JFS

BEIJING JOINT FLOW SYSTEM CO.

HYDRAULIC ACTUATOR

Content

Hydraulic Actuator

Introduction

The hydraulic actuated valve integrates mechanical, electric and hydraulic systems into one. It is one of the most advanced control solutions in the world and is widely used for many applications such as pump discharge, pipeline process control and inlet of turbines. It can be automatically operated according to control requirements and can be fast acting and "failsafe" to prevent a turbine from running away or reduce the water hammer in pumping stations. It can be supplied in different combinations such as with a butterfly or ball valve and with a complete control system.

The Hydraulic actuator is composed of three major parts:

A. Power-pack control unit (hydraulic control system)

B. Hydraulic cylinder

C. Electric control panel

In its basic form, the hydraulic actuator is an assembly consisting of an electric motor, pump, valves, oil tank and a few other connecting elements. A large variety of driving circuits are possible with only the central manifold and its built-in valves. If the hydraulic system needs more complex circuits, extra modular blocks can be mounted on the power pack (hydraulic control unit) to extend its capabilities.

This modular feature of our hydraulic actuators makes it possible for us to satisfy many different requirements of our customers whose needs can be very different. It is a tailor-made product to suit a customer's specific applications.

Due to different valve torque requirements, we need to design different sizes of cylinders and oil tanks of the power-pack. We now give a brief introduction of two major parts, the Power-pack control unit and the Electric control panel.

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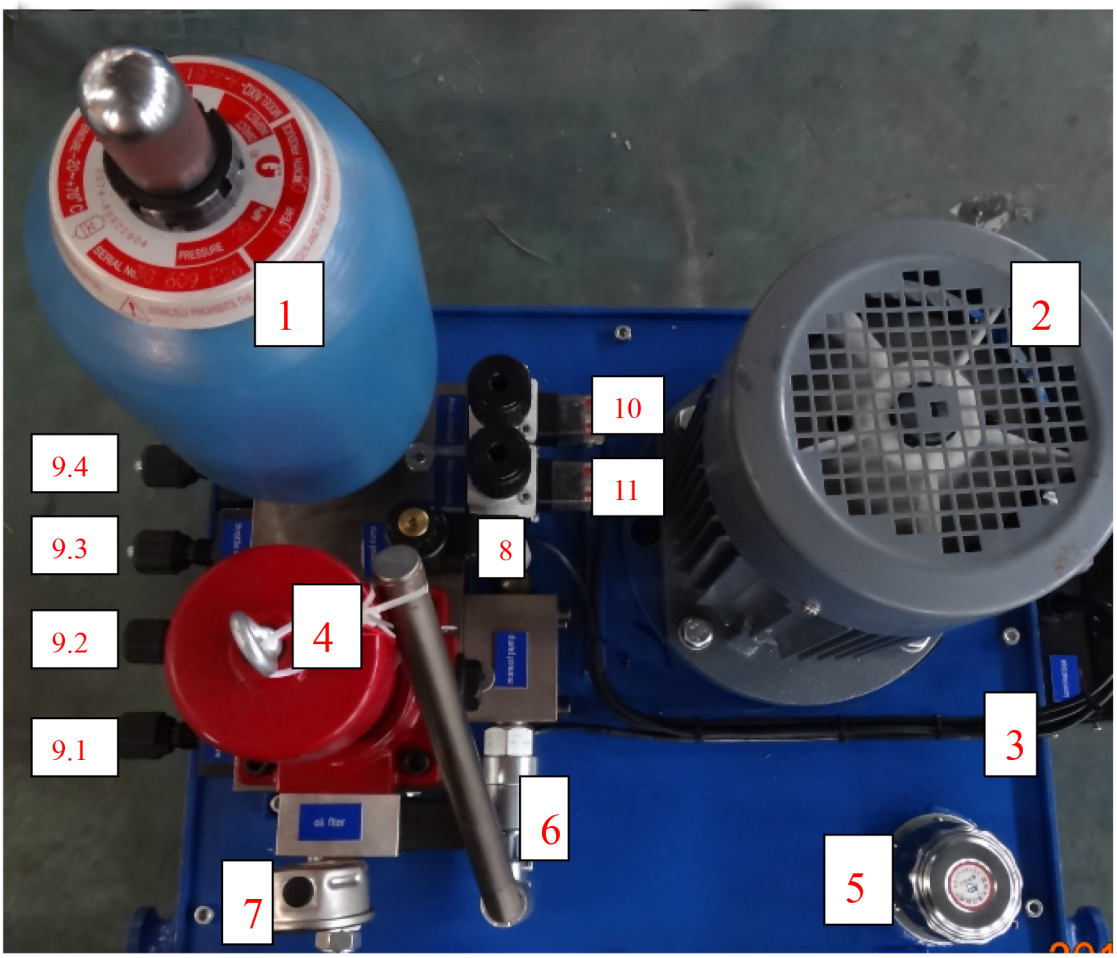
Part A Hydraulic Power Pack



No.	Parts name	No.	Parts name
1	Accumulator	8	Solenoid valve
2	Oil pump	9.1	Open speed control throttle valve
3	Terminal box	9.2	Pressure relief throttle valve
4	Oil filter	9.3	Quick close throttle valve
5	Air filter	9.4	Accumulator cut off throttle valve
6	Hand pump	10	High pressure relay
7	Pressure gauge	11	Low pressure relay

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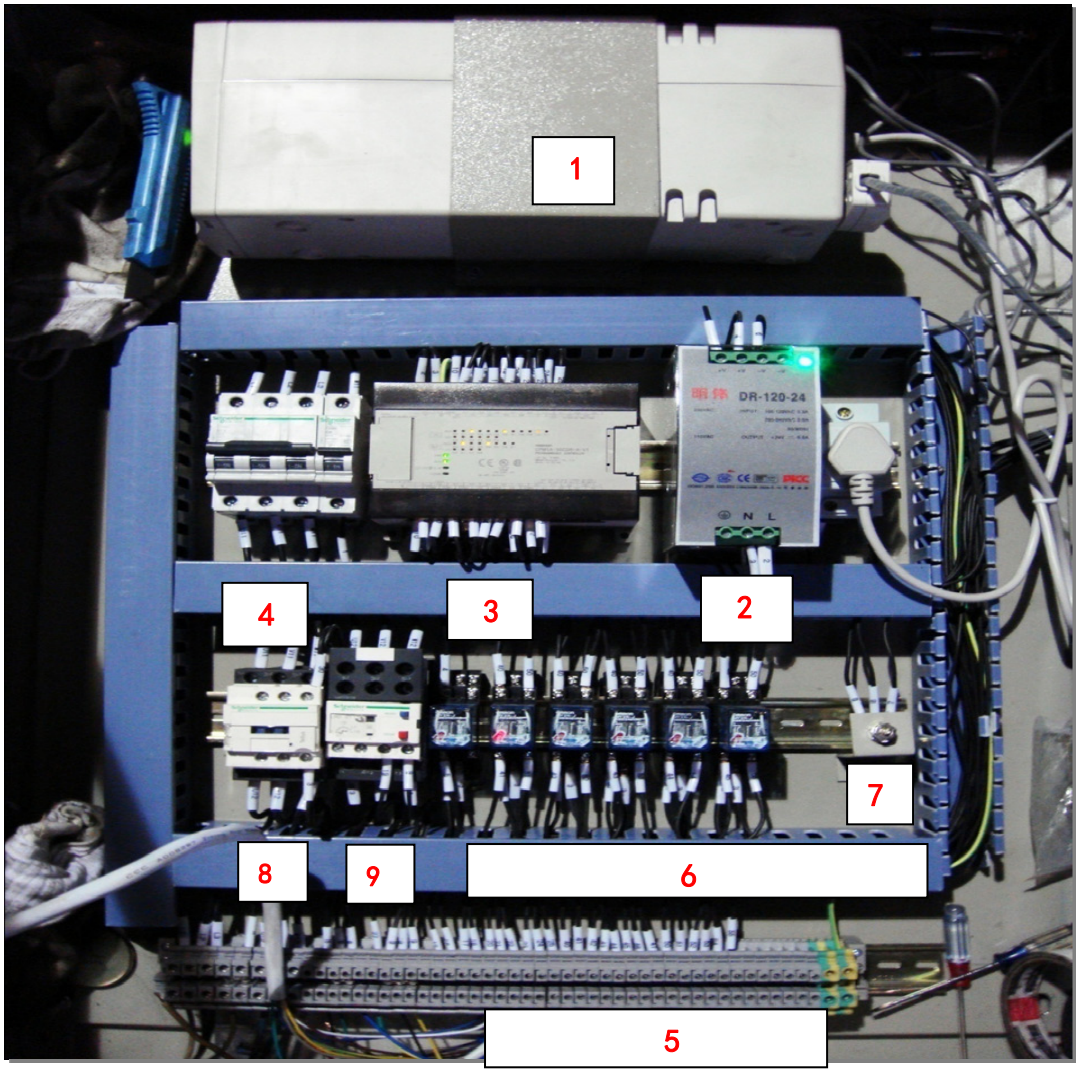
Part B: Electric Control Panel



No.	Parts name	No.	Parts name
1	UPS	6	Terminal board
2	24V DC power supply	7	Potentiometer
3	"OMRON" PLC	8	A.C. contactor
4	3PH main switch	9	Overheat protector
5	Remote signal output terminal		

The internal circuit may vary according to the voltage of solenoid.

Part C: Major Parts Introduction

High pressure rubber tube from the hydraulic power pack is connected to the actuator cylinder which drives the butterfly or ball valve open/closed (see figure 1).

Figure 1

The hydraulic power pack is a stand-alone unit with no assembly required other than filling the hydraulic power pack with oil. The unit should be located as close as possible to butterfly/ball valve (the distance between valve and power pack unit must be less than connected tube which is only 3m as standard). The area in which the unit is fixed should be a flat level hard surface (such as concrete) that gives protection against exposure to standing or runoff water.

Hydraulic power pack and electric control box (see figure 2)

Figure 2

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The unit operates on hydraulic oil which is pumped to supply the desired pressure to actuate the butterfly/ball valve.

CAUTION

Assure that the supply pressure from the power unit does not exceed the design rating pressure of the butterfly/ball valve.

Fill the oil tank with hydraulic oil through the air filter until the level is in the middle of the level gauge (see figure 3). Monitor the oil level during start up, as the system will consume a volume of hydraulic oil from the tank. ***Loosen bolt of throttle valve (9.2 relief pressure, fully close in work condition) for adjusting and start motor discontinuously, if it does not rotate to right, inspect and readjust the circuit.*** Start motor under no load condition for 2-3 mins, if there is not any abnormal noise, then check the pressure gauge. When the pressure of hydraulic operating system is up to 16MPa (or as requested), tighten bolt to set the system pressure.

Inspect each connection of the pipes in the hydraulic system and the mounting surfaces to see if there is any oil leakage. After completing the above steps then the hydraulic system is ready for operation.

Figure 3

Check the four throttle valves to see if they are in good condition. 9.1 Accumulator cut-off valve should be in the fully open position. 9.2 Pressure relief valve should be in the fully close position. 9.3 Open the speed control valve to adjust the opening time. 9.4 Quick close valve can adjust quick closing time at first stage. (See hydraulic principle diagram) The direction of rotation of each throttle valve should follow the mark on knob. (See figure 4)

Figure 4

Each valve requires a supply line that directs oil from the cylinder back to the oil tank. It is important that these lines do not rust or be blocked. Minimize the number of bends in the lines to allow for easy oil flow and fast control valve response time. No bends should have an angle less than 90 degrees as this could pinch the line and slow down the hydraulic oil flow and reduce the valve response time.

Operation (PLC Type)

Local operation

Shift the manual switch on local control panel to "Local" position.(see figure 5)

Figure 5

To open the valve

Push the "OPEN" button on local control panel to start the opening procedure. The oil pump will run automatically to supply the oil pressure to cylinder which is installed on the valve, then turns the disc or ball .The indicating lamp keeps blinking till the valve reaches fully open position.

When the valve is in fully open position and the pressure in accumulator is up to 16Mpa (or as requested), the high pressure relay will shut down power supply and the oil pump will be shut off automatically. The hydraulic oil in the power pack control unit will hold the valve in fully opened position.

The valve opening speed is adjustable by turning throttle valve (9.3 Open speed control valve) on hydraulic power pack. (See figure 6)

Start the motor (1), main oil pump (12) is running. The oil will be pressurized from the oil tank and go through the oil filter (4)→one-way throttle valve (3.1)→throttle valve (9.1)→high pressure tube (16)→one-way throttle valve →oil cylinder. The hydraulic oil will push the piston and rod to move and this causes the valve shaft to turn simultaneously. Then the valve is opened.

Overflow valve (2) set pressure at 16.5Mpa (or 0.5MPa higher than requested). When pressure is above the set value, the hydraulic oil will go back to oil tank automatically to keep the system pressurized.

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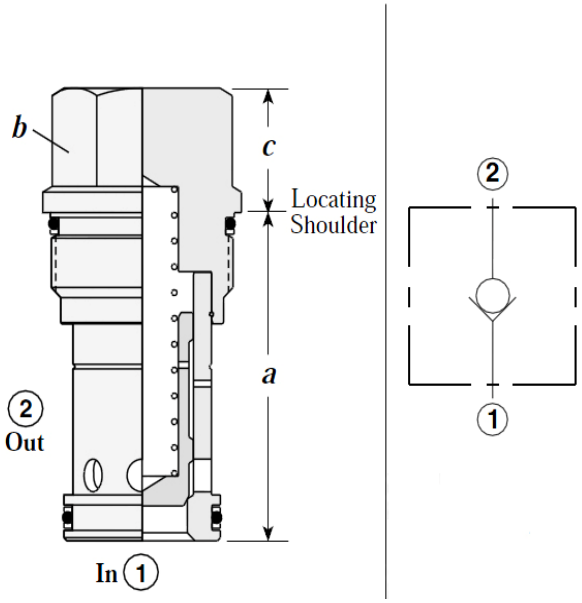

Figure 6

To close the valve

When closing the valve, first of all, press the "CLOSE" button and then the NC solenoid valve (see 7) is energized which will shift the valve position. The pressure in oil cylinder will drop and hydraulic oil goes back to oil tank through one-way throttling valve →high pressure tube (16) →solenoid valve (11). The valve will start to close .The indicating lamp keeps blinking till the valve reaches fully close position.

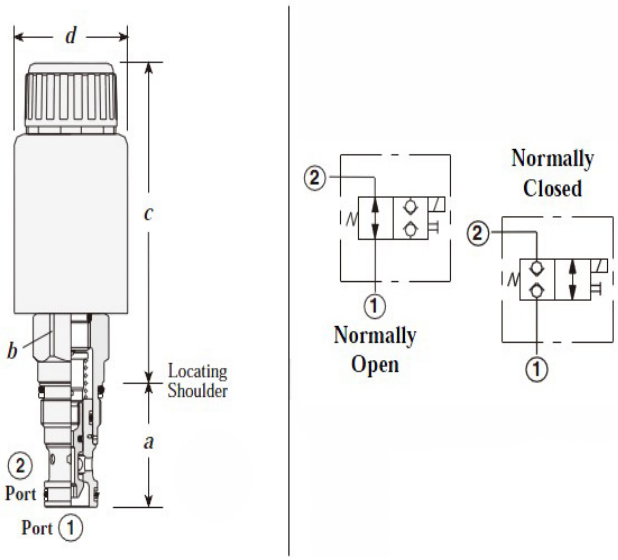

Figure 7

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Quick closing

Valve closing speed (30s-60s) can be controlled when valve is between 15~75 degrees by adjusting the throttle valve (9.4 Quick close valve), this process is called quick closing.

Slow closing

The second process is the slow closing (15s-60s) which controls the last 15 degrees of stroke by adjusting throttle valve which is assembled top on the oil cylinder (see figure 7).

This kind of two stage closing will eliminate potential surge and protect the system.

The degree of quick closing or slow closing also can be controlled by adjusting throttle valve (see figure 8) which is on the highest position of oil cylinder.

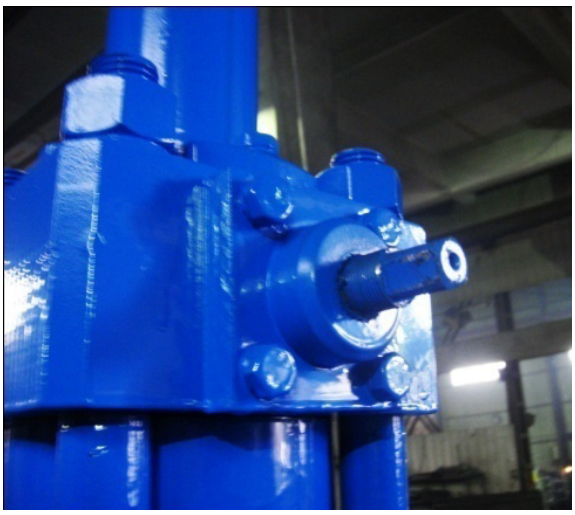

Figure 8

Figure 9

Indicator plate on oil cylinder bracket can show exactly the valve position. (See figure 10)

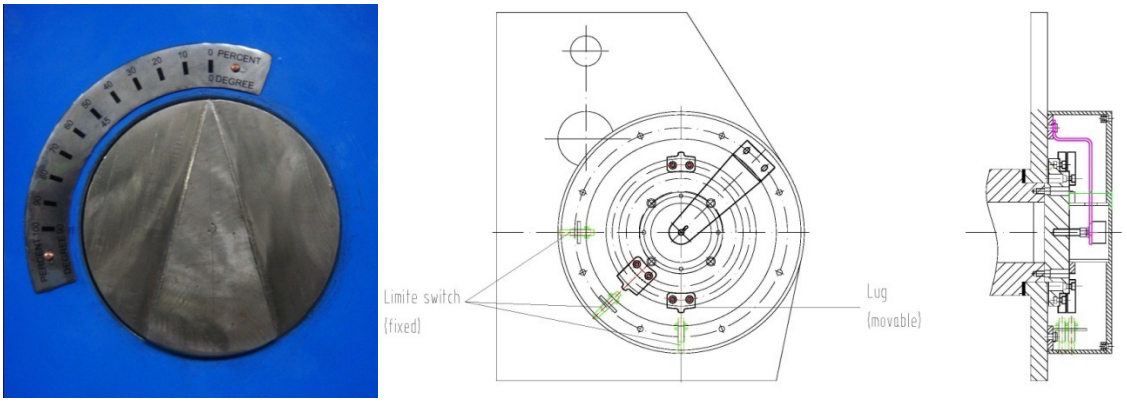

Figure 10

To stop the valve

Press the "stop" button will stop the valve movement. It will stay put in this position during normal operation.

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Remote Operation

By shifting the manual switch on local control panel to "REMOTE" position, the remote control indicator lamp will blink. Then the actions of opening valve, closing valve, and stop valve can be remotely controlled from the center control room. In addition, the local control panel control will send signals to remote center control room, such as valve position (0º, 15º, 75º, 90º), overload, overtime, valve position 4~20mA signal etc.

The local control panel will feedback to valve position by 4~20mA signal.(two wire DC).The on/off signal is dry contact (capacity: 220V AC 3A/220V DC 5A)

Command signal from center control room to local control panel as shown below：

Valve open Valve close Valve stop

Status signal from local control panel to center control room as shown below：

Valve fully open Valve fully close

Valve open 15°(start pump) Valve close 15°

Valve fault

Valve remote/local control status

Stop operation

Shifting the manual switch on local control panel to "Stop" position，all of the buttons on local control panel or remote control room cannot operate at the same time.

Manual Operation

Manual hand pump (stand-by) is used only during power failure, or if it becomes necessary to open/close the valve manually. (See figure 11)

Figure 11

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Pressure Protection

When the oil cylinder pressure drops below 10MPa, or the oil pump fails to work, the pressure preserved in the accumulator (see figure 12) can complete a full cycle of opening or closing the valve..(More time operations is on request)

Figure 12

Accumulator Specification	Nominal pressure	20Mpa
	Nominal Volume	2.5L
	Operating Temperature	-20～+70
	Length	430mm
	Weight	14.0Kg
	External Diameter	Ø152mm
	Structure	Hydraulic—bladder type
	Gas filled in the bladder	Nitrogen
	Operating Medium	Petroleum base hydraulic oil or emulsion
	Mounting	Vertical
	Connection	Thread

Charging of Nitrogen

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Accumulator shall be inspected before nitrogen is charged.

Nitrogen shall be charged slowly to ensure the bladder not be broken by quickly charging.

(Oxygen, compressed air or other flammable gas shall not be used.)

The Gas charging device shall be used in charging the Nitrogen. The Gas charging device is an inseparable part of accumulator and must be used in charging, draining, measuring and adjusting the charging pressure. The Gas Charging Device is selected according to the pressure of the accumulator.

Selecting the charging pressure

Buffering impact：Charging pressure shall be at least equal to the system rated or a little bit above.

Absorbing fluctuation：Charging pressure shall be 60% of average pressure of fluctuation.

Storage of energy：Charging pressure shall be lower than 90% of minimum working pressure (generally 60%-80%) and higher than 25% of maximum working pressure.

Compensation for heat expansion：Charging pressure shall be the minimum pressure of close circuit of hydraulic system or a little bit lower.

⚠ CAUTION

Before debugging, the air in the pipe shall be expelled.

Install a safety-valve in the oil inlet when accumulator is larger than 10L.

Check the nitrogen pressure before the accumulator take effect.

Oxygen and flammable gas are prohibited in avoidance of explosion.

The oil accumulator will start to work automatically when there is a little internal leakage. In case of the oil pressure is below 10MPa, low pressure relay (see figure 13) will start the motor, and compensate the pressure automatically, and it will be stopped when pressure reaches 16MPa.The hydraulic system will keep the oil pressure between 10 MPa to16 MPa. Pressure gauge（see figure 14） indicates the pressure value which is in oil cylinder and accumulator because they are directly connected. When the pressure in oil cylinder is more than 16.5 MPa, the overflow valve（see figure 15） will release excessive pressure.

Figure 13

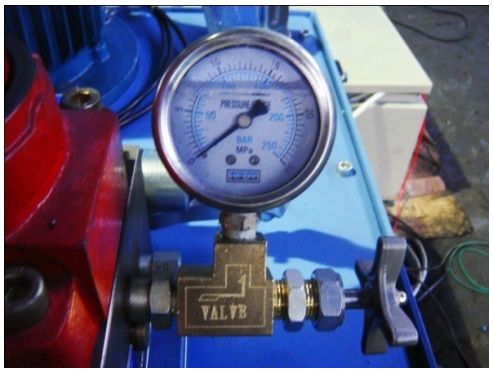

Figure 14

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High and low pressure relay are plunger type and have been factory locked. The setting value can be reset according to the scale on knob.

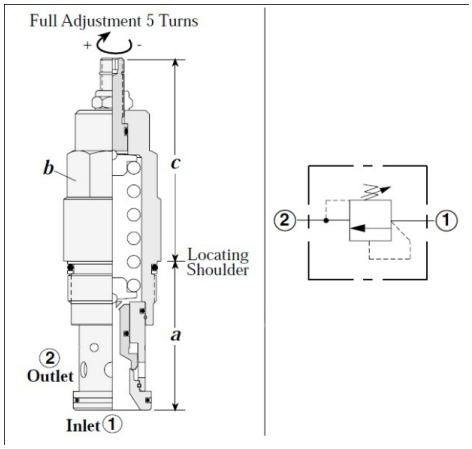

Figure 15

CAUTION

In case of power failure or any parts need to be changed, oil pressure in the system must be released completely by turning the pressure throttle valve to the closed position which can protect the system and maintenance workers from high pressure surge.

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Maintenance

A periodic maintenance program should be established for the hydraulic power pack. The oil tank should also be cleaned to remove any sediment or particles that have accumulated and could enter into the pump. Externally, examine the oil tank for any signs of rust or corrosion, polish and paint the areas to reduce further corrosion. It is recommended that the unit be mounted in a clean and dry location.

Once per month or every 30 days, examine all tubing on the hydraulic power pack and in the system looking for damage (dents or kinks) that would restrict the flow of hydraulic oil, replace any damaged tubing. The hydraulic oil in tank should be checked and assured that the oil level is in the middle indicating level and is free of debris. It is very necessary to follow regular inspection and maintenance schedule as below:

	3 months	Half a year	1 year
Clean the hydraulic oil in system	√		
Wash machined surface and hydraulic parts		√	
Replace anti-rust oil		√	
Wash oil filter and change filter screen		√	
Check cleanness and lubrication of hydraulic oil			√
Examine pressure in accumulator leakage			√

For the first 3 months of usage after installation, ensure that the oil tank is cleaned and there is no deterioration of the oil.

The specification of any new hydraulic oil should not below 20$^{\mu m}$.

YB-N46 abrasion resistant hydraulic oil or Shell 32# and 64# oil is recommended.

The Valve fault lamp on local control panel only indicates two conditions:

1. Valve opening time is more than the set value in PLC program.
2. Motor overload.

In case of valve fault lamp open, please check the motor and adjust open speed control throttle valve for valve opening time or modify the setting value for opening time in PLC program.

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To add oil of dashpot

If the oil of dashpot is lack, please replace or add the oil.

Note: Please open valve and make the counter weight upward 25 degree ~30 degree , And then lock the counter weight position. Remove the oil pressure gauge on the top of dashpot and add the oil.

Usually, the dashpot need 2/3 oil, it can keep dashpot operate normally. Quantity of oil please refer the table as below:

Tilling disc check valve model	Cylinder inner diameter	Travel of piston (Cylinder inner highly)	Quantity of oil
TDCV DN900	125mm	232mm	1.8~2.0L
TDCV DN1350	140mm	275mm	2.4~2.7L
TDCV DN1500	140mm	275mm	2.4~2.7L

Type of hydraulic oil of dashpot

	Type	Mark
Normally used	Mobil Hydraulic 46	LH-M 46
Replacement used	Shell Hydraulic 46	
	TOTAL DZF 46	

Trouble Shooting

Fault	reason	Remedy
Electric control malfunction	Vibration has caused a bad contact or wiring terminal is loose.	Check each limit switch and wiring terminal
	Electric component fault	Check electric component and repair or change them in time
Oil pump cannot build up pressure	Manual throttle valve malfunction or loose	Change or tighten
	Overflow valve malfunction	Clean，adjust or change
	Oil pump damage	Repair or change
	Oil cylinder sealing damage	Repair or change sealing ring
Low pressure retaining performance or frequent starting of the oil pump	Manual throttle valve malfunction or loose	Change or tighten
	Valve parts leaking	Check, repair or replace
	Aging sealing leakage	Check, repair or replace

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	Out leakage	Repair leakage parts
No oil supply from pump	Pump not running	Assure the correct connection with motor
	Incorrect rotation	Change motor phases
	Low oil level	Increase oil to middle level
	Air in oil suction pipe	Tighten nut
	Dirt in oil suction pipe	Change oil filter or clean pipe
	High oil viscosity	Replace with recommended oil
No pressure in oil circuit	Low pressure setting for overflow valve	Reset
	Overflow valve malfunction	Remove and inspect it for maintenance
	Oil leakage in valve or cylinder	Remove and inspect fittings
	Bubble in oil	Increase oil or put oil returning port under oil level
	Pump fault	Repair or replace
Valve slow closing	Valve block	Check and remove
	One way throttle valve fault	Check and adjust
	Throttle valve on oil cylinder fault	Reset
Pump noisy	Dirt in oil suction pipe	Clean pipe
	Air in oil suction pipe	Inspect pipe for maintenance
	Overflow valve vibration	Air in oil
	High oil viscosity	Replace with recommended oil
Oil cylinder slow operation	Damage on sealing face	Replace sealing ring
	Low flow in oil pump	Increase pump flow
	Oil leakage from overflow valve	Adjust overflow valve
Incorrect quick or slow closing	Throttle valve for adjusting closing degree on oil cylinder incorrectly set.	Reset
Leakage	Low oil viscosity	Replace with recommended oil
	Aging sealing	Replace the sealing ring
	Coupling screw or contact looseness	Tighten screw or contact

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Specification

Power Supply	380V /3PH /50Hz
Operation	Local / Remote
Installation	Indoor
Motor insulation	Class F
Opening and closing time	Opening 20-90 sec（adjustable）
	Closing in normal and emergency case
	First 60-80% closing, 2.5-10 sec (adjustable)
	Last 20-40% closing, 50-80 sec(adjustable)
Local Control Panel	
Protection	IP56/higher protection is on request
Operation switch	Supply
Limit switch	Fully open 1 NO contacts 1 NC contacts
	Fully close 1 NO contacts 1 NC contacts
2 speed operation	Supply
Local/off/remote selector switch	Supply
Valve status for remote indicator	Opening (blinking contact)
	Closing (blinking contact)
	Fully close (“NO” contact）
	Fully open（“NO” contact）
	Valve fault（“NO” contact）
Remote control	Close（“NO” contact）
	Open（“NO” contact）
Protective Coating	
External surface	
Surface preparation	GB/T 8923-2008/2009(Sa-2 1/2,St 3)
Primer	Epoxy zinc rich primer
Second coat	Micaceous iron oxide epoxy
Finish	Aliphatic polyurethane finish coating
Color	Munsell 2.5PB4/2
Total dry film thickness	Not less than 200μm
Internal Surface	

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Surface preparation	GB/T 8923-2008/2009(Sa-2 1/2,St 3)
Primer	Liquid epoxy containing no coal tar
Second coat	Liquid epoxy containing no coal tar
Finish	Liquid epoxy containing no coal tar
Total dry film thickness	Not less than 400μm
Exposed machined surface	Rust preventive coat by grease
Inspection and Test	
Material inspection	By mill certificated of body, disc, stem, body seat and disc edge
Visual inspection	Yes
Dimensional inspection	Yes
Leakage test	1.1 times rated pressure at 10 mins（leakage≤5.4cc./min）
Hydro static pressure test	1.5 times rated pressure at 10 mins
Operation test under no-flow condition	Yes

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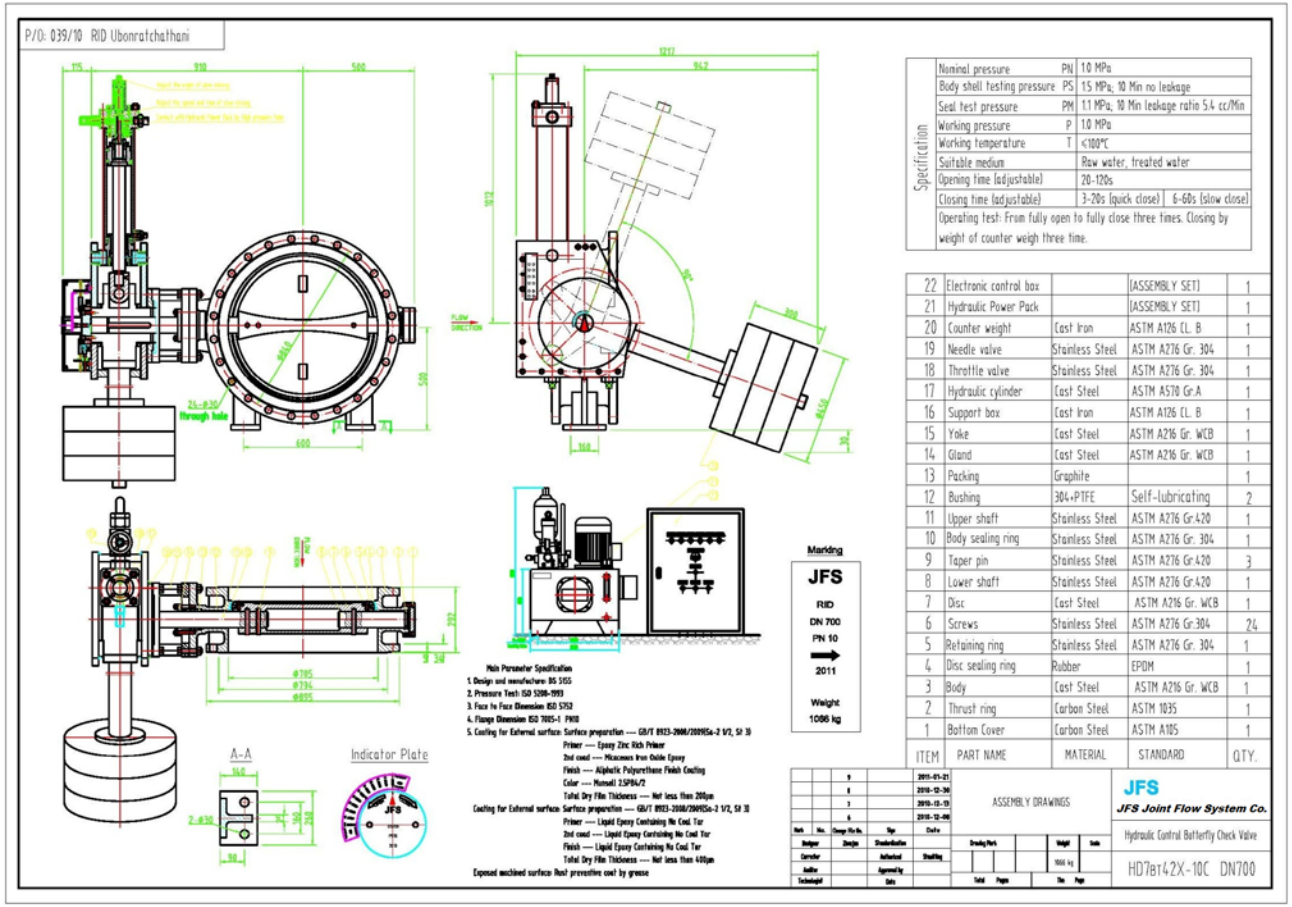
Typical Diagram



Appendix 1. Assembly drawing

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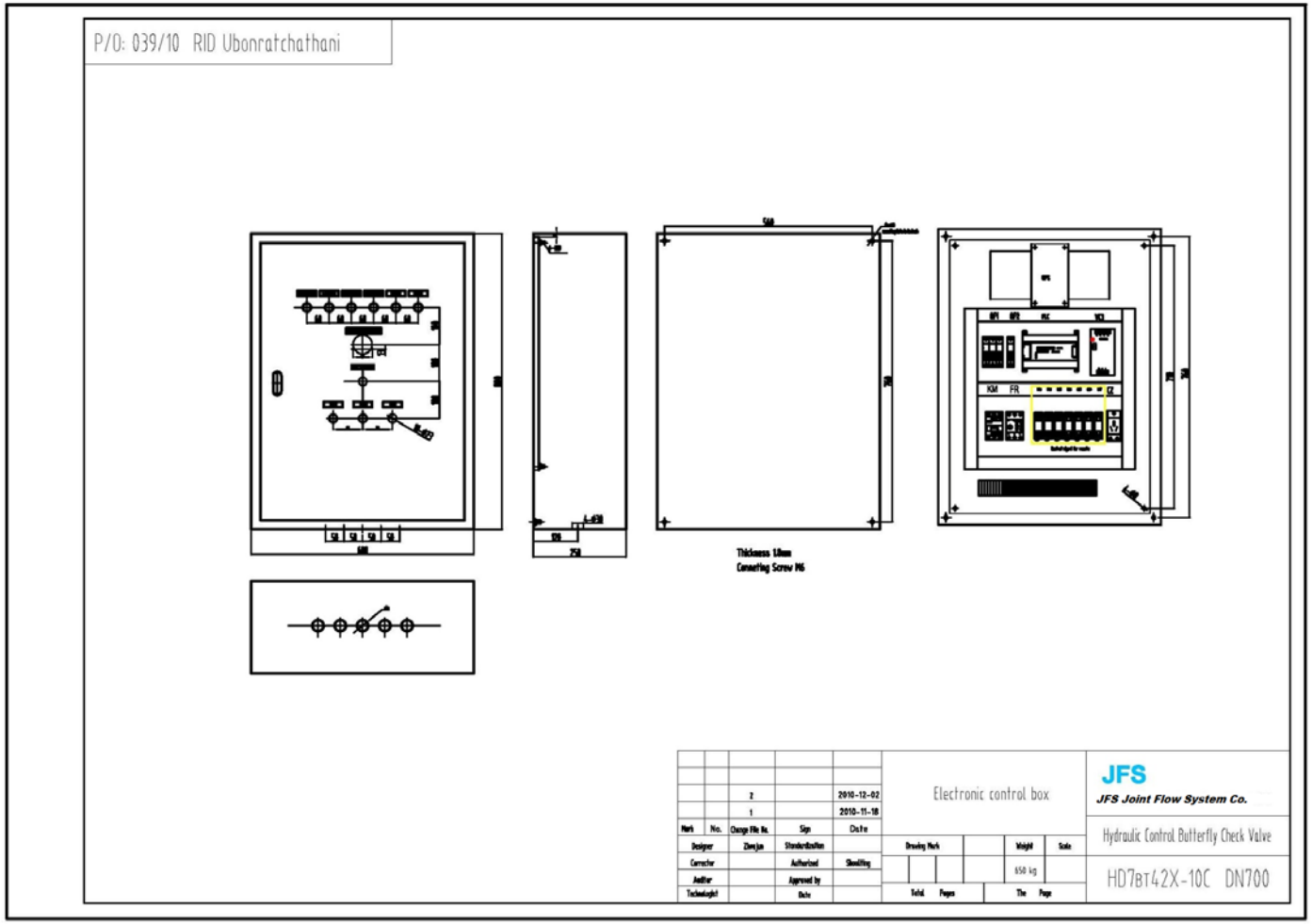

Appendix 2. Electric control panel

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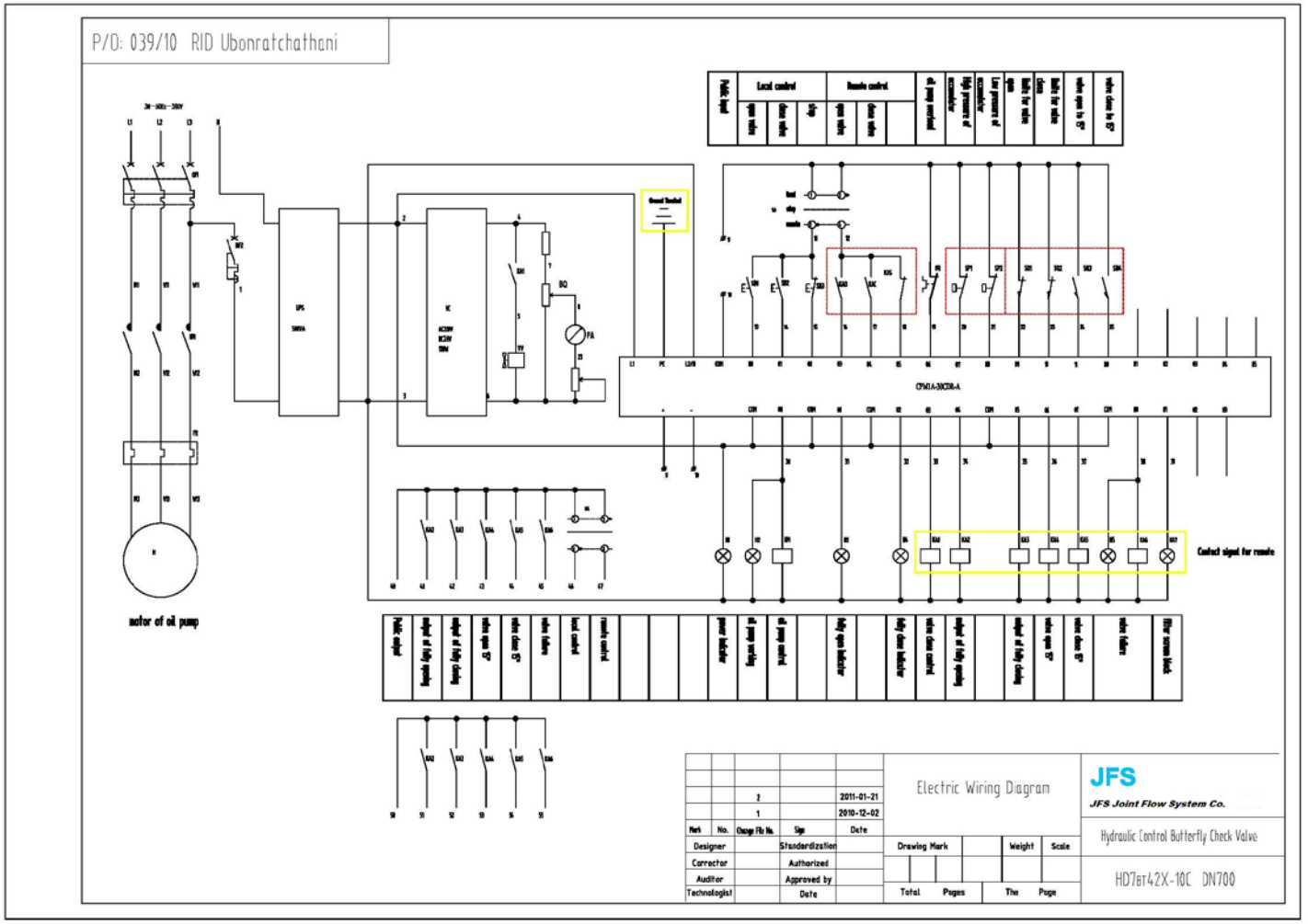

Appendix 3. Electric wiring diagram

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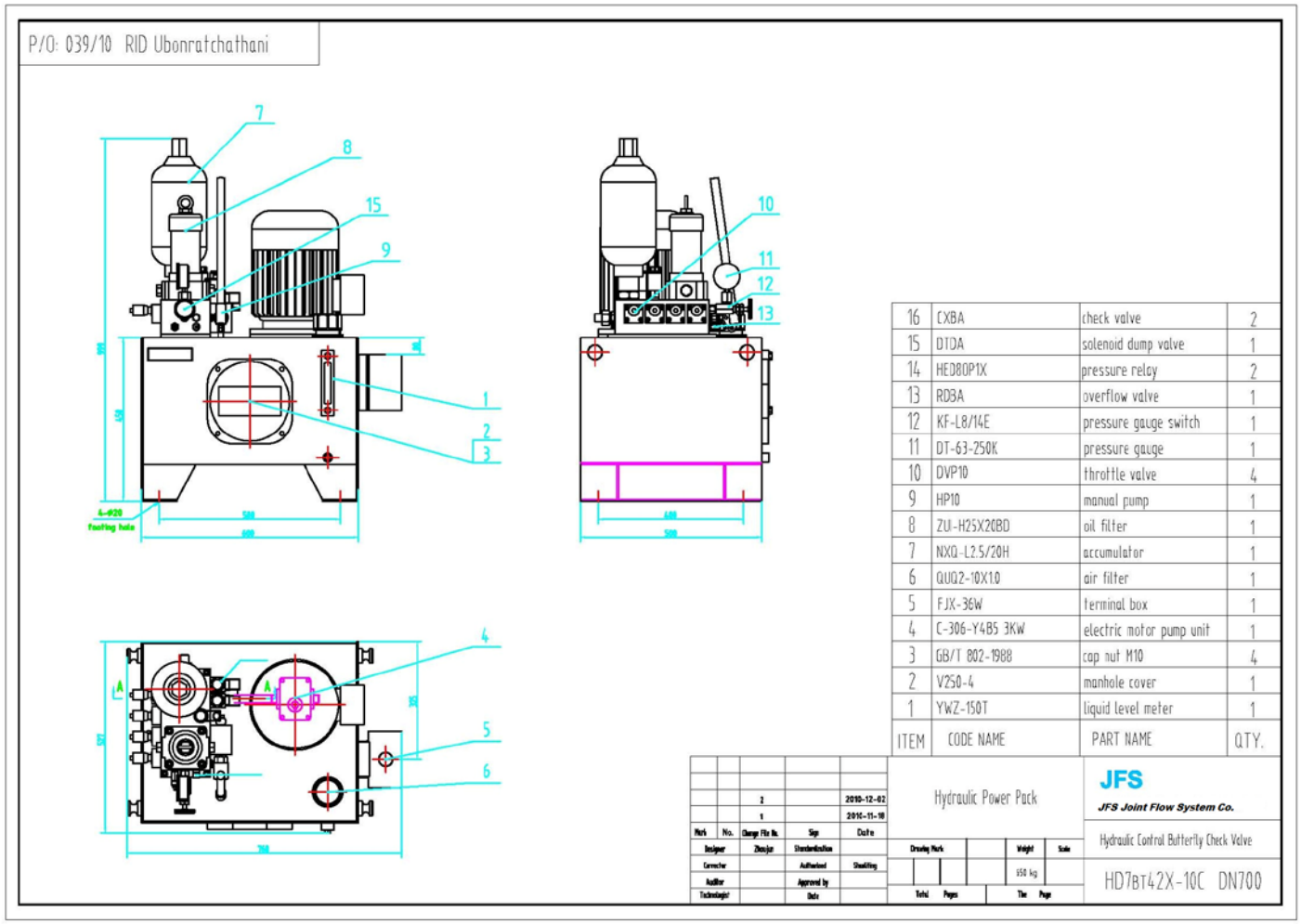

Appendix 4. Hydraulic power pack

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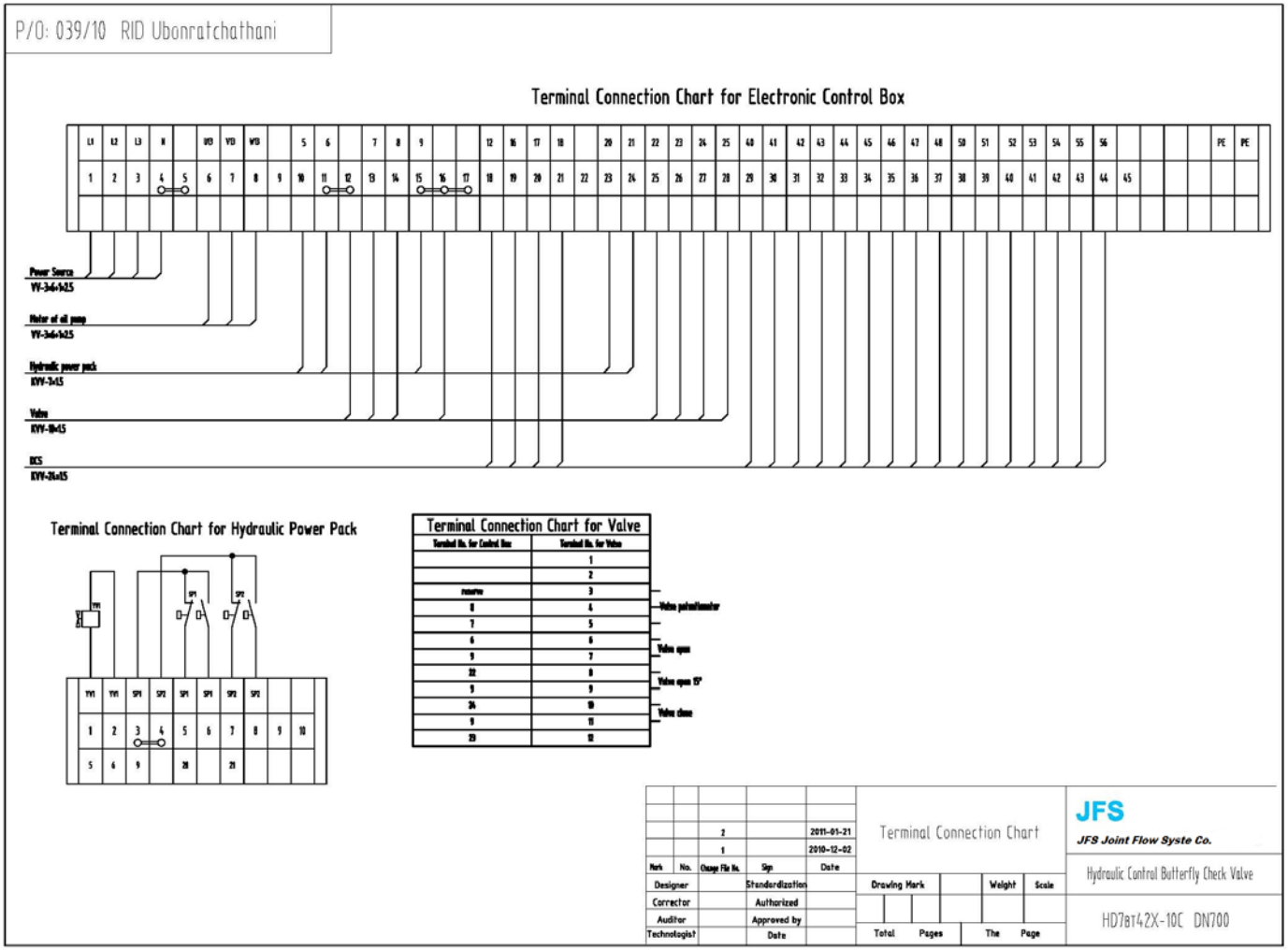

Appendix 5. Terminal connection chart

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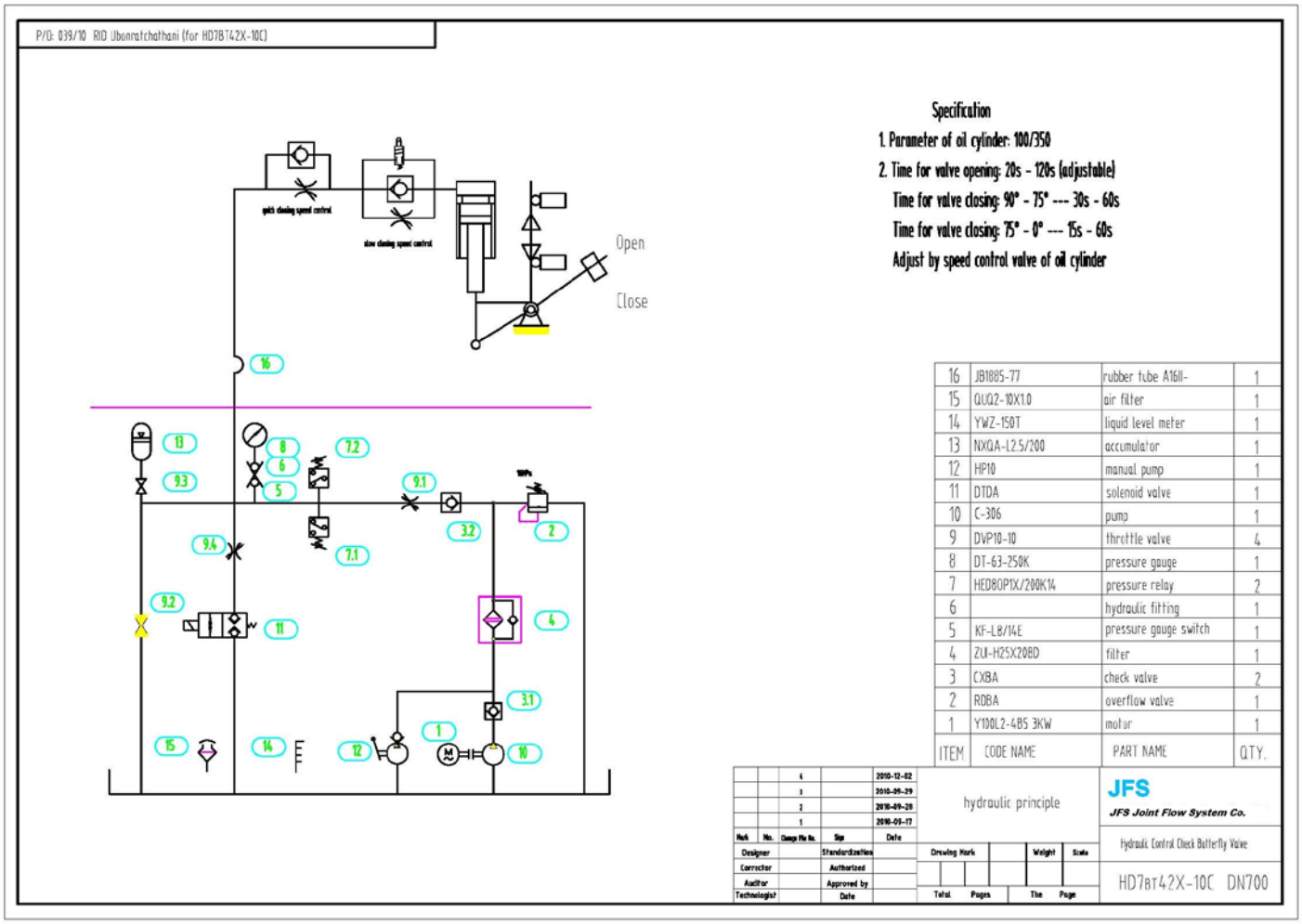

Appendix 6. Hydraulic principle