SLX-1 65/16-120/16-90/16

Horizontal 35kV Rubber Insulated Power Cable Production Line

(Steam Heating)

Technical Specification

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Horizontal 35kV Rubber Insulated Power Cable Production Line

This production line is applied to manufacturing 6～35kV rubber insulated power cable and rubber sheath continuous vulcanization.

1. Main technical parameters:

1.1 Voltage class

rubber insulated power cable: 6~35kV

1.2 Product specifications

copper core: 25㎜^{2}～630㎜^{2}

aluminum core: 35㎜^{2}～800㎜^{2}

1.3 Cable maximum weight: 9 kg/m

1.4 Cable maximum outside diameter: 60mm

1.5 Cable construction

Conductor shield: 0.5~1.5mm

Insulation: 1.2~10.5mm

Insulation shield: 0.5~1.5mm

1.6 Material

Conductor: compacted copper or aluminium stranded conductor

Conductor shield: rubber conductor shielding material

Insulation: EPR, polychloroprene（CR) and natural rubber ect.

Insulation shield: insulation shielding material

1.7 Line design speed: 0~40m/min.

1.8 Line execution: half catenary

Inclination of cooling section: 1°～2°

Total length of vulcanization section and cooling section: about102 m

a. Length of heating section: about 42m(6m×7 sections)

material: stainless steel seamless tube Φ219×5

design pressure: 25kg/cm^2

quick wind cooling system

b. Length of cooling section: 36m(6m×6sections)

1.9 Extruders arrangement:

Φ65-Φ120-Φ90 triple extrusion (is recommended)

Φ65 extruder for extruded conductor shield

Φ120 extruder for extruded rubber insulation

Φ90 extruder for extruded insulation shield

1.10 Pressurized and vulcanized medium in pipe: superheated steam

1.11 Cooling medium in pipe: water

1.12 Kinetic energy consumption:

Electricity:

Installed capacity 500 kVA, 380V±10%, 50Hz±1%, Three-phase Five-wire system

Water: water pressure: 0.2~0.6 MPa
Water consumption: 15m^3/h (circulating water in reservoir)
Compressed air: 0.6~0.8 MPa
Air consumption: 0.8m^3/min
Supersaturated steam: working pressure 1.8Mpa, steam consumption 240kg/h
(Prepare saturated steam boiler 2t, pressure 2.5Mpa)

2. Main equipment composition and technical requirements

2.1 Mobile active pay-off stand (2pcs.)

Drum dia: 800~2000mm GB4004-84, PN-type
Drum width: 600~1500mm
Weight: Max. 12t
Pay-off speed: 30m/min

2.2 Horizontal accumulator

Accumulating length: 120m
Guide wheel dia.: 1200mm
Accumulating tension: 120N~2400N
Driving wheel speed:0~2m/min
Accumulating wheel pair nos: 11 pairs
Accumulator can be controlled separately on itself or main ctrl cabinet in the main ctrl Room, accumulating amount is displayed on mian operating cabinet.
There is an audible and visual alarm to tell if the accumulator is empty or full, and emergency stop switches of limiting positions can make sure the equipment safe.
Accumulator motor power 11kW (DC motor)

2.3 Metering capstan (1 piece)

Pulling wheel dia: 1600mm
Line speed: 0~40m/min (four gearshifts)
Pulling force: 30kN
Cable dia.: 100mm
A speed sensor equipped with a line speed meter
Main drive adopts DC motor, which can run in 4 quadrants with power of 11Kw
Driver: PARKER 590

2.4 Φ65 Extruder 65/16D

a.Barrel
Material: 38CrMoAl
Hardness: ＞950HV with nitrizing treatment after quenching and tempering
Maximum working pressure: 60MPa
b.Screw
Material: 38CrMoAl
Hardness: ＞850HV with nitrizing treatment after quenching and tempering, nitriding depth＞0.5mm
Diameter: 65mm
Type: double-thread type, cooling at the center hole(temperature controller for independent screw cooling water)
Rate of rotation: 45 r/min
c.Gear box

Reduction gear ratio: 32:1
Dynamic bearing force: 788 kN for thrust bearings

d.Heating and cooling system
Heating way for barrel: water heating (industrial softened water)
Cooling way for barrel: water cooling (industrial softened water)
Cooling way for feeding hopper: water cooling (water in reservoir)

e.DC motor
Type: Z4-type
Power: 30 kW
Rated speed: 1450rpm
Drive: PAKER 590

f. Extrusion output: 70kg/h

g.Temperature control: By circulating temperature control machine,
Control accuracy： ±2℃

2.5 Φ90 extruder 90/16D

a. Barrel
Material: 38CrMoAl
Hardness: > 950HV with nitrizing treatment after quenching and tempering
Maximum working pressure: 60MPa

b. Screw
Material: 38CrMoAl
Hardness: > 850HV with nitrizing treatment after quenching and tempering, nitriding depth >0.5mm
Diameter: 90mm
Type: double-thread type, cooling at the center hole (independent screw cooling water temperature controller)
Rate of rotation:40rpm

c. Gear box
Reduction gear ratio: 36:1
Maximum pressure: 1040 kN for thrust bearing

d. Heating and cooling system
Heating way for barrel: water heating (industrial softened water)
Cooling way for barrel: water-cooling (industrial softened water)
Cooling way for feeding hopper: water-cooling (water in reservoir)

e. D C motor:
Type: Z4-type
Power: 75 kW
Rated speed: 1450rpm
Drive: PARKER 590

f. Extrusion output:150kg/h

g.Temperature control: By circulating temperature control machine,
Control accuracy： ±2℃

2.6 Φ120 extruder 120/16D

a. Barrel
Material: 38CrMoAl

Hardness: > 950HV with nitrizing treatment after quenching and tempering
Maximum working pressure: 40MPa

b. Screw
Material: 38CrMoAl
Hardness: > 850HV with nitrizing treatment after quenching and tempering, nitriding depth >0.5mm
Diameter: 120mm
Type: double-thread type, cooling at the center hole (independent screw cooling water temperature controller)
Rate of rotation:40rpm

c. Gear box
Reduction gear ratio: 36:1
Maximum pressure: 1600 kN for thrust bearing

d. Heating and cooling system
Heating way for barrel: water heating (industrial softened water)
Cooling way for barrel: water-cooling (industrial softened water)
Cooling way for feeding hopper: water-cooling (water in reservoir)
Cooling way for gearbox: water-cooling (water in reservoir)

e. D C motor:
Type: Z4-type
Power: 110 kW
Rated speed: 1450rpm
Drive: PARKER 590

f. Extrusion output: 380kg/h

g. Temperature control: By circulating temperature control machine,
Control accuracy： ±2℃

2.7 Triple-layer extrusion crosshead

a. Connecting way with the extruders: by connected guiding tubes

b. Technical parameters
Conductor diameter range: 4.5~34mm
Max. outside dia. after extrusion: 60mm
Extruded thickness:
First layer: 0.5~1.5mm
Second layer: 2.0~12mm
Third layer: 0.5~1.5mm
Heating and cooling way: water heating
Temperature control accuracy:±2℃

2.8 Temperature control system（temperature control machine）

a. Type：LWM series
b. Temp.ctrl.range： 120℃
c. Temp.ctrl.accuracy ： ±1℃
d. Heating medium ： water
e. Cooling way： direct cooling
f. Heating energy ： 6KW

g. Pump motor： 1HP
h. Max. Pump flow ： 153 L/MIN
i. Max. Pump pressure ： 4KG/CM2
j. Max.power comsumption： 10 KW
k. Cooling water piping： 1/2 NCH
l. Water temperature control machine for separate control.（Water sources must be configured according to the product specifications）

2.9 Motorized Splice box

a. Material：telescopic tube is made of stainless steel 304
b. Action way：motorized control
c. As the pressure in the tube is interlink, for security the tube can be opened only when the pressure goes back to zero position.
d. Connection way with crosshead: sealed with PTFE gasket, screwed connection and slide way positioning.
e. If necessary, an interface of a derivometer can be reserved. (customer supplies the related parameters)

2.10 Heating and cooling for the vulcanizing tube

The catenary sections consist of 6m×7 sections and sag controller. The length is 42m long, heating medium is water steam.
The cooling sections consist of Φ150×6 sections, and 36m long, cooling medium: water.

2.11 Sag control

a. Type: Non-contacting type
b. Mounting position: mount it in the middle of catenary section
c. The sag controller will regulate the line speed of pull out capstan to be synchronized with the metering capstan after treating the acquired signal of the cable position.

2.12 End seal (1pc. provided by the customer)

a. Sealing way: primary seal with rubber seal ring approximately conical shaped.
b. Feature: change the pressure to the seal ring by regulating the screw. By making fine adjustments to the cable outlet aperture, control the cooling water leakage
c. Pneumatic and manual control.

2.13Pull-out caterpillar

a. Max. pulling cable dia.: 60mm
b. Max. pulling force: 30 kN
c. DC drive
d. Motor type & power: Z4, 11kW; Drive: PAKER 590
e. Line speed: 0~40m/min, four gears
F. Clamping length: 2300mm

2.14 Mobile Take-up stand

a. Drum dia:1600~2500mm
b. Drum width: 1180~1900mm
c. Weight: Max. 14t
d. DC drive: Power 7.5kw
E. Driver: PARKER 590
F. Take- up speed: 0~40m/min
G. Has fast mobile function.

H. Traversing range: 0~65mm
Pay-off speed: 30m/min

2.15 Superheated steam supply and discharge

a. Pressure of supplied superheated steam: not more than 2.5Mpa

b. Steam can be supplied automatically or manually. Under the automatic state, the pressure is controlled automatically by the regulating valve.

c. There is a pressure gauge on the splice box to display the steam pressure in tube. It also mounted pneumatic valve and pressure relief valve for steam supply and discharge. When the steam pressure in tube goes beyond the stipulated value, the system will alarm and close the steam supply valve. The tube pressure displays on the main operating cabinet.

2.16 Oil and water circulating cooling

a. Bodies of three extruders are cooled with oil or water in the independent enclosed circuit. The water should be softened water.

b. Gearbox of extruders and hopper stand are cooled with softened water. Pressure range should be 0.2~0.4MPa. Water supplied by customer and water supply inlet temperature is 20~25℃. Water pressure is regulated by hand valve.

c. Crosslinking tube cooling is equipped with 2 sets of vertical stainless steel water pump with high lifting distance, pressure is 2.0MPa, form a circulating system with reservior.

d. Cooling circle zone is controlled by pneumatic ball valve; flow rate is adjusted by hand valve. Pneumatic ball valve and hand valve are in series.

e. Cooling water level in pipe is controlled by magnetic turn-over plate level gauge and pneumatic automatic gall valve and hand valve.

f. When working, all interfaces that make displacement with crosslinking pipes (including nitrogen) are stainless steel hose.

2.17. Electrical control

a. When the system is running, the whole line is based on the metering capstan. Sag controller is acted as auxiliary adjustment to make sure the metering capstan and pull out capstan run synchronously.

b. All the electrical drive systems can realize synchronously speed up and down, also can be separately controlled by single machine. It has the function of whole line reversal.

c. In the whole line there are five emergency stops respectively in pay off, accumulator, main operating station, hauling machine and take-up.

d. Electrical control cabinet display
PROFIBUS DP bus communication
Main control cabinet CPU adopts Siemens S7-412
DC drive current and voltage (rotating speed) display
Electricity supply voltage and current dispaly
Temperature display of every temperature measuring point in extruder heating
Line speed display
Cable position display
Accumulating quantity
Meter counting
Opening degree of water level regulating valve

Steam pressure display

e. Acoustic-optical alarm system

Overpressure alarm for melt pressure of barrel on extruder.
Water level high or low
Sag controller high or low
Over-pressure alarm for vulcanizing tube
Accumulator empty or full
Oil or water pump stop alarm

f. Electrical control cabinet operation

Switch on by electrical or manual
Start-stop operation on transmission, temperature control and water pump for every unit
Single machine of transmission cabinet up or down regulation, whole line speed up and down regulation
Set cable position in the vulcanizing pipe (upward or downward adjustment)
Automatic or manual operation for air supply system
Automatic or manual control for water level
Clamp and loosen operation before the accumulator
Start operation of the heating system and temperature setting

g. Electrical control cabinets composition

Electrical control cabinets in the main unit room consist of:
Inlet power supply cabinet
Outlet power supply cabinet
Drive cabinet for extruders
Temperature control cabinet for extruders
Drive cabinet for haul-off
Main control cabinet (vulcanizing pressure display)
Ambient temperature in the main unit room: 0~30℃

2.18 TV supervisory system

Three color TV cameras are respectively installed at pay off, take-up and window of sag controller. Monitor is installed in the main machine hall.

2.19 Tools and accessories

a. Tools for disassembling the crosshead, 1 set
b. Tools for disassembling the screw of Φ65 extruder, 1 set
c. Tools for disassembling the screw of Φ90 extruder, 1 set
d. Tools for disassembling the screw of Φ120 extruder, 1 set
e. Extrusion die-tool for test running, 3 sets
f. Tool carriage, 1

2.20 Inspection and acceptance of production line

After commissioning when both parties think everything is OK, trial production inspection and acceptance can be conducted. In most cases, there are three specifications of big, medium and small size. Supplier offers Die-tools. (Both sides can make other consultation) 35kV cable specification for check and accept is over 95mm^2.

Sequence No.	Specification	Voltage	Quantity	Standard
1	35mm^2	3.6/6kV	3000m	GB12972.6-91
2	120mm^2	10kV	3000m	GB12706.2-2002

3	630mm^2	35kV	1000m	GB12706.2-2002

(Both sides can make other consultation)

The rubber cable from the production line should meet requirements of the related configuration clause in the above-mentioned standard.

It will be regarded as the inspection and acceptance of production line after the three specifications of cable from trial production line reach the standard.

2.21

Main Equipments List

Serial No.	Equipment	Specification	Quantity	Remark
1	Mobile Pay-off stand	800~2000mm	2	
2	Accumulator	Accumulating length 120m	1	
3	Metering capstan	Belt type pulling force: 30kN	1	
4	Triple extrusion crosshead	Including 3 crosshead heaters	1	
5	Splice box	Motorised control	1	
6	Φ65extruder	L:D 16:1	1	
7	Φ90 extruder	L:D 16:1	1	
8	Φ120 extruder	L:D 16:1	1	
9	Sag controller	Contactless	1	
10	Vulcanizing tube	Stainless Steel (Φ219×5)	1 set	
11	Cooling tube	Stainless Steel (Φ150×5)	1 set	
12	End seal	Pneumatic and manual control	1	
13	Pull-out caterpillar	Pulling force:30Kn	1	
14	Mobile Take-up stand	Φ1600~2500mm	2	
15	Water and air control system		1set	
16	Electrical control cabinet		1set	
17	Blow dryer		1	

2.22**The following parts should be supplied, made or purchased by customer**.

a. Connection pipe for air,steam and water tube.
b. Cable bridge, wire and cable for installation.
c. Equipment bracket, pipe support (supplier offers drawings)
d. Air compressor
e. Crosshead heater
f. Saturated steam boiler is not less than 2t, pressure 2.5Mpa