

# **Technical Specification**

## **For**

Triple-layer Extrusion Dry Cross-linking  
Cable Production Line (1~110kV)

**Attachment 1:**

Technical Specification for  
Triple-layer Extrusion Dry Cross-linking Cable Production Line

The production line is designed for manufacturing 1~110kV XLPE insulated power cable.

**1. Main technical specification**

- 1.1 Voltage Class XLPE 1~110kV
- 1.2 Conductor 25~800mm<sup>2</sup> Cu  
35~1000mm<sup>2</sup> Al
- 1.3 Cable weight max. 12.5kg/m
- 1.4 Cable diameter max. 80mm
- 1.5 Cable construction
  - Conductor shield 0.5~2mm
  - Insulation 3.4~20mm
  - Insulation shield 0.5~2mm
- 1.6 Material
  - Conductor: compressed Cu, aluminium stranded conductor、 Milliken conductor
  - Conductor shield: cross-linking conductor screening material
  - Insulation: XLPE
  - Insulation shield: strippable insulation screening material
  - Line design speed: 0~25m/min.
- 1.7 Line execution: half catenary
  - Inclination of cooling section ( declination type ) : 1° ~ 2°
  - Catenary factor: 200~150
  - Length of cross-linking section: about 42 m  
material: Stainless steel 304,  $\phi 250 \times 4$
  - Design temperature: max. 450°C
  - Length of pre-cooling section: 12 m  
material: Stainless steel  $\phi 250 \times 4$
  - Length of cooling section: 78m
  - Material: Stainless steel  $\phi 150 \times 4$
  - Design pressure: 1.6 MPa
- 1.8 Extruders arrangement:
  - $\phi 80$ -  $\phi 175$ -  $\phi 100$  triple extrusion
  - $\phi 80$  for conductor screen
  - $\phi 175$  for cross linked polyethylene(XLPE)
  - $\phi 100$  for insulation screen
- 1.10 Pressurized medium in pipe: nitrogen
- 1.11 Cooling medium in pipe: nitrogen and water
- 1.12 Kinetic energy consumption:
  - Electricity: installation capacity 1000 kVA

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

Water: water pressure: 0.2~0.6 MPa

Water consumption: 15m<sup>3</sup>/h (circulating water from reservoir)

Compressed air: 0.6~0.8 MPa

Air consumption: 0.8m<sup>3</sup>/min

Nitrogen: pressure 2.0~2.5 MPa

purity 99.5%

consumption: 0.5~0.8m<sup>3</sup>/h

It is necessary to prepare two nitrogen storage containers no less than 6m<sup>3</sup> to start up the line.

## 2. Main components and technical requirements

### 2.1 Pay-off stand (Gantry lower beam type)

- a. Drum diameter: 2000~3150mm GB4004-83 PN-type
- b. Drum width: 1500~2300mm
- c. Drum weight: max. 18t
- d. DC motor is used for main drive, running in four-quadrant

### 2.2 Horizontal accumulator

- a. Accumulating length: 120m
- b. Guide pulley diameter: 2000mm
- c. Operation is performed on the accumulator and operating cabinet in master control room, accumulating value is displayed on the control cabinet.
- d. 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.
- e. The motor is a DC servo motor 7.5kW.
- f. Drive: Parker 590
- g. A PLC controls the accumulating and motorized pay-off.

### 2.3 Auxiliary capstan

- a. Pulling cable diameter: max. 80mm
- b. Pulling force: max. 16 kN
- c. Drive: Parker 590
- d. DC motor: Z4 Power 7.5kw
- e. Line speed: 25m/min

### 2.4 Metering capstan

- a. Pulling way: disk type capstan
- b. Pulling wheel diameter: 2500mm
- c. Pulling speed: 0~25m/min
- d. Pulling force: max. 40 kN
- e. Cable diameter: max. 80mm
- f. A speed sensor equipped with a line speed meter
- g. It has core around positioning device which guarantee different size of core from metering capstan outlet to align to the center of crosshead.
- h. Main drive adopts DC motor, runs in four quadrants.

### 2.5 $\phi$ 80 Extruder 80/20D

- a. Barrel  
Material: 38CrMoAlA

- Hardness: more than 950HV
- Working pressure: max. 70MPa
- b. Screw
  - Material: 38CrMoA1A
  - Hardness: more than 850HV
  - Diameter: 80mm
  - Rate of rotation: max. 48rpm
- c. Gear box
  - Reduction gear ratio: 32:1
  - Lubricating method: inject oil from oil-pump
  - Dynamic bearing force: 788 kN for thrust bearings
- d. Heating and cooling system
  - Heating way for barrel: electric heating
  - Cooling way for barrel: water cooling
  - Cooling way for feed hopper: water cooling
  - Cooling principle for the barrel: adopts independent totally enclosed water cooling way.
- e. DC motor:
  - Type: Z4-type
  - Power: 45 kW
  - Rated speed: 1450rpm
- f. Material feeding: automatic vacuum feeding and dry, stainless steel hopper.
- g. Extrusion output: 60kg/h
- h. Barrel temperature control:
  - Thermocouple E type
  - Control accuracy:  $\pm 2^{\circ}\text{C}$
- i. Pressure control: by a melt pressure measuring sensor installed before the filter screen at the end of barrel.

## 2.6 $\phi 100$ extruder 100/20D

- a. Barrel
  - Material: 38CrMoA1A
  - Hardness: more than 950HV
  - Working pressure: max. 70MPa
- b. Screw
  - Material: 38CrMoA1A
  - Hardness: more than 850HV
  - Diameter: 100mm
  - Rate of rotation: max 41.5 rpm
- c. Gear box
  - Reduction gear ratio: 36:1
  - Lubricating method: inject oil from oil-pump
  - Maximum pressure of thrust bearing: 1160 kN
- d. Heating and cooling system
  - Heating way for barrel: electric heating
  - Cooling way for barrel: water cooling
  - Cooling way for feed hopper: water cooling
  - Barrel cooling principle: Adopt fully enclosed water cooling way.

- e. DC motor:
  - Type: Z4-type
  - Power: 75 kW
  - Rated speed: 1450rpm
- f. Material feeding: automatic vacuum feeding, dry, stainless steel hopper
- g. Extrusion output: 110kg/h
- h. Temperature control for barrel
  - Thermocouple E type
  - Control accuracy:  $\pm 2^{\circ}\text{C}$
- i. Pressure control: by a melt pressure measuring sensor installed before the filter screen at the end of barrel.

## 2.7 $\phi 175$ extruder 175/25D

- a. Barrel
  - Material: 38CrMoAlA
  - Hardness: more than 950HV
  - Working pressure: max. 50MPa
- b. Screw
  - Material: 38CrMoAlA
  - Hardness: more than 850HV
  - Diameter: 175mm
  - Type: BM-type cooling at the center hole
  - Rate of rotation: max. 34.3 rpm
- c. Gear box
  - Reduction gear ratio: 43.73:1
  - Lubricating method: inject oil from oil-pump
  - Maximum pressure: 1830 kN for thrust bearing
- d. Heating and cooling system
  - Heating way for barrel: electric heating
  - Cooling way for barrel: water cooling
  - Cooling way for feed hopper: water cooling
  - Cooling for the gearbox: Water cooling
  - Cooling principle for the barrel: Adopt fully enclosed water cooling way.
- e. DC motor:
  - Type: Z4-type
  - Power: 185 kW
  - Rated speed: 1450rpm
- f. Material feeding: automatic vacuum feeding, stainless steel hopper
- g. Extrusion output: 380kg/h
- h. Barrel temperature control:
  - Thermocouple E type
  - Control accuracy:  $\pm 2^{\circ}\text{C}$
- i. Pressure control: by a melt pressure measuring sensor installed before the filter screen at the end of barrel.

## 2.8 Triple Crosshead (2 sets separately for producing 1-35kV & 10-110kV cable)

- a. Technical parameters

### Crosshead A for 1-35kV

Conductor diameter range: 6~34mm

Outlet wire diameter: max. 70mm

Extrusion thickness:

First layer: 0.3~2.0mm

Second layer: 2.5~12mm

Third layer: 0.3~2.0mm

## **Crosshead B for 10-110kV**

Conductor diameter range: 6~35.5mm

Outlet wire diameter: max. 80mm

Extrusion thickness:

First layer: 0.5~2.0mm

Second layer: 3.4~20mm

Third layer: 0.5~2.0mm

Heating way: with oil. Temperature control accuracy:  $\pm 2^{\circ}\text{C}$

- b. Head material: 38CrMoAlA, treated by nitriding, connected 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. Oil heater adopts 3-way heating, control 3 zones temperature of crosshead by manual flow regulation. Quick change coupler conneted with crosshead.

## **2.9 Motorized Splice box**

- a. Material: Telescopic tube is made of stainless steel 304
- b. Action way: double hydraulic cylinders 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)
- f. Motorized control device for the telescopic tube.

## **2.10 ETH quick cooling system for the first section** (similar to maillefer crosslinking operation system)

Adding the ETH quick cooling shaped system for the splice box and the first section of the pipe heating. This system consists of high temperature high pressure circulating blower (imported), cooler, switch valve group and pollution discharge device. This system forms a separate nitrogen circulating system with the splice box and first heating section. The nitrogen cools in the cooler (customer supplies the cooled water, Temperature of cooling water  $\leq 25^{\circ}\text{C}$ ) from splice box via circulating blower, then into the tubes from the lower flange of the 1<sup>st</sup> heating section, make the outer screen and part of insulation of cable which freshly output from the crosshead would be cooled and shaped, and easy to control to avoid the pear-shaped outer screen and insulation layer and guarantee the cable requirement on ellipticity and eccentricity.

## **2.11 Heating for cross linking tube**

- a. 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. There are totally 7 sections in heating tube. Each section is 6m long. Pipe size is  $\phi 250 \times 4$ . Material is stainless steel.
- c. Interlink control with silicon controlled contactless switch.
- d. Temperature control accuracy is  $\pm 5^{\circ}\text{C}$ .
- e. 2 sets of thermocouples, one is for use, the other is for standby.
- f. Total power for heating: 420KW
- g. Heating tube adopts hot bending, meets the standard of pressure vessel, Pressure in tube  $\leq 1.6\text{MPa}$
- h. 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.

## 2.12 Air cooling system for heating section tube(to be used during stop machine)

- a. Air cooling system controls heating section temperature  $\pm 3^{\circ}\text{C}$
- b. Each section of heating section air cooling system consists of an air blower and 3 sections of covers.
- c. Air blower to be installed below each heating section, air in from below and air out from the upper side.
- d. Intellectual operation system will guarantee most of cable in the heating tube is accepted product during machine stops.
- e. Insulation material is aluminium silicate, inner hole  $\Phi 273\text{mm}$
- f. Cover material: aluminum alloy aluminum plate

## 2.13. Catenary controller

- a. Type: contactless
- b. Mounting position: in the middle of heating section and make sure the cable not touch the pipe.
- c. When the catenary controller gets the cable position signal, rotate speed of lower hauling machine will be regulated.

## 2.14 Precooling section

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.

## 2.15 Cooling section

Material: stainless steel pipe size:  $\phi 150 \times 4$

Cooling medium: water, nitrogen

## 2.16 End seal

- a. Seal type: primary seal plus secondary 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. Double cylinders pneumatic control, movable distance is 500mm.

## 2.17 Twister

- a. Application:

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. Technical parameter and features:

Max. Cable dia.: 80mm

equipment center height: 1000mm

Max.inclination angle of belt: 15°

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

## 2.18 Blow dryer

Technical parameter:

Pump power:2.2KW

Wire outer dia.: 25-100 mm

Air flow: 130m<sup>3</sup>/h

## 2.19 Pull-out caterpillar

a. Pulling force: max. 40 kN

b. Pulling Speed: 0~25m/min, four gear shifts same as metering capstan

c. Cable diameter (max.): 100mm

d. Main Drive uses DC motor 22KW, running in four quadrants

## 2.20 Mechanical meter counter

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

## 2.21 Auxiliary caterpillar

a. Pulling cable diameter.(max.): 100mm

b. Pulling force: max. 20 kN

c. Drive: Parker 590

d. DC motor: Motor type & power: Z4, 7.5kW;

e. Line speed: 25m/min

## 2.22 Take-up stand (Gantry lower beam type)

a. Drum diameter: 2000~4000mm GB4004-84

b. Drum width: 1500~2500mm

c. Maximum bearing capacity: 20t

d. DC drive, which can run in 4 quadrants.

e. Drive: PARKER 590

f. Take-up speed: 0~25m/min, two gear-shifts

g. Has the function of quick travel

h. traversing range:  $\phi 20 \sim \phi 120$

## 2.23 Nitrogen supply and discharge

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

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

c. 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. There is a pollutant-emission outlet for nitrogen.

e. Discharging amount of nitrogen waste is 0.5m<sup>3</sup>/h, which can be increased or decreased according to the situation but maximum should not exceed 1 m<sup>3</sup> /h.



- f. Nitrogen waste discharge is controlled automatically, and discharging time can be set on technological requirements.
- g. Suction pump after the heating section will be opened when machine is stopped, which prevents the air in pipes from entering main machine hall.

## 2.24 Oil, water and nitrogen circulating cooling

- a. Bodies of three extruders are cooled with water or oil 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 25~35°C. Water pressure is regulated by hand valve.
- c. Cooling for cross-linking tubes consists of two sets of water pumps which forms a circulating system with reservoir.
- d. Nitrogen cooling for the crosslinking pipe is equipped with circulating air fan cooling system.
- e. Cooling circle zone is controlled by pneumatic ball valve.
- f. Cooling water level in pipe is controlled by differential pressure transmitter and digital controller.

## 2.25 Electrical control system

- A. 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. 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 offs, accumulators, main operating station, hauling machine and take-ups.

### D. Audio-Visual alarm system

- Overpressure alarm for melt pressure of barrel on extruder.
- Water level high or low
- Catenary controller high or low
- Over-pressure for nitrogen.
- Over-temperature for crosslinking pipe
- Accumulator empty or full
- Oil or water pump stop

### E. Electrical control cabinet operation

- Switch on by electrical or manual
- Start-stop operation on transmission, temperature control and water pump for every unit
- Speed control for the whole line
- Set cable position in the vulcanizing pipe (upward or downward adjustment)
- Automatic or manual operation for nitrogen supply system
- Discharge amount adjustment of nitrogen waste
- Automatic or manual control for water level
- Clamp and loosen operation before the accumulator
- Start the heating system and set the temperature
- Hanging mobile control operating case

### F. Electrical control cabinets consist

- Electrical control cabinets in the main unit room consist of:

- Power supply cabinet for in-wire
  - Drive cabinet for extruders
  - Temperature control cabinet for extruders
  - Temperature control cabinet for crosslinking pipe heating
  - Drive cabinet for haul-off,
  - Main control cabinet
- G. Ambient temperature in the main unit room: 0~30℃

## 2.26 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. offal length  $\approx$  start speed\*(start temperature-preheat temperature)/ 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; offal length  $\approx 2*(270-150)/8=30m$ . The produced cable after you push stop button is waste. Waste length  $\approx$  ending speed\*( ending curing time +ending cooling time). For example, ending speed is 0.1m; ending curing time is 25 minutes ; ending cooling time is 45 minutes; waste length  $\approx 0.1* (25*45) =7m$ . 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.

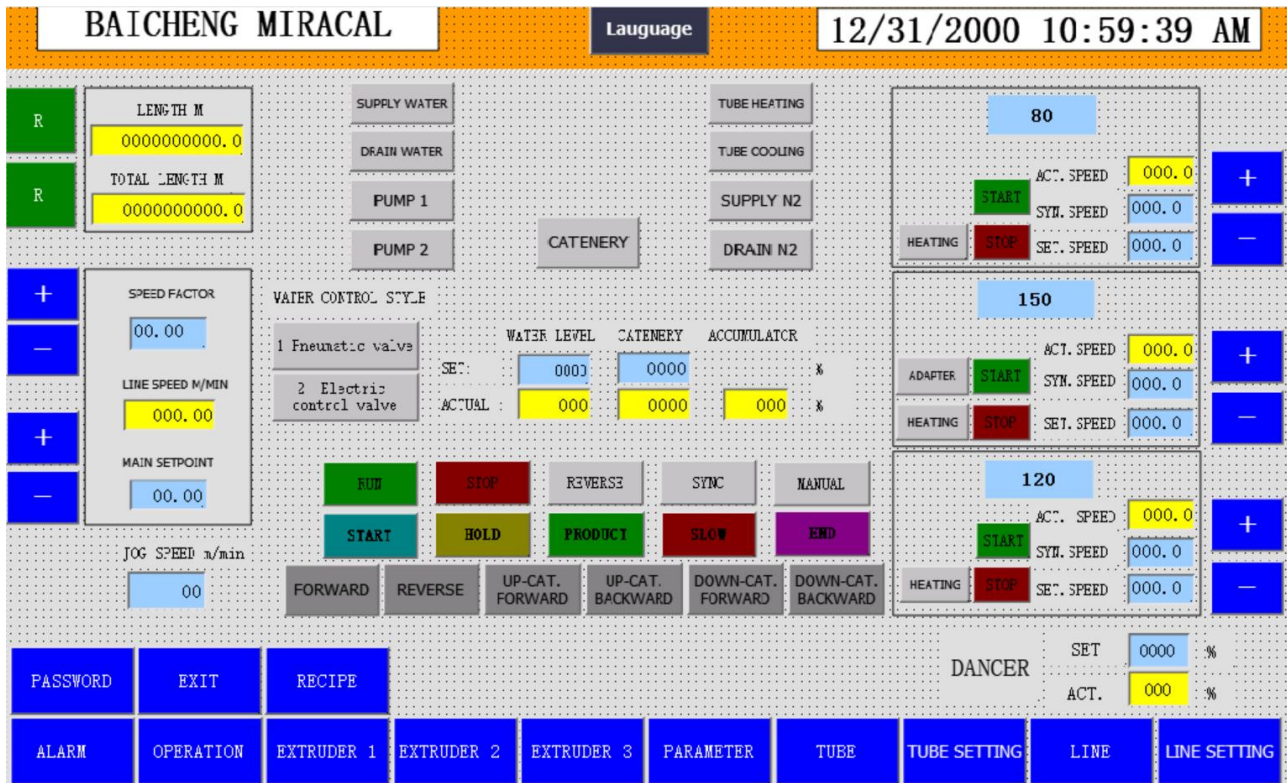
### Front view of Main control cabinet plate



Set total line flow diagram, LED display, clear.

#### 2)、touch screen view instruction :

##### A、“main view”instruction :



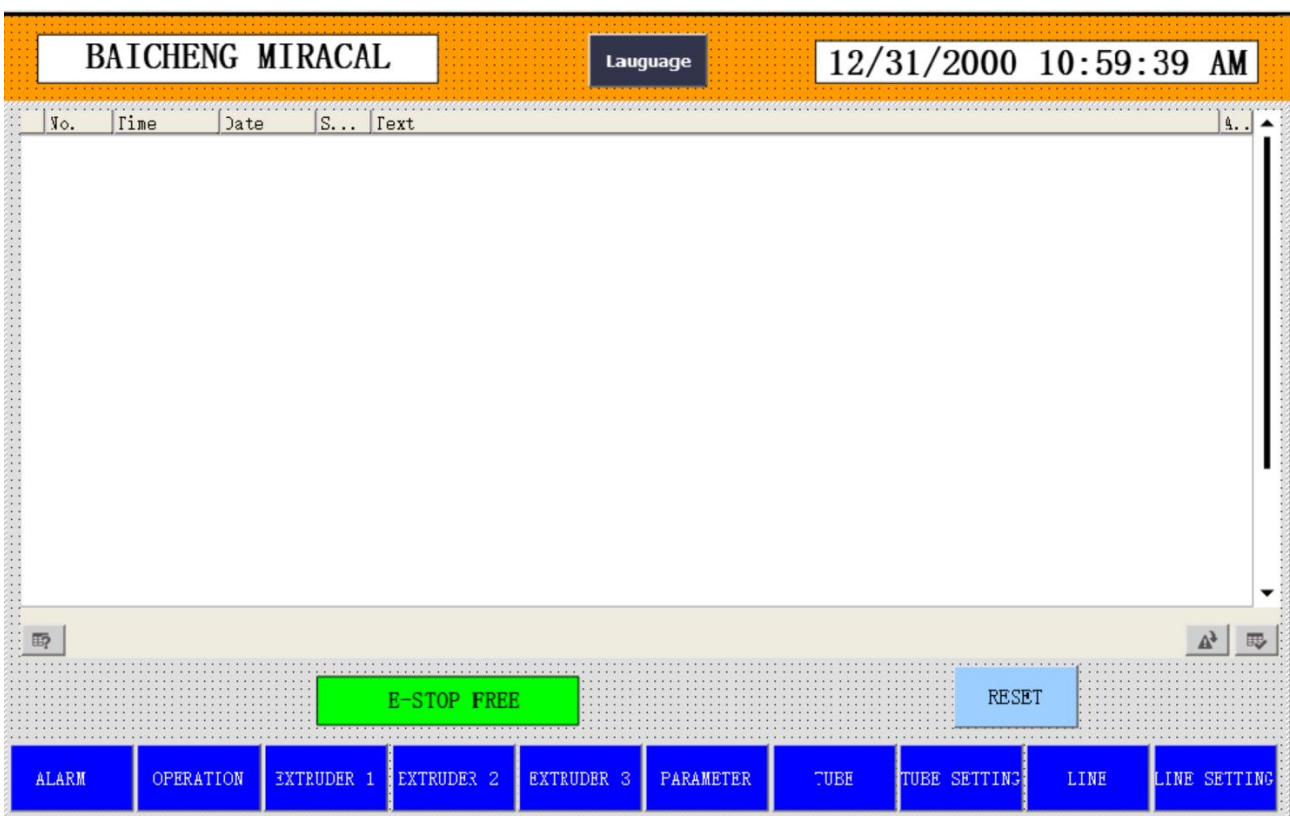
Display content as below:

- 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:

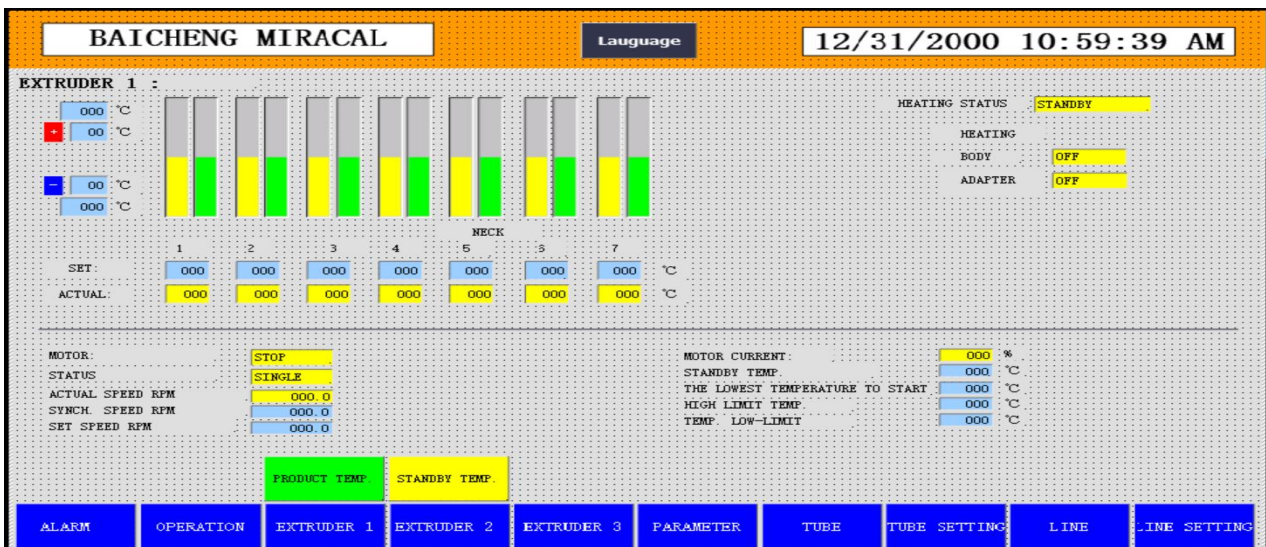
- 1>、current alarm status and emergency stop status ;
- 2>、set emergency stop reposition button ;



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

Display content as below:

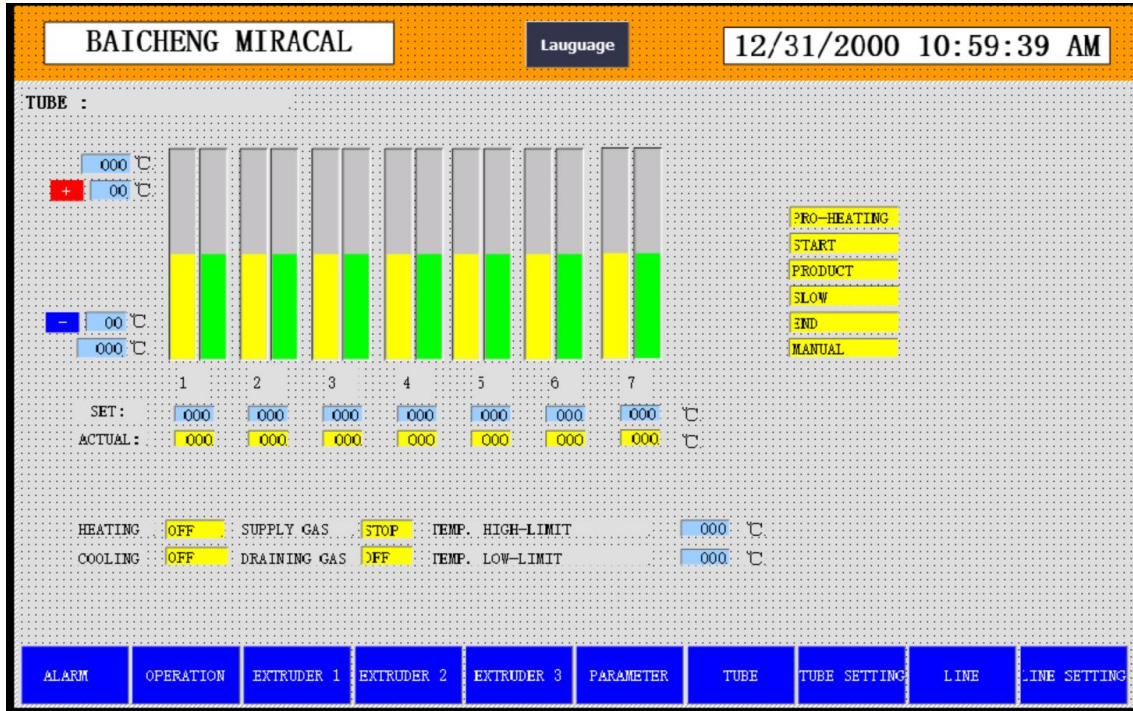
- 1>、 main motor status and running mode ;
- 2>、 screw rev and current ;
- 3>、 heating status ;
- 4>、 each heating area status, actual measure temperature, set temperature ;
- 5>、 standby temperature, save power ;
- 6>、 high low limit alarm ;
- 7>、 min startup temperature, protect device.



**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 seperate 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				%					
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				℃					
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 ;

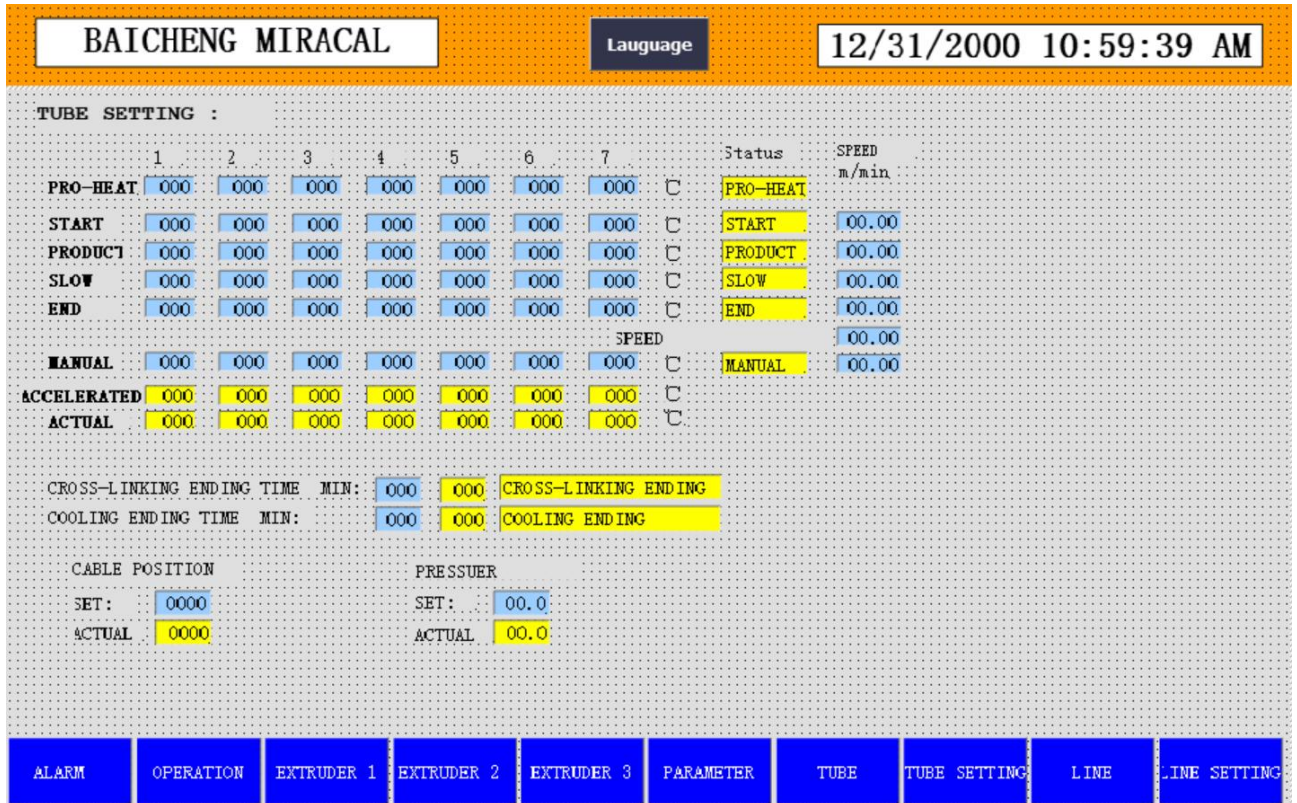
BAICHENG MIRACAL		Language		12/31/2000 10:59:39 AM									
TUBE PID CONTROL :													
	1	2	3	4	5	6	7						
SET:	000	000	000	000	000	000	000	℃					
ACTUAL	00000	00000	00000	00000	00000	00000	00000	℃					
HEATING	000	000	000	000	000	000	000	%					
COOLING	000	000	000	000	000	000	000	%					
1/KP	00.0	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	S					
TI	000	000	000	000	000	000	000	S					
TD	000	000	000	000	000	000	000	S					
TD	000	000	000	000	000	000	000	S					
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 ;



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**TUBE SETTING :**

	1	2	3	4	5	6	7	Status	SPEED m/min
PRO-HEAT	000	000	000	000	000	000	000	<input type="checkbox"/>	PRO-HEAT
START	000	000	000	000	000	000	000	<input type="checkbox"/>	START
PRODUCT	000	000	000	000	000	000	000	<input type="checkbox"/>	PRODUCT
SLOW	000	000	000	000	000	000	000	<input type="checkbox"/>	SLOW
END	000	000	000	000	000	000	000	<input type="checkbox"/>	END
									SPEED
MANUAL	000	000	000	000	000	000	000	<input type="checkbox"/>	MANUAL
ACCELERATED	000	000	000	000	000	000	000	<input type="checkbox"/>	
ACTUAL	000	000	000	000	000	000	000	<input type="checkbox"/>	

CROSS-LINKING ENDING TIME MIN: 000 000 CROSS-LINKING ENDING

COOLING ENDING TIME MIN: 000 000 COOLING ENDING

CABLE POSITION      PRESSUER

SET: 0000      SET: 00.0

ACTUAL 0000      ACTUAL 00.0

ALARM    OPERATION    EXTRUDER 1    EXTRUDER 2    EXTRUDER 3    PARAMETER    TUBE    TUBE SETTING    LINE    LINE SETTING

## 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 ;

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LINE SETTING

TUBE	1	2	3	4	5	6	7		
PRE-H	000	000	000	000	000	000	000	°C	
START	000	000	000	000	000	000	000	°C	00.00 m/min
PRODUCT	000	000	000	000	000	000	000	°C	00.00 m/min
SLOW	000	000	000	000	000	000	000	°C	00.00 m/min
END	000	000	000	000	000	000	000	°C	00.00 m/min
	SPEED								00.00 m/min
MANUAL	000	000	000	000	000	000	000	°C	00.00 m/min
CROSS-LINKING ENDING TIME MIN :	000			PRESSURE BAR :			00.0		
COOLING ENDING TIME MIN :	000			CABLE POSITION SETTING:			0000		

EXTRUDER	1	2	3	4	5	6	7	8	9	10	SPEED	SYM.	RPM
1	000	000	000	000	000	000	000				°C		000.0
2	000	000	000	000	000	000	000	000	000	000	°C		000.0
3	000	000	000	000	000	000	000	000	000		°C		000.0

ALARM OPERATION EXTRUDER 1 EXTRUDER 2 EXTRUDER 3 PARAMETER TUBE TUBE SETTING LINE LINE SETTING

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 ;

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	WATER LEVEL PID	CATENERY PID	DANCER PID
SET :	0000	0000	0000
ACTUAL :	000	0000	0000
1/KP	00.0	00.0	00.0
TI	00000.00	00.00	00.00
DI	00000.00		

	LINE SPEED	LIMIT SPEED
GEAR 1	00.0	00.0
GEAR 2	00.0	00.0
GEAR 3	00.0	00.0
GEAR 4	00.0	00.0

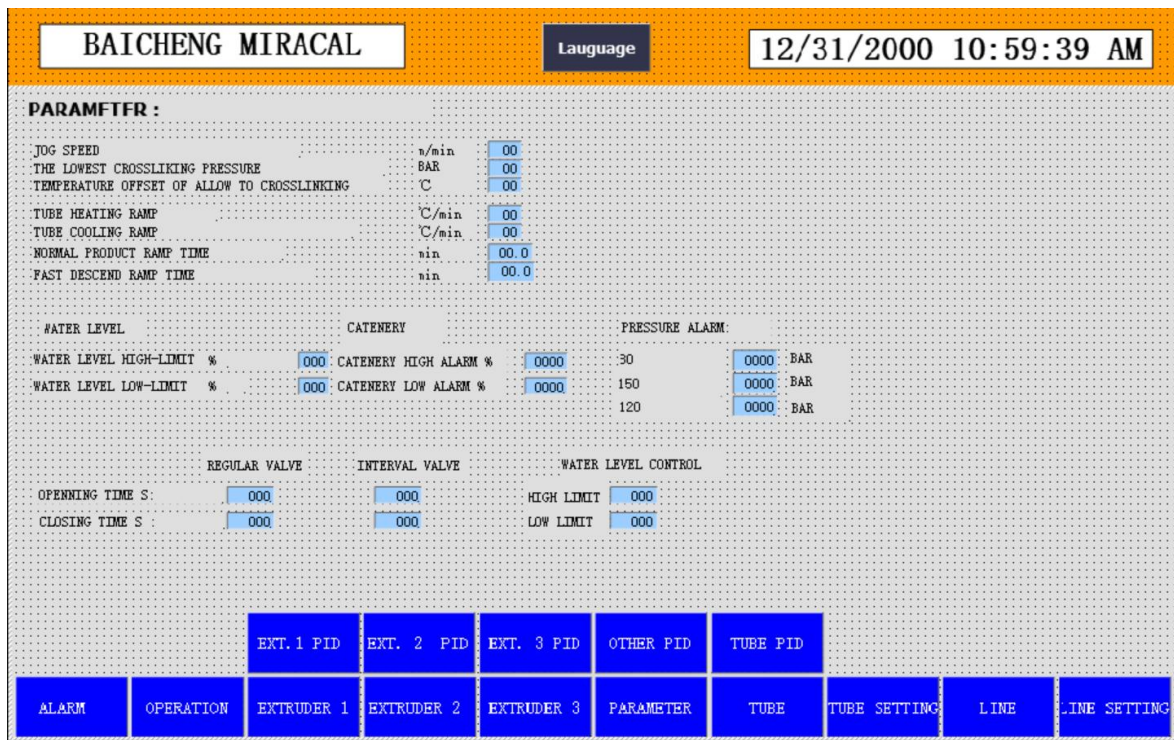
EXT. 1 PID EXT. 2 PID EXT. 3 PID OTHER PID TUBE PID

ALARM OPERATION EXTRUDER 1 EXTRUDER 2 EXTRUDER 3 PARAMETER TUBE TUBE SETTING LINE LINE SETTING

**J、“technical parameter”split view**

Display content as below:

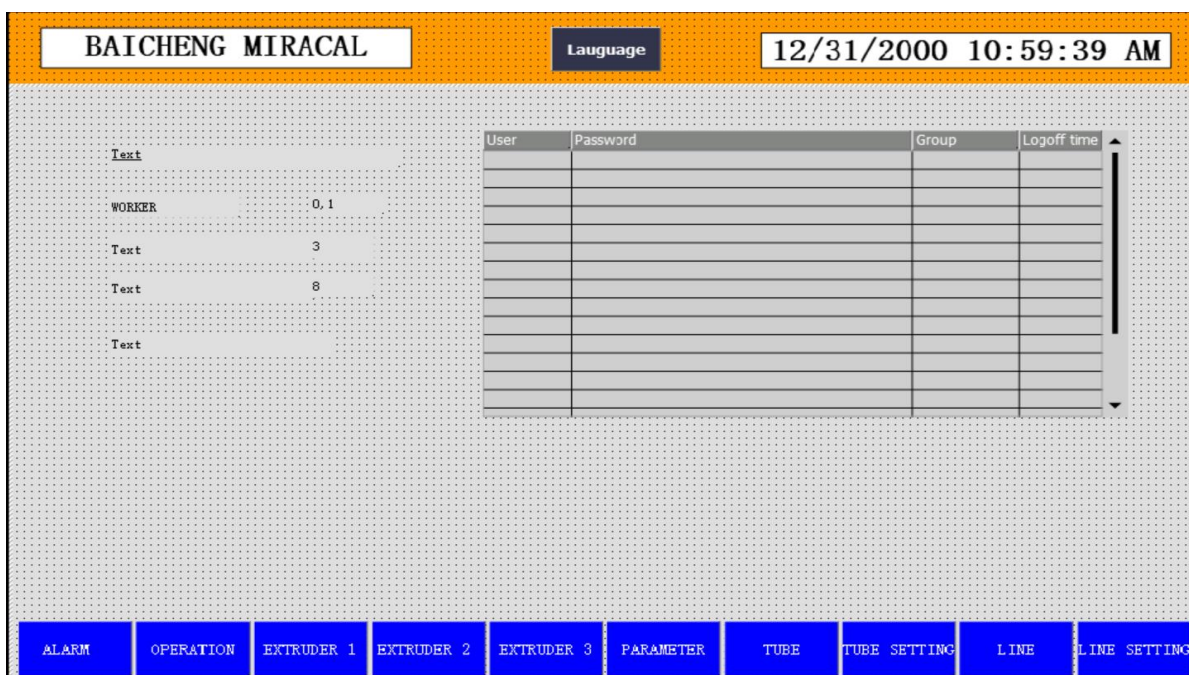
- 1>、 set water level and melt pressure alarm limit of catenary controller ;
- 2>、 set open close time of each automatic magnetic valve ;
- 3>、 set each parameter of automatic curing ;



**K、“password management”split view**

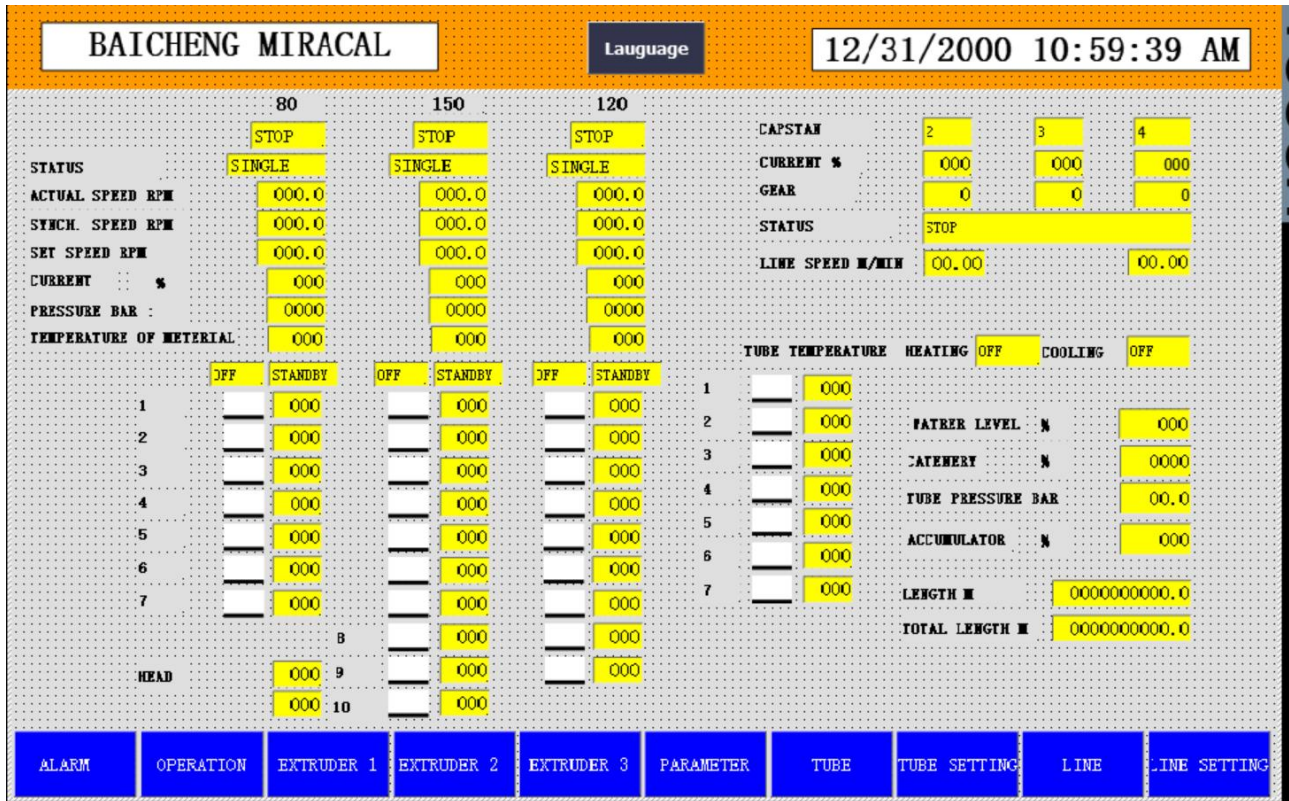
Display content as below:

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



**L、“line”split view :**

Display content as below:

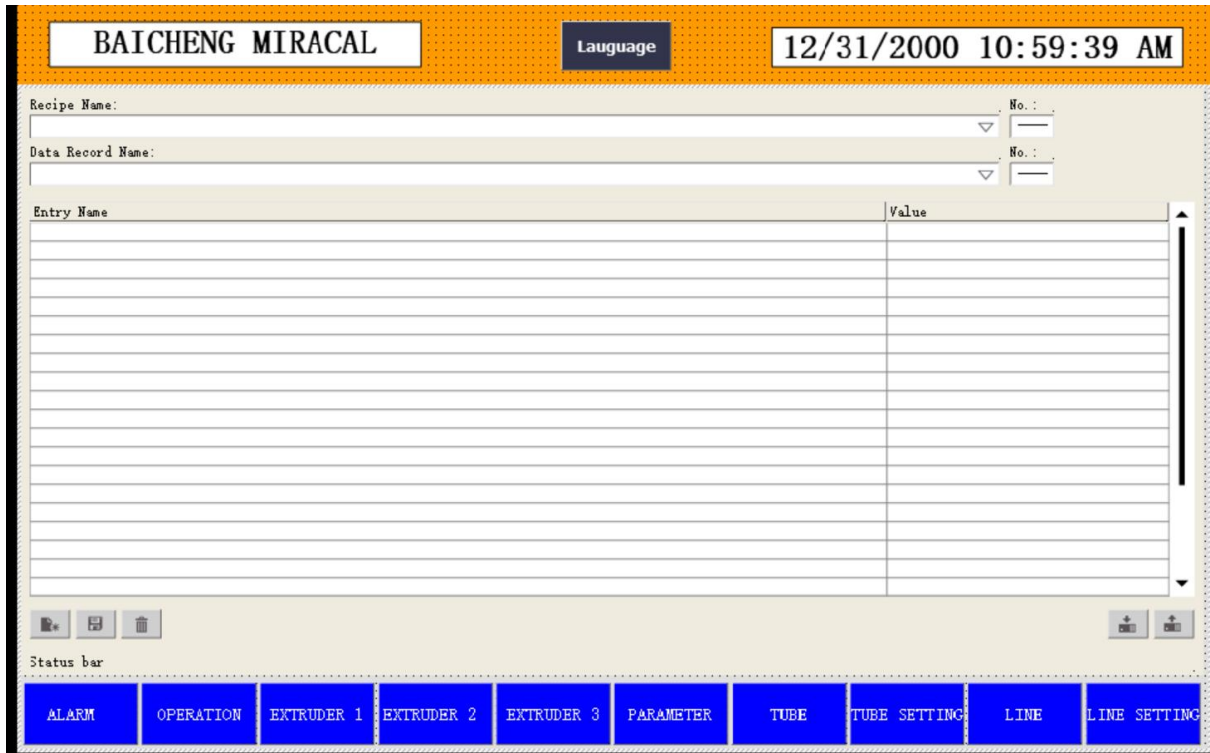


- 1>、 all temperature, rev, current, pressure, running mode status of 3 extruders ;
- 2>、 all temperature of tube, heating cooling status ;
- 3>、 current, gear shift, speed, running status of each caterpillar ;
- 4>、 working status of producing, producing length ;
- 5>、 actual value of catenary controller,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

### 2.27 TV monitor system

4 color telecameras are respectively installed at pay off, take-up, accumulator and window of catenary controller. Monitor is installed in the main machine hall.

### 2.28 Tools and accessories

- a. Tools for disassembling the crosshead, 1 set
- b. Tools for disassembling the screw of  $\phi 80$  extruder, 1 set
- c. Tools for disassembling the screw of  $\phi 100$  extruder, 1 set
- d. Tools for disassembling the screw of  $\phi 175$  extruder, 1 set
- e. Extrusion die-tool for test running, 3 sets
- f. Tool carriage, 1

## 2.29 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 1500mm<sup>2</sup>, 800mm<sup>2</sup>, 300mm<sup>2</sup>. 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 should be ready by customer. The production material should be Dow or Borealis.

Order No.	Specification	Voltage	Quantity
1	95mm <sup>2</sup>	10kV	1000m
2	400mm <sup>2</sup>	35kV	1000m
3	630mm <sup>2</sup>	132kV	1000m

After commissioning, when both parties think every condition is ready, product trial production and acceptance will be done. Generally, there are three specifications of large, middle, and small size. Supplier will offer die tools.

The cross linking cable from the production line should meet requirements of the configuration clause in GB/T 12706 –2000 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.

## Attachment 2: Main Equipments List

Item	Name of equipment	Specification	Quantity
1	Pay-off stand	Φ3150mm (Gantry lower beam type)	2
2	Dancer		2
3	Center controller		1
4	Accumulator	Wheel dia, 2000mm, accumulating length 120m	1
5	Auxiliary capstan	Pulling force: 16kN	1
6	Metering Capstan	Pulling force: 40kN	1
7	Φ80extruder	L:D 1:20 with moving system	1
8	Φ100extruder	L:D 1:20 with moving system	1
9	Φ175extruder	L:D 1:25 with moving system	1
10	Triple crosshead	1-35kV	2
		10-110kV	
11	Motorized Splice box		1
12	ETH quick cooling system for the first section		1
13	Crosslinking heating tube		
14	Air cooling device for heating section	Each section consists of 1 air blower, 3 sections of covers.	9 Sets
	Heating section insulation	Aluminum silicate insulation cotton aluminum alloy aluminum plate skin	9 Sets
15	Catenary controller	Contactless	1
16	Pre-cooling tube section	Φ250×4 stainless steel	1
17	Back water tube (used for water air balance)	Stainless steel T can	1 Set
18	Water and air balance system	Magnetic turnover plate level gauge, pneumatic ball valve, manual ball valve etc.	1 Set
19	Cooling tube section	Φ150×4 stainless steel	1
20	Complete set of nitrogen pressure control system		
21	Nitrogen cooling circulating system	Heat exchanger, big and small circulating air fan	
22	Air way control		

	system		
23	Complete set of water control system		1 set
24	Pipe electrical heating transformer	Heating transformer( drying type)	7 pieces
25	Pipe bottom supporting wheel	Bearing pedestal structure for heating and pre-cooling section, wheel structure for the cooling section	Complete set
26	Copper & aluminum bar for heating	Copper bar thickness 12mm, aluminum bar thickness 16mm	1 Set
27	End seal	Soft seal, pneumatic control	1
28	Twister		1 set
29	Blow dryer		1set
30	Pull-out caterpillar	Pulling force: 40kN	1
31	Meter counter with 5 digits.	Mechanical and inductive integrated type	1 Piece
32	Auxiliary caterpillar	Pulling force: 16kN	1
33	Take-up stand	Φ4000mm (Gantry lower beam type)	2
34	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.	<ol style="list-style-type: none"> <li>1. Main power cabinet</li> <li>2. 2 sets of operating system for the main operating cabinet (Siemens S7-400PLC +Siemens 12'touch screen+1 Lenovo desktop computer )</li> <li>3. Temperature control cabinet for 3 extruders and guiding hose</li> <li>4. Pipe heating control cabinet</li> <li>5. 3 extruders driving cabinet</li> <li>6. Drive cabinet for upper capstan and lower caterpillar</li> <li>7. Drive cabinet for accumulator(Siemens PLC+ Siemens text display+ Parker 590P, original Eurotherm)</li> <li>8. Upper auxiliary capstan control cabinet</li> <li>9. Lower auxiliary caterpillar</li> </ol>	1set
35	Industrial camera	Color	4
36	TV monitor		1
37	Guide rail for pay-off and take up stand		1 set
38	Conductor holder		1
39	Steering wheel		1 set



40	Splicer		1 Set
41	Oil heater for crosshead		3 Units
42	φ 175 screw cooler		1 Unit
43	Material feeding system	Feeding for Φ80 extruder, Φ100extruder & Φ175 extruder	1 Set for every extruder
44	Tool carriage		1 Piece
45	Disassembling tool for extruder screw	Used for Φ80 extruder, Φ100extruder & Φ175 extruder	1 Set
46	Rubber cushion for end seal		40 pcs.
47	Insulating material and external packaging	External packaging adopts stainless steel	1 Set

### Attachment 3: Auxiliary equipment part to be provided by the buyer

No.	Description & Specification	Qty.	Remark	
1	Connecting tube of gas and water pipe	1 set	Supplier to provide drawings	
2	Connecting cable for installation and copper connectors	1 set	See suppliers' list	
3	Plastic-sprayed cable tray	1 set	Tee and cross pipe fitting, cover and supporter etc.	
4	Metering capstan support	1 set	Supplier to provide drawings	
5	Supporting column for crosslinking tube	1 set	Supplier to provide drawings	
6	Catenary controller platform	1 set	Supplier to provide drawings	
7	Short circuit transformer platform	7 Pcs.	Supplier to provide drawings	
8	Electrical cabinet bottom platform	1 set	Supplier to provide drawings	
9	Circulating cooling water pool outside	1 Pc.	100m <sup>3</sup> User self design	
10	Mounting adjustment pad	1 set	Supplier offers list	
11	Various of expansion bolts for Mounting	1 set	Supplier offers list	
12	N G	Air compression machine 22kW	1	screw type
	S	Thermal resistant cold dryer	1	UT-10GF
		Air and nitrogen buffer tank	2	0.5 m <sup>3</sup>
		Adsorption nitrogen	1	40 m <sup>3</sup> /h

	generator		
	Oil free nitrogen booster	1	VWN-40/25
	Hight pressure nitrogen storage tank	2	2.5MPa 、 5m <sup>3</sup>
13	Clean room of 100,000 class	1set	
14	Air conditioner room for electrical cabinet	1set	
15	Stainless steel hose for 3 extruders material feeding	1set	
16	The PD and AC high voltage test and PD fault location Test System for XLPE Cable of 110KV or below	1(Set)	
17	Water reservior 100m <sup>3</sup>	1 Pc.	
18	X-RAY8000NXT	1	Sikora