

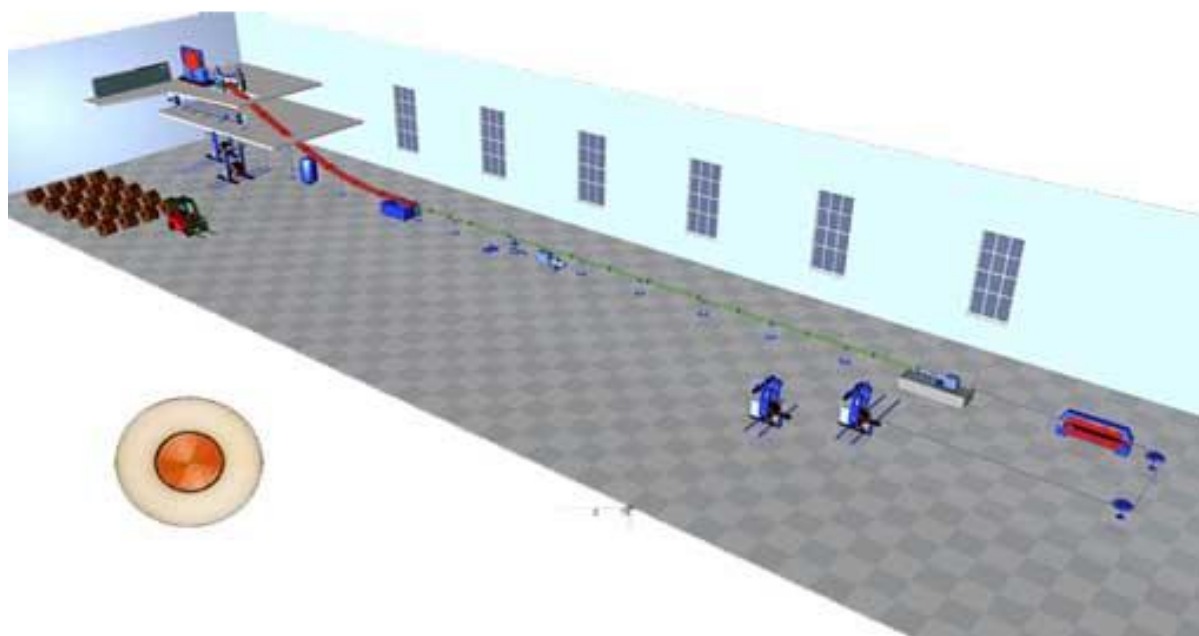
6-35KV 智能型三层共挤干法交联电缆生产线

Technical Specification for 6~35KV Intelligent-type Triple-layer

Extrusion Dry Cross-linking Cable Production line

7 段智能技术说明

(6~35KV, 7 sections)



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附件 Appendix 1:

三层共挤干法交联电缆生产线技术说明
Technical Specification for
Triple-layer Extrusion Dry Cross-linking Cable Production Line

本生产线适用于 6~35kV 电压等级交联聚乙烯绝缘电缆生产。
The production line is designed for manufacturing 6~35kV XLPE insulated power cable.

一、生产线主要技术规范 Main technical specification

1. 电压等级 Voltage Class
交联聚乙烯 XLPE: 6~35kV
2. 产品规格 Conductor Size
铜芯 Cu: 25~630mm²
铝芯 Al: 35~800mm²
3. 电缆最大重量 Cable weight: Max. 10kg/m
4. 电缆最大直径 Cable diameter: Max. 70mm
5. 电缆结构 Cable construction
导体屏蔽 Conductor shield: 0.3~2mm
绝缘 Insulation: 2.5~12mm
绝缘屏蔽 Insulation shield: 0.3~2mm
6. 材料 Material:
导体 Conductor: 紧压铜、铝绞线 compressed Cu, aluminium stranded conductor
导体屏蔽 Conductor shield: 交联导体屏蔽料
cross-linking conductor screening material
绝缘 Insulation: 交联聚乙烯 XLPE
绝缘屏蔽 Insulation shield: 绝缘屏蔽料 insulation screening material
7. 设计线速度 Line design speed: 0~30m/min
8. 布管形式 Line execution: 半悬链式 half catenary
冷却段倾角 Inclination of cooling section: 1° ~2°
悬链系数 Catenary factor: 200~150
交联段 Cross-linking section: 7 sections/ 42m
材料 Material: 不锈钢 304 Stainless Steel 304 Φ219×4
设计最高温度 Design temperature: max.: 450°C
预冷段 Length of pre-cooling section: 2 sections/12m
不锈钢 304 Stainless Steel 304: Φ219×4
冷却段 Cooling section: 11 sections/ 66m

材料 Material: 不锈钢 304 SS 304 $\Phi 159 \times 4$
(第一节冷却管 the first section of cooling tube is $\Phi 219 \times 4$)

设计压力 Design pressure: 1.6MPa

9. 挤出机排列方式 Extruders arrangement:

80-150-90 三层共挤 triple extrusion

80 线芯屏蔽 for conductor screen

150 交联聚乙烯 for cross linked polyethylene(XLPE)

90 绝缘屏蔽 for insulation screen

10. 管内加压介质 Pressurized medium in pipe: 氮气 nitrogen

11. 管内冷却介质 Cooling medium in pipe: 水 water

12. 动能消耗 Kinetic energy consumption:

电: 安装容量 Electricity: installation capacity: 810kVA

380V $\pm 10\%$, 50Hz $\pm 1\%$, 三相四线 three-phase and four-wire

控制单相电压 220V Control single phase voltage: 220V

水 Water: 水压 water pressure 0.2~0.6MPa

用水量 Water consumption 15m³/h(水库循环水 circulating water from reservoir)

压缩空气 Compressed air: 0.6~0.8MPa 用气量 Air consumption: 0.8m³/min

氮气 Nitrogen:

压力 pressure 2.0~2.5MPa,

纯度 purity 99.5%,

消耗量 consumption 0.5~0.8m³/h(标准状态 standard state)

为满足起车需要, 应备有不小于 6m³ 储氮罐

It is necessary to prepare a nitrogen storage container no less than 6m³ to start up the line.

二、生产线主要组成及技术要求 Main components and technical requirements

1. 放线架(龙门行走式) Portal Traveling Pay-off stand

a. 线盘直径 Drum diameter: 1600~2500mm GB4004-84 PN 型 Type

b. 线盘宽度 Drum width: 1180~1900mm

c. 最大盘重 Drum weight: Max. 16t

d. 放线张力 Pay off tension: 5000N

e. 主驱动采用直流电机, 可 4 象限运行, 功率 5.5kW

DC motor is used for main drive, running in four-quadrant with 5.5kw power

f. 驱动器 Drive: 派克 PARKER 590P (原英国欧陆 original Eurotherm)

g. 放线舞蹈器/Dancer: 调节放线速度, 维持电缆中心位置不变

To regulate the payoff speed, and keep the cable in the center when line is running
结构特点: 机电一体化龙门型结构, 整体移动往返, 维持放出中心线不变。放线盘安装形式为无轴式, 左右立柱上下移动、交流电机驱动。整体移动由交流电机经减速器驱动, 根据放线缆芯直径, 当放线盘每转一圈, 指令交流电机运动、行走一个节距, 放线架具备张力控制和速度控制, 采用舞蹈器控制速度。放线架能全线正反转, 具备

联动和单动功能。放线架具有显示屏，屏上可设置工艺参数，放线架可单控还可主操作台控制。

Structure features: mechatronical portal type structure, totally move to and fro, keep the central line of payoff no changing. The mounting type of the payoff is shaftless type, left & right columns move up and down, driven by AC motor. Moving as a one is driven by the AC motor via the reducer. It can control the tension and speed. Adopting dancer to control the speed. Pay off stand can turn fro and back, has the function of linking action and single action. It has display screen and set technology parameters on the screen. It also can be controlled separately and by the master operating station.

2. 放线舞蹈器 **Dancer on the pay off:**

可通过最大电缆直径 100mm，调节放线速度，维持电缆中心不变。

Can be through Max.cable dia. 100mm, adjust pay off speed, keep the cable center unchanged.

注：我公司操作系统中有两套放线形式，舞蹈器速度控制和恒张力控制，可自由选择操作。

Special attention: Operating system has two pay off types, dancer speed control and constant tension control, can choose freely for operation.

3. 卧式储线器 **Horizontal accumulator**

a. 储线长度 Accumulating length: 120m

b. 导轮直径 Guide pulley dia.: 1600mm

c. 张力 Tension: 300~3200N 可调 adjustable

d. 动轮速度 Traction wheel speed: 0~2m/min

e. 储线器操作在储线器上和主控室操作柜上，储线量在操作柜上有显示

Operation is performed on the accumulator and operating cabinet in master control room, accumulating value is displayed on the control cabinet.

f. 储线器电机功率 Motor power 11kW(直流电机 DC motor)

g. 储线在空、满时有声光报警、极限位置有急停开关保证设备安全

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.

h. 储轮采用加厚铸铝件制造，强度大，光洁圆整度好

Accumulating wheel is made of thickened casting aluminum, with good strength and smooth roundness.

结构特点：为卧式移动型储线器，由定轮，动轮，支架，限位器，控制箱等组成。储线架为卧式，共有两组导轮 4+5 模式，一组固定，另一组可移动，控制采用张力控制。换盘接头时由压紧汽缸夹住从放线上来的缆芯，储线装置开始吐线，直到放线换盘结束，汽缸松开，活动轮在稀土伺服电机软特性控制下，反向移动到初始位置。储线在空、满状态时有声、光报警，极限位置设限位开关，由计算机操作屏显示。

Characteristic: It is horizontal moving type, consists of fixed wheel, moving wheel, support,

position limit, controlling cabinet etc. The accumulating stand is horizontal and has two groups of guide wheels 4+5 mode, one group is fixed, the other is movable, control adopts tension control. The pressing cylinder will clamp the core from the pay off when changing drums. The accumulating device begins to discharge conductor core until drum changing is over. At this time the cylinder is unloosed. The running wheel moves back to the initial position under the control of servo motor with the soft character. The accumulator has audio & visual alarm for full or empty. There is a switch for limiting position, display on PC operating screen.

4. 夹线器 Conductor clamp

- a. 换盘或接头时夹住由放线上来的线芯

To clamp the conductor when change drum & connect the conductor

- b. 可通过最大线芯 Max. core diameter can be through: 100mm

- c. 气动夹紧结构, 橡皮板压紧

Pneumatic clamp structure, rubber plate clamped

5. 上辅助牵引机 Upper auxiliary caterpillar

- a. 牵引电缆外径 Pulling cable outer diameter: $\leq 100\text{mm}$

- b. 牵引功率 Pulling power: 5.5kW

- c. 最大牵引力 Max. pulling force: 10kN

- d. 牵引速度 Pulling speed: **0~30m/min**

- f. 换挡与上下主牵引同步 Gear shift is synchronous with upper and lower capstan

技术特点: 当电缆换盘或更换电缆规格时, 夹线器夹紧, 储线器吐线时它起到到隔离上牵引和储线器之间张力的作用, 防止竹节的产生。

When changing the cable tray or the cable specification, the clamper clamps, the accumulator discharges the line, the upper auxiliary caterpillar can isolate the tension between the metering capstan and accumulator, which prevents the generation of "bamboo knot".

6. 线芯清扫器 Cleaning device for the wire core

交流电机带动刷子旋转对导线导体进行清洗, 本装置放在进线牵引的底部。

AC motor drive the brush rotating to clean the wire conductor, this device is put on the bottom of the wire input haul-off.

7. 上牵引机 Metering capstan

- a. 牵引方式 Pulling way: 包带牵引 disk type capstan

- b. 牵引轮直径 Pulling wheel dia.: 2000mm

- c. 调整范围 Adjustable range: 0~30m/min 分四档 with four gear-shifts

- d. 牵引力 Pulling force (max): 30kN

- e. 牵引皮带接触长度 3 米以上 belt touching length is 3m or over 3m

- f. 电缆直径 Cable diameter (max): 100mm

- g. 配有线速表的速度传感器 A speed sensor equipped with a line speed meter

h. 主驱动采用直流电机，可 4 象限运行，功率 11kW

Main drive adopts DC motor, which can run in 4 quadrants with power of 11Kw

i. 驱动器 Drive: 派克 Parker 590P (原英国欧陆 original Eurotherm)

j. 牵引轮盘采用整体铸造工艺 Pulling wheel adopts integral whole casting technology.

结构特点: 由牵引轮, 张紧轮, 机架, 底架, 变速箱, 减速机, 气动系统, 电控系统, DC 调速电机等组成。用于将导体线芯从低处向上牵引到一定高度, 同时承担硫化管中的电缆位置。为 CCV LINE 基准线速, 履带牵引机/包带牵引机应与其同步。具有线芯左右上下定位装置, 可保证不同规格线芯从上牵引出口时对准机头中心。传动装置部分底座采用固定式底座, 减速机采用螺旋伞齿减速机, 电机采用直流电机。

Structure features: It consists of puling wheel, tension wheel, frame, under frame, gearbox, reducing gearbox, pneumatic system, electric control system, DC speed adjustable motor etc. It is used for pulling the core from down to a certain level and bearing the cable position in curing tube. It is the basic line speed in CCV LINE, caterpillar/pull out capstan should synchronously run with it. It has core around positioning device which guarantee different size of core from metering capstan outlet to align to the center of crosshead. Transmission device base adopts fixed base, reducer is spiral gear reducer, motor is DC motor.

8. 80 挤出机 Extruder 80/20D

a. 机筒 Barrel

材料 Material: 38CrMoA1A

硬度 Hardness: >950HV

最大工作压力 Working pressure: max.70MPa

b. 螺杆 Screw:

材料 Material: 38CrMoA1A

硬度 Hardness: >850HV

直径 Diameter: 80mm

型式 Type: 新 BM 分离型螺杆带中心孔冷却 Newly BM separate type with center hole cooling

转速 Rate of rotation (max): 46.5rpm

c. 齿轮箱 Gear box

减速比 Reduction gear ratio: 32: 1

润滑方式 Lubricating method: 油泵喷淋 inject oil from oil-pump

推力轴承动态承受力 Dynamic bearing force 788kN

d. 加热和冷却系统 Heating and cooling system

机筒加热方式 Heating way for barrel: 电加热 electric heating

机筒冷却方式 Cooling way for barrel: 水或油冷却 water or oil cooling

喂料斗冷却 Cooling way for feed hopper: 水冷却 water cooling

机筒加热区段数 Quantity of heating section for barrel: 4 个

每段加热功率 Heating power for each heating section: 3kW(铸铝 cast aluminum)

- e. 直流电机 DC motor
型式 Type: Z4 型
功率 Power: 45kW
额定转速 Rated speed: 1450rpm
驱动器 Drive: 派克 Parker 590P (原英国欧陆 original Eurotherm)
- f. 上料系统 Material feeding system: 100kg 干燥料斗、4.0kw 真空自动上料机, 扬程 18 米。100kg dry hopper, 4.0kw automatic vacuum feeding device with lifting height of 18m.
- g. 出胶量 Extrusion output: 60kg/h
- h. 机筒温度控制 Barrel temperature control
一次仪表 Primary instrument: 热电偶 E 型 Thermocouple E
二次仪表 Secondary figure meter: 数字显示 PID 调节, 集中安装于控制柜
digital display, regulated by PID, mounted in control cabinet.
控制精度 Control accuracy: $\pm 2^{\circ}\text{C}$

i. 压力控制, 在机筒末端滤网前安装融熔压力测量传感器, 压力在电气柜有数字显示, 超压时仪表会报警, 立即采取措施保护挤出机。挤出机底部有遥控电动行走小车, 通过遥控方式操作, 电机带动涡轮箱减速行走, 不用人工手遥操作。

Pressure control: by a melt pressure measuring sensor installed before the filter screen at the end of barrel, there is a digital display for pressure on the electric cabinet. When overpressure occurs, there will be an alarm to protect the extruders, there is remote control electrical mobile car on the bottom of extruder in the remote control way. The motor drives the worm-gear box to slowly walk, manual control is not needed.

结构特点: 用于挤出导体屏蔽层。由减速箱, 机筒, 螺杆, 底座, 快速夹紧装置, 电加热、冷却系统, DC 电机, 料斗及上料系统组成。底部有电动移动系统, 通过减速机移动安全方便。机身采用铸铝管状加热器电加热、独立分区全封闭水冷却。冷却水电磁阀根据各区温控要求, 由计算机控制开、断频率, PID 调节控温精度 $\pm 2^{\circ}\text{C}$ 。挤出机与三层共挤机头, 通过导胶管连接。导胶管外有加热器, 温度显示在总操作屏上。

Structure characteristic: It is used for extruding the conductor screen layer. Consist of reducing gearbox, barrel, screw, base, quick clamping device, electric heating & cooling system, DC motor, hopper and loading system. Bottom has electric drive moving system, safely and conveniently move by reducer. Extruder body adopts electric heating by cast aluminum tube type heater, independent partition and fully enclosed water cooling. Control to connect or cut off frequency of cooling water magnetic valve by PC according to temperature control requirement in each area, PID regulating temperature control accuracy $\pm 2^{\circ}\text{C}$. Extruder connect triple crosshead by a model adapter. Heater on adapter, display temperature main operating screen.

9. 90 挤出机 Extruder 90/20D

- a. 机筒 Barrel
材料 Material: 38CrMoA1A
硬度 Hardness: >950HV

最大工作压力 Working pressure: max 70MPa

b. 螺杆 Screw

材料 Material: 38CrMoA1A

硬度 Hardness: >850HV

直径 Diameter: 90mm

型式 Type: 新 BM 分离型螺杆带中心孔冷却 Newly BM separate type with center hole cooling

转速(max) Rate of rotation: max.: 41.5rpm

长径比: 20:1

c. 齿轮箱 Gear box

减速比 Reduction gear ratio: 36: 1

润滑方式 Reduction gear ratio: 油泵喷淋 inject oil from oil-pump

推力轴承动态最大压力 Maximum pressure for thrust bearing: 1040kN

d. 加热和冷却系统 Heating and cooling system

机筒加热方式 Heating way for barrel: 电加热 electric heating

机筒冷却方式 Cooling way for barrel: 水或油冷却 water or oil cooling

喂料斗冷却 Cooling way for feed hopper: 水冷却 water cooling

机筒加热区段数 Quantity of heating section for barrel: 4 个

每段加热功率 Heating power for each heating section: 4kW (铸铝 cast aluminum)

e. 直流电机 DC motor

型式 Type: Z4 型

功率 Power: 55kW

额定转速 Rated speed: 1450rpm

驱动器 Drive: 派克 Parker 590P (原英国欧陆 original Eurotherm)

f. 上料 Material feeding: 自动真空吸料机、干燥、不锈钢料斗

automatic vacuum feeding device, dry and stainless steel hopper

自动上料机 Automatic material feeding device ZJ400: 气泵功率 Air pump power 4.0Kw, 上料量 feeding amount: 400Kg/h

料斗式干燥机 Hopper type dryer: capacity: 150Kg

风机功率 blower power: 0.25Kw, 配置除尘机, 安装于上料机的空气滤清箱

下方 Equipped with dust collector mounting under the air filter box of material feeder

g. 出胶量 Extrusion output: 60kg/h

h. 机筒温度控制 Barrel temperature control:

一次仪表 Primary instrument: 热电偶 E 型 Thermocouple E

二次仪表 Secondary figure meter: 数字显示 PID 调节控制柜集中安装

digital display, regulated by PID, mounted in control cabinet

控制精度 Control accuracy: $\pm 2^{\circ}\text{C}$

i. 压力控制: 在机筒末端滤网前安装融熔压力测量传感器, 压力在电控箱上有数字显示, 当超压时仪表会报警, 立即采取措施保护挤出机。挤出机底部有遥控电动

行走小车，通过遥控方式操作，电机带动涡轮箱减速行走，不用人工手遥操作。

Pressure control: by a melt pressure measuring sensor installed before the filter screen at the end of barrel, there is a digital display for pressure on the electric cabinet. When overpressure occurs, there will be an alarm to protect the extruders, there is remote control electrical mobile car on the bottom of extruder in the remote control way. The motor drives the worm-gear box to slowly walk, manual control is not needed.

10. 150 挤出机 Extruder 150/25D

a. 机筒 Barrel

材料 Material: 38CrMoAlA

硬度 Hardness: >950HV

最大工作压力 Working pressure: max.50MPa

b. 螺杆 Screw

材料 Material: 38CrMoAlA

硬度 Hardness: >850HV

直径 Diameter: 150mm

型式 Type: 屏障型中心孔冷却 Barrier type screw with center hole cooling

转速(max) Rate of rotation: Max.40rpm

c. 齿轮箱 Gear box:

减速比 Reduction gear ratio: 37.5: 1

润滑方式 Lubricating method: 油泵喷淋 inject oil from oil-pump

推力轴承动态最大压力 Maximum pressure of thrust bearing 1600kN

d. 加热冷却系统 Heating and cooling system

机筒加热方式 Heating way for barrel: 电加热 electric heating

机筒冷却方式 Cooling way for barrel: 水或油冷却 water or oil cooling

喂料斗冷却 Cooling way for feed hopper: 水冷却 water cooling

机筒加热区段数 Quantity of heating section for barrel: 7 个

每段加热功率 Heating power for each heating section: 5kW

(铸铝 cast aluminum)

e. 直流电机 DC motor

型式 Type: Z4 型

功率 Power: 132kW

额定转速 Rated speed: 1450rpm

驱动器 Drive: 派克 Parker 590P (原英国欧陆 original Eurotherm)

f. 上料 Material feeding: 自动真空上料、不锈钢料斗

automatic vacuum feeding device, stainless steel hopper

自动上料机 Automatic material feeding device ZJ600: 气泵功率 Air pump power

4.0Kw, 上料量 feeding amount: 650Kg/h

不锈钢料斗 SS Hopper: 主料斗装料量 Main hopper capacity:200kg

辅料斗容积 auxiliary hopper 32 升 L,feeding amount:20kg

g. 出胶量 Extrusion output: 250kg/h

h. 机筒温度控制 Temperature control for barrel

一次仪表 Primary instrument: 热电偶 E 型 Thermocouple E

二次仪表 Secondary figure meter: 数字显示 PID 调节, 集中安装于控制柜
digital display, regulated by PID, mounted in control cabinet

温控精度 Control accuracy: $\pm 2^{\circ}\text{C}$

i. 压力控制 Pressure control

在机筒末端滤网前安装熔融压力测量传感器, 压力在电气柜有数字显示, 当超压时仪表会报警, 立即采取措施保护挤出机。挤出机底部有遥控电动行走小车, 通过遥控方式操作, 电机带动涡轮箱减速行走, 不用人工手遥操作。

Pressure control: by a melt pressure measuring sensor installed before the filter screen at the end of barrel, there is a digital display for pressure on the electric cabinet. When overpressure occurs, there will be an alarm to protect the extruders, there is remote control electrical mobile car on the bottom of extruder in the remote control way. The motor drives the worm-gear box to slowly walk, manual control is not needed.

用于挤出电缆绝缘层。由减速箱, 机筒, 螺杆, 底座, 快速夹紧装置, 电加热、冷却系统, 螺杆冷却系统, DC 电机, 料斗及上料系统组成。底部有电动移动系统, 通过减速机移动安全方便。机身采用铸铝管状加热器电加热、独立分区全封闭水冷却。冷却水电磁阀根据各区温控要求, 由计算机控制开、断频率, PID 调节控温精度 $\pm 2^{\circ}\text{C}$ 。挤出机与三层共挤机头, 通过导胶管连接。导胶管和法兰盘外有加热器, 温度显示在总操作屏上。DC 电机在 250-1500r/min 之间无级调速。

Structure characteristic : It is used for extruding insulation layer. Consist of reducing gearbox, barrel, screw, base, quick clamping device, electric heating & cooling system, screw cooling system, DC motor, hopper and loading system. Bottom has electric drive moving system, safely and conveniently move by reducer. Extruder body adopts electric heating by cast aluminum tube type heater, independent partition and fully enclosed water cooling. Control to connect or cut off frequency of cooling water magnetic valve by PC according to temperature control requirement in each area, PID regulating temperature control accuracy $\pm 2^{\circ}\text{C}$. Extruder connect triple crosshead by a model adapter. There is a heater out side of the model adapter and flange. The temperature display on the main operating screen. DC motor speed is stepless speed regulating between 250-1500r/min.

结构特点: 用于挤出电缆绝缘层。由减速箱, 机筒, 螺杆, 底座, 快速夹紧装置, 电加热、冷却系统, 螺杆冷却系统, DC 电机, 料斗及上料系统组成。底部有电动移动系统, 通过减速机移动安全方便。机身采用铸铝管状加热器电加热、独立分区全封闭水冷却。冷却水电磁阀根据各区温控要求, 由计算机控制开、断频率, PID 调节控温精度 $\pm 2^{\circ}\text{C}$ 。挤出机与三层共挤机头, 通过导胶管连接。导胶管和法兰盘外有加热器, 温度显示在总操作屏上。DC 电机在 250-1500r/min 之间无级调速。

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11. 挤出机机身集中冷却系统 Cooling system for extruders

3 台主机机身冷却系统, 2 立方不锈钢水箱 1 台, 10 平方板式换热器 1 台, 2 台不锈钢立式管道泵 (一用一备) 组成, 连接不锈钢管路、法兰、螺丝等需方自备, 2 立方水箱内装软化水由一台不锈钢管道泵分别向 3 台挤出机提供机身、料斗座、齿轮箱冷却用水。(注: 换热器来水冷却需方自备水源, 进水温度 $25^{\circ}\dots 40^{\circ}$)

Cooling system for extruders is consisting of a set of 2m^3 stainless steel water tank, 10m^2 exchanger, 2 pumps (one use, one standby). The stainless steel tubes, flanges, screws will be prepared by buyer. There is a stainless steel inline pump to be installed in the water tank which is used for pumping cooling water to 3 Extruders, hopper base, gearbox. (Mark: the water of exchanger is prepared by buyer, temperature is $25^{\circ}\text{C}-40^{\circ}\text{C}$)

12. 三层共挤机头 Triple-layer extrusion crosshead

a. 技术参数 Technical parameters

导体直径范围 Conductor diameter range: $6\sim 34\text{mm}$

出线直径(max) Outlet wire diameter: max. 70mm

挤出厚度 Extrusion thickness:

第一层 First layer: $0.3\sim 2.0\text{mm}$

第二层 Second layer: $2.5\sim 12\text{mm}$

第三层 Third layer: $0.3\sim 2.0\text{mm}$

加热方式: 油温度控制机加热 (3 台), 温控精度 $\pm 2^{\circ}\text{C}$

Heating way: oil temperature controller heating (3 sets), temperature control accuracy: $\pm 2^{\circ}\text{C}$

b. 机头材料: 38CrMoAlA 经氮化处理加工, 螺纹紧压与挤出机相连接, 本公司专利技术生产, 经多年客户使用无问题, 技术成熟稳定, 氮化强度大多数使用不损坏 Its material is 38CrMoAlA with nitrogen treatment, connects with the extruder by screw pressed. It is produced by our patent technology, and no problem occurred after many years used by our clients. Its technology is mature and stable. No destroyed with good nitride strength after years used.

c. 油加热器采用 3 路加热, 通过手动调节流量控制机头 3 个区温度, 油加热器与机头采用快插接头方式连接。

Oil heater adopts 3-way heating, control 3 zones temperature of crosshead by manual flow regulation. Quick change coupler conneted with crosshead.

结构特点：在分流体上通过环流道对电缆料进行圆周上的分配，通过节流环的节流间隙控制并保证电缆料沿机头轴向圆周上各点的流速一致，从而保证了挤包层在圆周上各点厚度一致。该机头由于采用了环流分配流道和节流环，与国外三层共挤机头相比，大大缩短了分流体和机头的长度，减轻了重量；清理机头时，拆卸方便，易于清理，生产时调偏容易，省时省力，材料 38CrMoA1A。为油加热自然冷却式，由机头体，分胶体，模芯，模套，导胶管（油加热器），连接法兰（油加热），不锈钢编织管，材料 38CrMoA1A 等组成。3 台挤出机分别通过各自的导胶管，分胶体，模芯，模套实行各层的挤出。机头上设置 2 个热电偶测温点。

13. 电动式上封闭器 Motorized Splice box

- a. 材料 Material: 伸缩管为不锈钢 304 Telescopic tube is made of stainless steel 304
- c. 动作方式 Action way: 双液压缸控制 double hydraulic cylinders control
打开时管内压力连锁，压力回零时才能打开，以保安全。
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. 与机头连接方法，聚氟乙烯垫密封，螺纹连接，滑道定位。
Connection way with crosshead: sealed with PTFE gasket, screwed connection and slide way positioning.
- e. 可留出外径测偏仪接口(用户提供有关参数)。
If necessary, an interface of a derivometer can be reserved. (customer supplies the related parameters)
- f. 电动控制伸缩管装置 Motorized control device for the telescopic tube.

结构特点：上封闭器伸缩管材料不锈钢 304，由内伸缩管、外定位套、墙板、滑轨等组成。在丝杠的作用下，带动内伸缩管移动，与机头之间采用四氟环自动密封定位。具有机械连锁，确保安全。

上封闭器上端与三层共挤机头连接，下端与管路第一节加热管连接。生产时与三层共挤机头连接在一起；不生产时前部伸缩管缩回近 1000mm 便于三层共挤机头的清胶与拆卸。

Characteristic: splice box material is stainless steel 304, consist of inner telescope tube, outer positioning sleeve, wall plate, slidig rail etc. Under the action of leading screw, make inner expansion tube moving, automatic seal and position by Teflon ring with crosshead. Ensure safety with mechanic interlock.

The top of the splice box is connected with the triple crosshead. The bottom is connected with first heating tube. Connect together with triple crosshead when producing; the telescope tube in front

Will draw back nearly 1000mm when stop producing. It will be convenient to clean material and disassemble triple crosshead.

14. 交联管加热 Heating for cross linking tube

- a. 采用特种干式变压器短路加热，热效率高，加热温度均匀，维护简单。
Special dry transformer is adopted for short-circuit heating, which has the feature of high thermal efficiency, even heating temperature as well as easy to maintain.

- b. 加热管共 7 节，每节长 6m，管径：Φ219×4，材料：不锈钢。
There are totally 7 sections in heating tubes. Each section is 6m long. Pipe size is φ219×4. Material is stainless steel.
- c. 采用可控硅触发模块无触点开关加热，联锁控制。
Interlink control with silicon controlled trigger module contactless switch, linking control.
- d. 温度表集中安装在控制柜上，温度控制精度±5℃。
Thermometer is mounted on the cabinet, and temperature control accuracy is ±5℃
- e. 两套热电偶：一套使用，一套备用
2 sets of thermocouples: one is for use, the other is for standby.
- f. 加热总功率 Total power for heating: 420KW
- g. 交联管采用热弯曲成型，满足压力容器标准，管内压力≤1.6MPa
Heating tube adopts hot bending, meets the standard of pressure vessel, Pressure in tube ≤ 1.6MPa
- g. 每段交联管底部含支撑托轮，加热伸长冷却收缩时起到滑动作用，交联管连接采用石棉垫绝缘。
The bottom of each section of crosslinking pipe contains supporting roller, which plays a sliding role when extend upon heating shrink upon cooling. Crosslinking pipe connection is insulated by asbestos.

结构特点：加热管管壁最高温度为 450℃，每节管由导电板，铝排，绝缘管，吊架，干式变压器，管路支架组成。正常生产时，每节管的加热温度不一样，管内介质为氮气，压力 1.0-1.6Mpa。变压器容量：60KVA，电压：初级 380V，次级 9-11V，试验压力：2.0Mpa(常温，水压)

Structure features: Max. temperature 450℃ of curing tube wall, consist of conducting plate, aluminium bar, insulation tube, hanging bracket, dry transformer, stand of tube etc. The heating temperature in each tube is different when normally producing, medium in tube is nitrogen, pressure 1.0-1.6Mpa. Transformer capacity: 60KVA, voltage: primary 380V, secondary 9-11V, test pressure: 2.0Mpa (normal temperature, water pressure)

15. 悬垂控制器 Catenary controller

全套悬垂控制器 1 台及一套备用的悬垂控制器电控系统

A complete set of catenary controller and an additional set of electrical system of catenary controller for spare.

- a. 型式 Type: 非接触式 contactless
- b. 安装位置：安装在加热段中间，保证在加热段中电缆不擦管。
Mounting position: in the middle of heating section and make sure the cable not touch the pipe.
- c. 悬垂控制得到电缆位置信号，信号经处理后调整下牵引机转速。
When the catenary controller gets the cable position signal, rotate speed of lower hauling machine will be regulated.

结构特点：悬垂控制器由管体，前法兰，线圈架，支架，后法兰，发射线圈，接收线圈组成。

在消化吸收国外最新技术的基础上研发的最新产品。工作原理为非接触式场强控制，抗干扰能力强。电缆在管内的波动范围很小，运行稳定，维护简单。

指示电缆在管内位置，通过本身的电信号调节下牵引机转速与包带牵引机同步，控制电缆悬浮在管路中部，防止电缆在加热段碰管，产生废品。

技术参数：长度：1290mm，管道直径：Φ219×4，管内介质：氮气，工作压力 1.0-1.6Mpa，试验压力：2.0Mpa。

characteristic: Consist of tube body, front flange, coil stand, stand, back flange, sending coil, receiving coil.

Innovate the latest product after absorbing foreign latest technology. Working principle : contactless field strength control, strong antijamming capacity. Small fluctuating range of cable in tube, running stably, easy to maintain.

Indicate cable position in tube, regulate revolution of caterpillar synchronize metering capstan by electric signal, control cable to suspend in middle of tube, prevent cable touch tube in curing tube and produce reject.

parameter: length: 1290mm, tube diameter: Φ219×4, medium in tube: nitrogen, working pressure 1.0-1.6Mpa, test pressure: 2.0Mpa.

16. 预冷段 Precooling section

电缆预冷段位于电缆在热氮区和水冷区之间，使电缆在生产过程中温度有一个渐变过程，减少电缆绝缘的应力提高产品质量。

Precooling section is between nitrogen heating zone and water-cooling zone, which makes the temperature gradually change during the course of cable production. It can minimize cable insulation stress and improve the quality of products.

其中包括 1 节胖管，2 节 Φ219×4 管，工作压力 1.0-1.2Mpa，中间设置定时排氮孔。

Including 1 section fat tube, 2 sections of Φ219×4 tube, pressure 1.0-1.2Mpa, set timing nitrogen discharging hole in middle.(with water level inductive alarm device)

17. 冷却段 Cooling section

材 料：不锈钢 304，管径：Φ159×4，（第一节冷却管 Φ219×4）

Material: stainless steel 304, pipe size: φ 159×4 (the first section is φ 219×4)

冷却介质：水，通过冷却水库闭路循环，其水位高度通过水汽平衡系统自动控制。最后一节管设置进水口，采用不锈钢管，分段（6025mm/节）热弯曲成形，符合悬链曲线和压力容器标准，管内压力≤2.0Mpa。各段交联管底部配有支撑导轮，当交联管加热伸长（或冷却收缩）时起滑动作用。各段交联管的连接，内衬 XB450 橡胶石棉板，厚度 4mm。

Cooling medium: water (circulating water from reservoir), water level is automatic

control by water and air balance system. At the last section of tube, set water inlet, adopts stainless steel tube, hot bending and forming in sections (6025mm/section), conforms to catenary curve and pressure vessel standard, pressure in pipe ≤ 2.0 MPa. Each section of crosslinking tube bottom equipped with supporting roller, which plays a sliding role when extend upon heating shrink upon cooling. Crosslinking pipe connection is insulated by XB450 rubber asbestos, thickness is 4mm.

18. 下封闭器 End seal

a. 封闭方式：一次密封加二次封闭，用近似园锥形橡皮密封圈密封。

Sealing way: primary seal & secondary seal with rubber seal ring approximately conical shaped.

b. 特点：通过调节螺杆改变对密封圈的压力，可以对电缆出线口孔径进行微调，控制冷却水渗漏量。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. 双气缸气动控制，可移动距离 500mm Double cylinders pneumatic control, movable distance is 500mm.

结构特点：下密封装置材料为 304 不锈钢，由内伸缩管、外定位套、气缸、移动水箱等组成采用气压控制伸缩移动。采用近似园锥形硅橡胶密封圈定位，为了保证电缆表面不擦伤，在密封处控制一定的泄流量。下密封为气动操作方式，机械锁紧装置。下部设置辊轮，可以在轨道上移动，解决管路热胀冷缩的问题。出口处有独立可调节托辊

Characteristic: End seal material is stainless steel 304. It consists of telescope tube, outer position sleeve, cylinder, traveling water tank etc. Adopts pneumatic control telescopic moving. Positioning with approx conical rubber seal ring, control leakage in seal part to guarantee no scratching the surface of cable. It adopts pneumatic operating way and has mechanic lock device. Set roller in bottom, can move on rail, resolve problem of thermal expansion. In outlet, set independent adjustable roller.



(带二次密封效果图 with secondary seal effect picture)

19. 电缆搓线器 Twister

a. 用途 Application:

被动式，主要用于三层共挤交联电缆生产线的硫化管内的电缆的扭绞，防止管内电缆在交联前护套层离心，从而提高电力电缆的质量。

Passive type, is mainly used to twist the cable in the curing tube of ccv line, protect cable sheathing layer in pipe from centrifugation before crosslinking, so thus improve the power cable quality.

b. 技术参数和特点: technical parameter and features:

最大电缆直径 Max. Cable dia.: 80mm

设备中心高 equipment center height: 1000mm

皮带最大倾角 Max.inclination angle of belt: 15°

组成: 机械结构, 皮带入口装置, 角度调整装置, 皮带装置和引导装置。

Composition: mechanical structure, belt entrance device, angle adjustable device, belt and leading device.

20. 电缆吹干机 Blow dryer

技术参数 Technical parameter:

泵功率 pump power: 2.2KW

线外径 wire outer dia.: 25-100 mm

空气流量 Air flow: 130m³/h

21. 下履带式牵引机 Pull-out caterpillar

- 牵引电缆直径 Pulling cable dia. (max): 100mm
- 牵引力 Pulling force (max): 30kN
- 直流传动 DC drive: 4 象限 quadrants
- 电机型号及功率 Motor type & power: Z4, 11kW,
驱动器 Drive: 派克 Parker 590 (原英国欧陆 original Eurotherm)
- 线速度 Line speed: 0~30m/min, 分四档, 分档同上牵引
with four gear-shifts the same as metering capstan

结构特点: 由压紧气缸, 张紧气缸, 润滑系统, DC 电机, 变速箱, 减速箱, 履带, 机架组成。电机通过变速箱, 减速箱和传动分配箱带动 2 个主动轮旋转, 2 个被动轮在移动块上自由转动。主动轮和被动轮之间通过履带连接起来, 其张紧力的大小由 2 个张紧气缸控制。上排, 下排各有 9 个压紧气缸, 通过履带对电缆施加压力, 同时两个履带在主动轮带动下不停地运转。由于履带和电缆之间存在很大的摩擦力, 从而牵引电缆。并具有电机马达负荷及电机温度报警功能。

Characteristic: It is consisting of clamping cylinder, tensile cylinder, lubricating system, DC motor, gearbox, reduction box, tracks, and racks. The motor drives 2 action wheels to rotate by the gearbox, reduction box and driven distribution box. 2 driven wheels is freely running on the mobile blocks. The action wheels and driven wheels are connected by tracks. Its tensile force is controlled by two tensile cylinders. There are 9 separate clamping cylinder up and down which gives the cable pressure by tracks, meanwhile, two tracks constantly run under the driving wheel drive. As the friction existing between the tracks and cable, the cable is pulled out. Also has motor overloading and motor temperature alarm functions.

22. 机械式计米器 Mechanical meter counter

带有 5 位计米器, 作为长度测量。(准确长度以操作台计米长度为准)

The meter counter with 5 digits is used for measuring length. (Accurate length is subject to meter-counting length of operation station)

结构特点: 由夹线轮, 长度显示表, 支架组成。

Structure features: It consists of wire clamping wheel, length indicator and bracket.

23. 下辅助牵引机 Lower auxiliary caterpillar

- 牵引电缆外径 Pulling cable outer diameter \leq 100mm
- 牵引力 Pulling force (max): 10kN
- 直流电机 DC motor: 5.5kW
- 线速度 Line speed: 0~30m/min

技术特点: 电缆收线转弯时起到辅助拉动的作用。

Technical features: it plays helper pulling role when cable take up turning.

24. 机械与感应式计米器 Mechanical and inductive meter counter

带有 5 位计米器, 作为长度测量。(准确长度以操作台计米长度为准)

The meter counter with 5 digits is used for measuring length. (Accurate length is subject to meter-counting length of operation station)

带有感应计米，计米在主操作屏上有显示。

With inductive meter counter, it will be displayed on the main operating screen.

25. 收线转向轮 take up steering wheel unit

a. 转向架、拖线架 turning rack, wire supporter rack

b. 根据图纸设计要求提供数量 provide the number according to drawing design requirements.

26. 收排线架（龙门行走式）Take-up stand (Portal Traveling Type)

a. 线盘直径 Drum dia: 2000~3150mm, GB4004-83 PN 型

b. 线盘宽度 Drum width: 1180~2300mm

c. 最大承重 Maximum bearing capacity: 18t

d. 直传动，功率 7.5kW，可 4 象限运行

DC drive, which can run in 4 quadrants. Power: 7.5kw

e. 驱动器 Driver: 派克 Parker 590P (原英国欧陆 original Eurotherm)

f. 收线速度 Take-up speed: 0~30m/min 分二档 two gear-shifts

g. 有快速移动功能 Has the function of quick travel

结构特点：机电一体化龙门型结构，整体移动往返，维持收卷中心线不变。收线盘安装形式为无轴式，左右立柱的上下移动、两端顶针按 PN2000-PN3150 标准线盘配顶针，两端顶针的分开合拢，由交流电机驱动。主传动为 7.5kW 直流电机，经齿轮箱减速，四象限可逆控制。根据电缆直径，当线盘每转一圈，控制交流电机点动时间、行走一个节距，收线速度 0~30m/min，并具有快速移动功能。

Structure features: mechatronical portal type structure, totally move

to and fro, keep the central line of payoff no changing. The mounting type of the take up is

shaftless type, left & right columns move up and down, the pintles in both side equipped

pintles as PN2000-PN400 standard drum, the pintles in both side open and close is driven

by AC motor. Main drive is DC motor of 11Kw, speed down visa gearbox, and reversible

controlled in four quarants. Traversing is moving in whole, and driven by AC motor via

reducer, and will be ordered to jog and walk for a pitch, when the drum turns a round accor.

to the cable diameter. The take-up speed is 0~25m/min, and has quick moving

function.

27. 氮气供给和排放 Nitrogen supply and discharge

a. 供氮源压力不大于 2~2.5MPa，开车前应有足够储备量

Pressure of nitrogen supply source: not more than 2~2.5MPa, make sure of enough nitrogen storage before set up.

b. 供氮可手动、自动，自动状态压力由调节阀自动控制

Nitrogen is supplied automatically or by hand. Under the automatic state, the pressure is controlled automatically by regulating valve.

- c. 上封器处有压力表观察系统压力，压力超过规定值时会报警或关闭供氮阀
There is a pressure gauge on the splice box to watch system pressure. When the pressure is going beyond the stipulated value, the system will alarm or close the nitrogen supply valve.
- d. 预冷段后有排污氮口（预冷段上有继电器控制的放气阀，把混入氮气中的混合水蒸气定时排放出去，避免混合水蒸气进入加热段。）
There is a pollutant-emission outlet for nitrogen after precooling section (on the precooling section, there is a vent valve controlled by a relay, which can discharge the mixed water vapor in the nitrogen regularly, so that it avoid the mixed water vapor to get into the heating section.)
- e. 污氮排放为 $1\text{m}^3/\text{h}$ 根据情况可增减最大不超过 $1.5\text{m}^3/\text{h}$
Discharging amount of nitrogen waste is $0.35\text{m}^3/\text{h}$, which can be increased or decreased according to the situation but maximum should not exceed $0.8\text{m}^3/\text{h}$.
- f. 污氮排放为自动控制，排放时间可根据工艺要求设定
Nitrogen waste discharge is controlled automatically, and discharging time can be set on technological requirements.
- g. 在加热段后有抽气泵，当停车时开启，不让管内气体进入主机房
Suction pump after the heating section will be opened when machine is stopped, which prevents the air in pipes from entering main machine hall.

28. 油、水循环冷却 Oil and Water circulating cooling

- a. 三台挤出机机身冷却，为独立封闭循环冷却，采用油或水冷却，水为软化水。
Bodies of three extruders are cooled with oil or water in the independent enclosed circuit. The water should be softened water.
- c. 挤出机齿轮箱，料斗座用软化水冷却，压力范围 $0.2\sim 0.4\text{MPa}$ ，由用户供水供水进口温度 $25\sim 40^\circ\text{C}$ ，水压力用手阀调节
Gearbox of extruders and hopper stand are cooled with softened water. Pressure range should be $0.2\sim 0.4\text{MPa}$. Water supplied by customer and water supply inlet temperature is $20\sim 25^\circ\text{C}$. Water pressure is regulated by hand valve.
- c. 交联管冷却，配有二套立式高扬程不锈钢水泵，压力为 2.0MPa ，与水库成循环系统
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. 冷却循环区由气动球阀控制，流量由手阀调节，气动球阀和手阀串联
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. 管道冷却水由磁力翻版液位计器和气动自动球阀与手阀控制
Cooling water level in pipe is controlled by magnetic turn-over plate level gauge and pneumatic automatic gall valve and hand valve.
- f. 所有工作时与交联管有位移处的接口(包括氮气)均采用不锈钢软管

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

29. 电气控制 Electrical control

- a. 系统运行时以上牵引为基准，悬垂控制器辅助调节，保证全线同步。

When the system is running, the whole line is based on the metering capstan. Catenary controller is acted as auxiliary adjustment to make sure the whole line run synchronously.

- b. 全部电气传动系统，在电气上可以同步升、降速，也可以各单机独立调节。并有全线倒车功能。

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. 全线分布有五处急停点，分布于放线、储线、主操作台、牵引机及收线。

In the whole line there are five emergency stops respectively in pay offs, accumulators, main operating station, hauling machine and take-ups.

- d. 电控柜显示部分 **Cabinet display**

有表示全线设备布置的工艺流程模拟屏，配有发光二极管，表示设备运行状态。There is a simulation screen of process flow equipped with LED to display as follows:

直传动动的电流、电压（转速）显示

Whole line layout, running situation, voltage (rotate speed) and current of DC drive
供电电压、电流显示 Supply voltage and current

挤出机、硫化管加热温控系统的每一测温点的温度显示

Temperature at every point for measuring temperature of heating temperature control system for extruders and vulcanizing tube

线速度显示 Line speed

三台挤出机熔融压力显示 Melt pressure of three extruders

电缆位置显示 Cable position

储线量显示 Accumulating quantity

计米显示 Meter counting

水位调节阀启开程度显示 Opening degree of water level regulating valve

氮气储气量（压力）显示 Nitrogen storage amount (pressure) display

- e. 声光报警系统 **Acoustic-optical alarm system**

挤出机机筒熔融压力超压报警

Overpressure alarm for melt pressure of barrel on extruder

水位高、低报警、悬垂高低报警

Water level high or low, Catenary controller high or low

氮气超压报警、交联管路超温报警

Alarm of over-pressure for nitrogen, and over-temperature for crosslinking pipe

- 储线空、满报警 Accumulator empty or full alarm
油泵、水泵停报警 Oil or water pump stop alarm
- f. 电控柜操作 **Electrical control cabinet operation**
电源柜电动或手动合闸操作 Switch on by electrical or manual
各单机、传动、温控及水泵等起、停操作
Start-stop operation on transmission, temperature control and water pump for every unit
传动柜单机升、降调节，全线升、降速调节
Single machine of transmission cabinet up and down adjustment, speed control for the whole line
电缆在硫化管中位置的调节（偏上或偏下）
Set cable position in the vulcanizing pipe (upward or downward adjustment)
供氮系统自动或手动操作，污氮排放量调节
Automatic or manual operation for nitrogen supply system, discharge amount adjustment of nitrogen waste
水位控制自动或手动操作
Automatic or manual control for water level
储线器前有夹紧、放松操作
Clamp and loosen operation before the accumulator
加热系统的开启操作温度设定
Start the heating system and setting the temperature
- g. 电控柜组成 Electrical control cabinets consist of:
主机房电控柜集中安装包括
Electrical control cabinets in the main unit room consist of:
进线电源柜 Power supply cabinet for in-wire
出线电源柜 Power supply cabinet for out-wire
挤出机传动柜 Drive cabinet for extruders
挤出机温控柜 Temperature control cabinet for extruders
交联管加热温控柜 Temperature control cabinet for crosslinking pipe heating
牵引传动柜 Drive cabinet for haul-off
主控制柜 Main control cabinet
主机房环境温度 Ambient temperature in the main unit room: 0~30℃

30. 工装附件 Tools and accessories

- a. 机头拆卸工装一套
Tools for disassembling the crosshead, 1 set
- b. 80 挤出机螺杆拆卸工装一套
Tools for disassembling the screw of ϕ 80 extruder, 1 set
- c. 90 挤出机螺杆拆卸工装一套
Tools for disassembling the screw of ϕ 90 extruder, 1 set

- d. 150 挤出机螺杆拆卸工装一套
Tools for disassembling the screw of ϕ 150 extruder, 1 set
- e. 三套试车挤出模具
Extrusion die-tool for test running, 3 sets
- f. 工具小车一台 Tool carriage, 1

31. 生产线验收 Inspection and acceptance of production line (需安装西克拉测偏仪 need to mount Sikora device)

生产线调试后通过双方认为条件具备时, 进行产品试生产验收, 一般为大、中、小三种规格, 供方提供模具, 具体规格见表, 用户也可以根据电缆销售情况改变品种, 但模具自备。66kV 电缆验收规格为 300mm² 以上。

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. Specific specification can be seen in the following table. Customer can change the cable variety according to the sales status, but the die-tool is ready by customer. 66kV cable specification for check and accept is over 300 mm².

序号 No.	规格 Specification	电压 Voltage	数量 Quantity
1	35 mm ²	6kV	3000m
2	120 mm ²	10kV	3000m
3	300 mm ²	35kV	1000m

(双方可另行商定)(Both sides can make other consultation)

生产线生产的交联电缆应符合 GB/T 12706 -2002 标准中有关结构条款的要求。生产线生产三种规格的电缆达到标准后, 即作为本生产线验收。

The cross linking cable from the production line should meet requirements of the configuration clause in GB/T 12706 -2008 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.

32. 干法交联线自动硫化工艺控制系统 Automatic curing technology control system

A. Automatic curing technology control system adopts S7-400 large PLC of German Siemens Company. Human-machine interface is Siemens color touch screen (12 inch screen). Monitoring control of computer adopts Siemens protocol runtime software. Main operation is equipped with operation buttons and simulation display screen for production line which is intuitive to control and convenient to operate.

Software package

According to curing technology characteristic, software system separates product process into five stages of preheat—start—produce—slow—end. The cable produced from achieving start temperature to slow temperature is regular product, and the process offal is modicum as start up and stop the machine. When start up machine and regulate it, you can pre-heat the tube to shorten the time from room temperature to starting temperature and reduce the start offal. $\text{offal length} \approx \text{start speed} * (\text{start temperature} - \text{preheat temperature}) / \text{ramp upswing speed of temperature}$. For example: preheat 150 degrees; starting temperature 270 degrees; start speed 2 meters ; temperature ramp upswing speed set at 8 degrees per minute; $\text{offal length} \approx 2 * (270 - 150) / 8 = 30\text{m}$. The produced cable after you push stop button is waste. $\text{Waste length} \approx \text{ending speed} * (\text{ending curing time} + \text{ending cooling time})$. For example, ending speed is 0.1m; ending curing time is 25 minutes ; ending cooling time is 45 minutes; $\text{waste length} \approx 0.1 * (25 * 45) = 7\text{m}$. The products could be divided into the automatic synchronization and manual synchronization. In automatic synchronization condition, tube temperature upswing and descent will be controlled according to rate of system setting (operator could modify the rate). In manual synchronization state, the operator could set tube temperature by hand. Whether it is automatic synchronization or manual synchronization, the line speed will track automatically come after the tube's actuality temperature, so the quality of products will not be influenced by human factor. The percent of pass of wire and cable will increase quickly, and realize few operators to work. It also can improve the production efficiency and cut down the production cost. The monitoring control system protocol runtime adopt network structure of opening type. It can transmit real time or history date to management network of branch or other departments so that realize system resource sharing in network.

Functions and characteristic of system

- a. Detecting and handling function: It will detect and handle with linearization to the temperature of pipe, extrusion, pressure, revolution of screw, capstan line speed, motor current parameter and so on, and collect state of performing component on line.
- b. Closed loop control function: there is a PID control function about automatic curing temperature, It will control line speed in different type cable curing process when it could complete automatic transformation of tube temperature.
- c. The graphics function: It shows every unit state, production specification, type and cable's length of single unit with parameter table, process chart, running graft, bar diagram.
- d. Record function: to record line temperature and pressure parameter with fashion of

parameter list and curve.

e. On-line adjustment function: As system running, after engineering technical personnel enter the password, you can modify instrument range, alarm limit, specification and type of cable, curing tube temperature and other running parameter on curing.

f. Print function: it could print running class diagram and day diagram of line definite time.

g. Alarm regulation: when the temperature, pressure, curing time and so on parameter surpass the limit, it will send out alarm, and record and converse the alarming message.

h. History inquiry function: According to requirement of curing running, it will record history date and be on file with curing process parameter, curve and status in a certain interval according to running time (year/month/ day/ time/ minute/second). It is easy to inquiry and trace the product quality.

i. Make sure the system safe: provide password for system safety, and prescript the visiting right. It only allows to operate own interface, alarm spot and date, to prevent operator from exceeding authority to operate.

j. Good human machine interface: Chinese operating interface. Easy to operate and master. There is a random on-line help to make it easy to learn and train.

Temperature control system

A、 hardware :

Control and acquisition of each kind signal by SIEMENS S7-300 series module.

Error range between actual temperature and display temperature on touch screen in each temperature measure point when normally startup and running stably:

extruder : $\pm 2^{\circ}\text{C}$

curing tube : $\pm 3^{\circ}\text{C}$

B、 software :

With SIEMENS STEP7 program software, PID operation, output by I/O point, control heating、 cooling solid relay.

C、 control :

With SIEMENS 400 series large CPU, more bigger memory capacity of program, more fast operation speed, simultaneously processing much more and more complicated data, better accuracy.

Catenary control system

With high field type receiving theory, cancel failing of electromagnetic induction type control, measure more accurate, stably, with shift fit function. Adapt disturbance of conductor preheater and AC drive.

Synchro drive control

Transport control with Eurotherm SSD-590P+1000 line rotary encoder, guarantee error $\leq 1r/m$ between motor rev and set value.

Touch screen menu function :

1) 、 Summarize :

Lenovo desktop computer, SIEMENS color multifunctional 12" touch screen.

Program software with PROTOOL language Chinese programming, human machine interface interaction, menu type input, clear intuitive.

Electric control system of 1 set CCV line consist of 4 sets of TV monitors, 1 color touch screen. Set main operation plate, temperature control and melt pressure secondary gauge, button, indication light on system.

With touch screen operation system and computer operation system, more safety and stably.

With normal switch on main control cabinet, more convenient and quick to use.

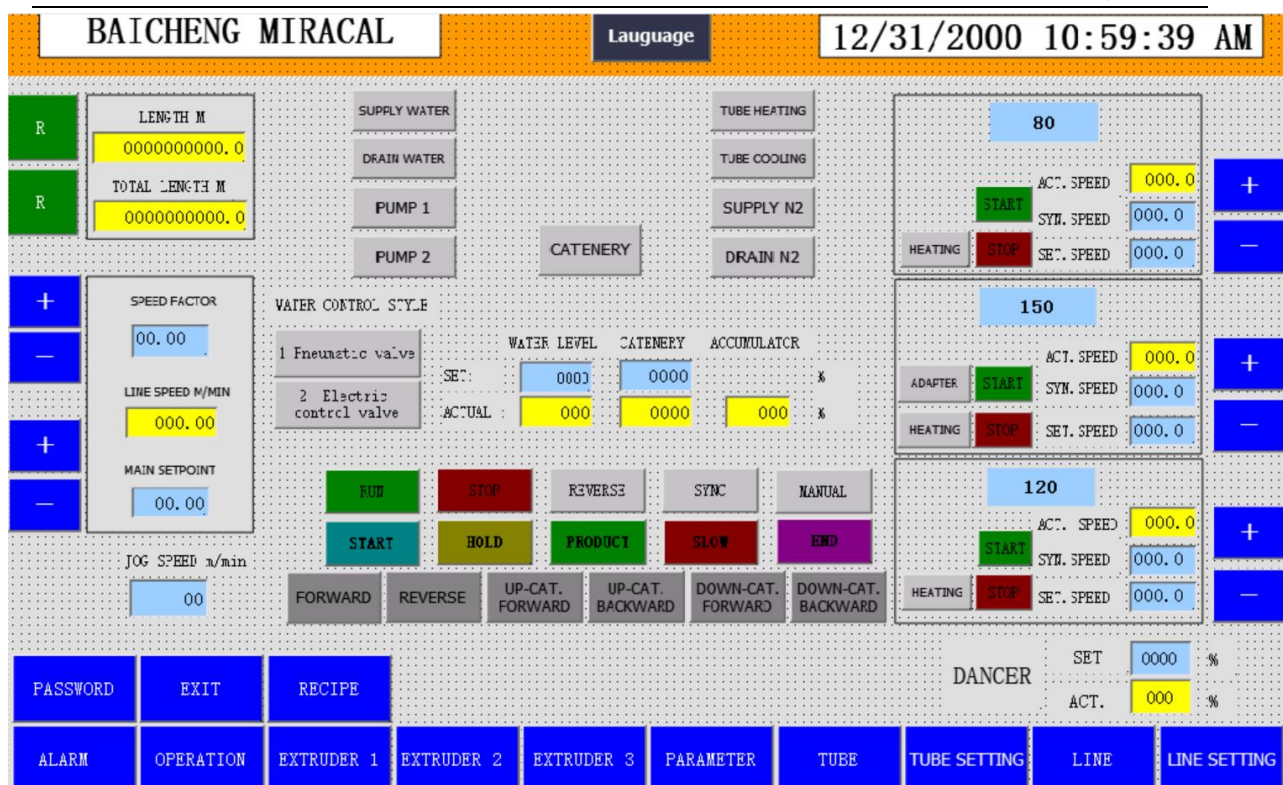
Front view of Main control cabinet plate



Set total line flow diagram, LED display, clear.

2) 、 touch screen view instruction :

A、“main view”instruction :



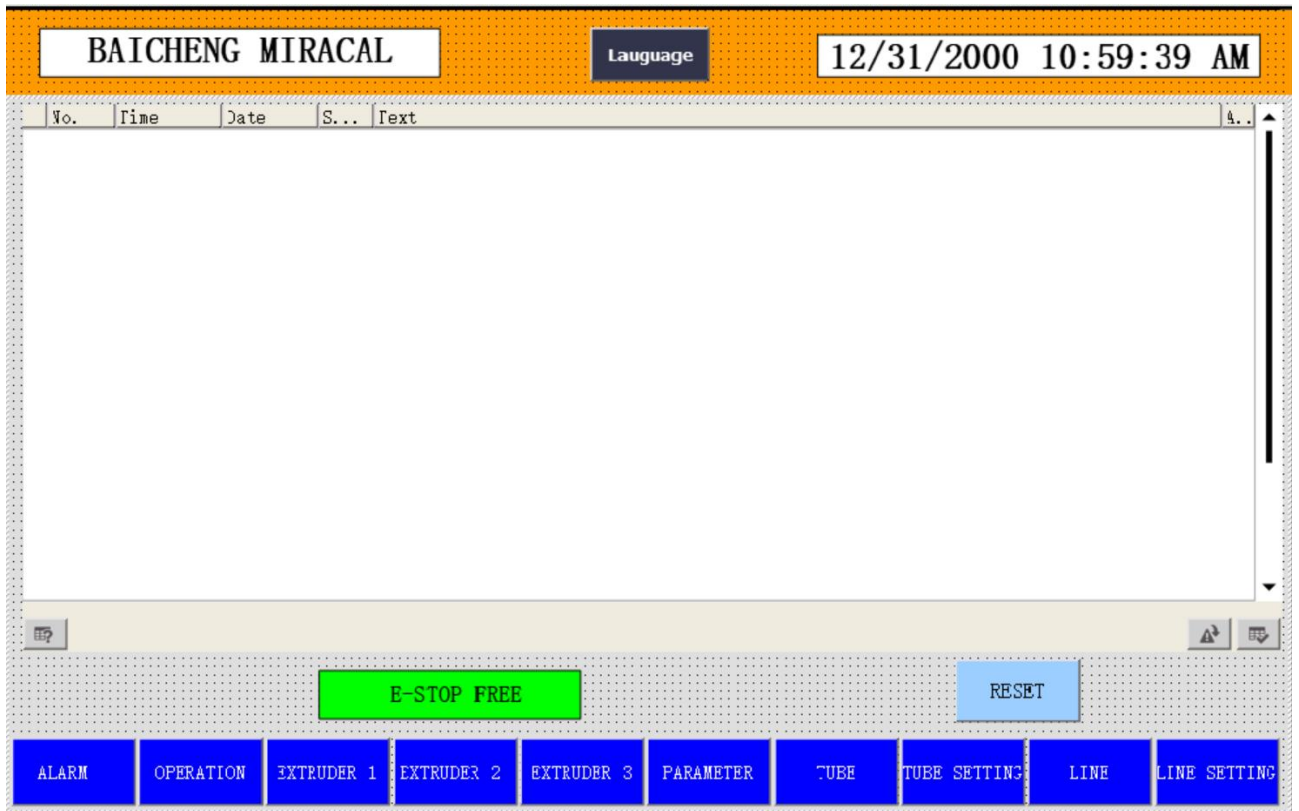
Display content as below:

- 1>、 line speed, latest alarm, counting length ;
- 2>、 3 extruders heating, startup, synchro rev, single machine rev and actual rev ;
- 3>、 setting line speed, actual line speed, setting line speed factor ;
- 4>、 accumulating quantity percentage ;
- 5>、 catenary status, water level status ;
- 6>、 total operation button ;
- 7>、 alarm prompt latest failure, search failure site ;
- 8>、 control up helper caterpillar and down one ;

B、“alarm”split view :

Display content as below:

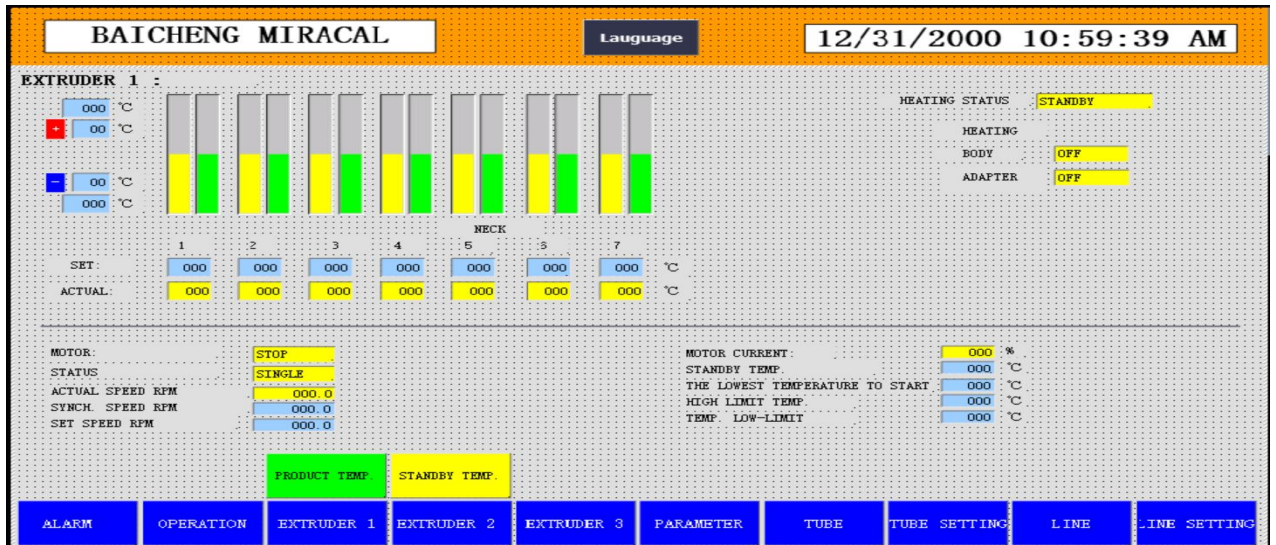
- 1>、 current alarm status and emergency stop status ;
- 2>、 set emergency stop reposition button ;



C、“extruder”split view (3 extruders in seperate view) :

Display content as below:

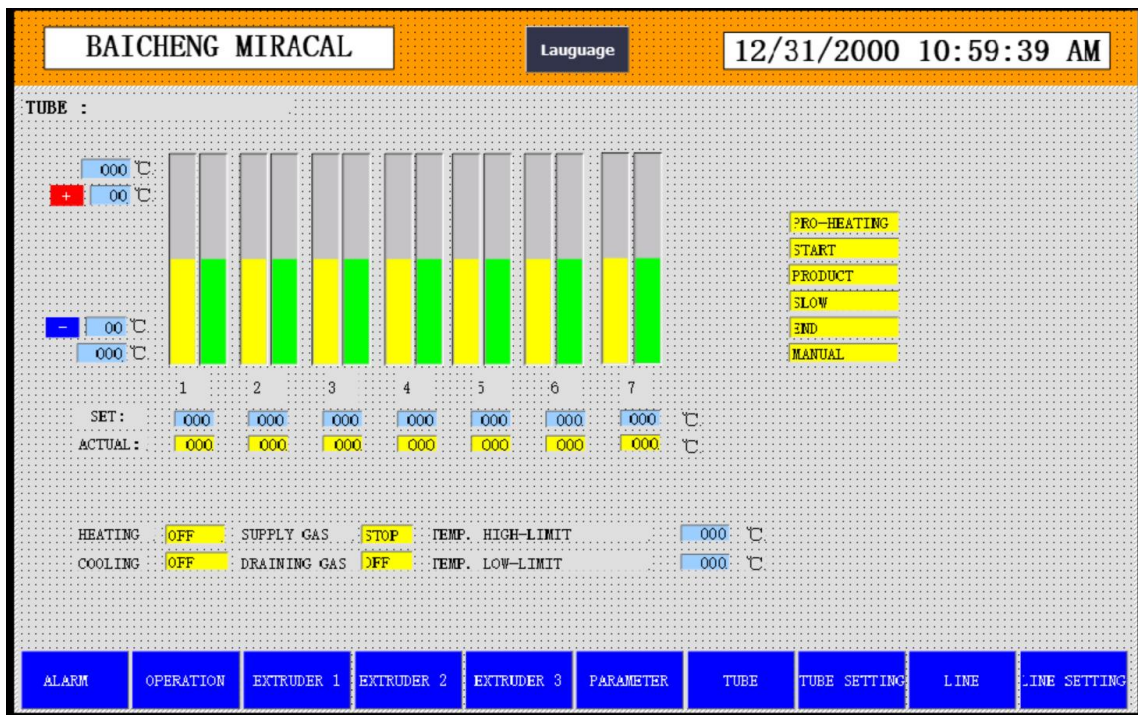
- 1>、 main motor status and running mode ;
- 2>、 screw rev and current ;
- 3>、 heating status ;
- 4>、 each heating area status, actual measure temperature, set temperature ;
- 5>、 standby temperature, save power ;
- 6>、 high low limit alarm ;
- 7>、 min startup temperature, protect device.



D、“curing tube”split view :

Display content as below:

- 1>、running status mode of line ;
- 2>、air providing status ;
- 3>、heating status ;
- 4>、each heating ares status, actual measure temperature, set temperature ;
- 5>、high low limit alarm ;



E、“extruder PID set”split view (3 extruders in separate view) :

Display content as below:

- 1>、PID set each area temperature control in extruder ;
- 2>、heating and cooling control status ;
- 3>、compensation regulate measure temperature offset in extruder ;

BAICHENG MIRACAL							Language	12/31/2000 10:59:39 AM					
EXTRUDER 1 PID CONTROL							TEMPERATURE			TEMP. HEAD			
	1	2	3	4	5	6	7	80	150	120	1	2	
SET:	000	000	000	000	000	000	000	℃					
ACTUAL	000	000	000	000	000	000	000	℃	000	000	000	℃	
HEATING %	000	000	000	000	000	000	000	%					
COOLING %	000	000	000	000				%					
I/SP	00.0	00.0	00.0	00.0	00.0	00.0	00.0	℃					
I/KP	00.0	00.0	00.0	00.0				℃					
TI	000	000	000	000	000	000	000	S					
TI	000	000	000	000				S					
TD	000	000	000	000	000	000	000	S					
TD	000	000	000	000				S					
TEMP. OFFSET	000	000	000	000	000	000	000	℃	000	000	000	℃	
			EXT. 1 PID	EXT. 2 PID	EXTRUDER 3 PI	OTHER PID	TUBE PID						
ALARM	OPERATION	EXTRUDER 1	EXTRUDER 2	EXTRUDER 3	PARAMETER	TUBE	TUBE SETTING	LINE	LINE SETTING				

F、“curing tube PID set”split view:

Display content as below:

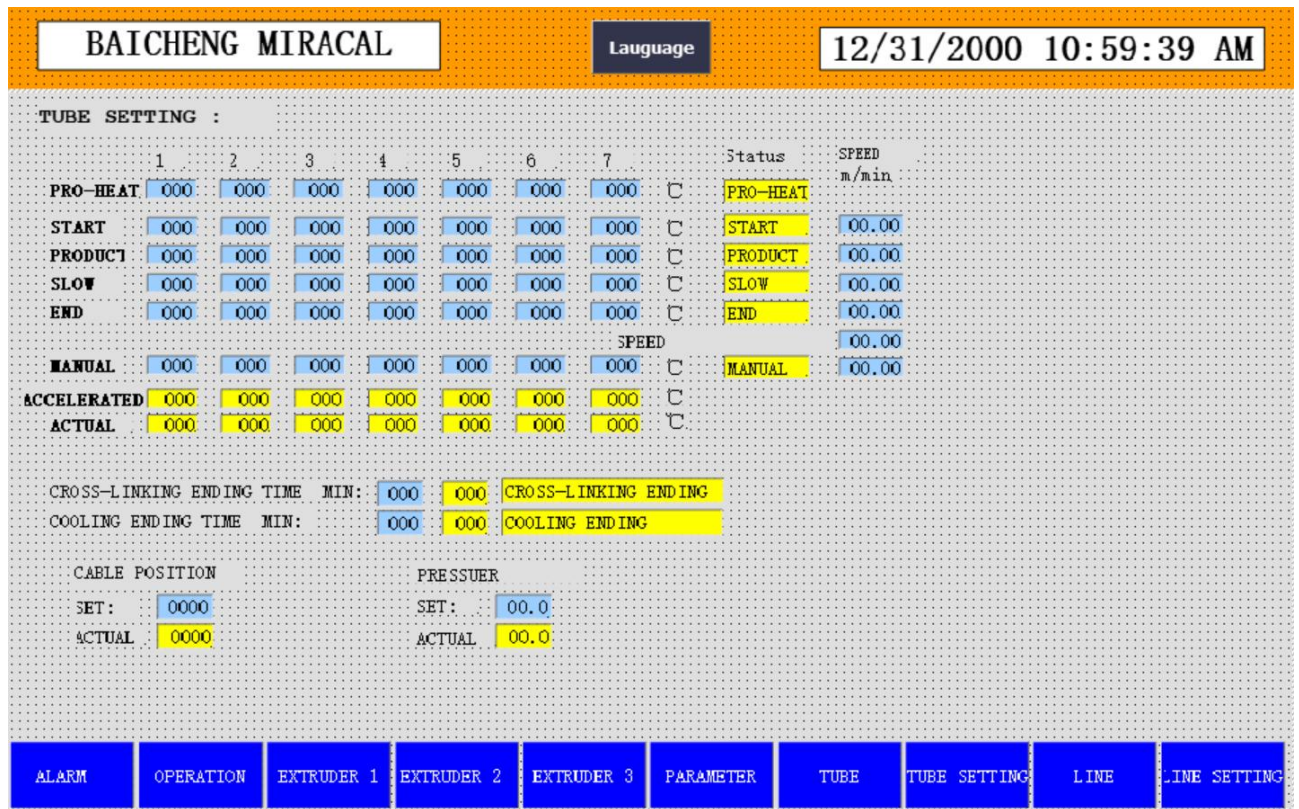
- 1>、PID set temperature control each area in tube ;
- 2>、heating and cooling control status ;
- 3>、compensation regulate measure temperature offset in tube ;

BAICHENG MIRACAL		Language		12/31/2000 10:59:39 AM					
TUBE PID CONTROL:									
	1	2	3	4	5	6	7		
SET:	000	000	000	000	000	000	000		
ACTUAL	00000	00000	00000	00000	00000	00000	00000		
HEATING	000	000	000	000	000	000	000		
COOLING	000	000	000	000	000	000	000		
1/KP	00.0	00.0	00.0	00.0	00.0	00.0	00.0		
1/KP	00.0	00.0	00.0	00.0	00.0	00.0	00.0		
TI	000	000	000	000	000	000	000		
TI	000	000	000	000	000	000	000		
TD	000	000	000	000	000	000	000		
TD	000	000	000	000	000	000	000		
TEMP. OFFSET	000	000	000	000	000	000	000		
		EXT. 1 PID	EXT. 2 PID	EXT. 3 PID	OTHER PID	TUBE PID			
ALARM	OPERATION	EXTRUDER 1	EXTRUDER 2	EXTRUDER 3	PARAMETER	TUBE	TUBE SETTING	LINE	LINE SETTING

G、“curing tube set”split view :

Display content as below:

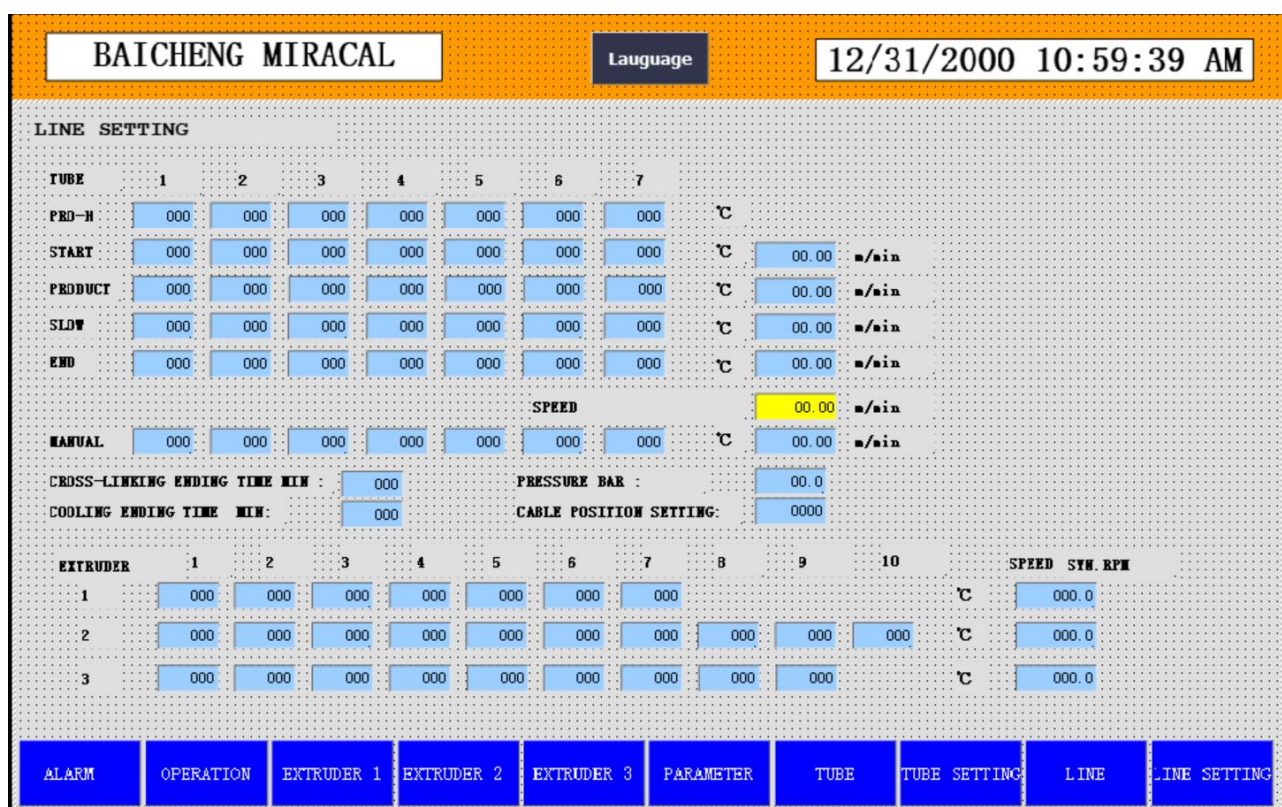
- 1>、temperature set in each running phase of each area ;
- 2>、running mode status of line ;
- 3>、line speed set in each producing mode and current speed ;
- 4>、curing complete phase time set and remaining time ;
- 5>、cooling phase time set and remaining time ;
- 6>、temperature in tube heating process ;



H、“line set”split view :

Display content as below:

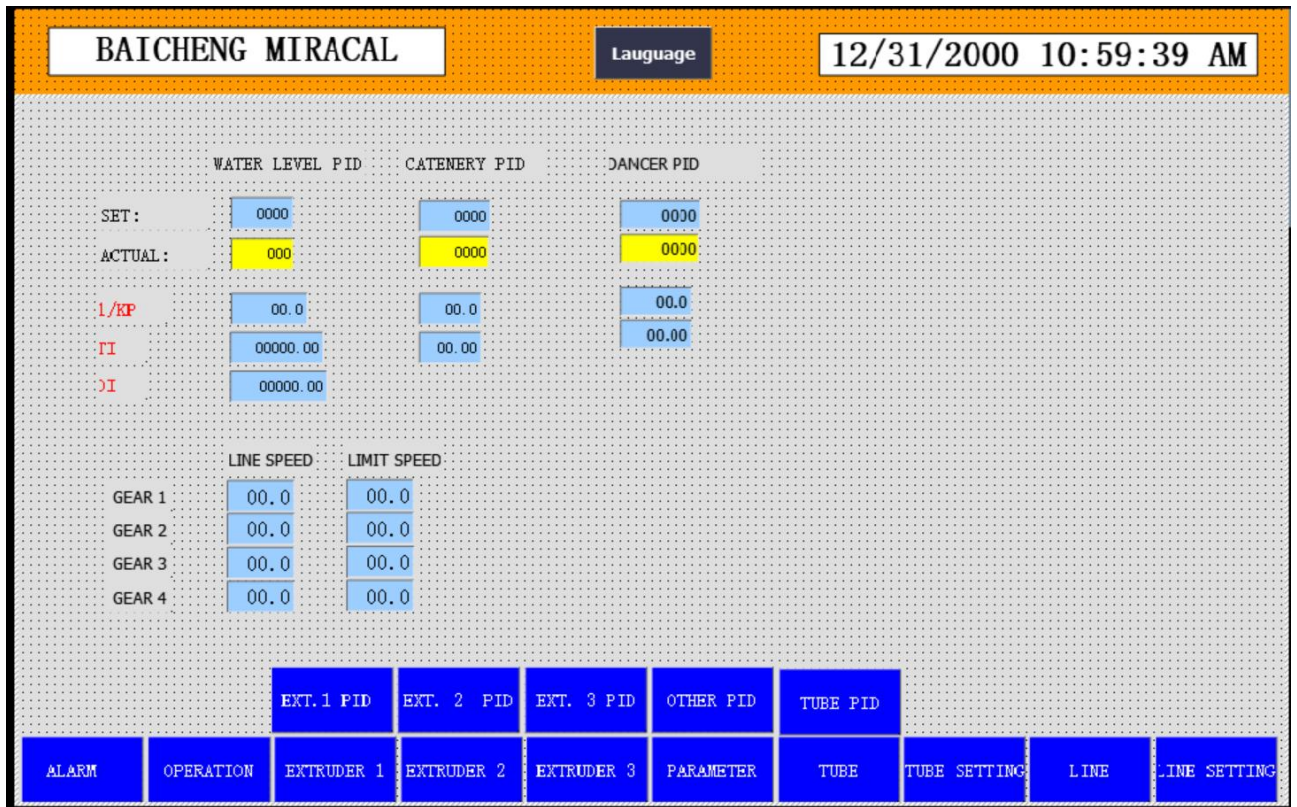
- 1>、line speed in every producing mode ;
- 2>、set temperature of extruder and tube ;
- 3>、extruder synchro rev ;



I、“other PID”split view :

Display content as below:

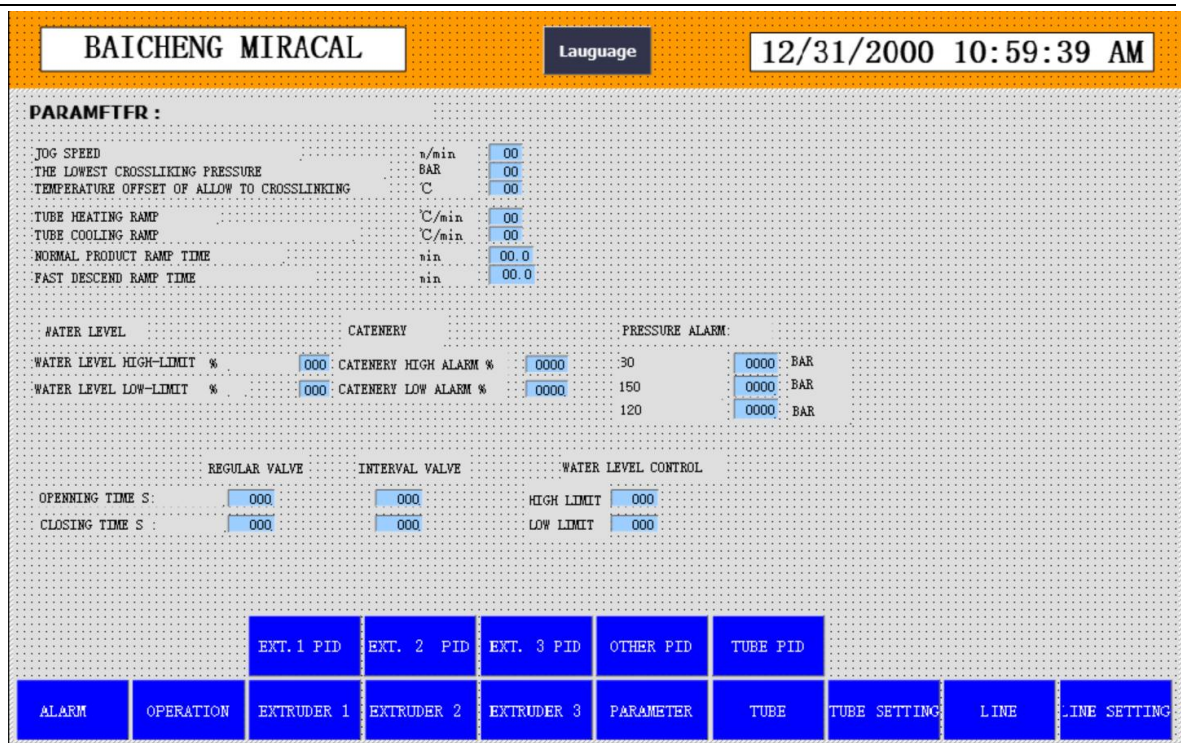
- 1>、PID set water level、catenary controller、metering capstan and caterpillar ;
- 2>、separate set and actual valve ;



J、“technical parameter”split view

Display content as below:

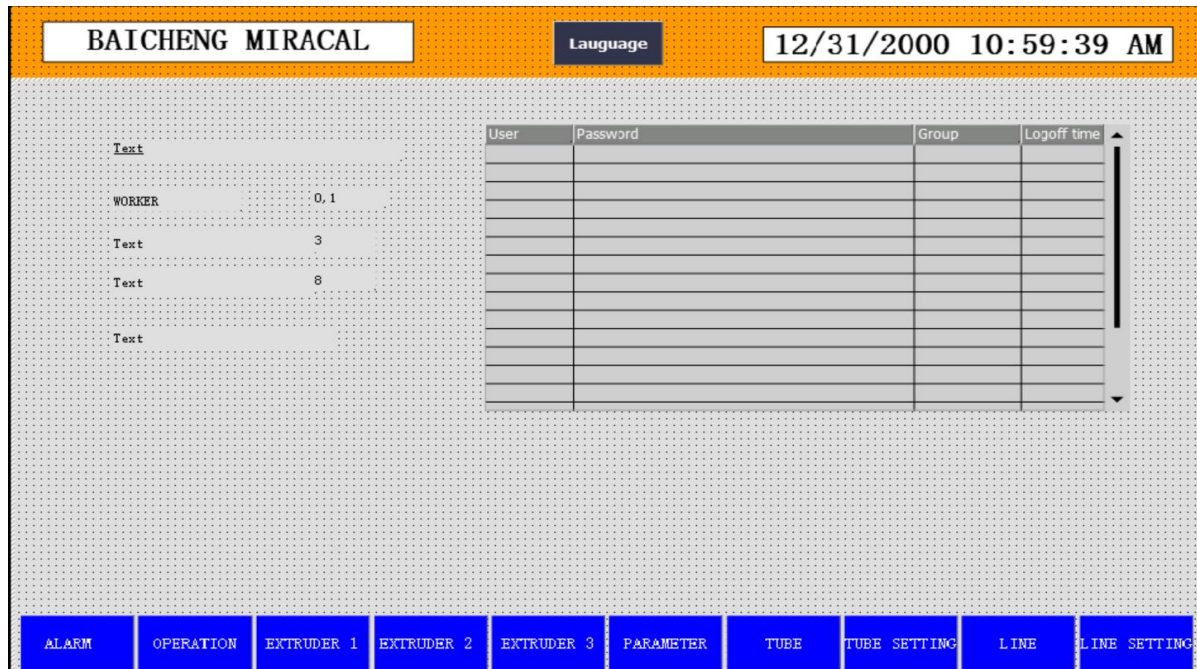
- 1>、 set water level and melt pressure alarm limit of catenary controller ;
- 2>、 set open close time of each automatic magnetic valve ;
- 3>、 set each parameter of automatic curing ;



K、“password management”split view

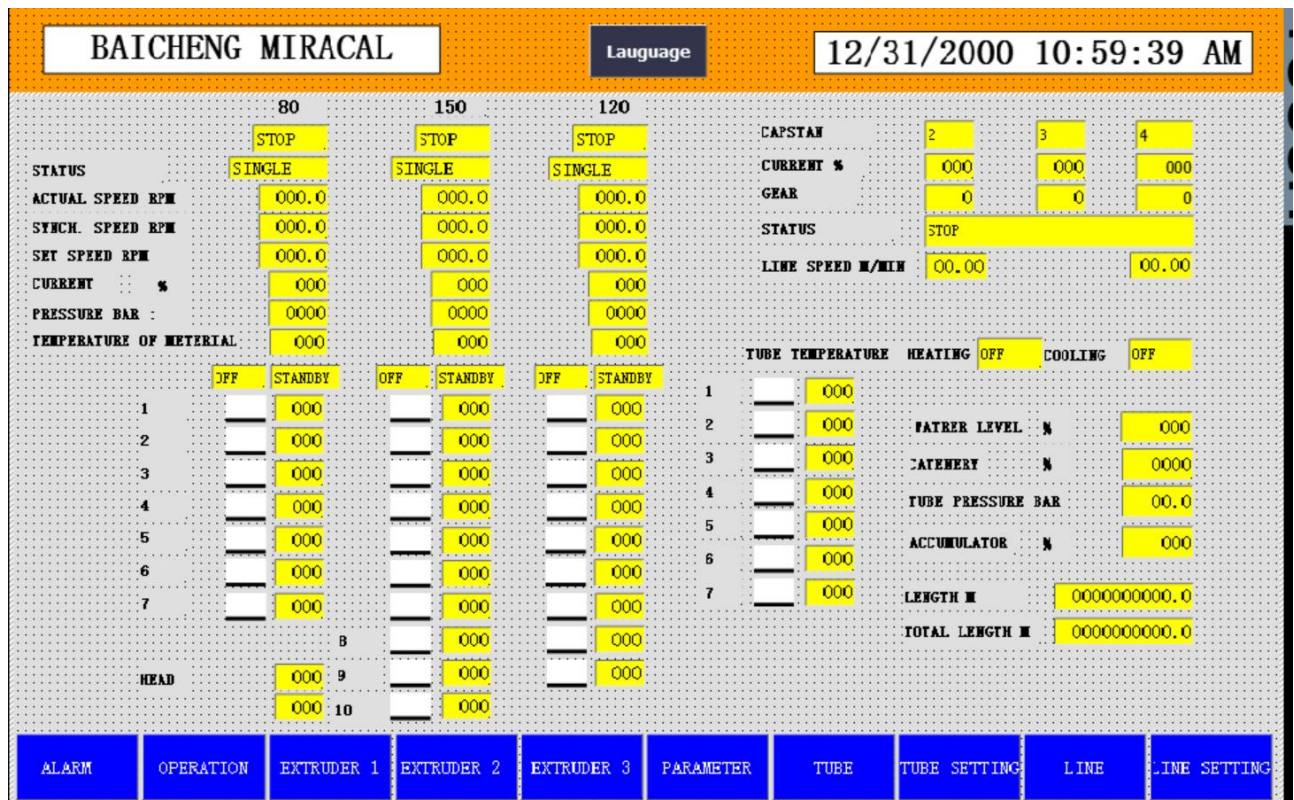
Display content as below:

1>、set and manage user`s each grade password ;



L、“line”split view :

Display content as below:



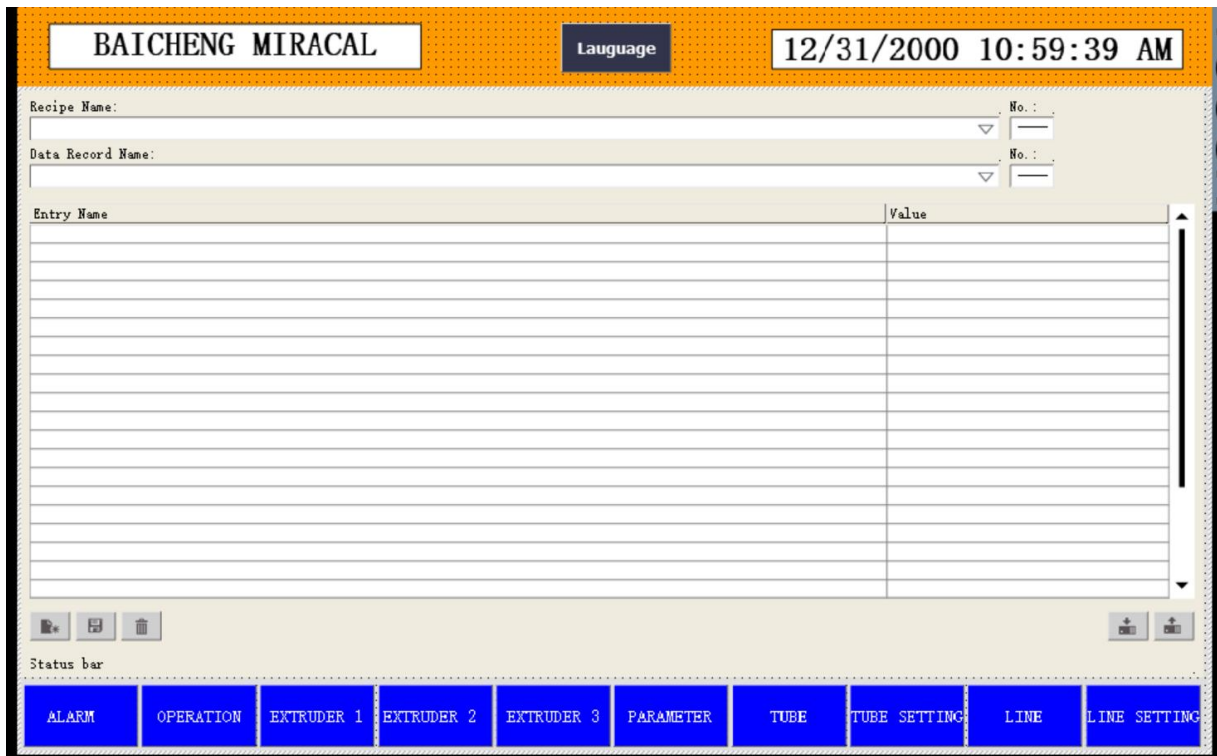
- 1>、all temperature, rev, current, pressure, running mode status of 3 extruders ;
- 2>、all temperature of tube, heating cooling status ;
- 3>、current, gear shift, speed, running status of each caterpillar ;
- 4>、working status of producing, producing length ;
- 5>、actual value of catenary controller, water level, tube pressure etc ;

M、“formula”split view :

Display content as below:

- 1>、memory line information ;
- 2>、information including each area temperature of extruder, each area temperature of tube, line speed, tube pressure, catenary position, producing size etc.
- 3>、manage memory formula, e.g. upload, download, new, delete etc.

Convenient to consult it when producing same size in the future.



N、“curve”split view :

Sampling in setting time, draw curve by portray point graphics in increase decrease speed process of 3 extruders, metering capstan and caterpillar.

Guarantee to high efficiency PID regulate upto setting temperature in min increase temperature process by record, portray, observe the increase temperature curve in each curing tube. Efficiently overcome thermal inertia, overshoot min and promptly attenuate.

O、“print”split view

Connect printer or CD rerorder, can memory parameter in cable producing process.

P、 line with synchro increase decrease speed, total line reverse and single machine regulate function.

附件 2

Attachment 2:

主要设备明细 Main Components List

序号 Item	设备名称 Name of equipment	规格 Specification	数量 Quantity
1	主动式放线架 Motorized Pay-off stand 1. 恒张力放线 Constant tension pay off 2. 舞蹈器速度放线 Dancer speed pay off	Φ1600 mm~Φ2500mm (龙门上横梁行走式 portal upper beam travelling type)	2 台 2 Pcs.
2	放线舞蹈器 Pay off Dancer	调节放线速度, 维持电缆中心位置不变 Adjust pay off speed, keep the center position unchanged	1 台 1 Piece
3	放线转向轮组 托线轮等转向轮组 Steering wheel group of payoff and supporting wheel	根据整线布局确定角度及数量 To define the angle and numbers accor. to whole line layout	1 台 1 Piece
4	气动夹线器 Pneumatic Wire clampler	橡胶板夹紧 clamped by rubber plate	1 台 1 Piece
5	卧式储线器 (11KW 直流电机) Horizontal accumulator (11KW DC Motor)	储线长度: 120m, 导轮直径 1600mm (西门子 PLC/派克 590 驱动器) Accumulating length:120m, guiding wheel dia. 1600mm (Siemens PLC/PARKER 590 DRIVE)	1 台 1 Piece
6	上包带式主牵引机 斜齿传动 Metering capstan, helical gear transmission	牵引力 Pulling force: 30KN (轮盘 wheel dia. Φ2000mm) 斜齿传动、防止竹节产生 Helical gear transmission can protect from cable bamboo joint.	1 台 1 Piece
7	上辅助履带式牵引机 含电器柜在内 Upper auxiliary	牵引力 Pulling force: 10KN	1 台 1 Piece

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	caterpillar, electrical cabinet included		
8	线芯清扫器 Cleaning device for the wire core		1 台 1 Piece
9	机头(三层共挤) Head (Triple extrusion crosshead)	含三套试机模具、导胶管、机头支架、油加热器快插接头 8 个,耐油不锈钢金属软管 Inclu. 3 sets of dies for trial run, guiding pipe, stand of crosshead, 9 quick connectors for oil heater, oil resistant stainless steel metal hose	1 台 1 Piece
10	机头加热器 Heater of crosshead	油循环温度控制 Oil circulating temperature control	3 台 3Pcs.
11	80 挤出机 ϕ 80 extruder	长径比 L/D=1: 20	1 台 1 Piece
	80 挤出机行走小车 Mobile car for ϕ 80 extruder	遥控电机涡轮箱减速行走方式 Remote motor worm gear box slow walking way	1 台 1 Piece
	80 挤出机上料系统 Material feeding system for ϕ 80 extruder	100kg 干燥料斗、4.0kw 自动上料机 100kg dry hopper, 4.0kw Automatic feeding device	1 套 1 Set
12	150 挤出机 ϕ 150 extruder	长径比 L/D=1: 25	1 台 1 Piece
	150 挤出机行走小车 Mobile car for ϕ 150 extruder	遥控电机涡轮箱减速行走方式 Remote motor worm gear box slow walking way	1 台 1 Piece
	150 挤出机上料系统 Material feeding system for ϕ 150 extruder	200kg 干燥料斗、4.0kw 自动上料机 200kg dry hopper, 4.0kw Automatic feeding device	1 套 1 Set
13	90 挤出机 ϕ 90 extruder	长径比 L/D=1: 20	1 台 1 Piece
	90 挤出机行走小车 Mobile car for ϕ 90 extruder	遥控电机涡轮箱减速行走方式 Remote motor worm gear box slow walking way	1 台 1 Piece
	90 挤出机上料系统 Material feeding system for ϕ 90 extruder	150kg 干燥料斗、4.0kw 自动上料机 150kg dry hopper, 4.0kw Automatic feeding device	1 套 1 Set
14	3 台主机机身冷却系统 Cooling system for 3 extruders machine body	3kw 不锈钢立式高扬程管道水泵, 2 立方不锈钢水箱, 10 平方板式换热器。3kw stainless steel vertical high lifting distance	1 套 1 Set

		pipe pump, 2m ³ stainless steel water tank, 10m ² plate heat exchanger.	
15	电动式上封闭器 Motorized splice box		1 台 1 Piece
16	交联加热管 (42 米) Cross linking heating tube (42m)	Φ219×4 不锈钢 304, 包括交联管托轮 Φ 219 × 4 stainless steel 304, including tube supporting wheel 7 sections	7 节 /Sections
17	加热段风冷系统 Air cooling device for heating section	每节管由 1 台风机, 3 节罩板组成 Each section consists of 1 air blower, 3 sections of covers.	7 套 7 Sets
	加热段管路保温 Heating section insulation	硅酸铝保温棉、铝合金铝板外皮 Aluminum silicate insulation cotton aluminum alloy aluminum plate skin	7 套 7 Sets
18	悬垂控制器 Catenary controller	非接触式, 场强控制 Contactless, field control 全套悬垂控制器 1 台及 1 套备用的悬垂控制器电控系统 A complete set of catenary controller and an additional set of electrical system of catenary controller for spare.	1 台全套+1 套备用电控系统 1 complete set of catenary controller & 1 set of electrical system of catenary controller for spare
19	预冷管段 (12 米) Pre-cooling tube section (12m)	Φ219×4 不锈钢 304 2 段 Φ219×4 stainless steel 304 2 sections	2 套 2 Sets
20	回水管 Back water tube (水汽平衡用 used for water air balance)	不锈钢丁字罐 Stainless steel T can	1 套 1 Set
21	水汽平衡系统 Water and nitrogen balance system	两种控制方式 方式 1: 自动手动调阀, 差压变送器及软管。 方式 2: 磁力翻板液位计与气动球阀。 Two control ways. Way 1: Automatic and manual control valve, differential pressure transmitter and hose. Way 2: Magnetic turn-over plate level gauge and pneumatic valve	1 套 1 Set

22	冷却管段 (66 米) Cooling tube section (66m)	Φ 159×4 不锈钢 304(第一节 Φ 219×4) 11 段 φ 159×4 stainless steel 304 (φ 219×4 for the first section) 11 sections	1 套 1 Set
23	氮气压力控制系统 Control system for nitrogen pressure	自动及手动控制阀组 Automatic and manual control valve group	1 套 1 Set
24	氮气排放系统 Nitrogen drain system	风机及自动球阀等 Air blower and automatic ball valve	1 套 1 Set
25	气路控制系统 Air pipe control system	气动球阀等 Pneumatic ball valve etc.	1 套 1 Set
26	水控制冷却系统 Water control cooling system	多级立式高扬程 15kw 水泵 2 台、自动手 动调阀, 不锈钢软管 2 sets of water pumps of 15kw with multi-level vertical high-lift distance Automatic and manual control valve, stainless steel hose	1 套 1 Set
27	管路电加热变压器 Pipe electrical heating transformer	加热变压器 (干式) Heating transformer(drying type)	7 台 7 Pieces
28	管路底部托轮 Pipe bottom supporting wheel	加热段、预冷段、轴承座结构 冷却段托轮式结构 Bearing pedestal structure for heating and pre-cooling section, wheel structure for the cooling section	整套 Complete set
29	加热用铜铝排 Copper & aluminum bar for heating	铜排厚 12mm、铝排厚 16mm Copper bar thickness 12mm, aluminum bar thickness 16mm	1 套 1 Set
30	电缆搓线机 Cable Twister	皮带式 Belt type	1 台 1 Piece
31	电缆吹干机 Cable Dryer	含电机软管等 Including .motor hose etc.	1 套 1 Set
32	下封闭器 End seal	软性封闭、带二次密封, 气动控制, 材料 不锈钢, 可调电缆中心控制泄水量装置 Soft seal, with secondary seal, pneumatic control, stainless steel, adjustable water discharge control device for cable center	1 台 1 Piece
33	5 位计米器 Meter counter with 5 digits.	机械及感应一体式 Mechanical and inductive integrated type	1 台 1 Piece

34	下履带式牵引机 Pull-out caterpillar	牵引力 40kN Pulling force: 40kN	1 台 1 Piece
35	下履带式辅助牵引机 Auxiliary caterpillar	牵引力 10kN Pulling force: 10kN	1 台 1 Piece
36	收线辅助转向轮、托架 Auxiliary steering wheel, support for take up stand	根据整线布局确定角度及数量 Define the angle and quantity according to the whole line layout.	1 套 1 Set
37	主动收线架 Active Take-up stand	Φ2000 mm~Φ3150mm (龙门上横梁行走式 Portal upper beam traveling type)	2 台 2 Pcs.
38	整套操作电控柜 不含收放线 注：供电电源标准 380v、50Hz，超出此范围电器控制需增加费用。 Complete set of operating electrical control cabinet, not including take up and pay off stand. Note: power supply standard:380V, 50Hz, if your required is not in this scope, electrical control part expense will be raised.	1. 主电源柜 Main power cabinet 2. 共 2 套操作系统主操作柜 (S7-400PLC+西门子 12 触摸屏+联想台式电脑 1 套) 2 sets of operating system for the main operating cabinet (Siemens S7-400PLC +Siemens 12'touch screen+1 Lenovo desktop computer) 3. 3 台主机及导胶管等温控柜 Temperature control cabinet for 3 extruders and guiding hose 4. 管路加热控制柜 Pipe heating control cabinet 5. 3 台主机驱动柜 3 extruders driving cabinet 6. 上下牵引驱动柜 Drive cabinet for upper capstan and lower caterpillar 7. 储线器驱动柜(西门子 PLC+西门子文本显示器+派克 590P,原英国欧陆原装进口) drive cabinet for accumulator(Siemens PLC+ Siemens text display+ Parker 590P, original Eurotherm) 8. 上辅助牵引控制柜 Upper auxiliary capstan control cabinet 9. 下辅助牵引控制柜 Lower auxiliary caterpillar	1 套 1 Set
39	液压接头机 Hydraulic splicer	含压接模具 includ. Crimping dies.	1 台 1 piece

40	手动压线钳 Manual wire clamp	含压接模具 includ. Crimping dies.	1 个 1 piece
41	80 挤出机螺杆拆卸工装 Disassembling tool for φ 80 extruder screw		1 套 1 Set
	90 挤出机螺杆拆卸工装 Disassembling tool for φ 90 extruder screw		1 套 1 Set
	150 挤出机螺杆拆卸工装 Disassembling tool for φ 150 extruder screw		1 套 1 Set
42	工具小车 Tool carriage		1 台 1 Piece
43	下封闭胶垫 Rubber cushion for end seal	软性硅胶 soft silicone	30 个 30 Pcs.
45	出厂随机文件 Ex-factory Documents	模具图纸、布置图、地基图、电器原理图、 电器接线图、水气管线图、使用说明书、 技术说明书、驱动器说明书、所有自制件 图 Die drawing, layout, foundation drawing, electric diagram, ,electric wiring diagram, water-air pipe line drawing, operating instructions, technical instructions, drive manuals, drawings of all the part made by customer.	1 套 1 lot
46	X-RAY8000NXT 测偏 仪 SIKORA DEVICE X-RAY8000NXT	含冷水机 Inclu. Water chiller	1 套(Set)

附件 3、需方自制、自购、自备生产线辅助设备部分

Attachment 3: Auxiliary equipment part that buyer shall prepare and provide

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序号 No.	名称及规格 Description & Specification		数量 Qty.	备注 Remark
1	气水路连接管 Connecting tube of gas and water pipe		1 套 1 set	供方提供图纸 Supplier to provide drawings
2	安装连接电缆、铜接头 Connecting cable for installation and copper connectors		1 套 1 set	供方清单 See suppliers' list
3	表面喷塑电缆桥架 Plastic-sprayed cable tray		1 套 1 set	三通四通、盖板、支架等 Tee and cross pipe fitting, cover and supporter etc.
4	上牵引机台架 Metering capstan support		1 套 1 set	供方提供图纸 Supplier to provide drawings
5	交联管支承立柱 Supporting column for crosslinking tube		1 套 1 set	供方提供图纸 Supplier to provide drawings
6	悬垂控制器平台 Catenary controller platform		1 套 1 set	供方提供图纸 Supplier to provide drawings
7	短路变压器平台 Short circuit transformer platform		7 个 7 Pcs.	供方提供图纸 Supplier to provide drawings
8	电控柜底部平台 Electrical cabinet bottom platform		1 套 1 set	供方提供图纸 Supplier to provide drawings
9	户外循环冷却水池 Circulating cooling water pool outside		1 个 1 Pc.	100m ³ 需方自行设计 100m ³ User self design
10	安装调整用垫板 Mounting adjustment pad		1 套 1 set	供方提供清单 Supplier offers list
11	安装用各类膨胀螺栓 Various of expansion bolts for Mounting		1 套 1 set	供方提供清单 Supplier offers list
12	N G S 制 氮 机 系 统	空压机 Air compression machine 22kW	1	螺杆式 screw type
		耐高温冷干机 Thermal resistant cold dryer	1	UT-10GF
		空气氮气缓冲罐 Air and nitrogen buffer tank	2	0.5 m ³
		吸附式制氮机 Adsorption nitrogen generator	1	40 m ³ /h

	全无油氮气增压 Oil free nitrogen booster	1	VWN-40/25
	高压储氮罐 High pressure nitrogen storage tank	2	2.5MPa 、5m ³
13	10 万级净化间 Clean room of 100,000 class	1 套 set	
14	电控柜空调房 Air conditioner room for electrical cabinet	1 套 set	
15	三台主机原料不锈钢输送管 Stainless steel hose for 3 extruders material feeding	1 套 set	
16	35KV 及以下交联电缆局部放电, 交流耐压及局部放电故障定位试验系统 The PD and AC high voltage test and PD fault location Test System for XLPE Cable of 35KV or below	1 套 (Set)	
17	60 m ³ 户外循环冷却水池(一条线) 60 m ³ Circulating cooling water pool outside for 1 line	1 个 1 Pc.	(两条线共用 100 m ³)用户自行设计 Totally 100m ³ for two lines and self design by customer
18	高清工业摄像机 High definition industrial camera	4 台 4 Pcs.	彩色 Colorful
19	电视监控器 TV monitor	1 个 1 Pc.	液晶 32 寸, 分割四画面显示 32" LCD, split four pictures display

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