable being by external electromagnetic field.

7 抗辐射能力强 Strong radiation resistance

由于电缆组成材料均为无机物，因而在经受核辐射后，电缆的电气及机械性能不会产生任何变化。

As the material of cable is inorganic, the electric and mechanical performance of cable can not be changed after suffering from the nuclear radiation.

8 使用寿命长 Long service life

由于电缆由无机材料组成，因而不会老化，其使用期限最低达数百年以上。

The cable is made of inorganic material , therefore, it is not aged, its service life reaches hundreds of years at least.

9 外径小、重量轻 Small outer diameter and light weight

和同载流量塑料电缆相比，矿物绝缘电缆外径，重量要减少很多，既可减小占用空间，又便于安装。

Compared with the plastic cable of same current-carrying capacity, the outer diameter of MI cable and the weight of that are reduced much, in terms of these , the cable can reduce the occupied space and is easily installed.

10 环保、安全 Environmental protection and safety

电缆组成材料均为无机物，不含任何有机物。因而电缆即使处于1000°C以上加热中，也不会产生丝毫的烟雾，更无卤素及毒性气体。该电缆是能真正实现绿色环保，无“二次灾害”的安全型产品。

The material of cable is inorganic, without any organic matter. Therefore, even if the cable is heated with 1,000°C above, it can't produce halogen, smoke, or poisonous gas. This cable can really realize the green environmental protection, it is the safety product without secondary damage.

11 机械强度高 High mechanical strength

电缆结构密实、坚固耐用，可承受外力的挤压、撞击、弯曲、压扁等，在电缆压扁至原来电缆外径的1/3 ~ 2/3时，仍可继续安全的正常使用。

Due to compact, firm and durable structure, it can withstand the external extrusion, collision, bend or bruising, although the cable is changed by 1/3 ~ 2/3 of the original shape due to crushing, it still can be used normally.

12 弯曲性能 Bending performance

电缆经充分退火后，具有一般塑料电缆所无法相比的可弯曲性。最小弯曲半径仅为电缆外径的2~6倍，如果需重复、多次弯曲时，需要用喷灯如热弯曲部分，避免电缆破裂。

After the cable is annealed fully, its high flexural property is incomparable for plastic cable. The min bending radius is two to six times smaller than cable outer diameter. What's more, if it required to be bent repeatedly, please use blow lamp for hot bending parts, preventing cracking of cable.

13 良好的接地 Perfect earthing

对于矿物绝缘电缆来说，不需要独立的接地导线，因为电缆的铜护套已起到接地导线的作用，并可提供极好的低接地电阻，与有机电缆相比，它可以节省一根地线。

MI cable need not the individual earthing conductor, because the copper sheath of cable has take the effect of earthing conductor, and provides extremely good low earthing resistance. Comparing with the organic cables, it saves an earth wire.

四、电缆抗火灾能力 Fire resistance

电缆在火焰中应有条件

无论是在工厂还是建筑物中，电气线路的安全性至关重要。据国家有关部门统计，在火灾起因中，由于电气引起的火灾占30%以上。而由电缆引起的火灾又占电气火灾的30%以上。因而要求电缆不但要有抗外在火焰破坏的能力，而且要有自身不会产生和传播火源的特性，防止老化。由于矿物绝缘电缆构成材料均为无机物绝缘体氧化镁不会老化，由它构成的线路，也不会导致火情的发生和传播。如一旦由其它原因引发火灾，该电缆在火烧中不仅能受熊熊大火的考验，还会受到其它坠物的不断冲击和消防笼头水的喷淋。此时，电缆在不产生烟雾和毒性气体的同时，还能保证消防设备的正常启动、火情扑灭及人员的撤离，是评价该线路抗火灾能力的关键。

Essential conditions of cable in the flame

Whether in the factory or in the building, the security of electric circuit is of paramount importance. According to the statistics from some relevant departments, more than 30% of fires are caused by the electric cause, and more than 30% of which are caused by cable. Accordingly, on one hand, the cable must have the ability to resist the destroy from external flame, on the other hand, the cable must have the character that it should not produce or transmit fire source, and should be able to anti aging. Since the material of MI cable is inorganic, the insulator magnesia would not age, the circuit consisted by MI cable would not cause or transmit fire. Once the fire is caused for other reasons, the cable should be able to withstand the test of fire and the continuous impact of other precipitations as well as the fire hydrant spraying. While not producing the smoke and poisonous gas, the cable can guarantee the normal start of fire fighting equipment, extinction of fire, and evacuation of personnel that is the key to evaluate the fire resistance of circuit.

耐火性能试验方法 Fire-resistive performance test method

试验项目 Test item	GB/T19216	BS6387	IEC331
耐火试验 Fire-resistive test	750°C 90min	A级 (Class A) 650°C 180min B级 (Class B) 750°C 180min C级 (Class C) 950°C 180min S级 (Class S) 950°C 20min	750°C 180min
喷淋试验 Water spray test	无 Without	W级 (Class W) 650°C 15min	无 Without
冲击试验 Impact test	无 Without	X级 (Class X) 650°C 15min Y级 (Class Y) 750°C 15min Z级 (Class Z) 950°C 15min	无 Without



耐火试验 Fire-resistive test

喷淋试验 Water spray test

冲击试验 Impact test

补充：包括英国BS6387标准在内试验要求均不严格，BS6387要求3种试验分别在三个新试样上分别进行与火灾实际情况不符，英国地铁公司电缆火灾安全试验要求，所有试验在一根试样上完成，试验条件更加苛刻，950°C3小时，每十分钟用钢棒冲击一次，用水喷淋15分钟（钢棒仍在冲击）然后试样在冲击点进行180°弯曲，再进一步进行机械冲击，最后试样浸水进行额定电压的试验，这种要求只有矿物绝缘电缆才能满足要求。

Supplement: all the test requirements including BS6387 are not strict enough, BS6387 requires that 3 types of tests to be carried out on three new samples respectively, which is inconformity with the actual fire condition, cable fire safety test of British Underground Corporation requires that all the tests should be carried out on one sample, the test conditions are more rigorous, 950°C for 3 hours, use steel bar to impact once every 10min, spray with water for 15min (steel bar keeps striking), then bend the sample for 180° at the struck point, make further mechanical shock, at last, dip the sample in water, and implement test of rated voltage, only mineral insulated cable is able to satisfy this kind of requirements.



塑料电缆 Plastic cable

矿物绝缘电缆 MI cable

电缆防火能力 Fire-proof capability

从前述内容看，只有英国地铁公司的电缆火灾安全性能的要求，才是电缆在火灾中经受的真正的耐火性能考验。因为电缆在火中并非不受外界干扰，它会受到消防水、火烧脱落物及其它重物的不断冲击，而且是在同一线路上。而有机（塑料）电缆耐火性能是靠导体和绝缘间的云母包带实现的，塑料耐火电缆一经火烧，云母和绝缘将分别形成硬壳及碳壳。碳壳一遇消防水将导电，云母硬壳遇水或其它重物的冲击将脱落，公安部四消防研究所及英国消防研究所对矿物绝缘电缆及塑料类耐火电缆进行拟实体火灾对比试验，试验证明，能够满足英国地铁公司耐火安全要求的只有矿物绝缘电缆。

According to the forementioned contents, only the fire safety performance requirements for cables issued by British Under ground Corporation can help the cable undergo the real fire- resistive test. It is impossible that the same cable has no outside interference, it will be impacted constantly by the fire fighting water, falling material or other heavy objects. And, the realization of the fire resistance of organic (plastic) material depends on the mica tape between the conductor and insulator, once the plastic fire-resistance cable is burned, the mica and insulator will form the hard shell and carbon shell respectively. Hereinto, the carbon shell will conduct the electricity immediately if sprayed by the fire fighting water, and the mica hard shell will come off if sprayed by the water or impacted by the heavy objects. Sichuan Fire Research Institute of Ministry of Public Security and UK Fire Research Institute performed the test of the cable performance when simulating the real fire for MI cable and plastic fire-resistance cable, the test proved that only the mineral insulated cable meets the requirements specified by British Underground Corporation on fire-resistive performance.

五、电缆抗过载能力 Overload resistance

试验条件: 试验均选用具有相同额定载流量规格的不同类别电缆, 所有试验电缆并联, 试验电缆同时连接到可调变压器。

试验方法: 逐渐加大电流变压器的输出电压, 从而改变通过被试验电缆的电流, 直至电流过载后观察电缆的状况。

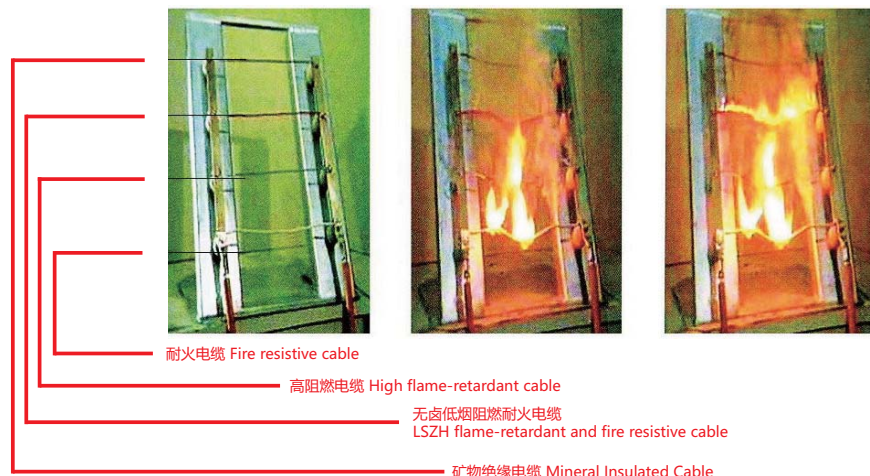
试验结论: 由下面试验效果图, 可以看出在对电缆加载过电流后, 试验中部分电缆因电能转换为热能, 而使电缆自身产生火源。从试验结果也可得出, 只有矿物绝缘电缆不会因为过载而出现电气故障, 更不会出现火情。

Test condition: The test adopts the cables that have the same rated current carrying capacity but different categories, all tested cables are connected in parallel, and connected to the adjustable transformer simultaneously.

Test methods: Increase the output voltage of current transformer gradually, to change the current passing the tested cable, and then, watch the cable status after the current overload occurs.

Test conclusion: As shown in following test efficiency diagram, we can know that after the over-current is applied to the cable, some tested cables produce the fire source by itself because its electric energy is converted into the thermal energy. Meanwhile, the test result shows that even if over load occurs, MI cable hasn't the electric fault or doesn't cause the fire.

电缆过载试验 Cable overload test



六、电缆价格性能比 Cable price/performance ratio

性能比较 Comparison of the performance

比较性能 Comparing the performance	矿物绝缘电缆 BTZ 型 Mineral Insulated Cable BTZ type	普通阻燃耐火电缆 ZN-YJV 型 Common flame-retardant and fire resistive cable ZN-YJV type	无卤低烟耐火电缆 WDZN-YJV 型 LSZH fire resistive cable WDZN-YJV type
电缆规格 Cable spec	4x120	4x150+1x70	4x150+1x70
敷设条件 Layout conditions	可明敷、不用桥架或穿管 Surface wiring is available, without tray or pipeline	需封闭桥架或穿管保护 Need enclosed tray or pipeline protection	需封闭桥架或穿管保护 Need enclosed tray or pipeline protection
使用寿命 Service life	100年以上 Over 100 years	20~40 年 20~40 years	20~40 年 20~40 years
阻燃性能 Flame-retardant performance	无法燃烧 No combustion	C类阻燃 CAT-C flame retardance	可达A类阻燃 CAT-A flame retardance
耐火能力 Fire- resistive capa- bility	耐火性能 Fire-resistive performance	950°C 180min(C级)	750°C 90min且电缆价格将有较大提高 Cable may be burned at 750°C for 90min, its price will be increased greatly
	喷淋试验 Water spraying test	650°C 15min(W级)	不能通过该项试验 Fail to pass this test
	机械冲击 Mechanical impact	950°C 15min(Z级)	不能通过该项试验 Fail to pass this test
耐温性能 Temperature resistance performance	正常为250°C最高可达1000°C Normal: 250°C; max: 1,000°C	最高为90°C, 短路时仅为250°C Max: 90°C; short circuit: 250°C	
环保性能 Environmental protection performance	无烟、无卤、无毒 No smoke, halogen or poison	燃烧中产生大量烟雾、毒气 Producing a great number of sm-oke and poisonous gas in burning	燃烧中有少量烟雾及毒性气体 Producing little smoke or poisonous gas in burning
占用空间 Occupying the space	Φ34mm	Φ55mm	Φ65mm

价格比较 Comparison of the price

在同样使用环境下进行价格比较: 电缆均传输相同的载流量; 矿物绝缘电缆铜护套替代接地线芯。

Comparing the price in the same service environment Both cables transmit the same current carrying capacity; the copper sheath of MI cable takes the place of earthing core.

比较项目 Comparison of the item	矿物绝缘电缆 BTZ 型 Mineral Insulated Cable BTZ type	普通阻燃耐火电缆 NH-YJV 型 Common flame-retardant and fire resistive cable NH-YJV type	无卤低烟耐火电缆 WDZN-YJV 型 LSZH fire resistive cable WDZN-YJV type
电缆规格 Cable spec	4x120	4x150+1x70	4x150+1x70
载流量 Current carrying capacity	380A	360A	365A
每米价格百分比 Price per meter (percentage)	100%	95%	102%

比较结论 Conclusion

- a. 电缆寿命长, 可避免因塑料电缆使用年限给工程造成的二次投资。
- b. 电缆外径小, 比塑料电缆节约很大的布线空间, 更便于设计、安装。
- c. 电缆敷设方式简单, 可以明敷不用穿管, 可再为工程节约造价。
- d. 电缆耐高温而且防爆、防腐、防水、防磁、耐机械损伤(包括动物啃咬)、不会老化、载流量大、过载能力强等, 其中任一项性能的效果均远优于塑料电缆。
- e. 该电缆是真正的绿色、安全产品
- 与目前最为“环保”的无卤低烟塑料电缆相比, 矿物绝缘电缆不但在电性能及机械性能方面有较大提高, 而且真正实现 无卤、无烟、无毒, 彻底消除 无卤低烟塑料电缆中残留的毒素。
- f. 该电缆已不再是主要用于消防系统
- 由于其优越的性能价格比而成为替代无卤低烟电缆、耐火电缆、阻燃电缆、母线槽(容量为3000A及以下)等产品的发展方向。
- g. 该产品的性能价格比远优于其它任何一种电缆。

- a. With long service life, it can avoid the secondary investment for project for the service life of plastic cable.
- b. With small outer diameter, it can save large of wiring space compared with the plastic cable, easily designed and installed.
- c. With simple layout, it can be exposed laid out without in pipeline, so it saves construction price for the project.
- d. With performances of high temperature resistant, flame-retardant, explosion-proof, corrosion resistant, waterproof, antimagnet, mechanical damage resistance (including the animal biting), anti aging, large current carrying capacity, high overload capacity, etc., any one item is far better than the plastic cable.
- e. This cable is the real green and safe product.

Compared with LSZH plastic cable that is the most environmental-protection at present, MI cable not only is improved greatly in the electric performance and mechanical performance, but also can realize the halogen free, no smoke and no toxicity, it completely eliminates the residual toxin in the LSZH plastic cables.

f. This cable is not the main fire control system any more. Owing to the excellent performance/price ratio, it will take the place of LSZH cable, fire-resistant cable, flame-retardant cable, bus slot (3,000A and below) gradually.

g. The performance/price ratio of product surpasses any kind of cables.

七、电缆设计、订货型号及表示方法

Cable design, ordering model and expression methods

等级 Class	型号 Model	名称 Name	截面 Section (mm ²)	芯数 Core	额定电压 Rated voltage (V)
轻型 Light-duty	BTTQ	轻型铜芯铜护套矿物绝缘电缆 Light-duty copper sheathed mineral insulated cable with copper conductor	1.0-4.0	2-7	500 (500/500)
	BTTVQ	轻型铜芯铜护套防腐外套矿物绝缘电缆 Light-duty copper sheathed mineral insulated cable with copper conductor and anticorrosion sheath			
	BTTYQ	轻型铜芯铜护套无卤低烟外套矿物绝缘电缆 Light-duty copper sheathed mineral insulated cable with copper conductor and non-halogen low-smoke sheath			
重型 Heavy-duty	BTTZ	重型铜芯铜护套矿物绝缘电缆 Heavy-duty copper sheathed mineral insulated cable with copper conductor	1-400	1-19	750 (750/750)
	BTTVZ	重型铜芯铜护套防腐外套矿物绝缘电缆 Heavy-duty copper sheathed mineral insulated cable with copper conductor and anticorrosion sheath			
	BTTYZ	重型铜芯铜护套无卤低烟外套矿物绝缘电缆 Heavy-duty copper sheathed mineral insulated cable with copper conductor and non-halogen low-smoke sheath			

注: 1. 截面为25mm²以上的电缆均由单芯电缆组成, 具体规格表示方法详见附表1。

Notes: 1. Cables whose sectional areas are 25mm² above are made up of single-core cables, refer to table 1 for detailed expression methods of specification.

表示方法: Expression methods

- 例一: 截面为1.5mm², 3芯轻型铜芯铜护套矿物绝缘电缆表示为: BTTQ 3×1.5
eg.1: Sectional area is 1.5mm², 3-core light-duty copper sheathed mineral insulated cable with copper conductor, can be expressed as BTTQ 3*1.5
- 例二: 截面为300mm², 5芯重型铜芯铜护套矿物绝缘电缆表示为: BTTZ 5×(1×300)
eg.2: Sectional area is 300mm², 5-core heavy-duty copper sheathed mineral insulated cable with copper conductor, can be expressed as BTTZ 5*(1*300)
- 例三: 截面为35mm², 4芯重型铜芯铜护套防腐外套矿物绝缘电缆表示为: BTTVZ 4×(1×35)
eg.3: Sectional area is 35mm², 4-core heavy-duty copper sheathed mineral insulated cable with copper conductor and anticorrosion sheath, can be expressed as: BTTVZ 4*(1*35)

八、应用、设计注意事项 Notices for application and design

- 设计应用时, 矿物绝缘电缆与普通塑料电缆相比, 布线方式更简单, 占用空间更小, 敷设方式更多样, 只是型号不同而已。
- 电缆明敷在建筑物空间, 并有美观要求的场所时, 应设计成裸的, 也可根据场合要求外套选用不同颜色的塑料或无卤低烟料。
- 有氨及氢气或其它对铜有腐蚀作用的环境下, 应设计成有塑料护套的电缆。
- 带有塑料外套的电缆可同其它塑料类电缆共同敷设在同一桥架、电缆沟、电缆隧道或人能触及的场所, 但该裸电缆应单独敷设, 否则会对其他塑料等有机电缆造成影响。
- 电缆无需穿金属管, 单芯电缆不允许单独穿管, 特殊场合必须穿金属管的线路, 单芯电缆必须每组回路拼紧后再穿管, 而且应设计成有塑料护套的电缆。
- 由于该电缆载流能力大, 建议提高一个截面等级设计选用, 35mm²及以上可提高二个截面等级使用。
- 由于该电缆铜护套可以作接地线用, 建议以四芯矿物绝缘电缆用于三相五线制线路。
- 当考虑到整个线路需减少采用中间联接时, 可将截面为25mm²及以下的多芯电缆, 设计成单芯电缆(根数等于多芯电缆的芯数), 或将大规格单芯电缆设计成小规格单芯电缆双拼或多拼联接, 这样都可以使电缆长度成倍增加。
- 当某线路路径较长, 而在整个线路中有需用矿物绝缘电缆的部位, 也有用普通塑料电缆的部位时, 则可通过转接箱予以转换。
- 电缆可用分支箱分支矿物绝缘电缆。

1. When comparing with the general plastic cables, the MI cable is simpler in layout, occupies less space, has more layout methods, and they are different in model expression.

2. When the cables are exposed laid out in buildings where should be beautiful in appearance, it should be designed into bare type, also plastics of different colors or LSZH material is available for sheath according to the location.

3. It should be designed into the one with the plastic outer sheath when it is intended for environment with ammonia and ammonia gas or other matters that would erode copper.

4. The cable with plastic sheath can be laid out with other plastic cables in the same bridge tray, cable duct, cable tunnel or other touchable occasions, but this bare cable should be laid out separately, otherwise, it would affect other plastic or other organic cables.

5. The cable need not to be set in metal pipe, single-core cable is not allowed to be set in pipe alone, when it must be set in metal pipe for special occasions, the each circuit group of single-conductor cables should be arranged together compactly before being set in the pipe, and should be designed into the one with the plastic outer sheath.

6. As the cable has high current carrying capacity, it is advised to upgrade a sectional area class for designing and using, and that of exceeding and including 35mm² can be used by upgrading two sectional area classes.

7. As the copper sheath of cable can be used as ground wire, it is advised to use four-core MI cable for three-phase five-wire systems.

8. When considering that the whole line should employ less intermediate connection, just design the multi-core cables whose sectional area is 25mm² and below into single-core cables (cable number equals to the core number of multi-core cable), or design the large-specification single-core cable into small-specification single-core cable in doubled or more connection, so the cable length can be exponentially increased.

9. When a transmission route is rather long, and it requires both MI cable and general plastic cable, then transmitting box can be used for transition.

10. Cable branching box can be use to branch the mineral insulated cables.

九、“分支”型矿物绝缘电缆 “Branch” type MI cable

分支箱 Branch box

“分支”型矿物绝缘电缆由主干线、分支线和分支箱组成，其施工方便、安装简单，且分支点可根据工程现场需要作适量调整，而无需定位测量和安装。其在工厂及建筑工程中的广泛应用，不但可提高电气安全性，而且使工程造价大为降低。分支箱可进行“T”联接和“+”字联接，在主动线路中替代母线槽，可节约造价。在水平线路敷设中采用分支型，则可以转换电缆走向。

“Branch” type MI cable is composed of trunk line, branch line and branch box, it is convenient in construction, simple in installation, and the branch point can be adjusted appropriately according to the on-site condition, need not location survey or installation. Its wide application in factory engineering and construction works not only improves the electrical safety, but also cuts down the construction cost considerably. Branch box is able to make “T” shaped connection and “+” shaped connection, replacing the bus duct in main power line can cut down the cost. In horizontal layout, the cable's wiring direction can be changed by employing the branch type cable.

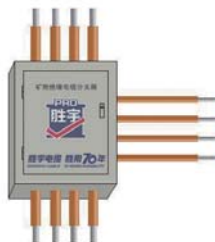
型号规格表示方法示例：

三相五线制供电系统中，铜护套做为地线，四根电缆截面为 300mm²，支线截面为16mm²，支线路数为7个，表示为：FZ-BTTZ 4(1×300)+7×(4×16)

Example for model and specification expression:

FZ-BTTZ 4(1×300)+7×(4×16)

In three-phase five-wire power supply system, copper sheath is used as earth wire, sectional area of four pieces of cable is 300mm², branch line is 16mm², branch line number is 7, it can be expressed as: FZ-BTTZ 4(1×300)+7×(4×16)



十、主要应用场所 Main application occasions

A. 公共建筑 Public buildings

- 公共娱乐场所 Public entertainment places
- 高层建筑 High-rise buildings
- 宾馆饭店 Hotels
- 医院、校、机关 Hospitals, schools, government units
- 百货商场、仓库 Department stores, warehouses
- 国家纪念馆和历史性建筑物 National memorials and buildings of historic interest
- 银行、邮电大楼 Banks, postal buildings
- 图书馆、博物馆、展览馆 Libraries, museums, exhibition halls
- 机场航站楼、车站、港口 Airport terminal buildings, stations, ports
- 电力调度楼、电信大楼 Power dispatching buildings telecommunication buildings

D. 地下场所 Underground buildings

- 地铁 Underground railways
- 地下仓库 Underground warehouses
- 隧道 Tunnels
- 地下广场 Underground squares

B. 高温场合 High-temperature situations

- 冶金工业 Metallurgical industry
- 焦炭行业 Coke industry
- 船舶工业 Shipbuilding industry
- 钢铁工业 Iron and steel industry
- 玻璃工业 Glass industry
- 其它高温场合的输配电线路
Transmission and distribution lines in other high-temperature situations

E. 运输和交通枢纽 Transportation and traffic junction

- 危险场所 Hazardous locations
- 石油化工工业 Petrochemical industry
- 炼油厂、加油站及油库 Refinery, filling station and oil house
- 制漆和颜料工业 Paint making and pigment industry
- 化工业 Chemical industry
- 核电站 Nuclear power station
- 海上石油平台 Offshore oil platform
- 天然气、煤气输送和压缩站 Natural gas, gas transportation and compression plant
- 医药工业 Medical industry
- 矿业、造纸业 Mining, paper industry
- 军事工业 Military industry

十一、附表（产品性能数据）Attached table (performance data)

说明：附表1-附表7中的载流量均摘自IEC 60364-5-52-2009《低压电气装置 第5-52部分：电气设备的选择和安装 布线系统》。

Remark: current-carrying capacities in attached table 1-attached table 7 are excerpted from IEC 60364-5-52-2009 Low-voltage electrical installations - Part 5-52: Selection and erection of electrical equipment - Wiring systems.

附表1 500V及750V级铜芯铜护套矿物绝缘电缆主要工程数据

Attached table 1 Main engineering data of copper-conductor copper sheathed mineral insulated cables of class 500V and 750V

导体芯数和标称截面 Core number of conductor and nominal sectional area	电缆外径 Overall diameter of cable		铜护套电阻20℃ Resistance copper sheath 20℃	成品电缆最大长度(仅供参考) Max length of finished cables (only for reference)	近似重量 Approximate weight		
	裸电缆 Bare cable	防腐外套电缆 Cable with anticorrosion outer sheath			裸电缆 Bare cable	防腐外套电缆 Cable with anticorrosion outer sheath	
mm ²	mm	mm	Ω/km	m	kg/km	kg/km	
轻载电缆 Light-duty cable 500V	2×1.0	5.1	6.7	3.95	150	104	125
	2×1.5	5.7	7.3	3.35	150	130	153
	2×2.5	6.6	8.2	2.53	150	179	205
	2×4.0	7.7	9.7	1.96	150	248	282
	3×1.0	5.8	7.4	3.15	150	135	159
	3×1.5	6.4	8.0	2.67	150	168	193
	3×2.5	7.3	10.1	2.23	150	224	258
	4×1.0	6.3	7.9	2.71	150	161	187
	4×1.5	7.0	9.0	2.33	150	203	230
	4×2.5	8.1	10.1	1.85	150	278	314
	7×1.0	7.6	9.6	2.06	250	172	207
	7×1.5	8.4	10.4	1.78	200	294	331
	7×2.5	9.7	11.7	1.36	160	413	455
	重载电缆 Heavy-duty cable 750V	1×1.5	4.9	6.5	4.13	500	88
1×2.5		5.3	6.9	3.71	500	114	135
1×4.0		5.9	7.5	3.09	500	140	162
1×6.0		6.4	8.0	2.67	500	172	198
1×10		7.3	9.3	2.23	450	235	258
1×16		8.3	10.3	1.81	350	319	356
1×25		9.6	11.6	1.40	260	451	439
1×35		10.7	12.7	1.17	220	573	619
1×50		12.1	14.1	0.959	180	764	816
1×70		13.7	15.7	0.767	170	1018	1076

该数据为电缆最大生产长度，交货时以实际生产长度为准
This data is the max production length of cable, please take the actual length as standard for delivery.

续附表 1 Attached table 1

导体芯数和标称截面 Core number of conductor and nominal sectional area	电缆外径 Overall diameter of cable		铜护套电阻20°C Resistance copper sheath 20°C	成品电缆最大 长度(仅供参考) Max length of finished cables (only for reference)	近似重量 Approximate weight		
	裸电缆 Bare cable	防腐外套电缆 Cable with anticorrosion outer sheath			裸电缆 Bare cable	防腐外套电缆 Cable with anticorrosion outer sheath	
mm ²	mm	mm	Ω/km	m	kg/km	kg/km	
重载电缆 Heavy-duty cable 750V	1×95	15.4	17.8	0.646	140	1298	1386
	1×120	16.8	19.2	0.556	120	1576	1674
	1×150	18.4	20.8	0.479	100	1890	1997
	1×185	20.4	23.2	0.412	80	2323	2468
	1×240	23.3	26.1	0.341	60	3031	3197
	1×300	26.0	—	0.280	45	3832	—
	1×400	30.0	—	0.223	35	5228	—
	2×1.5	7.9	9.9	1.90	250	212	243
	2×2.5	8.7	10.7	1.63	200	260	298
	2×4.0	9.8	11.8	1.35	185	342	385
	2×6.0	10.9	12.9	1.13	160	427	474
	2×10	12.7	14.7	0.887	140	582	636
	2×16	14.7	16.7	0.695	110	845	907
	2×25	17.1	19.5	0.546	80	113	1238
	3×1.5	8.3	10.3	1.75	220	242	274
	3×2.5	9.3	11.3	1.47	190	311	352
	3×4.0	10.4	12.4	1.23	165	399	444
	3×6.0	11.5	13.5	1.03	150	507	556
	3×10	13.6	15.6	0.783	130	728	786
	3×16	15.6	18.0	0.622	110	980	1069
	3×25	18.2	20.6	0.500	75	1370	1476
	4×1.5	9.1	11.1	1.51	185	298	333
	4×2.5	10.1	12.1	1.29	175	367	411
	4×4.0	11.4	13.4	1.04	150	472	521
	4×6.0	12.7	14.7	0.887	170	623	677
	4×10	14.8	16.8	0.690	110	861	923
	4×16	17.3	19.7	0.533	95	1275	1376
	4×25	20.1	22.9	0.423	80	1766	1909
	7×1.5	10.8	12.8	1.15	150	409	455
	7×2.5	12.1	14.1	0.959	120	562	614
12×1.5	14.1	15.6	0.744	160	706	774	
12×2.5	15.6	17.6	0.630	150	907	997	
19×1.5	16.6	18.6	0.570	110	982	1077	

该数据为
电缆最大
生产长度，
交货时以
实际生产
长度为准
This data is
the max
produc-
tion length
of cable,
please take
the actual
length as
standard
for
delivery.

附表2 500V及750V级铜芯铜护套矿物绝缘裸或防腐外套电缆，允许人接触的铜护套温度：70°C/环境温度：30°C(沿墙、楼板、线槽、穿管)

Attached table 2 Copper-conductor copper sheathed mineral insulated bare cable or cable with anticorrosion sheath of class 500V and 750V, touchable temperature of coppersheath: 70°C/ambient temperature: 30°C (along the walls, floors, line ducts, pipes)

载流量 A Current carrying capacity A				
导体标称截面 Nominal sectional area of conductor mm ²	两根导体(单相)两芯或单芯电缆 Two pieces of conductor (single-phase) two-core or single-core cable		三根导体 (三相) Three pieces of conductor (three-phase)	
	多芯或单芯电缆三角形排列 Multi-core or single-core cable Triangle arrangement		单芯电缆平列 Single-core cable Side-by-side arrangement	
	1	2	3	
(轻载) Light-duty 500V	1.5	23	19	21
	2.5	31	26	29
	4	40	35	38
重载 Heavy-duty 750V	1.5	25	21	23
	2.5	34	28	31
	4	45	37	41
	6	57	48	52
	10	77	65	70
	16	102	86	92
	25	133	112	120
	35	163	137	147
	50	202	169	181
	70	247	207	221
	95	296	249	264
	120	340	286	303
150	388	328	346	
185	440	371	392	
240	514	434	457	

注：1.对于单芯电缆，回路中各电缆的铜护套在两端连接在一起。
2.对于易触及的裸电缆，表列数值应乘以0.9。
Notes: 1. For single-core cables, copper sheaths are connected on the two ends.
2. For touchable bare cables, the listed data should be multiplied by 0.9.



附表3 500V及750V级铜芯铜护套矿物绝缘裸或防腐外护套电缆，不允许人接触的铜护套温度：105°C/环境温度：30°C（沿墙、楼板、线槽、穿管）

Attached table 3 Copper-conductor copper sheathed mineral insulated bare cable of class 500V and 750V, untouchable temperature of copper sheath: 105°C/ambient temperature: 30°C (along the walls, floors, line ducts, pipes)

载流量 A Current carrying capacity A				
导体标称截面积 Nominal sectional area of conductor mm ²	两根导体(单相)两芯或单芯电缆 Two pieces of conductor (single-phase) two-core or single-core cable		三根导体 (三相) Three pieces of conductor (three-phase)	
	多芯或单芯电缆三角形排列 Multi-core or single-core cable Triangle arrangement		单芯电缆平列 Single-core cable Side-by-side arrangement	
		或 		或
	1	2	3	
(轻载) Light-duty 500V	1.5	28	24	27
	2.5	38	33	36
	4	51	44	47
(重载) Heavy-duty 750V	1.5	31	26	30
	2.5	42	35	41
	4	55	47	53
	6	70	59	67
	10	96	81	91
	16	127	107	119
	25	166	140	154
	35	203	171	187
	50	251	212	230
	70	307	260	280
	95	369	312	334
	120	424	359	383
	150	485	410	435
	185	550	465	492
	240	643	544	572

注：1.对于单芯电缆，回路中各电缆的铜护套在两端连接在一起。

2.成组电缆不需要乘校正系数。

Notes: 1. For single-core cables, copper sheaths are connected on the two ends.

2. Group cables need not to be multiplied by correction coefficient.

附表4 500V及750V级铜芯铜护套矿物绝缘裸或防腐外护套电缆，允许人接触的铜护套温度：70°C/环境温度：30°C（自由空气）

Attached table 4 Copper-conductor copper sheathed mineral insulated bare cable or cable with anticorrosion sheath of class 500V and 750V, touchable temperature of copper sheath: 70°C/ambient temperature: 30°C (Free air)

载流量 A Current carrying capacity A						
导体标称截面积 Nominal sectional area of conductor mm ²	两根导体(单相)两芯或单芯电缆 Two pieces of conductor (single-phase) two-core or single-core cable		三根导体 (三相) Three pieces of conductor (three-phase)			
	多芯或单芯电缆三角形排列 Multi-core or single-core cable Triangle arrangement		单芯电缆平列 Single-core cable Side-by-side arrangement	单芯电缆垂直有间隙 Single-core cable Vertical with clearance	单芯电缆水平有间隙 Single-core cable Horizontal with clearance	
		或 				
	1	2	3	4	5	
(轻载) Light-duty 500V	1.5	25	21	23	26	29
	2.5	33	28	31	34	39
	4	44	37	41	45	51
(重载) Heavy-duty 750V	1.5	26	22	26	28	32
	2.5	36	30	34	37	43
	4	47	40	45	49	56
	6	60	51	57	62	71
	10	82	69	77	84	95
	16	109	92	102	110	125
	25	142	120	132	142	162
	35	174	147	161	173	197
	50	215	182	198	213	242
	70	264	223	241	259	294
	95	317	267	289	309	351
	120	364	308	331	353	402
	150	416	352	377	400	454
	185	472	399	426	446	507
	240	552	466	496	497	565

注：1.对于单芯电缆，回路中各电缆的铜护套在两端连接在一起。

2.对于易触及的裸电缆，表列数值应乘以0.9。

Notes: 1. For single-core cables, copper sheaths are connected on the two ends.

2. For touchable bare cables, the listed data should be multiplied by 0.9.



附表5 500V及750V级铜芯铜护套矿物绝缘裸或防腐外护套电缆，不允许人接触的铜护套温度：105°C/环境温度：30°C（自由空气）

Attached table 5 Copper-conductor copper sheathed mineral insulated bare cable of class 500V and 750V, untouchable temperature of copper sheath: 105°C/ambient temperature: 30°C (Free air)

载流量 A Current carrying capacity A						
导体标称截面积 Nominal sectional area of conductor mm ²	两根导体(单相) Two pieces of conductor (single-phase) two-core or single-core cable		三根导体 (三相) Three pieces of conductor (three-phase)			
	多芯或单芯电缆 三角形排列 Multi-core or single-core cable Triangle arrangement		单芯电缆平列 Single-core cable Side-by-side arrangement	单芯电缆 垂直有间隙 Single-core cable Vertical with clearance	单芯电缆 水平有间隙 Single-core cable Horizontal with clearance	
	1	2	3	4	5	
(轻载) Light-duty 500V	1.5	31	26	29	33	37
	2.5	41	35	39	43	49
	4	54	46	51	56	64
(重载) Heavy-duty 750V	1.5	33	28	32	35	40
	2.5	45	38	43	47	54
	4	60	50	56	61	70
	6	76	64	71	78	89
	10	104	87	96	105	120
	16	137	115	127	137	157
	25	179	150	164	178	204
	35	220	184	200	216	248
	50	272	228	247	266	304
	70	333	279	300	323	370
	95	400	335	359	385	441
	120	460	385	411	441	505
	150	526	441	469	498	565
	185	596	500	530	557	629
	240	697	584	617	624	704

注：1.对于单芯电缆，回路中各电缆的铜护套在两端连接在一起。

2.成组电缆不需要乘校正系数。

Notes: 1. For single-core cables, copper sheaths are connected on the two ends.

2. Group cables need not to be multiplied by correction coefficient.

附表6 500V及750V级铜芯铜护套矿物绝缘电缆空气中（环境温度不等于30°C时）的校正系数，应用于空气中敷设的电缆的载流量。

Attached table 6 Correction coefficient of copper-conductor copper sheathed mineral insulated cable of class 500V and 750V in the air (ambient temperature not equal to 30°C), can be applied to the current-carrying capacity of cables laid out in the air.

环境温度°C Environment temperature °C	防腐护套裸电缆，允许人接触70°C Bare cable with anticorrosion sheath, touchable 70°C	裸电缆 不允许人接触105°C Bare cable Untouchable 105°C
10	1.26	1.14
15	1.20	1.11
20	1.14	1.07
25	1.07	1.04
35	0.93	0.96
40	0.85	0.92
45	0.87	0.88
50	0.67	0.84
55	0.57	0.80
60	0.45	0.75
65	?	0.70
70	?	0.65
75	?	0.60
80	?	0.54
85	?	0.47
90	?	0.40
95	?	0.32

附表7 500V及750V级铜芯铜护套矿物绝缘电缆多回路或多根芯电缆成组校正系数，在应用于线管中或线槽中的电缆以及明敷电缆束时参照额定值。

Attached table 7 When is applied to cables in line pipes or line ducts as well as exposed laying cable bunch, refer to the rated value for the group correction coefficient of multi circuits of copper-conductor copper sheathed mineral insulated cable of class 500V and 750V or multi-core cable.

项 Item	电缆的排列 Arrangement of cable	校正系数 Correction coefficient												
		回路或多芯电缆的数量 Quantity of circuit or multi-core cable												
		1	2	3	4	5	6	7	8	9	12	16	20	
1	成束明敷或封闭在线管或线槽内 Exposed laying in bunch or enclosed in line pipe or line duct	1.00	0.80	0.70	0.65	0.60	0.57	0.54	0.52	0.50	0.45	0.41	0.38	
2	单层敷设在墙上、楼板或无孔托盘上 Lay out single layer on wall, floor or hole-free tray	1.00	0.85	0.79	0.73	0.75	0.72	0.72	0.71	0.70	0.70	0.70	0.70	
3	单层直接敷设在木制接板上 Lay out single layer on wooden floor directly	0.95	0.81	0.72	0.68	0.66	0.64	0.63	0.62	0.61	0.61	0.61	0.61	
4	单层敷设在垂直或水平的托盘上 Lay out single layer on vertical or horizontal tray	1.0	0.88	0.82	0.77	0.75	0.73	0.73	0.72	0.72	0.72	0.72	0.72	
5	单层敷设在梯型支撑或夹板等 Lay out single layer on ladder type support or plywood	1.0	0.87	0.82	0.80	0.80	0.79	0.79	0.78	0.78	0.78	0.78	0.78	

注：1. 表列系数适用于相同负载的均匀成组电缆。

2. 相邻电缆之间的水平间隙大于二倍电缆总直径时，不需要乘降低系数。

Notes: 1. The listed coefficients are suitable for uniform group cables that are same in load.

2. When horizontal clearance between two adjacent cables is larger than two times of overall diameter of cable, it need not to be multiplied by the reduction coefficient.

电缆附件

1. 终端

电缆在安装使用时，需采用一种永久性的终端连接器。终端由两种作用：一是使电缆绝缘材料（氧化镁）与外界隔离起密封用途，二是将电缆连接到开关柜或用设备上。即由二部份构成：

密封部分：一般由黄铜罐（或热收缩管）、罐盖、密封材料和导体的绝缘 绝缘套管所组成。

压盖部分：一般由压盖本体、压缩环和压盖螺母所组成。

安装施工方法

① 将电缆按所需长度先用管子割刀在上面割一道痕线（图1、铜护套不能割断），再用斜口钳将护套铜皮夹在钳口之间按顺时针方向扭转，一步步地夹住护套铜皮的边并以较小角度进行转动剥离，直至割痕处（图2）。

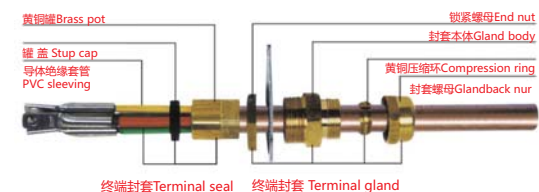
② 用清洁的干布彻底清除外露导线上的氧化镁绝缘材料，然后用绝缘测试仪进行绝缘电阻预量，达到要求后，将束头套在电缆上，并将黄铜封杯垂直打在电缆护套铜皮上（图3）。开始时应用手束拧，并用束头在封杯上滑动来检查封杯的垂直度。确认垂直后再用管钳夹住封杯的滚花 续 进行安装，直至护皮一端低于封杯内局部螺纹处。

③ 从约距电缆敞开端600mm处用喷灯火焰加热电缆，并将火焰不断地移向电缆敞开端，以便将水分排除干净，切记只可向电缆终端方向移动火焰，否则将会把水分驱回电缆内部（图4）。

④ 用欧姆表分别测量一下芯与芯、芯与护套之间绝缘电阻，若测量结果在200MΩ以上，则可以在封杯内注入封口膏（图5）。注意封口膏应从一侧逐渐加入，不能太快，以便将空气排空。等封口膏加满，再压上杯盖，接着用热 缩套管把线芯套上，并热缩（图6）。最后用欧姆表再测量一下绝缘电阻，如果绝缘偏低，则重新再做一次。



终端 Terminal

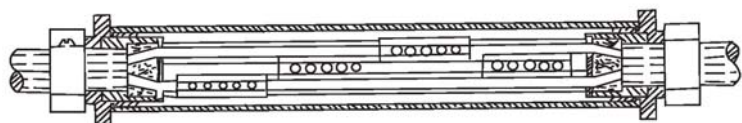


2. 中间连接器

由于矿物绝缘电缆生产长度受原材料（铜护套用铜管的长度）长度的限制，所以在电缆敷设安装过程中，需采用中间连接器将二根相同规格电缆联在一起，以保证满足线路长度的需要。该连接器的二端均由内螺纹无缝铜管、黄铜罐 或热缩性套管、铜压接管和绝缘热收缩套管所组成。如图所示。



注意：在安装有外护的防火电缆时，必须使用热缩套管将整个联接组件起来，对于芯电缆中间的联接应该注意每根线芯之间联接位置的交错。如下图所示。



3. 施工器具

所需施工工具及测量仪器有：锯弓、管子割刀、斜口钳、喷灯、螺丝刀、管丝钳、强力机械压钳（液压钳）、欧姆表等。

4. 问题和解决办法

- 问题：**绝缘电阻低
原因一：进入水份
解决办法：加热电缆端部排除水份（图4）
原因二：封口膏有气泡。
解决办法：再从封杯的一侧加入稍微过量的封口膏（注意：封膏时电缆的温度不能超过200t）。
原因三：封口膏注入时落入污染物。
解决办法：随时观测清洁度，遵守清洁度要求，或清除后重新注入。
- 问题：**导线接地故障
解决办法：清除拧紧封杯时所产生的细金属丝，重新固定线芯位置。
- 问题：**导线交叉或绞合
解决办法：在装封杯盖之前将导线拉直。

5. 型号及表示方法

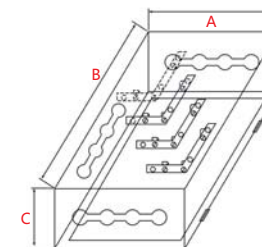
型号及规格

系列代号	型号					规格
	终端	中间联接器	重型	轻型	防腐外套	
SY	ZA	L	Z	Q	V	相应电缆的表示规格

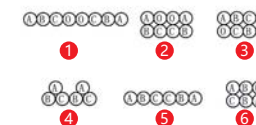
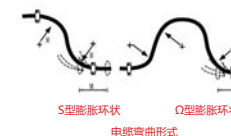
表示方法

- 例一：截面为1.5mm² 3芯轻型铜芯铜护套矿物绝缘电缆的终端表示为：SY-ZA-Q-3×1.5
 例二：截面为25mm² 4芯重型铜护套矿物绝缘电缆的中间联接器表示为：SY-L-Z-4×25

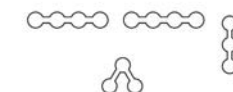
6. 接线箱



型号	A MM	B MM	C MM	电缆规格 mm ²
TB-FZX-1	250	340	160	1×16 ~ 1×35
TB-FZX-2	275	340	180	1×50 ~ 1×19
TB-FZX-3	350	340	180	1×120 ~ 1×240
TB-FZX-4	370	400	220	1×300 ~ 1×400



为减少电流损耗的多种单芯电缆排列图



柜、箱面板开孔方

设计、选用注意用项

1. 合理选定电缆规格

充分应用该电缆载流能力大的优点，建议提高一个截面等级选用。

充分利用该电缆铜护套可以作接地线的优点，建议减少一个线芯选用（指有接地线的三相以上线路）。

由于矿物绝缘电缆生产长度受到电缆原材料（铜护套用铜管长度）长度的限制，当您考虑到整个线路可以减少采用中间联接器时，可将截面为25mm²及以下的多芯电缆，设计成单芯电缆（根数等于多芯电缆的芯数），或将大规格单芯电缆设计成小规格单芯电缆双拼联接，这样都可以使电缆长度成倍增加。

2. 电缆的敷设方式

可以沿墙、支架、梯级桥架明敷。
 可以与其它塑料电缆共同敷设有同一桥架、竖井、电缆沟、电缆隧道等场所。

可以埋地敷设，但最好不要有中间接头，如无法避免，则接头处须做好防水处理。

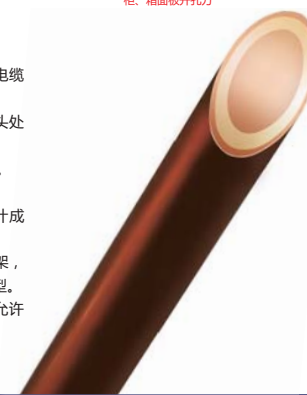
明敷在建筑物空间中有美观要求的专场所，应设计成BTTVZ型。

特殊场合必须穿金属管的线路，应设计成BTTVZ型。

有氨及氨气或其它对铜有强烈腐蚀作用的化 环境，应设计成BTTVZ型。

电缆最高使用温度超过70C，且同其它塑料电缆敷设在同一桥架，电缆沟、电缆隧道或人能触及的场所及的场所时，应设计成BTTVZ型。

电缆全长均为直线敷设或联接用电器可能产生振动时，要在允许的场合设置膨胀环。



3. 电缆固定间距和弯曲半径见表1和表2

表1 电缆敷设固定间距

电缆外径 (mm)	固定点之间最大间距	
	水平敷设 (mm)	垂直敷设 (mm)
D<9	600	800
D≥9	900	1200
D≥15	1500	2000
D≥20	2000	2500

表2 电缆设弯曲半径

电缆外径D (mm)	电缆内侧最小弯曲半径R (mm)
4~7	2D
>7~12	3D
>12~15	4D
>15	5D

4 一般使用时矿物绝缘电缆无需穿管，特殊场合必须穿管的，可参照表3选用。单芯电缆不允许单独穿金属管道敷设。

表3 穿管表

单芯电缆			
电缆规格 (芯数×截面)	穿管规格		
	二根电缆	三根电缆	四根电缆
1×10	Sc25	Sc25	Sc40
1×16	Sc25	Sc25	Sc50
1×25	Sc32	Sc32	Sc50
1×35	Sc32	Sc32	Sc65
1×50	Sc40	Sc40	Sc65
1×70	Sc40	Sc50	Sc80
1×95	Sc50	Sc50	Sc80
1×120	Sc50	Sc65	Sc100
1×150	Sc65	Sc65	Sc100

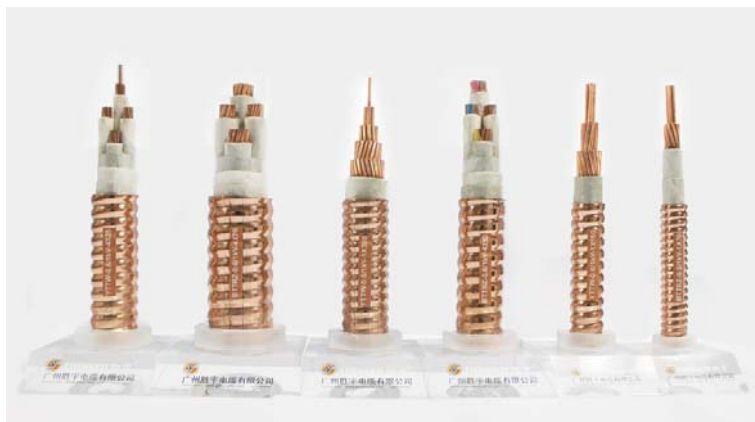
多芯电缆							
电缆规格 (轻载)	穿管规格	电缆规格 (轻载)	穿管规格	电缆规格 (重载)	穿管规格	电缆规格 (重载)	穿管规格
2×1	Sc15	7×2.5	Sc20	2×1.5	Sc15	3×6	Sc25
2×1.5	Sc15	10×1.5	Sc25	2×2.5	Sc15	3×25	Sc32
2×2.5	Sc15	12×1.5	Sc25	2×4	Sc20	4×1.5	Sc15
2×4	Sc15	19×1.5	Sc32	2×6	Sc20	4×2.5	Sc20
3×1	Sc15	21×1.5	Sc32	2×10	Sc20	4×4	Sc20
3×1.5	Sc15			2×16	Sc25	4×6	Sc20
3×2.5	Sc15			2×25	Sc32	4×10	Sc25
4×1	Sc15			3×1.5	Sc15	4×16	Sc32
4×1.5	Sc15			3×2.5	Sc15	4×25	Sc40
4×2.5	Sc15			3×4	Sc20	7×1.5	Sc20
7×1	Sc15			3×6	Sc20	7×2.5	Sc20
7×1.5	Sc15			3×10	Sc25		

金属护套铜无机矿物质电缆

MINERAL INSULATED CABLES



铜芯轧纹铜护套无机矿物绝缘电缆(YTTW、BTTRZ) MINERAL INSULATED CABLES WITH A RATED VOLTAGE NOT EXCEEDING 0.6/1KV

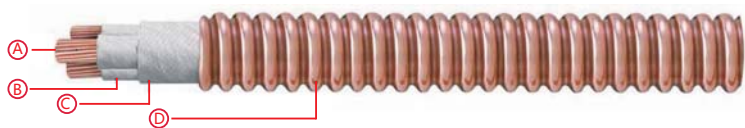


一、柔性防火电缆的结构 structure of flexible fireproof cable

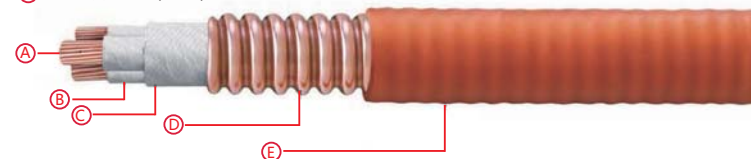
- ① 电缆导体：有多股铜线绞合而成，具有良好的弯曲特性。
- ② 绝缘层：采用耐高温，不燃烧的无机绝缘材料。
- ③ 铜护套：铜质材料，经特殊加工有良好的弯曲特性，并作为PE线。
- ④ 外护层：采用低烟无毒的塑性材质，有良好的防腐蚀特性。

1. Cable conductor: it is made up of stranded copper wires, with favorable flexural property.
2. Insulation layer: it adopts high-temperature resistant inorganic insulating materials
3. Copper sheath: copper materials, through special machining, with favorable flexural property, used as PE wire.
4. Outer sheath: it is made of plastic materials of low-smoke non-toxicity, with favorable corrosion protection.

- Ⓐ 绞合铜导体 Stranded copper conductor
- Ⓑ 无机绝缘材料 Inorganic insulation
- Ⓒ 无机纤维填充料 Inorganic fiber packing material
- Ⓓ 铜护套 Copper sheath



- Ⓐ 绞合铜导体 Stranded copper conductor
- Ⓑ 无机绝缘材料 Inorganic insulation
- Ⓒ 无机纤维填充料 Inorganic fiber packing material
- Ⓓ 铜护套 Copper sheath
- Ⓔ 低烟无毒外护套 (可选) Outer sheath



二、柔性防火电缆型号 Model of flexible fireproof cable



例1: YTTW-0.6/1kV-(4×50)

表示：4芯，4根50mm² 截面的柔性 防火电缆。

例2: YTTW-0.6/1kV-4×1×185)

表示：4根 单芯150mm² 截面拼凑的 柔性防火电缆。

eg.1: YTTW-0.6/1kV-(4×50)

It means 4 flexible fireproof cables of 50mm² in sectional area.

eg.2: YTTW-0.6/1kV-4×1×185)

It means 4 flexible fire-proof cables single core of 150mm² in cross section.

三、柔性防火电缆的耐火特性

Re-resistant property of flexible fireproof cable

1. 按国家标准，电线电缆燃烧试验方法耐火特性试验GB/T 19216.21-2003

- Ⓐ 选用火焰温度950°C~1000°C，燃烧时间为180min，线路保持完整。

2. 按英国BS6378标准，柔性防火电缆能满足以下要求：

- Ⓐ 单纯耐火C级：950°C 180min
 - Ⓑ 耐火加水W级：650°C 15min
 - Ⓒ 耐火加机械振动Z级：950°C 15min
- 以上测试按顺序在同一根试验上进行。

1. According to national standards, fire-resistant wire and cable fire test method characteristic test, According to GB/T 19216.21-2003/IEC 60331-21:1999
Class A. burn in fire with flame temperature 950°C, apply voltage of 750V between phase and phase and between phase and outer sheath, It should be able to withstand for 90min without breakdown.
Class B. bun in fire with flame temperature 750-800°C, ap-ply voltage of 750V between phaseand phase and between phase and sheath, it should be able to withstand for 90min without breakdown.

2. According to the BS6378, flexible fireproof cable satisfies the following requirements:

- Class A 650°C 3h
- Class B 750°C 3h
- Class C 950°C 3h
- Class S 950°C 20min

四、柔性防火电缆的优点 Advantages of flexible fireproof cable

- ① 防火性能优异，耐火等级不仅满足国标GB/T19216.21-2003要求1000℃、180min，还可满足英国BS6387:2013中规定的C、W、Z三项试验（耐火C级950℃ 180min、喷淋W级650℃ 15min、冲击Z级950℃ 15min）；
- ② 连续长度长，不管是单芯，还是多芯电缆，其长度能满足供电长度需要，每根连续长度可达1000m以上；
- ③ 截面大，单芯电缆截面可达630mm²，多芯电缆截面可达70mm²；
- ④ 具有柔性，电缆可以盘在电缆盘上，其弯曲半径6-10D, (D为电缆外径)！
- ⑤ 燃烧时无烟无毒，绝缘采用无机材料（不燃烧体），燃烧时不会产生任何有害气体，更不会发生2次污染，称得上是环保绿色产品；
- ⑥ 过载能力大，电缆不仅载流量大，而且具有较大的过载能力。根据布线要求，通常电缆表面温度名≤70℃，若布线不可触摸，也不与可燃建筑材料相接触时，电缆护套温度可提高105℃。过载时防火电缆长期工作温度可达250℃；
- ⑦ 耐腐蚀，有机绝缘耐火电缆有时需穿塑料管或铁管，塑料管易老化变脆，铁管易锈蚀，防火电缆有铜护套不须穿管，铜护套耐腐蚀性好；
- ⑧ 无电磁干扰，防火电缆与信息、控制等线在同一竖井中敷设时，在铜护套的屏蔽下，不会对信号、控制电线电缆传输的信息产生干扰；
- ⑨ 安全性好，防火电缆能在火焰中正常供电，启动灭火设备，减少火灾损失，对人身安全也特别可靠，其铜护套是优良导体，是最好的接地PE线，且连续到电缆全长，大大提高 接地保护灵敏度与可靠性；

1. Excellent fireproof property, the fireproof rating not only satisfies the national standard GB12666.6: category A 950°C 90min, but also meet up with the U.K. standard BS6387-1994: Class A 650°C3h; class B 750°C3h; class C 950°C 3h; meanwhile, it also is able to withstand the water spraying or mechanical strike;

2. Long continuous length: the length can satisfy the length demand for power supply in spite of single-core or multi-core cable, and continuous length of each cable can be as long as 1,000m.

3. Large sectional area, sectional area of single-core cable reaches 630mm² and that of multi-core cable reaches 70mm²;

4. Property of flexibility, the cable can be wound on the cable reel, with the bending radius 6-10D, (D is the outer diameter of cable) :

5. Smoke-free non-toxicity when burning, it adopts inorganic materials (non-inflammable materials) for insulation, its burn-ing would not produce any harmful gas or secondary pollution, it is a environmental protection product;

6. High overload capacity, the cable not only is high in current carrying capacity, but also has large overload capacity. According to the wiring requirements, the surface temperature of cable usually is ≤70°C, if it will not be touched or will not contact with flammable building materials, the temperature of cable sheath can be heighten to 105°C. When coming across overload, long-term working temperature of fireproof cable can reach 250°C.

7. Property of corrosion proof, organic insulated fireproof cable requires plastic tube or iron tube sometimes, the plastic tube is liable to deteriorate and iron tube is apt to rust or erode, but the fireproof cable has copper sheath and the tube is need-less, besides, copper sheath has favorable corrosion resistance;

8. Free of electromagnetic interference, when wiring in the same vertical shaft with information wire and control wire, because of shielding of copper sheath, the fireproof cable would not interfere the single and control wires or cables;

9. Favorable safeness, it is able to supply power and start the fire extinguishing apparatus normally in flame, it reduces fire damage. Besides, it is reliable for personnel safety, as its copper sheath is a kind of good conductor, is the best earthed PE wire, and covers the whole cable, The life of up to 100 years;

⑩ 使用寿命长，无机绝缘材料耐高温，且不易老化，他的寿命比有机绝缘电缆高许多倍，在正常工作状态下，其寿命可达100年以上；

⑪ 柔性防火电缆的包装运输和安装及配件近似于普通电缆，较简单；

⑫ 经济性好，柔性防火电缆由于制作工艺先进，安装简单，在同等条件下其综合费用比矿物绝缘电缆的费用明显降低。

10. Long service life, high-temperature resistance and degradation-resistance of inorganic insulated material, its service life is many times of that of organic insulated cables, under normal working conditions, its service life can be as long as that of buildings;

11. Transportation and packaging of flexible fireproof cables including installation fittings are simple, nearly the same as that of general cables;

12. Favorable economical efficiency, due to advanced manufacturing processes and simple installation, overall cost of flexible fireproof cable is much lower than that of mineral insulated cable under the same conditions.

五、柔性防火电缆的电气特性 Electrical characteristics of flexible fireproof cable

1. 额定电压：0.6/1kV；
2. 额定工作电压：轻载500V,重载750V；
3. 额定电流：单芯25A-1800A，多芯16A-500A；
4. 绝缘电阻：绝缘电阻>1000MΩ·km，电缆长度小于100m，则绝缘电阻>10000MΩ；
5. 工频耐压：500V等级电缆和750V等级电缆分别施加2000V和2500V电压在相与相，相与铜护套之间，历时15min，不应发生击穿。

1. Rated voltage: 0.6/1 kV;
2. Rated working voltage: light load 500V, heavy load 750V;
3. Rated current: single-core 25A-1,800A; multi-core 16A-500A;
4. Insulation resistance: insulation resistances 1,000MΩ·km. Cable length less than 100m, then the insulation resistance > 10,000MΩ;
5. Power frequency withstand voltage: apply voltage of 2,000V and 2,500V between phase and phase as well as phase and copper sheath of cables of 500V and 750V respectively, they should be able to withstand for 15min without being broken down.

六、柔性防火电缆的制造标准

Manufacturing standards of flexible fireproof cable

中华人民共和国建筑工业行业标准 JG/T 313-2014

额定电压0.6/1kV及以下金属护套无机矿物绝缘电缆及终端。

Metal sheath inorganic mineral insulated cables and their terminations with a rated voltage not exceeding 0.6/1 kv.

七、柔性防火电缆的规格及其参数(见表1-表9)

Specifications and parameters of flexible fireproof cable (refer to table 1 -table 9)

表1. 电缆结构尺寸 Table 1. Structural dimension of cable

导体标称截面 Nominal section of conductor mm ²	导体结构 根/直径 Conductor structure Pcs./dia.	导体标称直径 Nominal diameter of conductor mm	绝缘标称厚度 Nominal insulation thickness mm	金属护套厚度 Thickness of metallic sheath mm				电缆外径 O.D. of cable mm			
				1芯 1-core	2芯 2-core	3芯 3-core	4芯 4-core	1芯 1-core	2芯 2-core	3芯 3-core	4芯 4-core
1	1/1.13	1.13	0.80	0.4	0.4	0.4	0.4	4.13	6.46	6.76	7.26
1.5	1/1.38	1.38	0.80	0.4	0.4	0.4	0.4	4.38	6.96	7.30	8.06
2.5	1/1.78	1.78	0.80	0.4	0.4	0.4	0.4	4.98	7.96	8.80	9.90
4	1/2.25	2.25	0.80	0.4	0.4	0.4	0.4	5.26	9.30	10.20	11.00
6	1/2.76	2.76	0.80	0.4	0.4	0.4	0.4	5.96	10.70	11.30	12.60
10	7/1.34	4.02	1.00	0.4	0.4	0.4	0.4	7.8	14.20	14.80	16.90
16	7/1.68	5.04	1.00	0.4	0.4	0.4	0.4	8.8	16.80	17.70	19.20
25	7/2.12	6.36	1.00	0.4	0.5	0.5	0.5	10.50	19.30	20.40	22.20
35	7/2.50	7.50	1.10	0.4	0.5	0.5	0.5	11.50	21.55	22.70	24.90
50	19/1.76	8.80	1.20	0.5	0.5	0.5	0.5	13.60	19.70	22.80	25.00
70	19/2.12	10.60	1.20	0.5	0.5	0.6	0.6	15.30	21.90	25.60	28.20
95	19/2.50	12.50	1.20	0.5	0.5	0.6	0.6	18.30	24.10	28.50	32.20
120	37/2.02	14.14	1.20	0.5	0.5	0.6	0.6	19.80	25.00	31.30	35.00
150	37/2.25	15.75	1.40	0.5	0.6	0.6	—	21.80	28.50	33.90	—
185	37/2.60	17.50	1.40	0.5	0.6	—	—	23.40	30.80	—	—
240	37/2.87	20.09	1.40	0.6	0.6	—	—	26.10	34.20	—	—
300	61/2.50	22.50	1.60	0.6	—	—	—	28.80	—	—	—
400	61/2.80	25.20	1.60	0.6	—	—	—	31.70	—	—	—
500	61/3.20	28.80	1.80	0.6	—	—	—	36.20	—	—	—
630	61/3.60	32.40	2.00	0.6	—	—	—	40.00	—	—	—

注：

- *4芯导体也可由二种截面尺寸搭配组成3+1芯特殊结构电缆，电缆的外径则按组成计算。
- 电缆采用紧压线芯时，导体的直径应是标称直径的95%；金属护套外径则作相应调整而变小。增强绝缘时，电缆外径约增加5%。
- 特殊大规格2芯或3芯电缆，为减小电缆外径，导体线芯可采用半圆形或扇形。
- 经轧纹处理的铜护套厚度，将适当变薄，但应满足作为PE的电气性能要求；若铜护套不作PE线要求，只须保证其机械强度。

Notes：

- *4-core conductor may adopt two different sectional areas and combine into special structured 3+1-core cable, outer diameter of cable can be calculated based on the combination.
- When the cable employs compressed cores, diameter of cable should be 95% of nominal diameter; outer diameter of metallic sheath should be adjusted correspondingly. When enhancing the insulation, outer diameter of cable is increased for about 5%.
- For special large-spec. 2-core or 3-core cables. It can adopt hemicycle or sector conductor core to reduce the outer diameter of cables.
- Thickness of copper sheath after corrugation treatment will be thinner, but should be able to satisfy the electrical requirements of PE; if the copper sheath will not be used as PE wire, it will be only required to guarantee its mechanical strength.

表2. 电缆导体和铜护套在20℃时的直流电阻

Table 2. DC resistance of cable conductor and copper sheath at 20°C

导体标称截面 Nominal section of conductor mm ²	导体结构 根/直径 Conductor structure Pcs./dia.	导体计算截面 Calculation of conductor section mm	20℃导体电阻 Ω/km 不大于 Conductor resistance Ω/km at 20°C not more than	20℃铜护套计算电阻值Ω/km Calculation of resistance Ω/km of copper sheath at 20°C			
				1芯 1-core	2芯 2-core	3芯 3-core	4芯 4-core
1	1/1.13	1.003	18.1	4.03	2.5	2.38	2.23
1.5	1/1.38	1.496	12.1	3.77	2.31	2.22	2.00
2.5	1/1.78	2.488	7.41	3.28	2.02	1.82	1.64
4	1/2.25	3.976	4.61	3.12	1.72	1.59	1.47
6	1/2.76	5.983	3.08	2.73	1.51	1.43	1.30
10	7/1.34	9.872	1.83	2.07	1.17	1.14	1.01
16	7/1.68	15.52	1.15	1.82	1.02	0.966	0.709
25	7/2.12	24.71	0.727	1.54	0.705	0.666	0.606
35	7/2.50	34.36	0.524	1.40	0.630	0.592	0.539
50	19/1.76	46.22	0.387	0.986	0.691	0.589	0.536
70	19/2.12	67.07	0.268	0.888	0.620	0.434	0.390
95	19/2.50	93.27	0.193	0.751	0.557	0.386	0.335
120	37/2.02	118.6	0.153	0.687	0.537	0.345	0.305
150	37/2.25	147.1	0.124	0.622	0.386	0.315	—
185	37/2.50	181.6	0.0991	0.574	0.350	—	—
240	61/2.25	242.5	0.0754	0.426	0.312	—	—
300	61/2.50	299.4	0.0601	0.382	—	—	—
400	61/2.80	375.6	0.0470	0.340	—	—	—
500	61/3.20	490.6	0.0366	0.294	—	—	—
630	61/3.60	620.9	0.0283	0.264	—	—	—

注：

*3+1芯为特殊电缆，20℃铜护套电阻根据下列公式计算； $R_{20}=0.0178 \div \pi^4 \div [D^2 - (D-2h)^2] \times 1000$

式中：D-电缆外径；h-电缆铜护套厚度

Note:

*3+1-core cable is a special cable, resistance of copper sheath at 20°C can be gotten according to the following formula:
 $R_{20}=0.0178 \div \pi^4 \div [D^2 - (D-2h)^2] \times 1000$

wherein: D-O.D. of cable; h-thickness of copper sheath

表3. 电缆导体90°C和铜护套在70°C时的直流电阻
Table 3. DC resistance of cable conductor at 90°C and copper sheath at 70°C

导体标称截面 Nominnal section of conductor mm²	导体计算截面 Calculation of conductor section mm	90°C导体电阻 Ω/km不大于 Conductor resist 3nCG Ω/km at 90°C not more than	70°C铜护套电阻Ω/km Resistance of copper sheath at 70°C Ω/km			
			1芯 1-core	2芯 2-core	3芯 3-core	4芯 4-core
1	1/1.13	23.10	5.44	2.64	2.50	2.28
1.5	1/1.38	15.40	5.03	2.40	2.27	2.08
2.5	1/1.78	9.48	4.50	2.10	1.63	1.49
4	1/2.25	5.90	3.13	1.51	1.42	1.30
6	1/2.76	3.90	2.80	1.33	1.25	1.13
10	7/1.34	2.33	2.10	0.83	0.78	0.70
16	7/1.68	1.47	1.43	0.70	0.66	0.52
25	7/2.12	0.92	1.26	0.51	0.48	0.38
35	7/2.50	0.67	1.12	0.45	0.17	0.34
50	19/1.76	0.49	0.82	0.34	0.32	0.26
70	19/2.12	0.34	0.71	0.26	0.25	0.22
95	19/2.50	0.25	0.54	0.23	0.21	—
120	37/2.02	0.20	0.49	0.21	—	—
150	37/2.25	0.16	0.44	—	—	—
185	37/2.50	0.13	0.36	—	—	—
240	61/2.25	0.10	0.32	—	—	—
300	61/2.50	0.08	0.25	—	—	—
400	61/2.80	0.06	0.23	—	—	—
500	61/3.20	0.048	0.018	—	—	—
630	61/3.60	0.038	0.014	—	—	—

表4. 环境温度为40°C时，单芯电缆载流量及其参数

Table 4. Current carrying capacity and parameters of single-core cable at ambient temperature 40°C

标称截面 Nominnal section mm²	铜护套(PE线)截面 Copper sheath (PE wire) Sectional area (mm²)	绝缘厚度 Insulation thickness (mm)	近似外径 Approximate O.D. (mm)	导体电阻 90°C(Q/km) Core resistance 90°C(W/km)	额定电流 Rated current (A) ⊙ ⊙ ⊙ ⊙	额定电流 Rated current (A) ⊙ ⊙ ⊙	单位电压降 Specific voltage drop (V/A.Km)
1	4×4.4	0.80	3.53	23.10	?	?	23.10
1.5	4×4.7	0.80	3.78	15.40	32	26	15.40
2.5	4×5.2	0.80	4.18	9.48	42	34	9.48
4	4×7.6	0.80	4.85	5.90	56	44	5.90
6	4×8.4	0.80	5.36	3.90	70	56	3.90
10	4×11.0	1.00	7.02	2.33	97	77	2.33
16	4×15.5	1.00	8.24	1.47	125	100	1.47

续表 4. continue table 4

标称截面 Nominnal section mm²	铜护套(PE线)截面 Copper sheath (PE wire) Sectional area (mm²)	绝缘厚度 Insulation thickness (mm)	近似外径 Approximate O.D. (mm)	导体电阻 90°C(Q/km) Core resistance 90°C(W/km)	额定电流 Rated current (A) ⊙ ⊙ ⊙ ⊙	额定电流 Rated current (A) ⊙ ⊙ ⊙	单位电压降 Specific voltage drop (V/A.Km)
25	4×18.0	1.00	39.56	0.92	165	130	0.92
35	4×20.5	1.00	10.70	0.67	200	160	0.67
50	4×27.7	1.20	12.60	0.49	245	195	0.49
70	4×31.7	1.20	14.40	0.34	305	245	0.34
95	4×41.4	1.20	16.50	0.25	375	300	0.25
120	4×45.6	1.20	18.14	0.20	435	350	0.20
150	4×50.6	1.40	20.15	0.16	500	400	0.16
185	4×62.4	1.40	22.10	0.13	580	465	0.13
240	4×70.2	1.40	24.85	0.10	685	550	0.10
300	4×87.0	1.60	27.70	0.08	795	635	0.08
400	4×95.4	1.60	30.40	0.06	930	745	0.06
500	4×125.4	1.80	36.65	0.048	1050	855	—
630	4×146.5	1.80	42.63	0.038	1198	998	—

注：表4单芯电缆用于3相4线系统时单位电压降应乘以√3，用于单相系统时单位电压降应乘以2
Note: When the single-core cables in table 4 are applied to 3-phase 4-wire systems, the specific voltage drop should be multiplied by√3 and be multiplied by 2 when are applied to single-phase systems.

表5. 环境温度为40°C时，2芯电缆载流量及其参数。

Table 5. Current carrying capacity and parameters of two-cores cable at ambient temperature 40°C

标称截面 Nominnal section mm²	铜护套(PE线)截面 Copper sheath (PE wire) Sectional area (mm²)	绝缘厚度 Insulation thickness (mm)	近似外径 Approximate O.D. (mm)	导体电阻 90°C(Q/km) Core resistance 90°C(W/km)	额定电流 Rated current (A)	单位电压降 Specific voltage drop (V/A.Km)
2×2.5	10	0.80	6.96	9.48	33	18.96
2×4	15	0.80	8.10	5.90	44	11.80
2×6	17	0.80	9.12	3.90	57	7.80
2×10	39	1.0	12.44	2.33	78	4.66
2×16	46	1.0	14.48	1.43	104	2.86
2×25	54	1.0	17.32	1.26	135	2.52
2×35	67	1.10	19.90	1.12	168	2.24
2×50	82	1.20	23.00	0.82	204	1.64
2×70	96	1.20	26.80	0.71	263	1.42
2×95	110	1.20	30.60	0.54	320	1.08
2×120	126	1.20	33.88	0.49	373	0.96

表6. 环境温度为40°C时, 3芯电缆载流量及其参数。

Table 6. Current carrying capacity and parameters of three-cores cable at ambient temperature 40°C.

标称截面 Nominal section mm ²	铜护套(PE线)截面 Copper sheath (PE wire) Sectional area (mm ²)	绝缘厚度 Insulation thickness (mm)	近似外径 Approximate O.D. (mm)	导体电阻 90°C(Q/km) Core resistance 90°C(W/km)	额定电流 Rated current (A)	单位电压降 Specific voltage drop (V/A.Km)
3×2.5	13.6	0.80	7.56	9.48	29	16.40
3×4	15.4	0.80	8.57	5.90	38	10.20
3×6	17.4	0.80	9.67	3.90	46	6.74
3×10	27.7	1.0	13.22	2.33	65	4.03
3×16	32.3	1.0	15.42	1.47	85	2.54
3×25	44.3	1.0	18.46	0.92	118	1.59
3×35	57.8	1.10	21.43	0.67	150	1.16
3×50	66.2	1.20	24.55	0.49	192	0.85
3×70	85.8	1.20	28.63	0.34	228	0.59
3×95	98.1	1.20	32.72	0.25	273	0.43

表7. 环境温度为40°C时, 3+1芯电缆载流量及其参数。

Table 7. Current carrying capacity and parameters of 3+1 cores cable at ambient temperature 40°C.

电缆规格 Cable spec. mm ²	铜护套(PE线)截面 Copper sheath (PE wire) Sectional area (mm ²)	绝缘厚度 Insulation thickness (mm)	近似外径 Approximate O.D. (mm)	导体电阻 90°C(Q/km) Core resistance 90°C(W/km)	铜护套电阻 70°C(Q/Hm) Resistance of copper sheath 70°C(Q/km)	额定电流 Rated current (A)	单位电压降 Specific voltage drop (V/A.Km)
3×16+1×10	41.6	1.00	16.56	1.47	0.449	85	2.54
3×25+1×16	55.9	1.00	19.77	0.92	0.334	118	1.59
3×35+1×16	69.6	1.10	22.18	0.67	0.296	150	1.16
3×50+1×25	81.2	1.20	25.87	0.49	0.228	192	0.85
3×70+1×35	93.6	1.20	29.81	0.34	0.197	228	0.59
3×95+1×50	106.9	1.20	34.04	0.25	0.171	273	0.43

表8. 环境温度为40°C时, 4芯等截面电缆载流量及其参数。

Table 8. Current carrying capacity and parameters of 4-core constant section cable at ambient temperature 40°C.

标称截面 Nominal section mm ²	铜护套(PE线)截面 Copper sheath (PE wire) Sectional area (mm ²)	绝缘厚度 Insulation thickness (mm)	近似外径 Approximate O.D. (mm)	导体电阻 90°C(Q/km) Core resistance 90°C(W/km)	额定电流 Rated current (A)	单位电压降 Specific voltage drop (V/A.Km)
3×2.5	13.6	0.80	7.56	9.48	29	16.40

3×4	15.4	0.80	8.57	5.90	38	10.20
3×6	17.4	0.80	9.67	3.90	46	6.74
3×10	27.7	1.0	13.22	2.33	65	4.03
3×16	32.3	1.0	15.42	1.47	85	2.54
3×25	44.3	1.0	18.46	0.92	118	1.59
3×35	57.8	1.10	21.43	0.67	150	1.16

表9. 不同环境温度下载流量的修正系数

Table 9. Correction factor of current carrying capacity at different ambient temperatures

导体工作温度(°C) Working temperature of conductor (°C)	环境温度(°C) (空气中) Ambient temperature (°C) (in air)								
	10	15	20	25	30	35	40	45	50
60	1.58	1.50	1.41	1.32	1.22	1.11	1.00	0.86	0.73
65	1.48	1.41	1.34	1.26	1.18	1.09	1.00	0.89	0.77
70	1.41	1.35	1.29	1.22	1.15	1.08	1.00	0.91	0.81
80	1.32	1.27	1.22	1.17	1.11	1.06	1.00	0.93	0.86
90	1.26	1.22	1.18	1.14	1.09	1.04	1.00	0.94	0.89
105	1.22	1.19	1.15	1.11	1.08	1.04	1.00	0.95	0.91

YTTW系列柔性防火电线的载流量的说明:

电线的连续负荷载流量(额定电流), 是一个重要而复杂的物理量, 各厂家的样本上几乎都不相同。国际上也互不相同, 不同的因素很多, 难以说明, 但无论国内国外大家有个共同点: 都遵循IEC国际标准。本公司完全参照IEC 287标准定出柔性防火电线的载流量依据是环境温度40°C, 线芯温度90°C。由于无机绝缘电线电缆优良的耐高温特性, 是否能提高线芯温度, 缩减截面, 节省投资, 当然可以, 但本公司不提倡, 因为这样做会大大增加铜损, 从综合经济效益来看是不合算的。

表4-8中的单位电压降是按线芯温度90°C时的电阻值算出是偏高的, 仅供参考。

关于电线的敷设方式及载流量的修正系数, 请查阅供电设计手册。

Introduction to the current carrying capacity of YTTW series flexible fireproof wires and cables:

The continuous load current carrying capacity (rated current) of wires & cables is an important and complex physical quantity, it is always various in catalogue of domestic and international manufacturers. It is hard to explain the causes for difference, but there is a common ground that these manufacturers follow the IEC international standard. Likewise, we completely follow the current carrying capacity of flexible fireproof wires and cables stipulated as the IEC287 standard. The basis is ambient temperature 40°C and core temperature 90°C. Due to excellent high temperature resistance character of inorganic insulated wires and cables, the improvement of conductor temperature and reduction of the cross section are allowable, but we don't encourage that, because these behaviors will increase the loss of copper, to consider from the comprehensive economic benefit, it is uneconomical.

The specific voltage drop in the table 4-8 is on the high side calculated on the basis of resistance at conductor temperature 90°C, it is only for reference.

For the wire & cable layout mode and correction factor of current carrying capacity, please refer to the power supply and distribution design handbook.

八、YTTW电缆安装注意事项

Matters needing attention for installation of YTTW cables

① YTTW电缆安装方式同普通电缆一样不需要专业人员，也不需要安装培训，遵照厂家所提供的安装施工要领及注意事项，安装前厂家均可派人作指导。

② 电缆盘直接到现场进行放线，放线时可以从下至上，也可以从上至下。

③ 电缆的支架与固定

④ 水平吊架允许跨距1)电缆外径 $\leq 20\text{mm}$ ，允许跨距400mm； 2)电缆外径 $> 20\text{mm}$ ，允许跨距800mm

⑤ 垂直支架允许跨距1)电缆外径 $\leq 20\text{mm}$ ，允许跨距1500mm； 2)电缆外径 $> 20\text{mm}$ ，允许跨距1000mm

⑥ 在电缆桥架中敷设，固定电缆的允许跨距可参照a、b项；

⑦ 电缆敷设时允许存在自然的蛇形，但弯曲凸度 $\leq 2D$ ，D为电缆外径；

⑧ 单芯电缆绑箍固定严禁采用磁性材质，例如铁丝等；

⑨ 单芯电缆不能单根穿越磁性材质管及闭合的任何形状的磁性构件，必须穿过钢管时（如地下室至楼层）又不能三相四线一起穿，应将每根钢管锯开一条缝才能穿过。

1. YTTW cables are installed as the ordinary cables without the need of professional or specially-trained operators. The manufacturer will send related person(s) to direct the cable installation.

2. The cable is de-reeled from the reel previously transported to the work site. The de-reeling may be carried out from the bottom to the top or from the top to the bottom.

3. Cable support and fixing

a Permissible span for horizontal hangers: (1) 400mm, for cable diameter $\leq 20\text{mm}$; (2) 800mm, for cable diameter $> 20\text{mm}$

b Permissible span for vertical support: (1) 1500mm, for cable diameter $\leq 20\text{mm}$; (2) 1000mm, for cable diameter $> 20\text{mm}$

c For installation in cable tray, "a" or "b" may be referenced for the permissible span for fixing the cable,

d Natural snaking of cable is permissible during installation, but the curvature shall $\leq 2D$, where D is the cable diameter,

e It is strongly prohibited to bind and fix single-core cables with magnetic materials, e.g. iron wire.

f A single single-core cable shall not pass through a tube or closed component of any shape made of magnetic material. Where it is necessary

for the cable to pass through a steel tube (e.g. connection between basement and floor) and where it is not allowed for the whole 3-phase-4-wire system to pass through the tube together, a seam shall have been sawn on each tube before the cable passes through it.



中间连接器
Straight-through connector

多芯电缆直角弯
Right-angled bending of
a multicore cable

④ 电缆配件

⑤ 中间接头特长电缆或大截面多芯电缆（单根重量较重可分作三段）中间配有接头，在现场连接，耐火等级等同于本体；

⑥ 直角弯头电缆直角弯敷设时，现场弯曲难度大，可配预制直角弯接头，方便现场施工；

⑦ 终端接头根据用户需要，可配终端接头，也可以不配终端接头，在现场制作终端头时，剥去铜护套，端头剥去绝缘约30mm压制端子，用兆欧表检测铜护套及导体间绝缘电阻，合格后，套上热缩套管，保护未剥绝缘层；

⑧ 电缆弯曲

⑨ 电缆弯曲时，必须用直径不小于0.5m圆轮衬垫，弯曲时也必须用圆弧衬垫衬垫弯曲；

⑩ 电缆分割

⑪ 在现场电缆可以任意按需要分割，不必采用喷灯去湿；

⑫ 剥除铜护套时，严禁铜屑嵌入绝缘层，除肉眼查看外，应用兆欧表检测绝缘电阻（铜护套及导体间），如绝缘电阻不合格，说明铜护套的边刺，刺入绝缘中并与导体接触，必须清除。

4. Cable accessories

a. Straight-through connector: Extra-long cables or large size multicore cables may have a straight-through connector in the middle. Because a continuous length of cable is too heavy, it consists of two lengths. The two lengths of cable will be connected by the straight-through connector on-site, which has the same fire rating as the cable itself.

b. Quarter bend: It is difficult to bend the cable for a right angle in the installation. For this reason a quarter bend is used to ease the installation

c. Termination: the termination may be provided or not provided depending on the requirement of the customer. When the termination is made on-site, the copper sheath shall be stripped at the cable end and the insulation shall be stripped for ca. 30mm from the end for making compressed terminal. The insulation resistance between the conductor and copper sheath shall be measured with a megohm-meter. If the measurement complies with the standard, heat-shrinkable sleeve shall be applied to protect the exposed insulation.

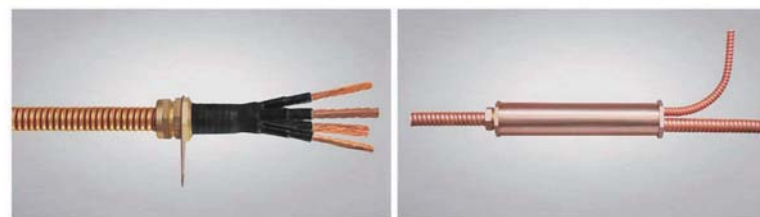
5. Bending

a. The cable shall be bent against a wheel having a diameter not smaller than 0.5m.

6. Cutting

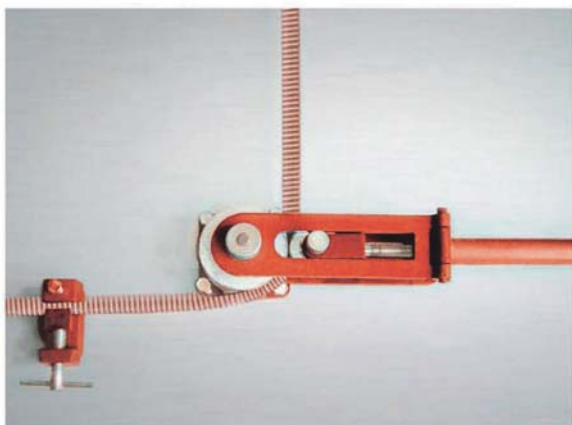
a. The cable can be cut to any length on-site without the need of drying it by burner.

b. When stripping the copper sheath, it is strongly prohibited to let bits of copper penetrate into the insulation. In addition to visual examination, the insulation resistance between the conductor and copper sheath shall be measured with a megohmmeter. Nonconformity indicates that burrs from the copper sheath have penetrated into the insulation and contact the conductor. These burrs must be re-moved.



终端 Termination

单芯分支电缆 Single-core branched cable



电缆弯管机 Cable pipe bending machine
电缆的弯曲半径为 $6-10D$,
D为电缆外径
The bending radius of cable is $6-10D$, hereinto, D is the cable outer diameter;

7 电缆接地

- ① 多芯电缆铜护套一端或多处接地无特殊要求；
- ② 单芯电缆铜护套应两端（多端也可）接地，若要节能单端接地时，另一端必须采用绝缘隔离，防止人员碰触，也要防止电缆周围有可燃材质；
- ③ 电缆接地可用铜带，铜卡紧固在铜护套上，用铜导体引到接地点。若采用铁制卡件，必须镀锌、镀铬件。

8 电缆通电

- ① 电缆两端已制作好终端，在接到电气设备之前，必须用千伏兆欧表检测绝缘电阻。单芯电缆检测导体及铜护套之间。多芯电缆检测，相线及相线之间，相线及中性线之间，相线及铜护套之间，中性线及铜护套之间。
- ② 电缆两端接到电气设备，对整个系统应用千伏兆欧表检测系统绝缘电阻，若 $\geq 0.5M\Omega$ 才可以通电。

7. Earthing

- a. There are no special earthing requirements for multicore cables which may be earthed at one end or at more than on earth spot.
- b. Single-core cables shall be earthed at both ends(more than two earth sports are permissible). If, for energy-saving, only one end of the copper sheath in a single-core cable is earthed, insulation isolation shall be provided at the other end to keep the cable from being touched. Also adjacent combustibles shall be removed.
- c. The cable may be earthed through a copper tape, which is securely fastened to the copper sheath and led to the earth spot by a copper earth bond. Iron ferrule used shall be plated with zinc or chromium.

8. Energization

- a. The cable shall be terminated at both ends. Before connecting the cable to the electrical equipment, the insulation resistance shall be measured with a megohmmeter. For single-core cables, the measurement shall be made between the conductor and copper sheath. For multicore core cables, the measurement shall be made between phase conductors, between phase conductor and neutral, between phase conductor and the copper sheath and between neutral and the copper sheath.

- b. The cable shall be connected to the electrical equipment. The insulation resistance of the system shall be measured with a meg-ohmmeter. Only when the insulation resistance is equal to or greater than $0.5M\Omega$ can the cable be energized.

九、电缆分支箱 Branch joint box

YTTW系列金属护套无机绝缘电缆的分支箱是YTTW分支电缆的配套产品。箱体采用高强度防火材料，经一次压成型，外形美观，适应现代建筑的装饰要求。采用优先进口元器件，具有短路保护、过载保护、动作灵敏可靠。若将箱内的元器件改用过路铜排，可做过路箱用。

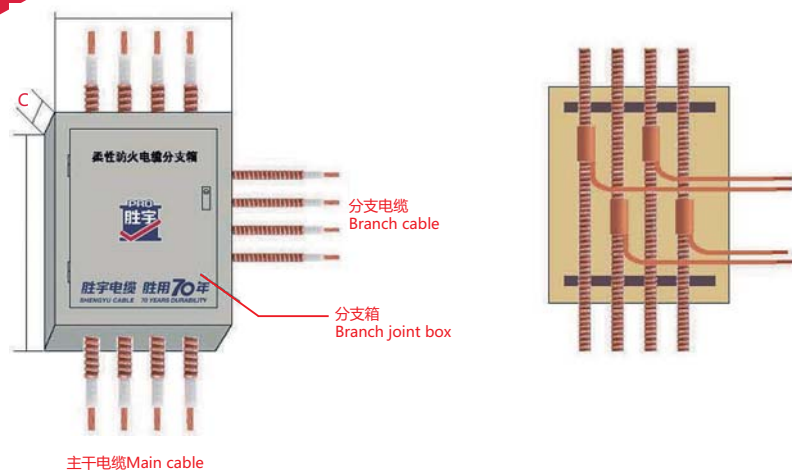


电缆分支箱
Branch joint box

The branch joint box is a necessary product for YTTW cables. The box is molded from high strength fire-resisting material. The body of the box is aesthetically pleasing and complies with the requirement for decoration of modern buildings. Encased are advanced components purchased from abroad which feature short-circuit protection overload protection and sensitive and reliable action. If copper busbar is substituted for the components in the box, then it may be used as a distribution box.

分支箱尺寸(mm) Dimensions of branch joint box

单芯电缆规格 Size of single-core cables (mm ²)	A	B	C
70、50	300	200	100
240、185、150、120	320	220	120
300、400	360	300	160
多芯电缆规格 Size of multicore cables (mm ²)	A	B	C
70、50	320	220	120
35、25	300	200	100



使用分支箱注意事项 Matters needing attention for use of branch joint box

- ① 树干式配电能节约大量投资，应首先考虑；
- ② 使用分支箱时，主干电缆不能敷设在线槽或桥架中，应直敷在支架上，因为线槽，桥架空间有限，很难装入分支箱；直接敷设在支架上，是符合规范的；
- ③ 树干式配电宜采用单芯电缆便于分支；
- ④ 本公司电缆分支时，主干电缆不会断开；
- ⑤ 分支电缆长度不大于3米；
- ⑥ 分支接头必须采用可靠的压缩连接；
- ⑦ 分支头宜在制造厂预制。

1. Tree-type distribution system shall be considered first due to large reduction in costs;
2. When the branch joint box is used, the main cable shall be install directly on an open support instead of cable trough or cable tray, because the limited space in the cable trough or cable tray cannot accommodate a branch joint box. Direct installation on an open support complies with the standard.
3. In a tree-type distribution system single-core cables are preferred for ease of branching.
4. As far as our products are concerned, the main cable will not be cut for branching.
5. The branch cable shall be not longer than 3m.
6. The branch joint shall be made by reliable compressed connection.
7. The branch joint shall be pre-fabricated in factory.

十、设计导则 Design guidelines

- ① 选用柔性防火电缆应符合GB50217与DGJ08-93规范规程的要求；
- ② 无特殊要求时，默认耐火标准为A类，如需耐火等级超A类或其他特殊要求，设计时应指明；

- ③ 电缆在竖井或桥架中敷设不需穿管；
- ④ 在计算长度时宜放长1-2m；
- ⑤ 铜护套可以作PE线，如大截面防火电缆，铜护套截面小于PE线要求截面时，应附加PE线。但不管任何情况，铜护套必须接地；
- ⑥ 腐蚀性特别严重的场所，应指明铜护套外加防腐护套；
- ⑦ 计算短路电流及压降时采用的阻抗，只须用电缆导体及铜护套的直流电阻，其感抗、容抗可忽略不计，由于电缆过载能力特大，一般不需验证热稳定；
近似压降计算公式 $V_d = K \times I \times L \times V_0 (V)$
式中：I-工作电流或计算电流(A)
L-线路长度(m)
V₀-查表中单位压降 (V/A · Km)
K-三相四线，K=√3；单相，K=1
- ⑧ 500A以下可选取多芯电缆，大于500A时选单芯电缆；电缆结构尺寸、额定电流、技术参数，详见表1至表9。

1. The selection of flexible fireproof cable should accord to the codes of GB50217 and DGJ08-93.
2. In case of no special requirements, the fire-resistance standard is defaulted to category A, if you have any other special requirements or need the fire-resistance class exceeding category A, please indicate them in designing.
3. If the cable is laid in shaft or tray, the pipe inserting process is not needed.
4. When the length of cable is calculated, it should be length-ened about 1-2m;
5. The copper sheath may be used as the PE wire, we take the fire-proof cable of large cross section as an example, if the cross section of copper sheath is smaller than that required by the PE wire, PE wire should be added. However, in all cases, the copper sheath must be earthed.
6. If the cable is used in the badly corrosive area, please indicate that the copper sheath should be provided with anticorrosion sheath additionally.
7. As for the resistance for calculating the short-circuit current and voltage drop, only the DC resistance of cable conductor and copper sheath is required, its inductance and capacitance may be negligible, and, because of the ultra large of cable overload capacity, the thermal stability needn't to be verified. Calculation formula of approximate voltage drop $V_d = K \times I \times L \times V_0 (V)$ Wherein, I--Working current or calculating current (A) L--Line length (m) V₀--Specific voltage drop of checking list (V/A · Km) K-Three-ph four-wire, K=√3 ; single phase, K=1
8. For 500A below, multi-core cable may be selected, and for 500A above, the single-core cable is chosen. Please refer to table 1-9 for the cable structure dimension, rated current and technical parameter, etc..

十一、运输与储存 Transit and storage

- ① 在运输过程中，电缆不能受机械撞击和雨雪侵袭受潮；
- ② 电缆应存储在干燥的库房内，同时库房中应不存在有损电缆的有害物质或气氛；
- ③ 施工现场电缆应放在干燥处；
- ④ 施工完毕后，余下的电缆其终端应给予可靠的密封。

1. In transit, the cable should be free of mechanical impact or the attack of rain and snow;
2. The cable should be stored in the dry warehouse where the harmful matter or gas should not exist.
3. In the construction site, the cable should be placed in the dry area;
4. After ending the construction, the terminals of residual cables should be given the reliable seal.