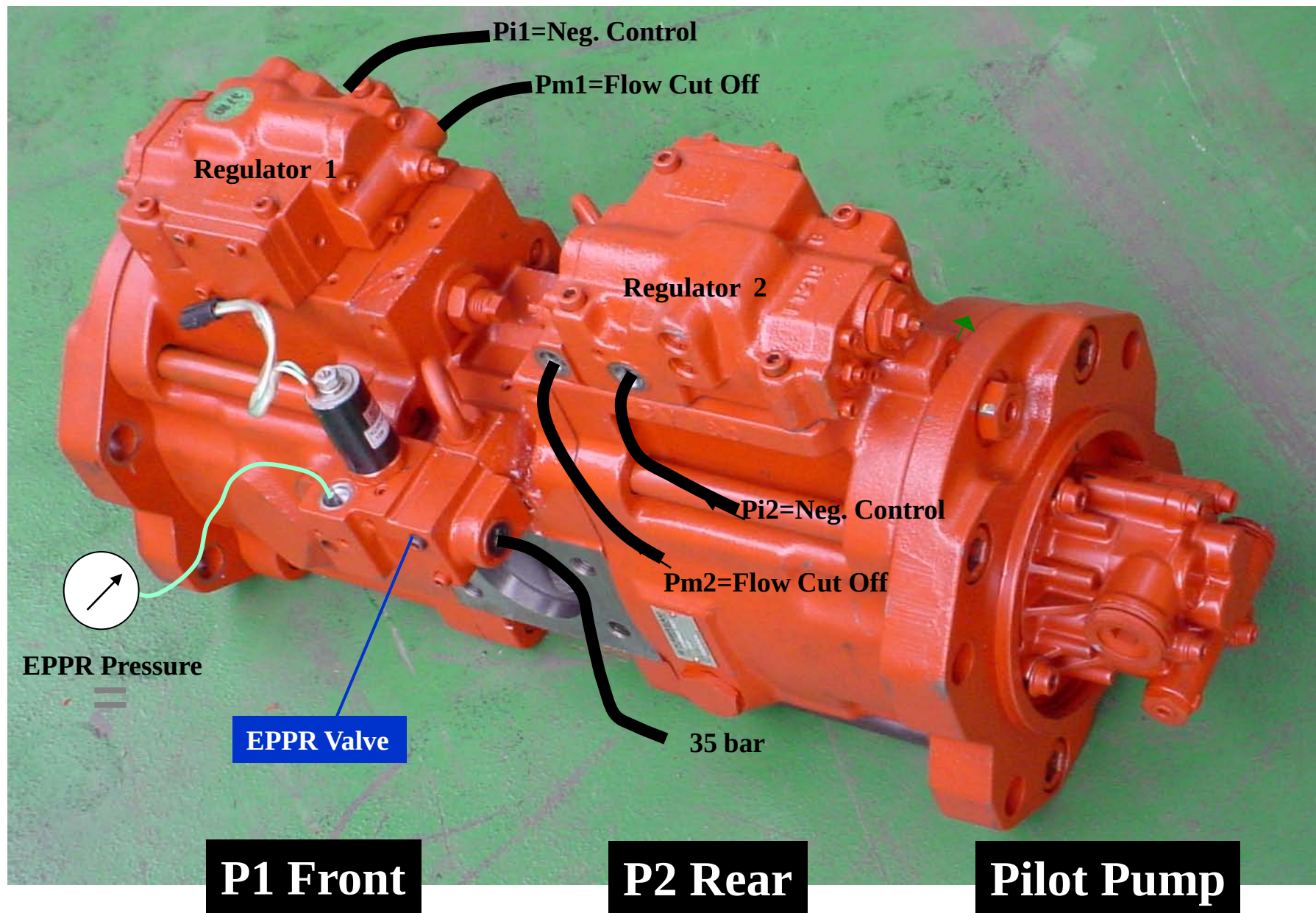


Hydraulic System

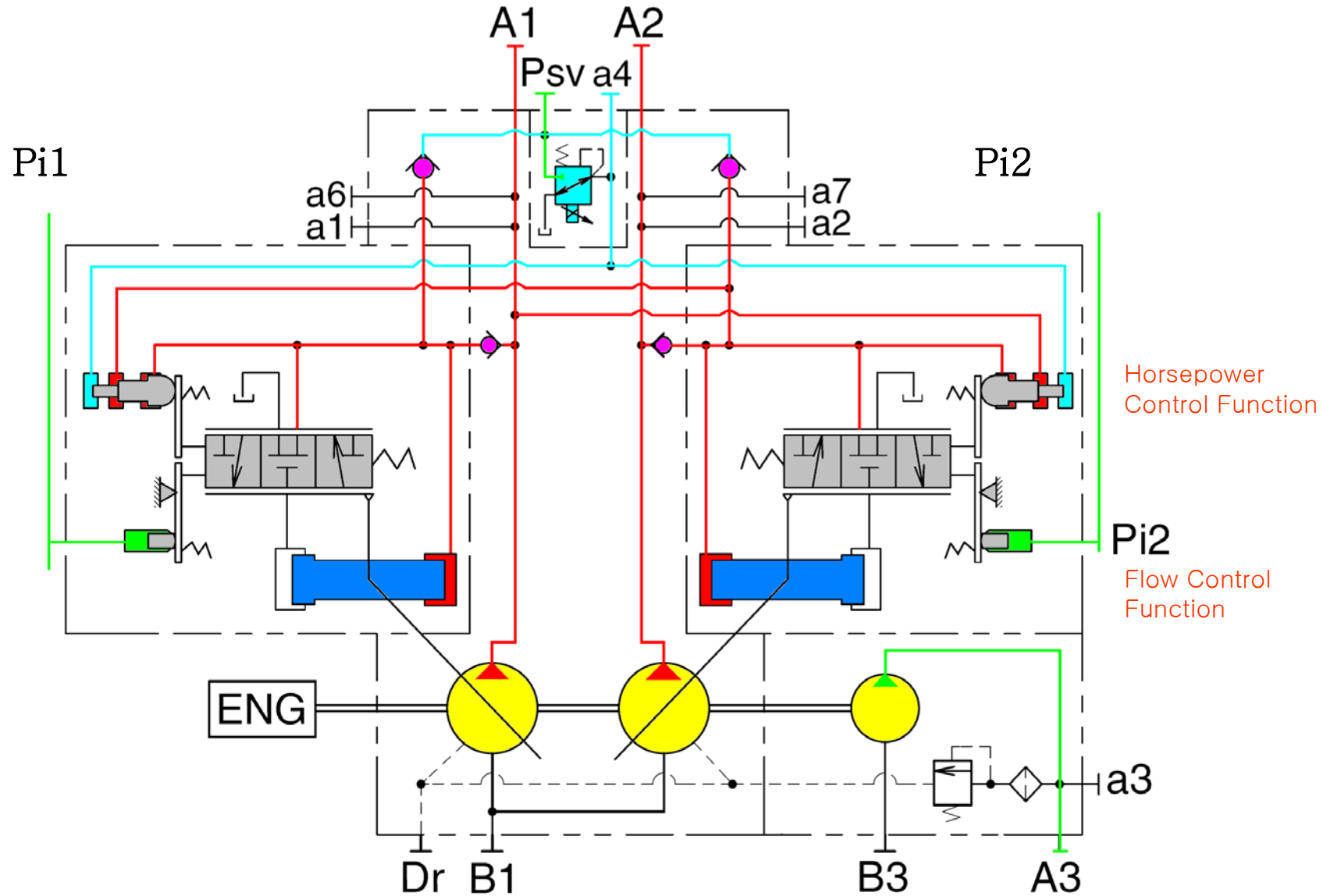
R210LC-9

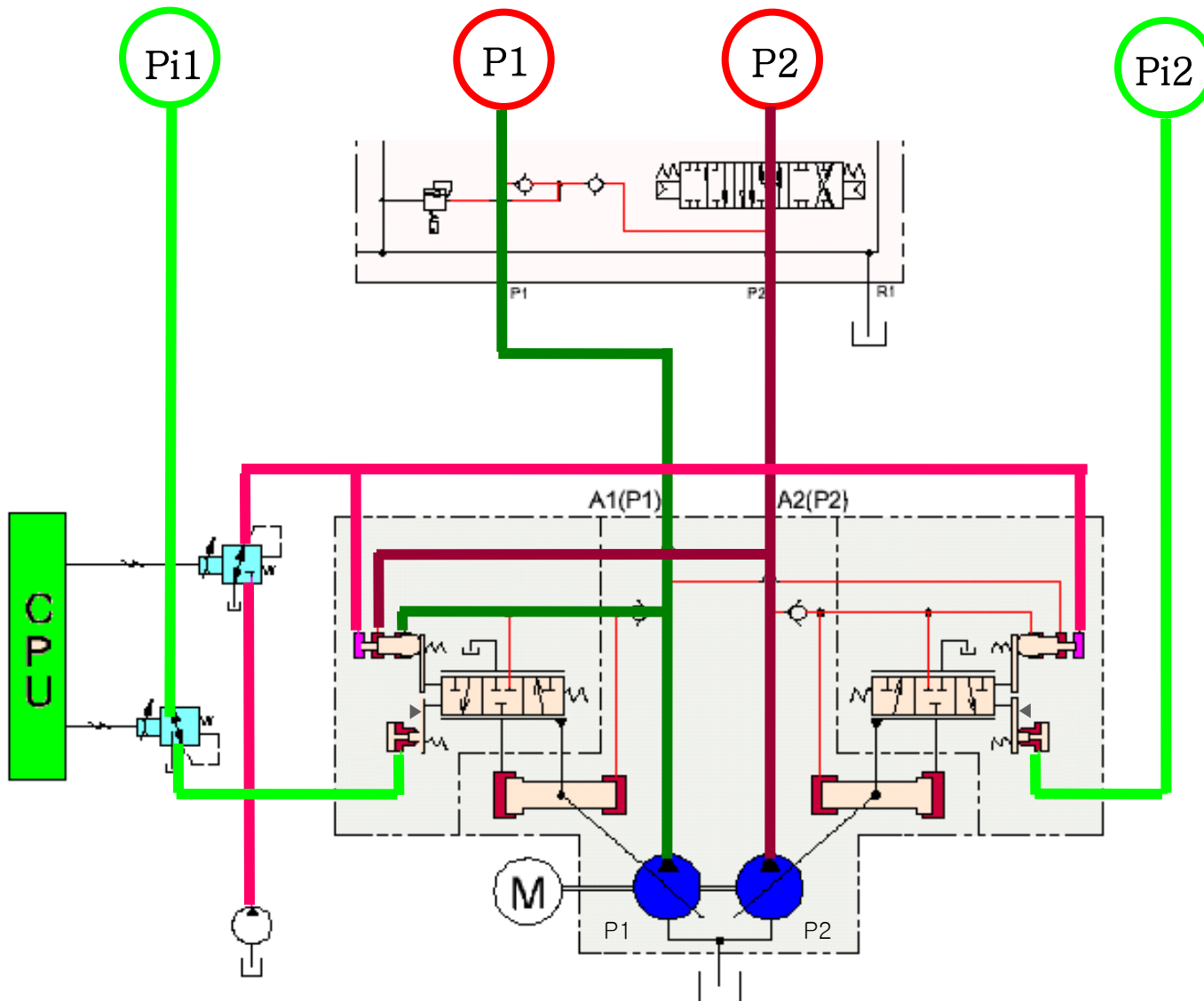
Pump Assembly



1. Main Pump

1-1. Hydraulic circuit



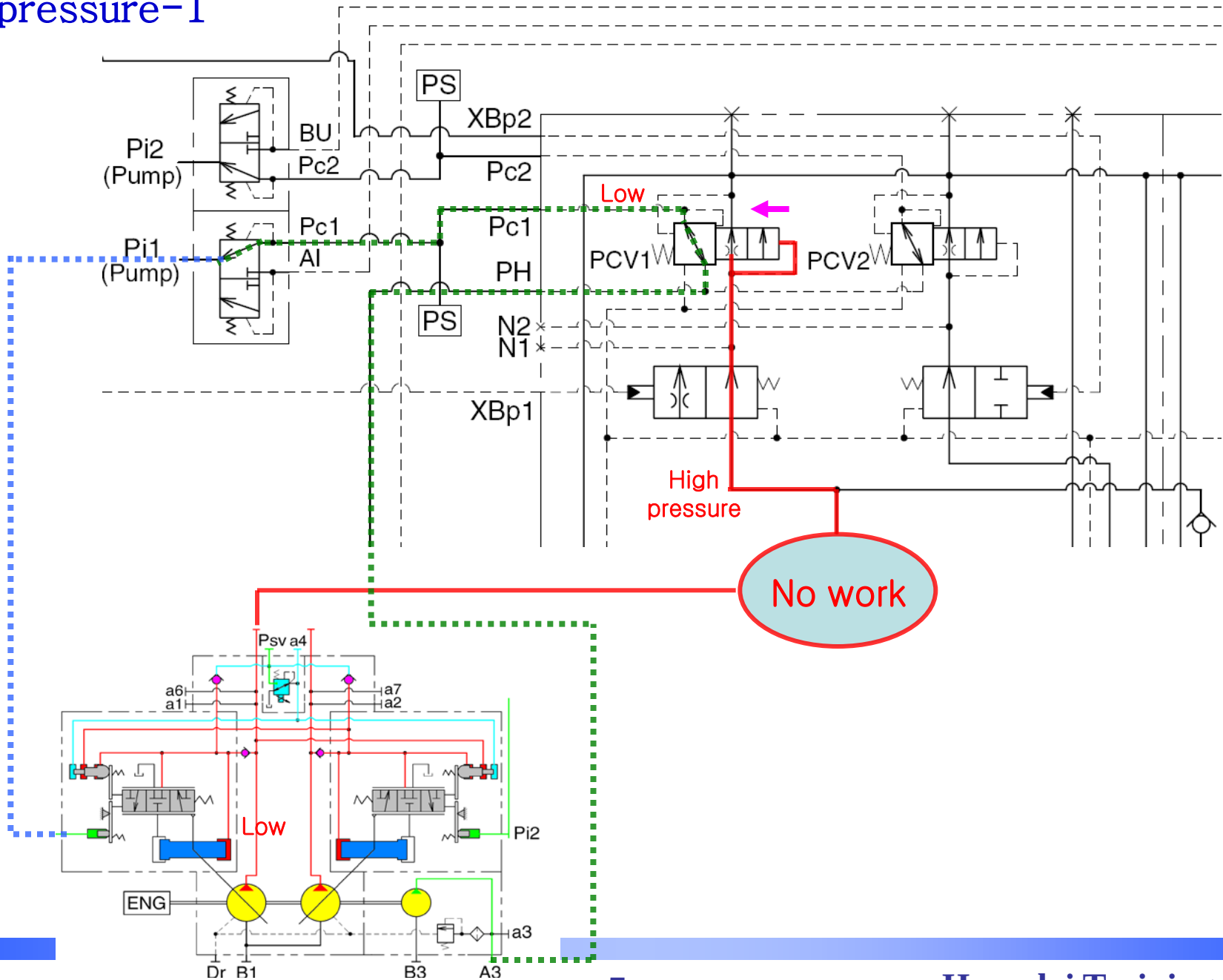


1) P1, P2 : Main Pump

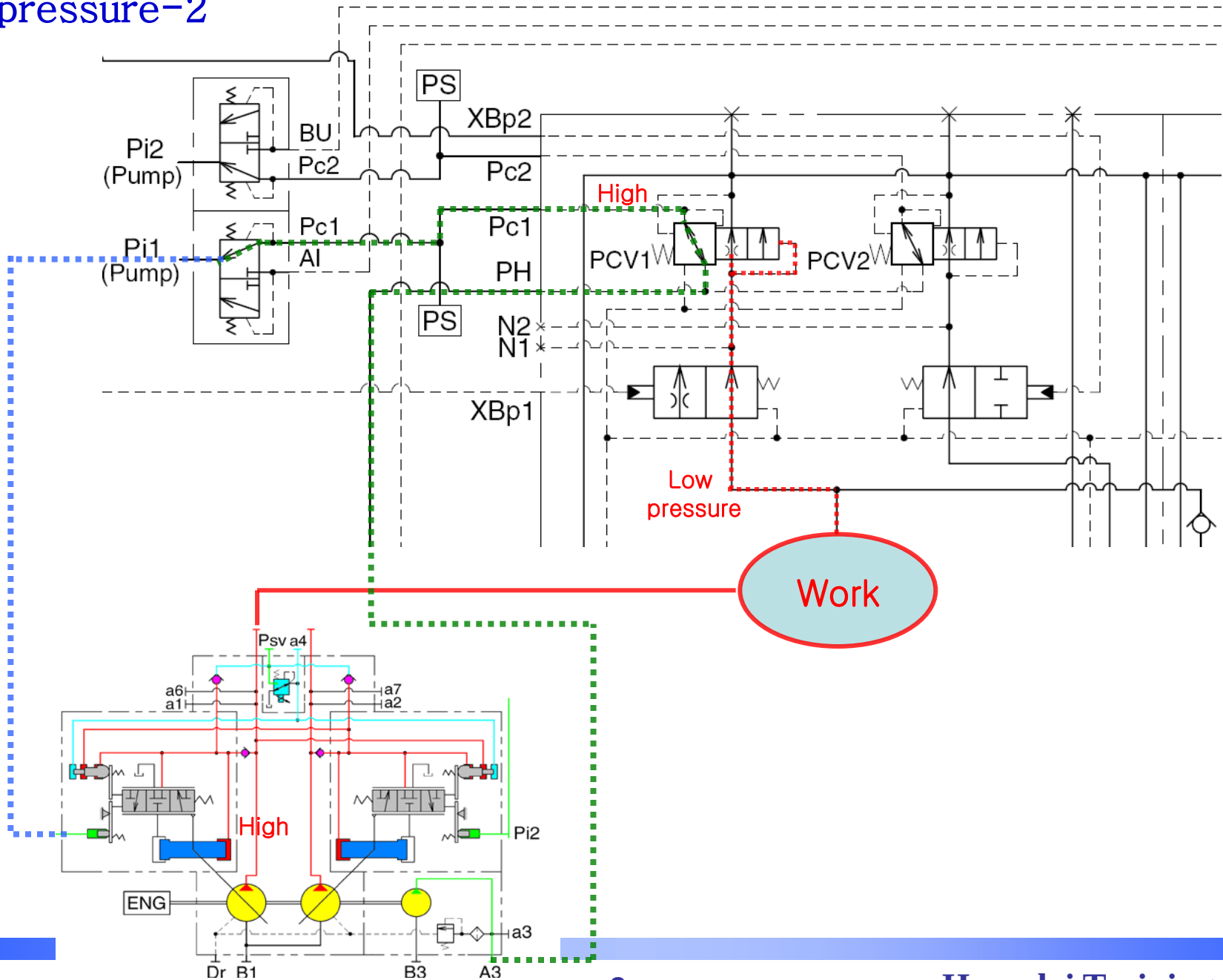
2) Pi1, Pi2 : Positive
control

3) Psv : EPPR V/V

Pi pressure-1

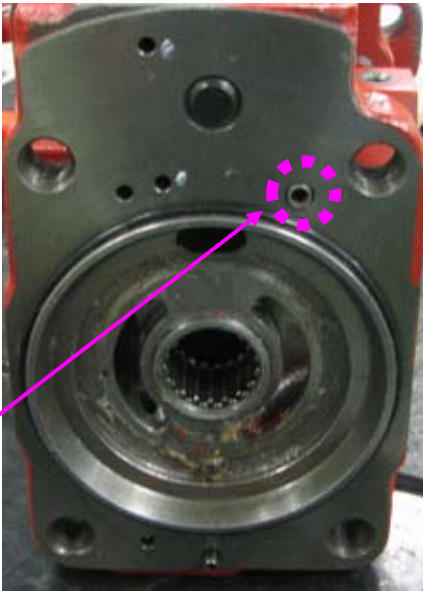
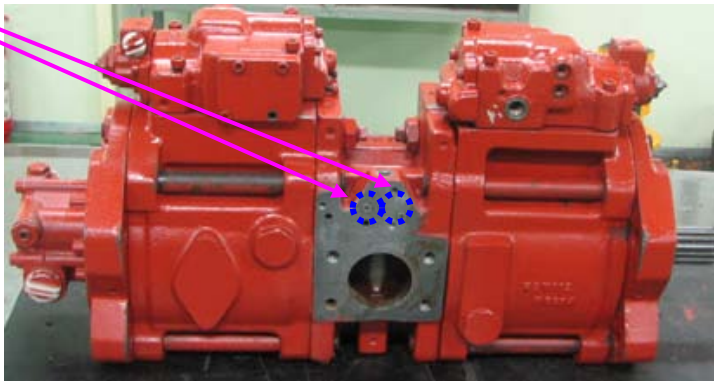
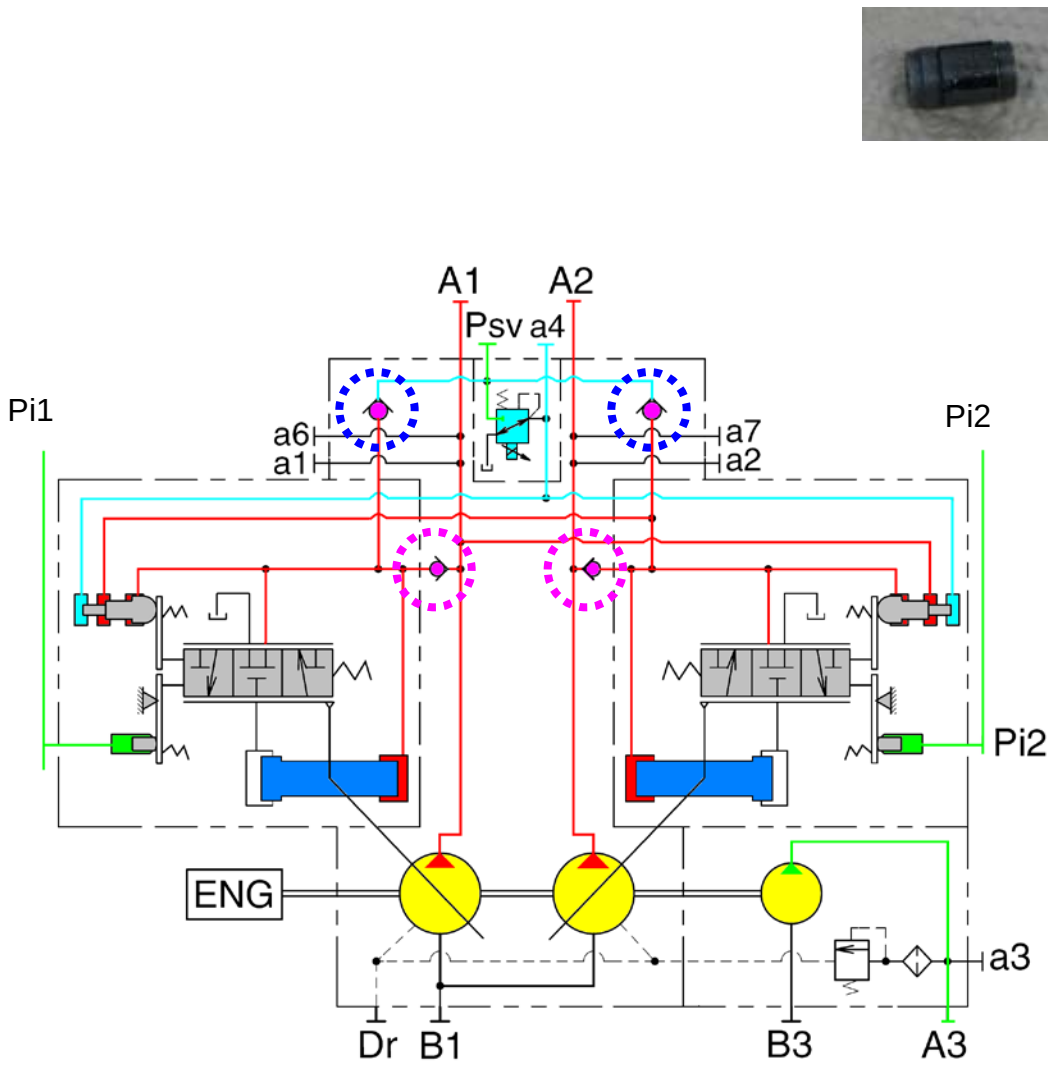


Pi pressure-2



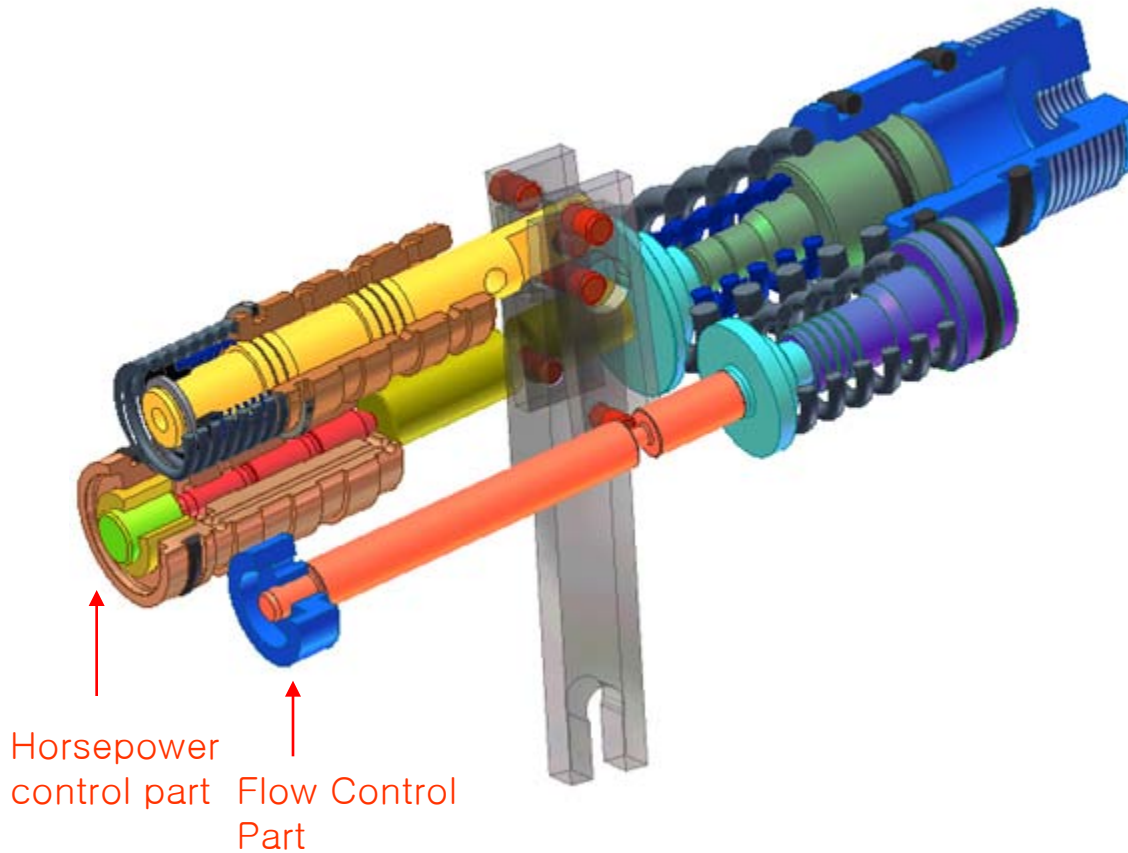
1-2. Check Valve

R210LC-9



2. Pump Regulator

2-1. Function-1



- 1) Horsepower control function
(negative system)

Power Shift Control

Pump self pressure and
the other Pump Pressure

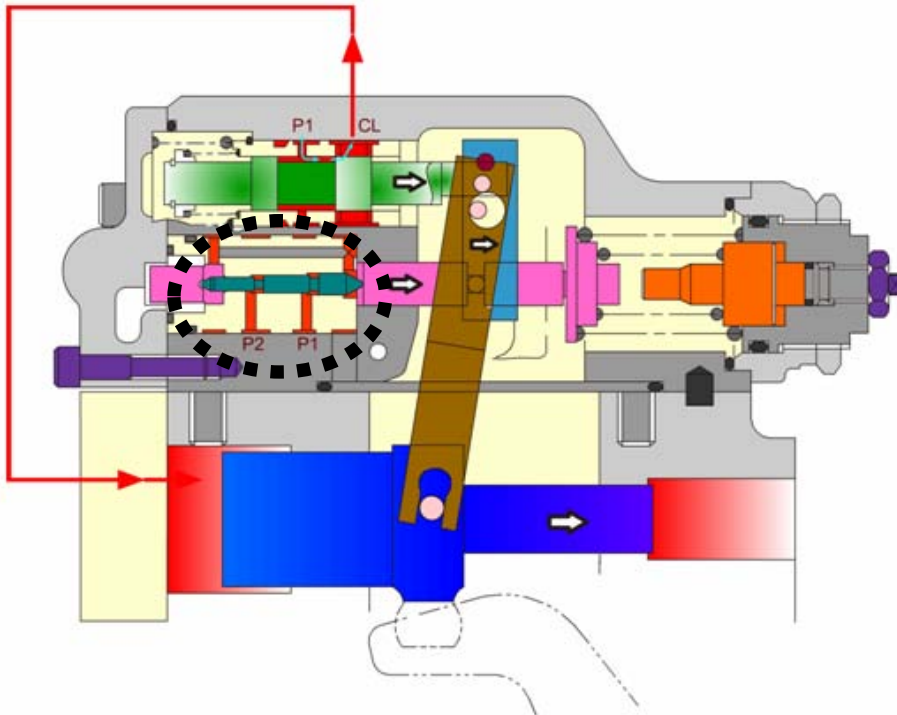
- 2) Flow Control Function
(Posi-Nega Flow Control)

(Pi1, Pi2) Control

Qmax cut-off EPPR Control

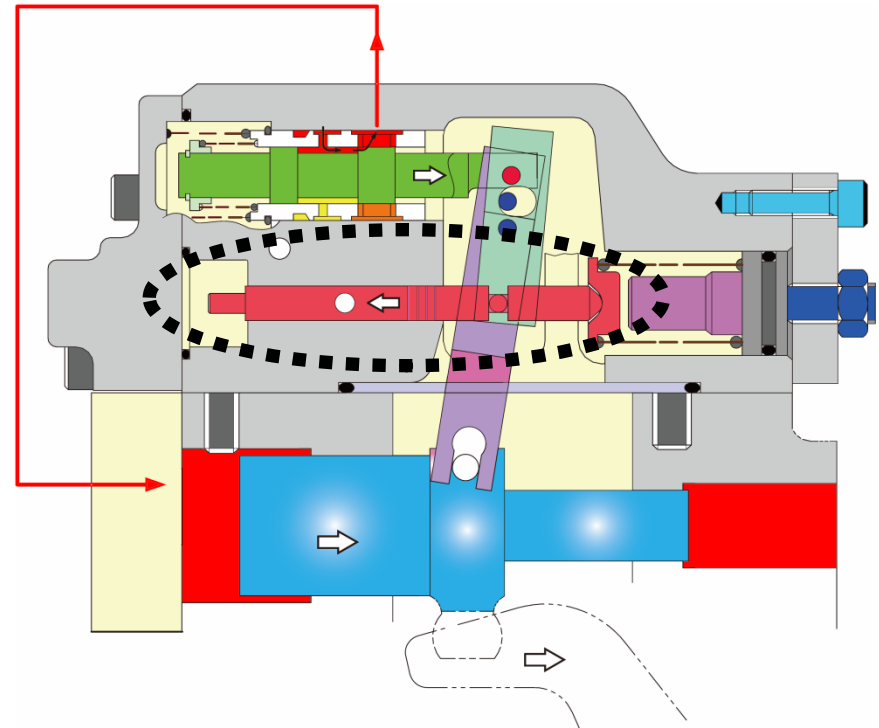
1) Horsepower Control Function (Negative Control)

– P1, P2, Pf Control



2) Flow Control Function (Posi-Nega Flow Control)

– Pi pressure and Max. Flow cut EPPR. Control

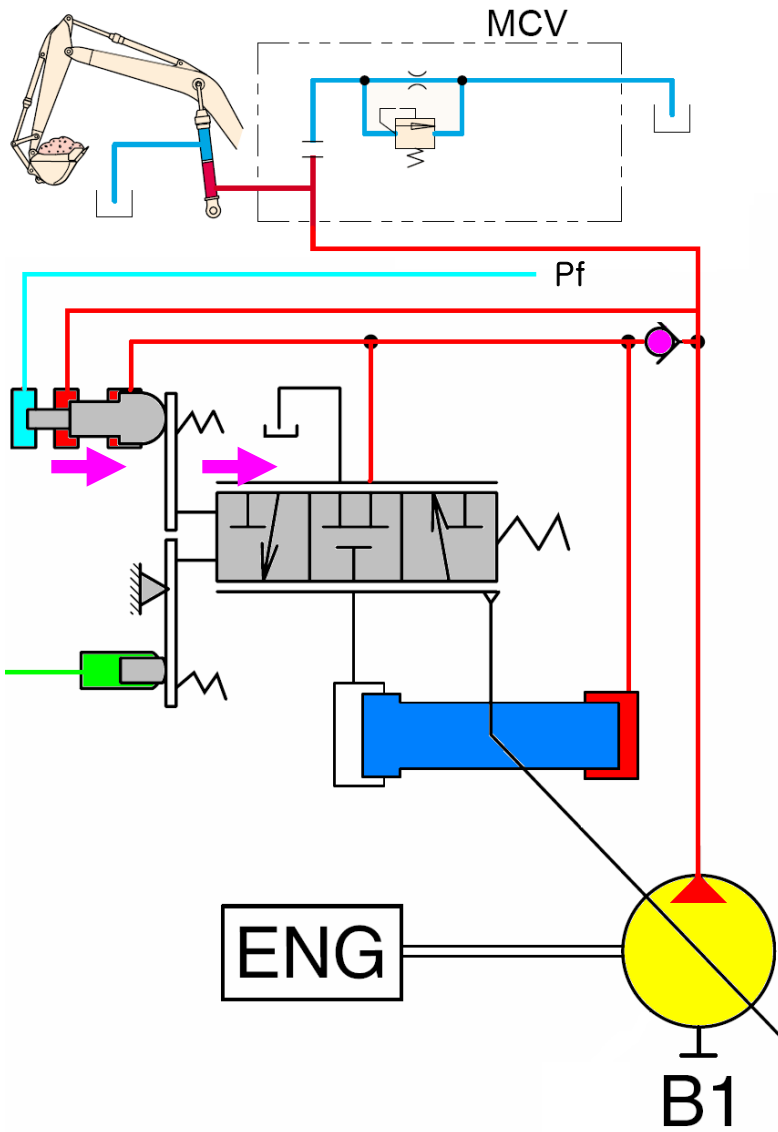




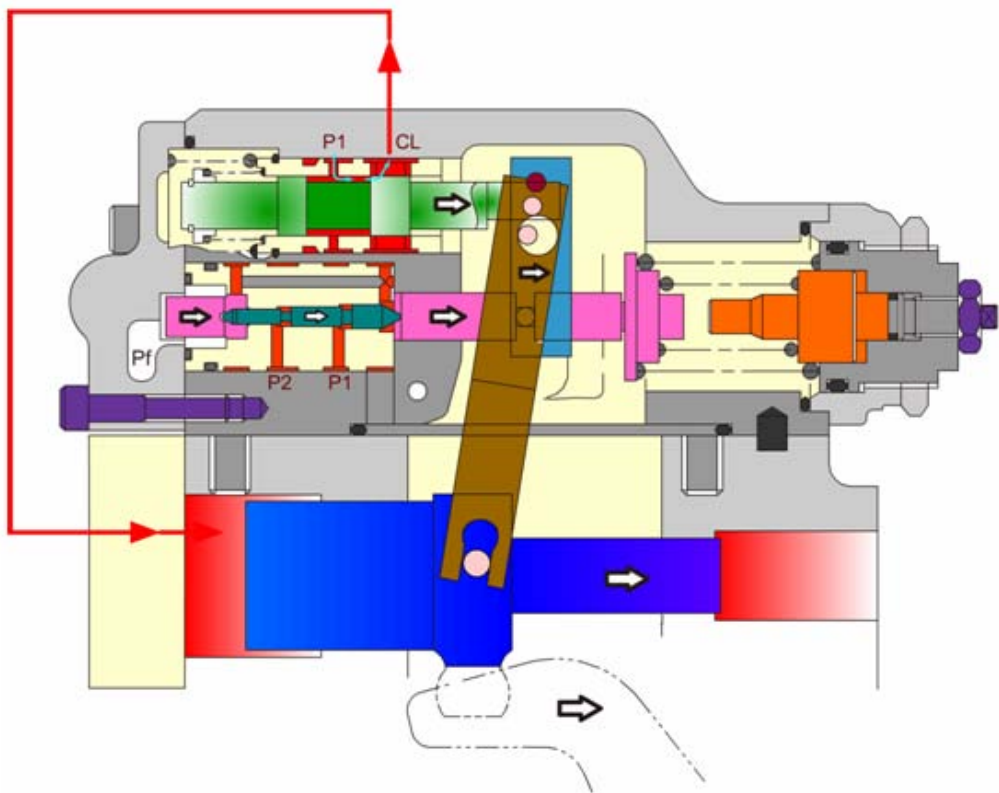
2-4. Horsepower Control (Negative Flow Control)

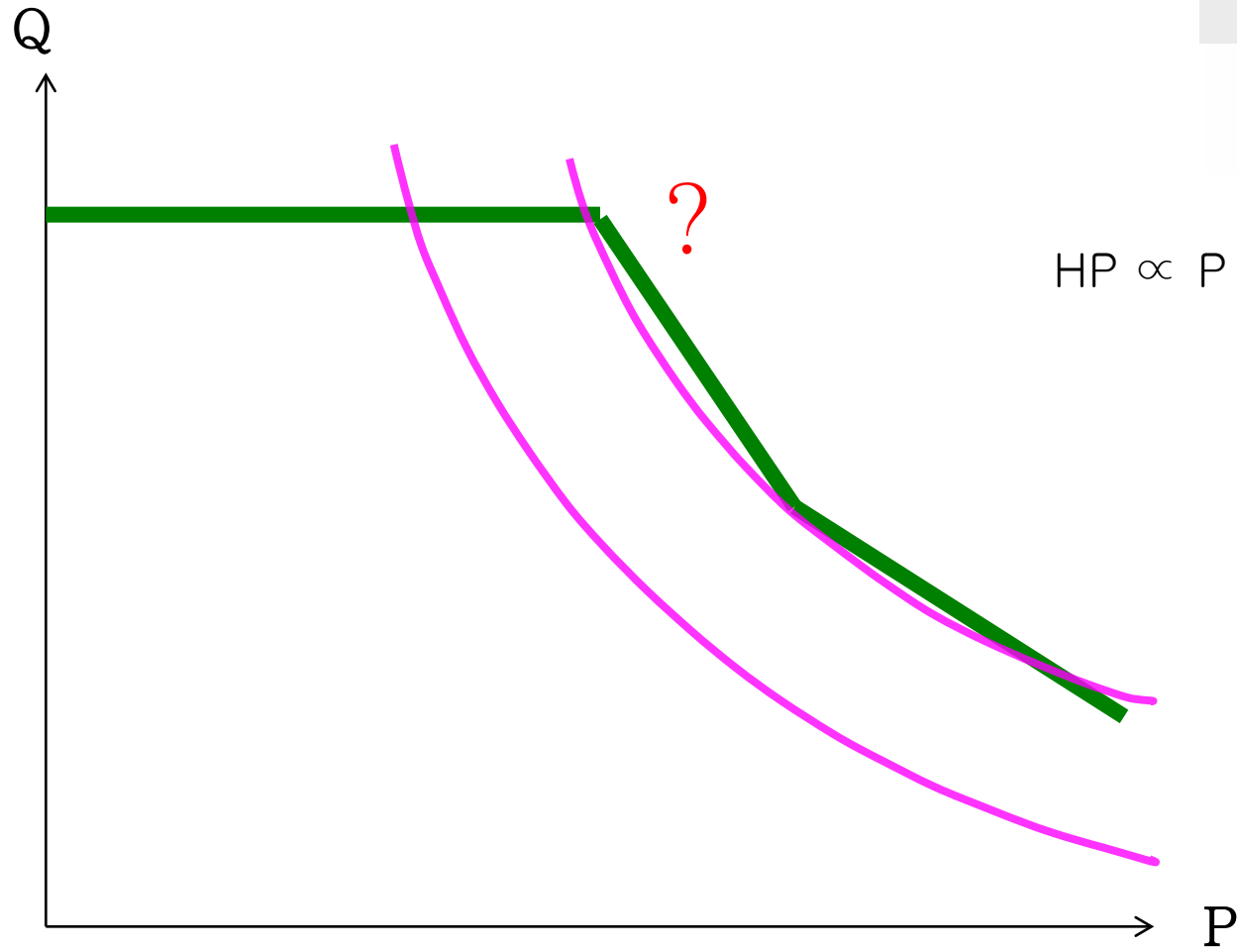
2-4-1. Overload protecting function

When P1,P2 pressure rise up, compensation piston begins to push the rod balancing with spring force. When the hydraulic pressure exceeds the spring force, then hydraulic oil will be supplied to large chamber of servo piston and the pump discharge rate will be reduced.

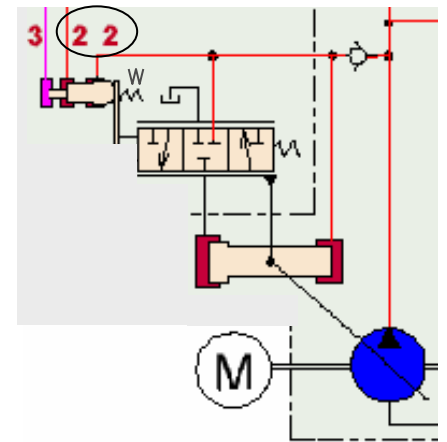


Cylinder Pressure $>$ Spring Force
(Discharge rate Decrease)

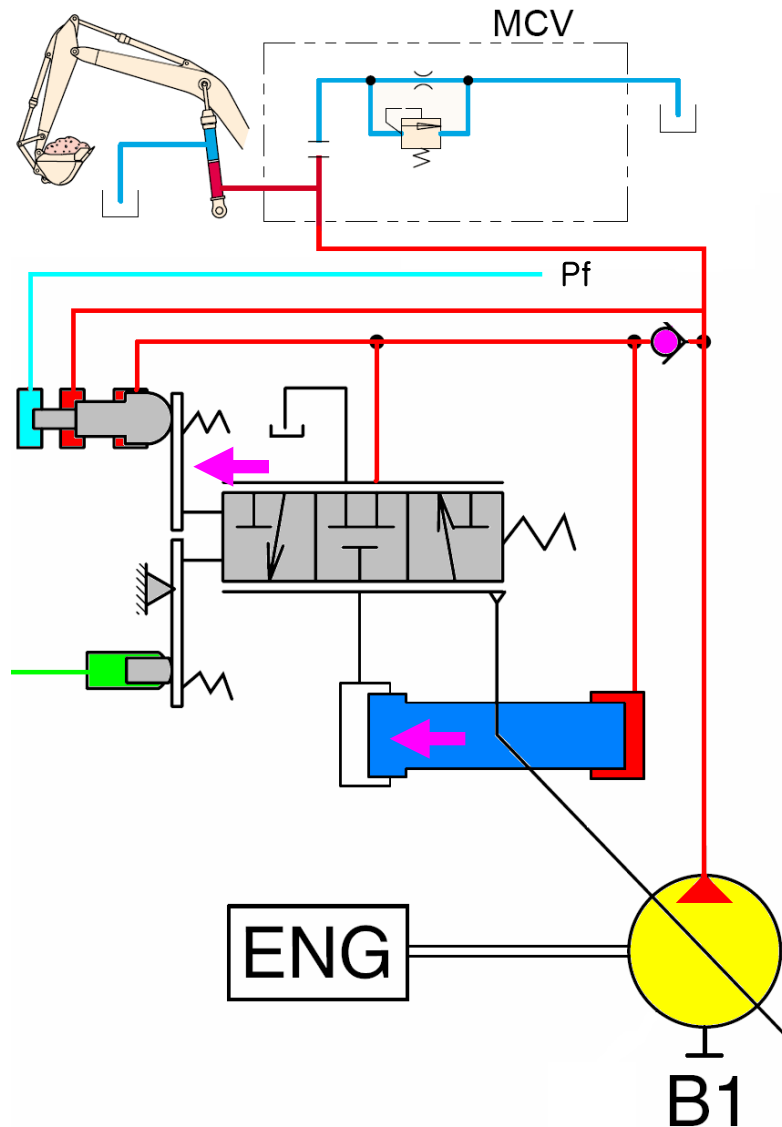




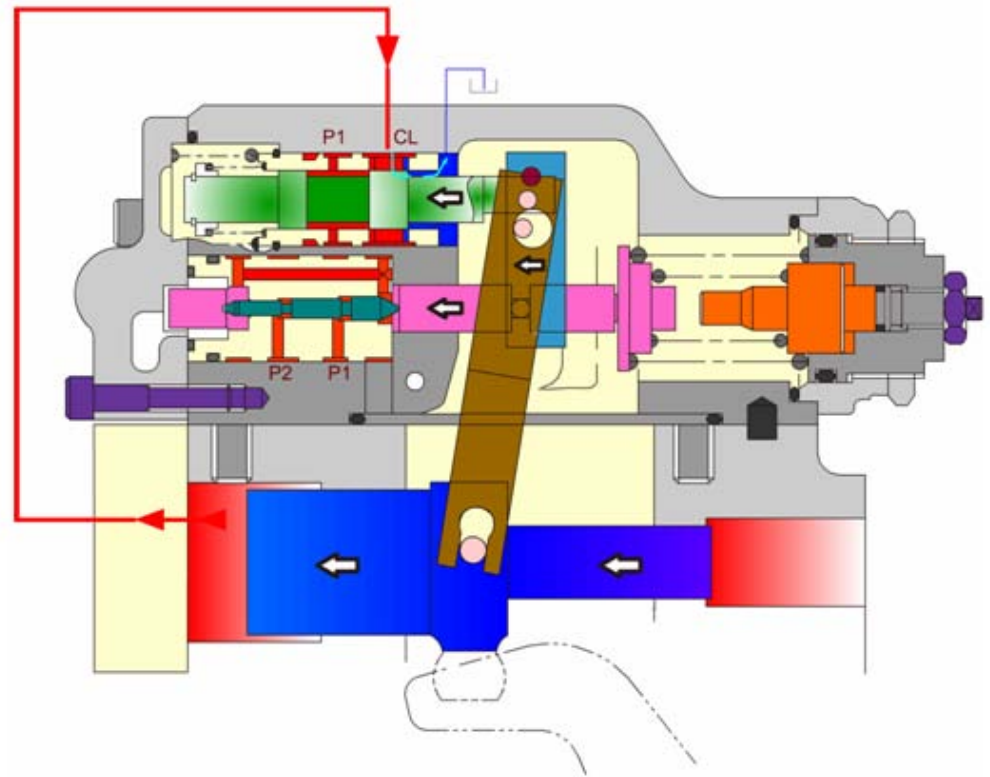
$$HP \propto P \times Q$$



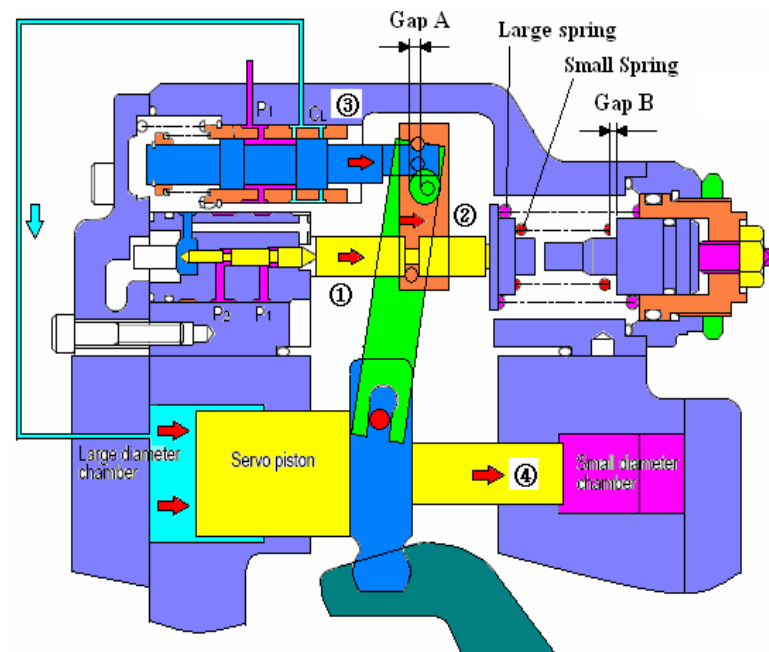
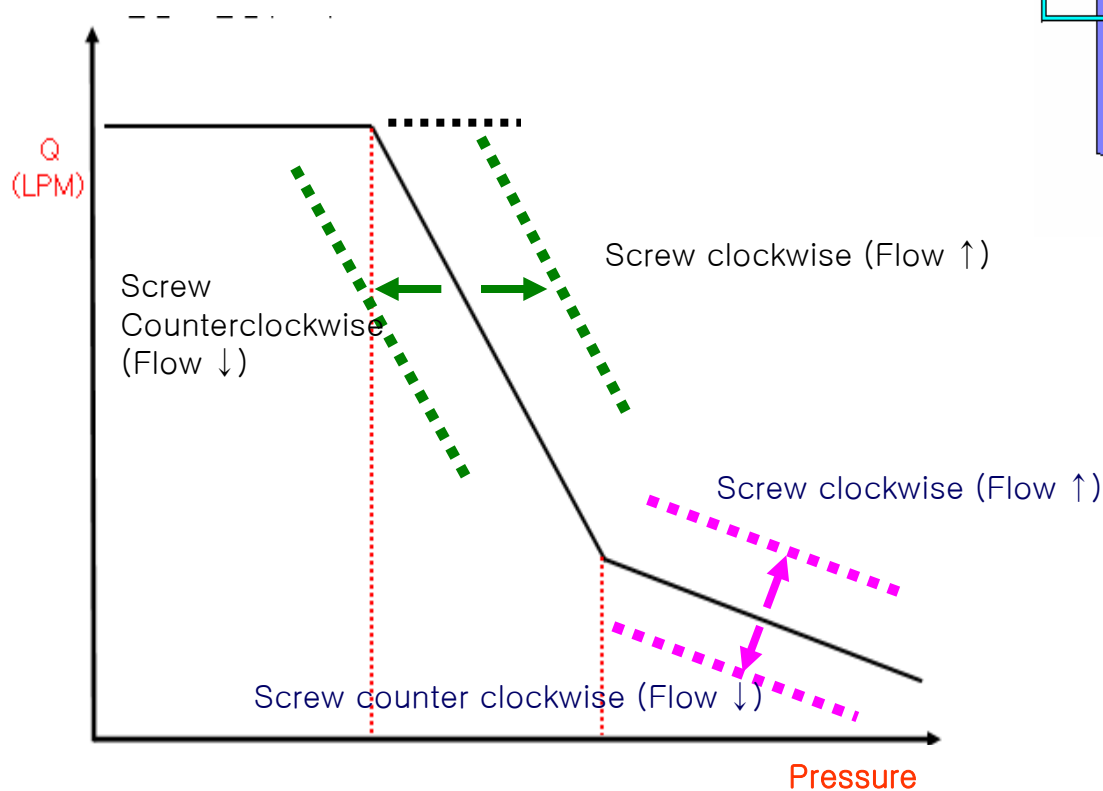
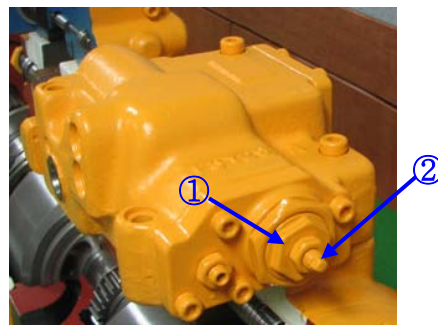
When P1,P2 pressure decrease, the spring force pushing the compensation piston rod exceeds the hydraulic pressure and shifts the compensation piston. Then large chamber of servo piston is connected to tank, that makes pump discharge rate increase.



Cylinder Pressure < Spring Force
(Discharge rate Increase)



2-4-3. Adjustment of power



① Adjustment of 1st power

- Release lock nut of 36mm
- Adjust screw of 24mm

② Adjustment of 2nd power

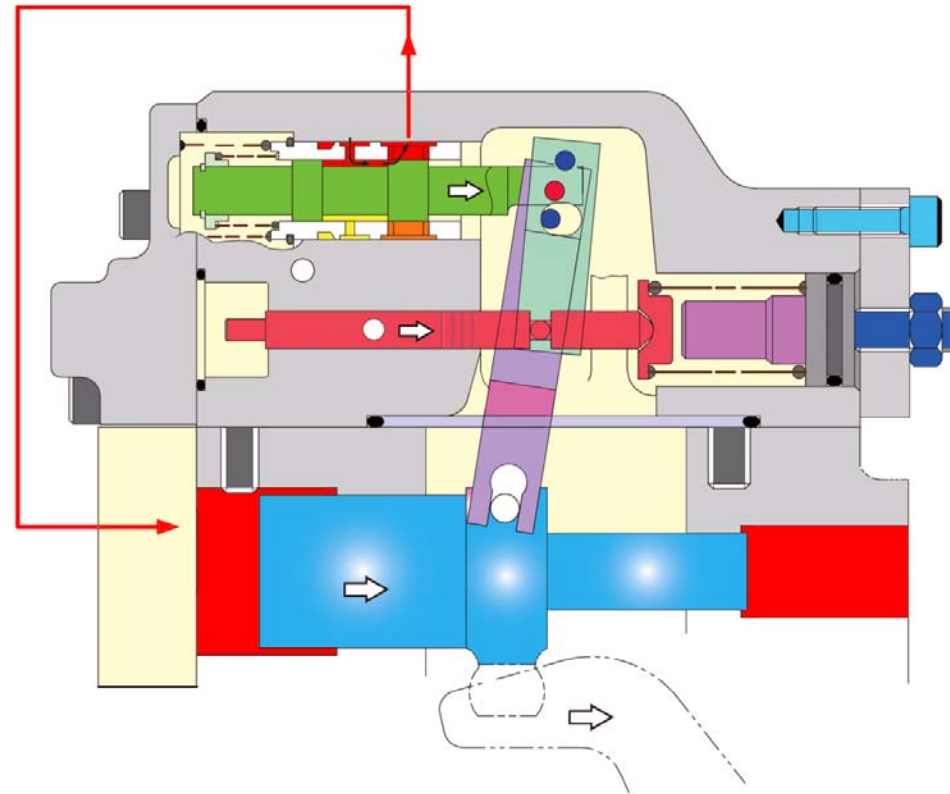
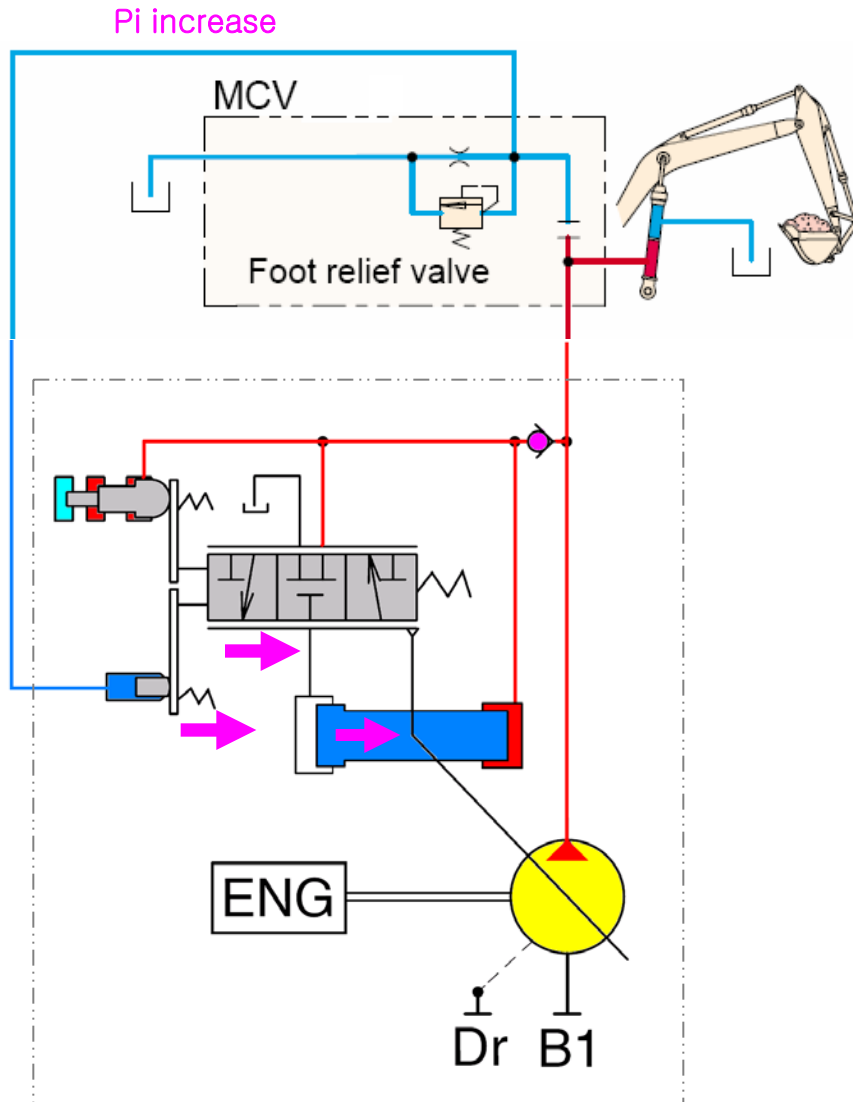
- Release lock nut of 13mm
- Adjust rectangle screw



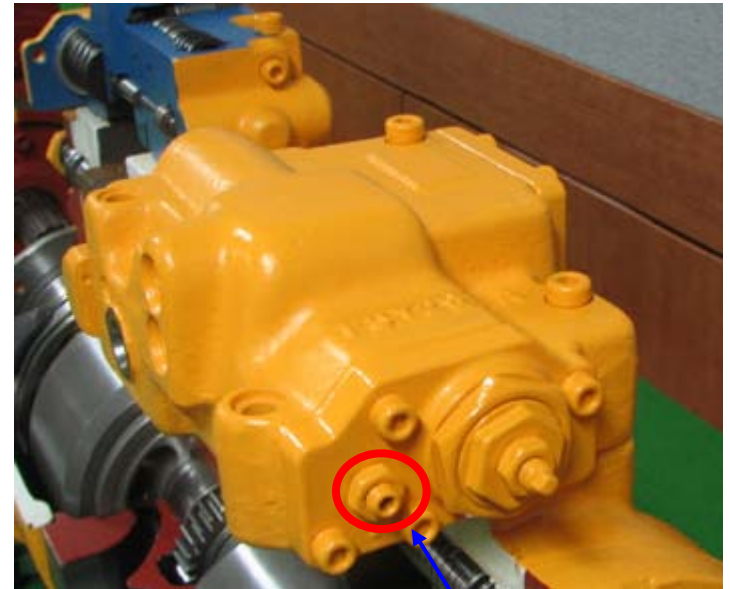
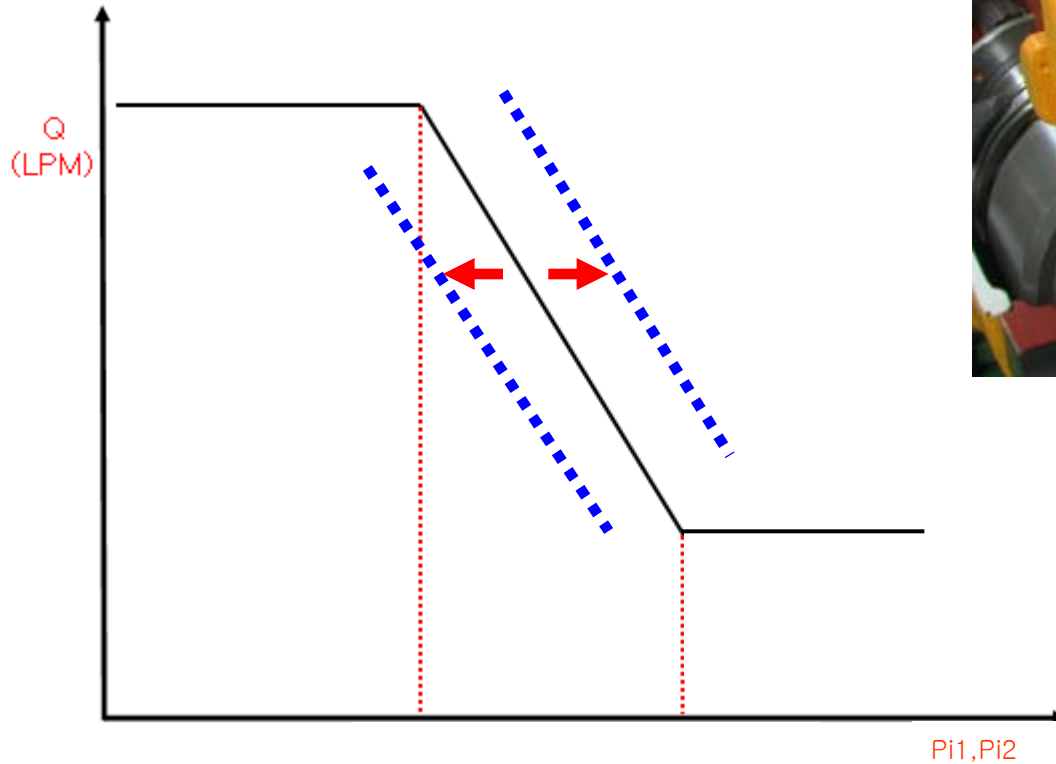
2-5. Flow Control Function (Negative Control Function)

2-5-1. Flow decrease

– RCV Lever neutral and fine control



2-5-2. P-Q Graph (Relation between P_i and Flow)



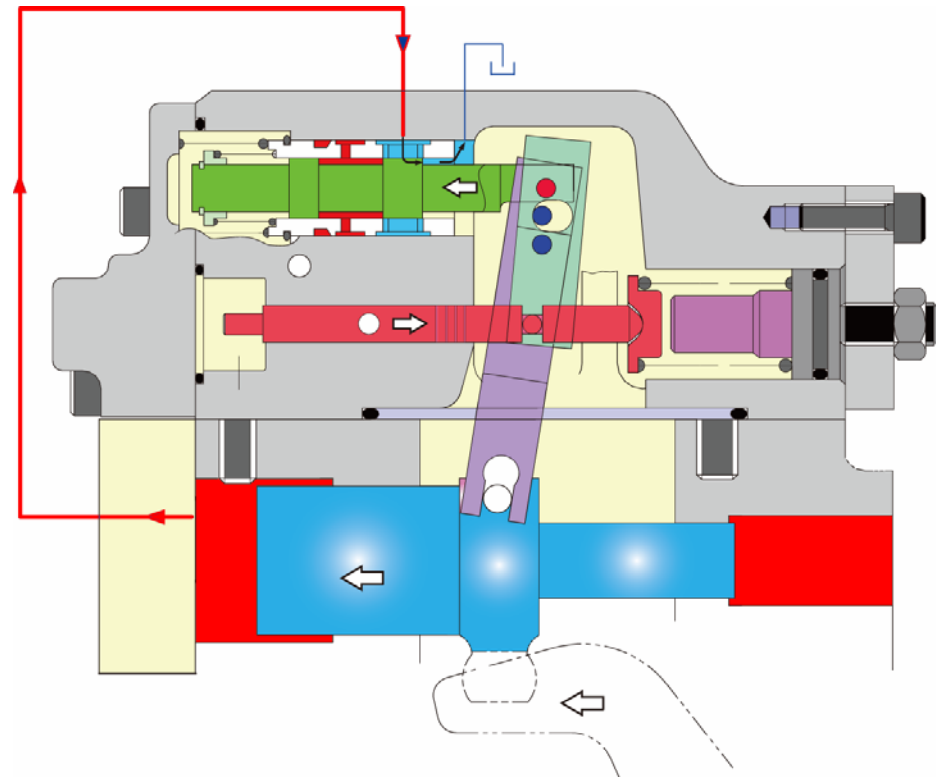
Pilot flow control Screw

Screw : Counter clockwise (Flow ↓)

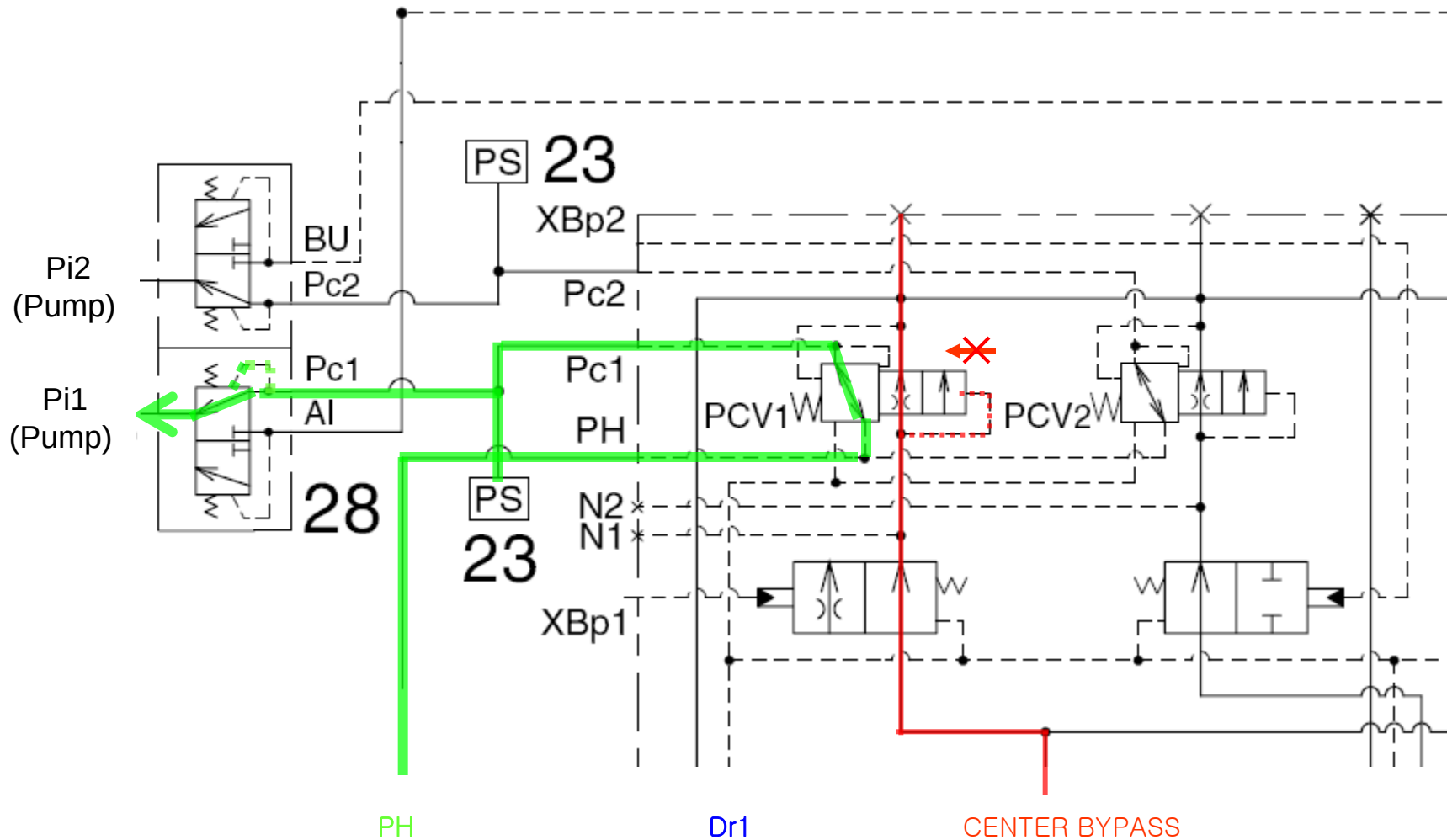
Screw : Clockwise (Flow ↑)

Flow control by controlling negative pressure (P_{i1}, P_{i2}).

- Operating Attachment

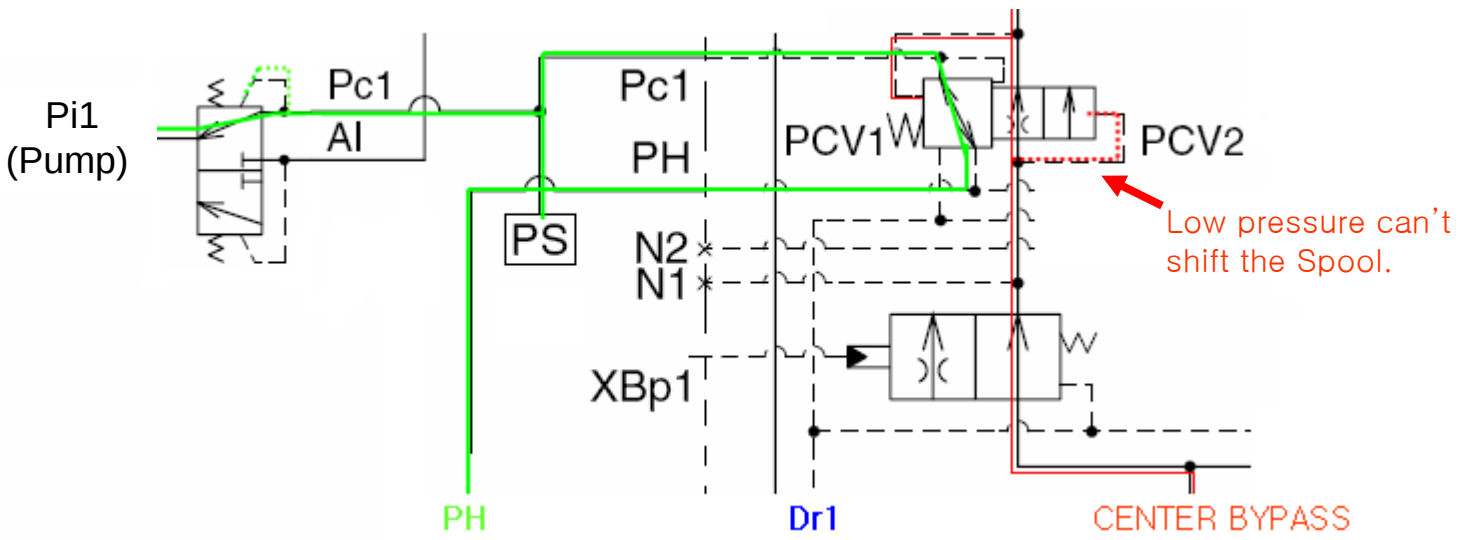
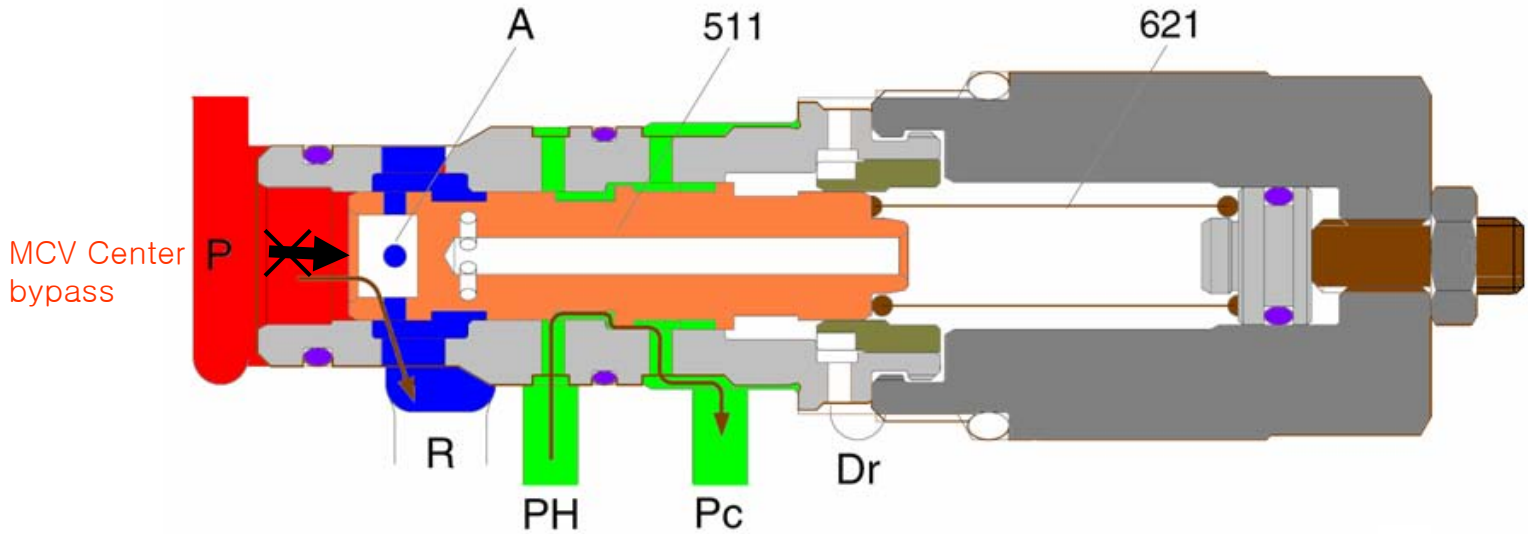


When any of main spools is changed over, the bypass circuit is cut off. The posi-nega conversion valve spool is not shifted. At this time, “PH” pressure discharged from “P3” pump will flow to regulator “Pi1” passing through posi-nega conversion valve and shuttle valve. That will make pump discharge rate increase.

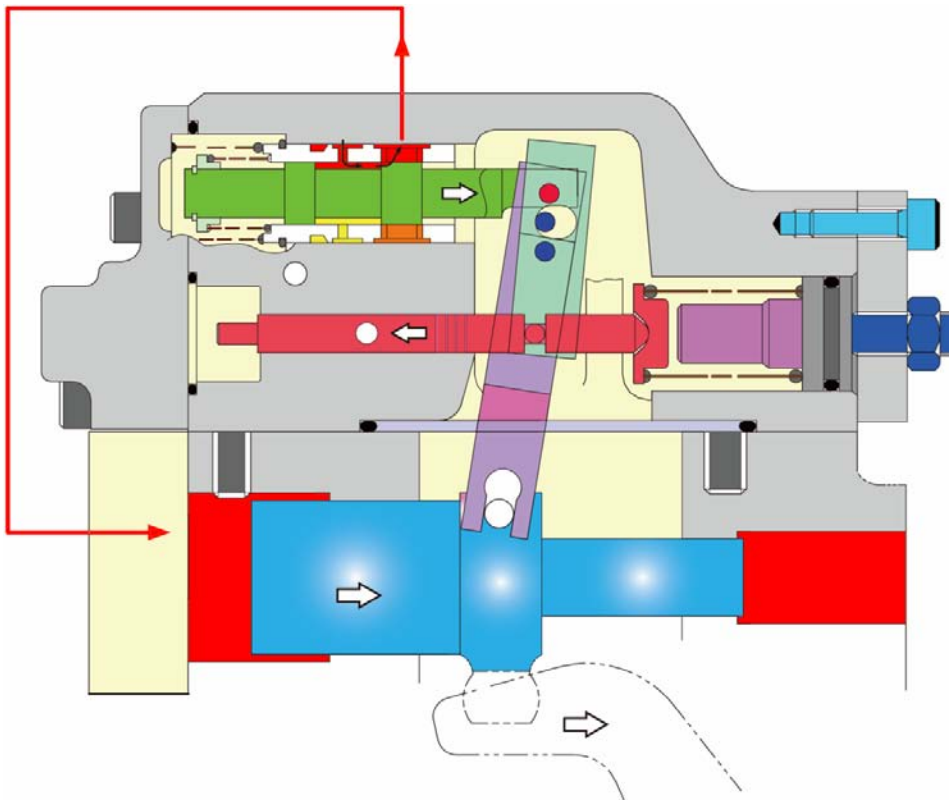


2-6-3. Posi-Nega Conversion Valve when RCV Lever is positioned at full position (Relief)

R210LC-9



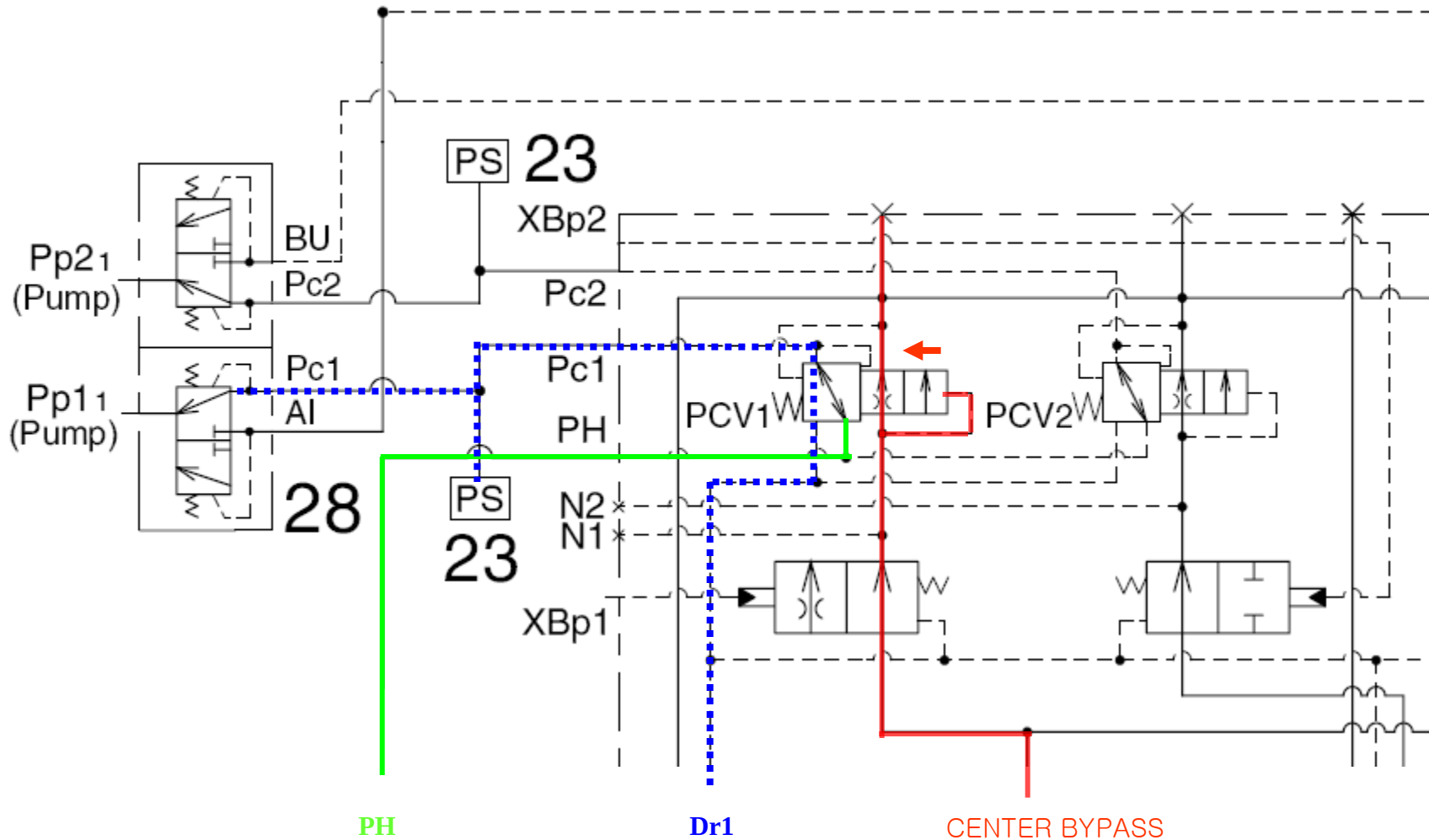
Pi decrease



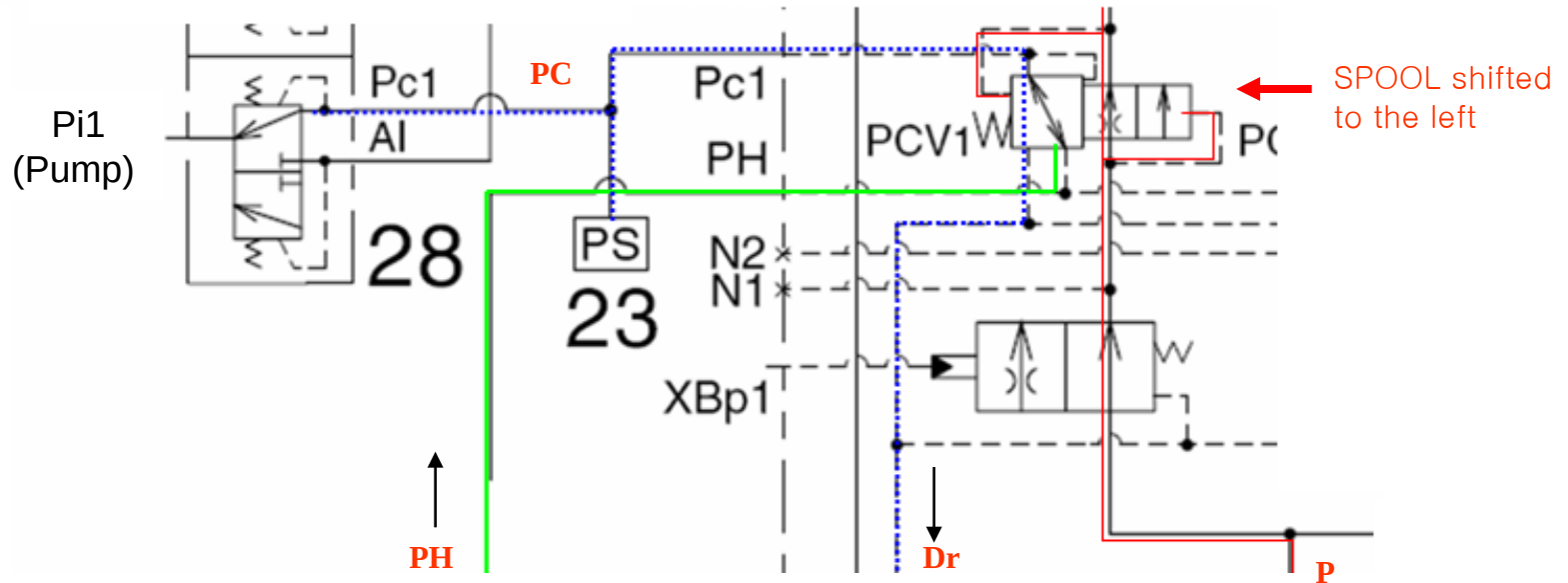
2-6-5. Flow Control when RCV lever is in neutral position

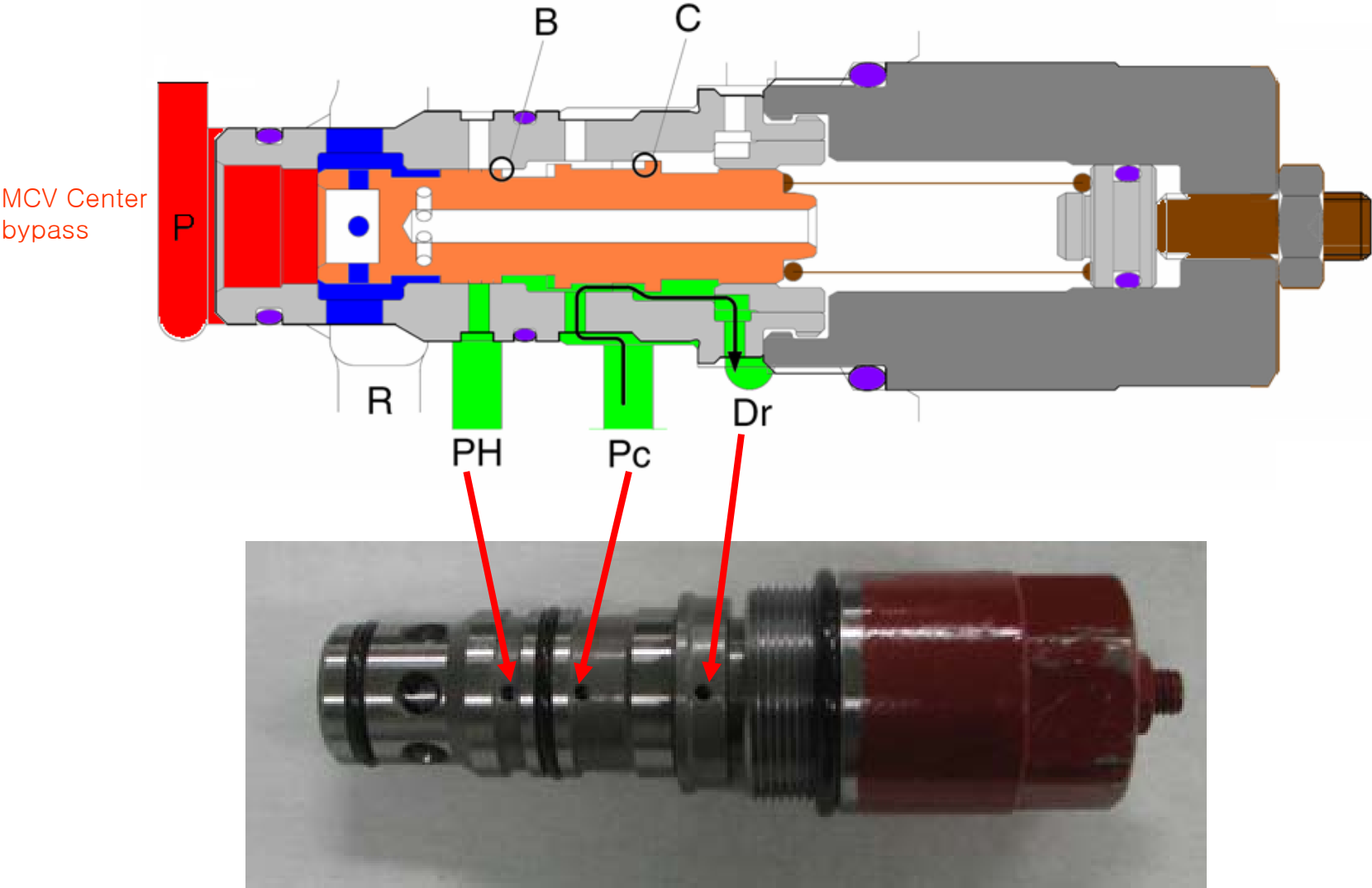
R210LC-9

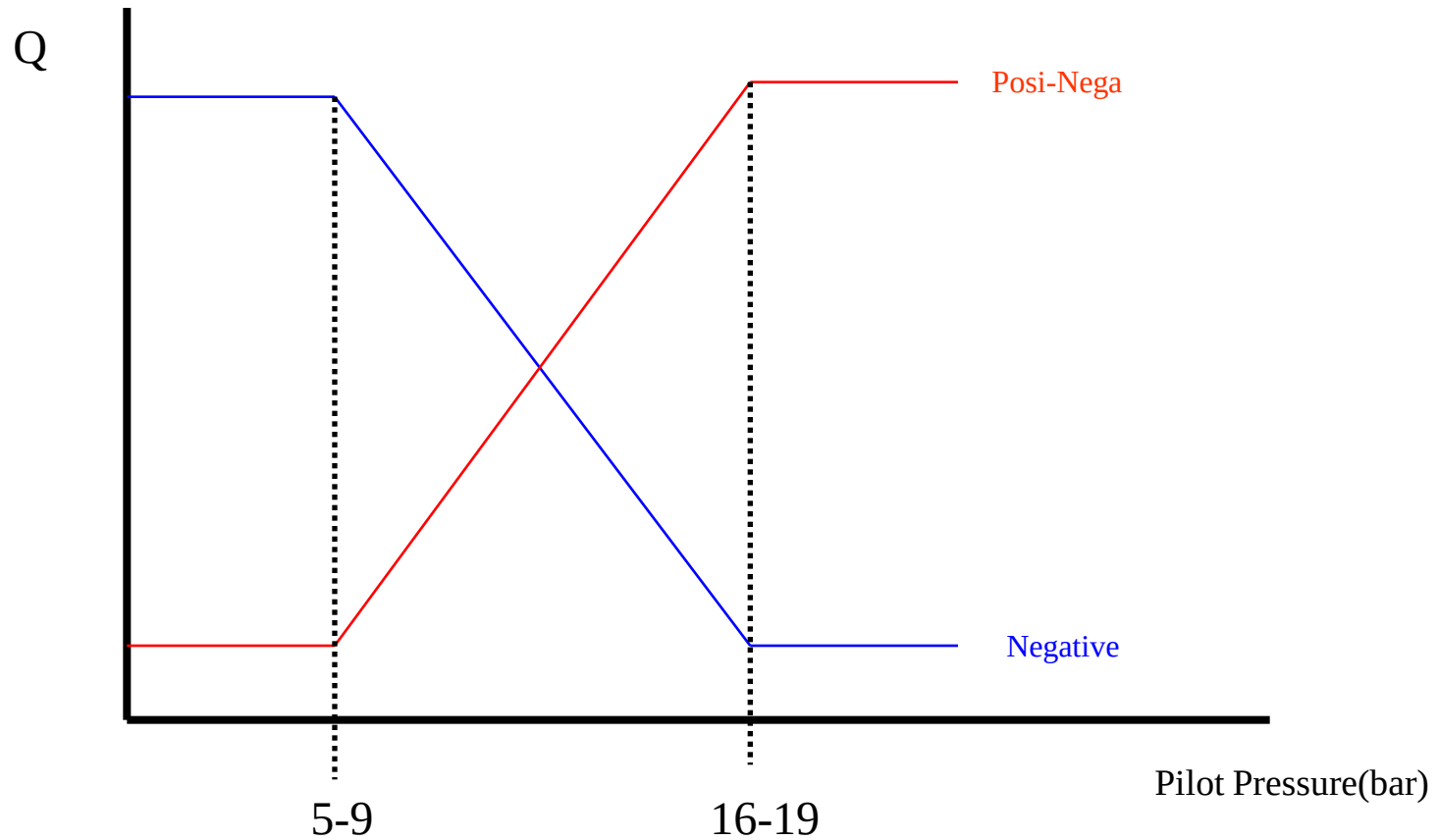
When hydraulic oil passing through the center bypass line increases, the posi-nega conversion valve spool moves to the left side. At this time, oil discharged from P3 pump will be blocked and Pc1 will be connected to the drain line, “Dr1”, it makes Pp1₁ line pressure lower and controls pump discharge flow rate to its minimum value.



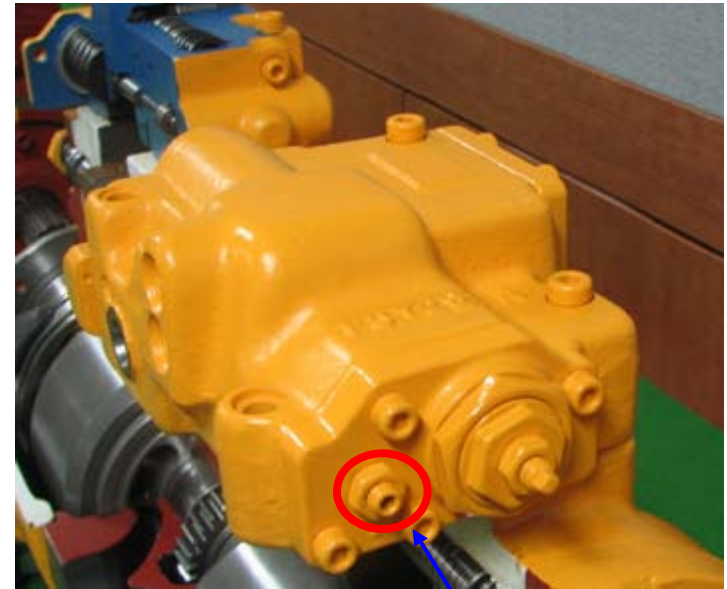
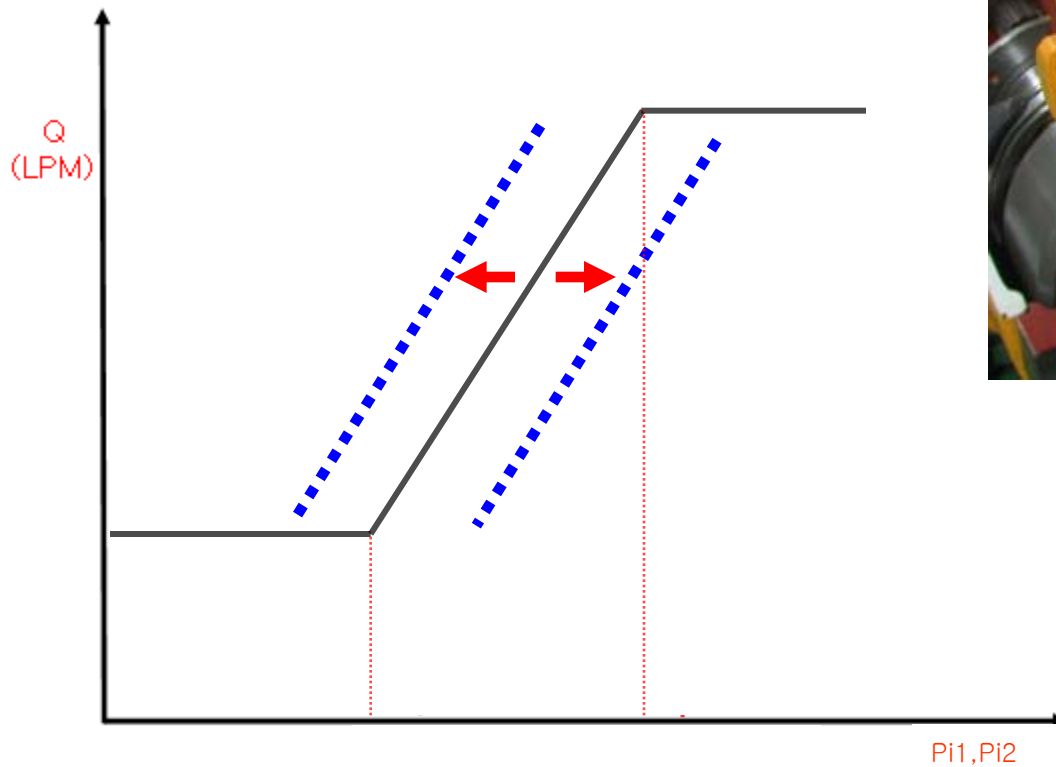
R210LC-9







2-6-8. P-Q Graph (Relation between Pi and Flow)



Pilot flow control Screw

Screw : Counter clockwise (Flow ↑)

Screw : Clockwise (Flow ↓)

Flow control by controlling negative pressure (Pi1, Pi2).

3. Pf (Power shift control by EPPR valve)

3-1. Current and Voltage each Mode

According to the mode, CPU sends EPPR valve the variable current value. So, swash plate angle is changed.

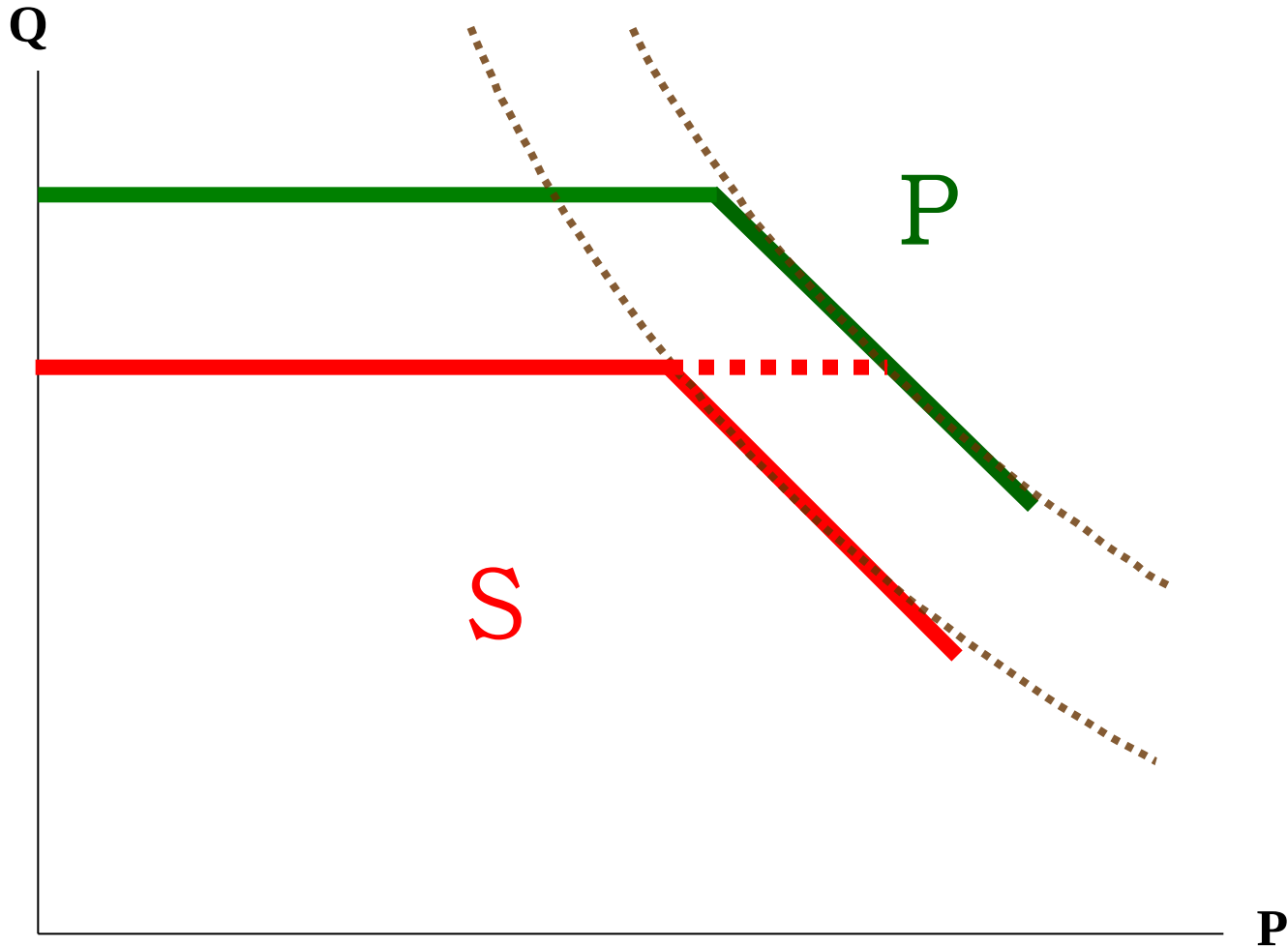
Eppr v/v pressure and current value by each mode

R210LC-9

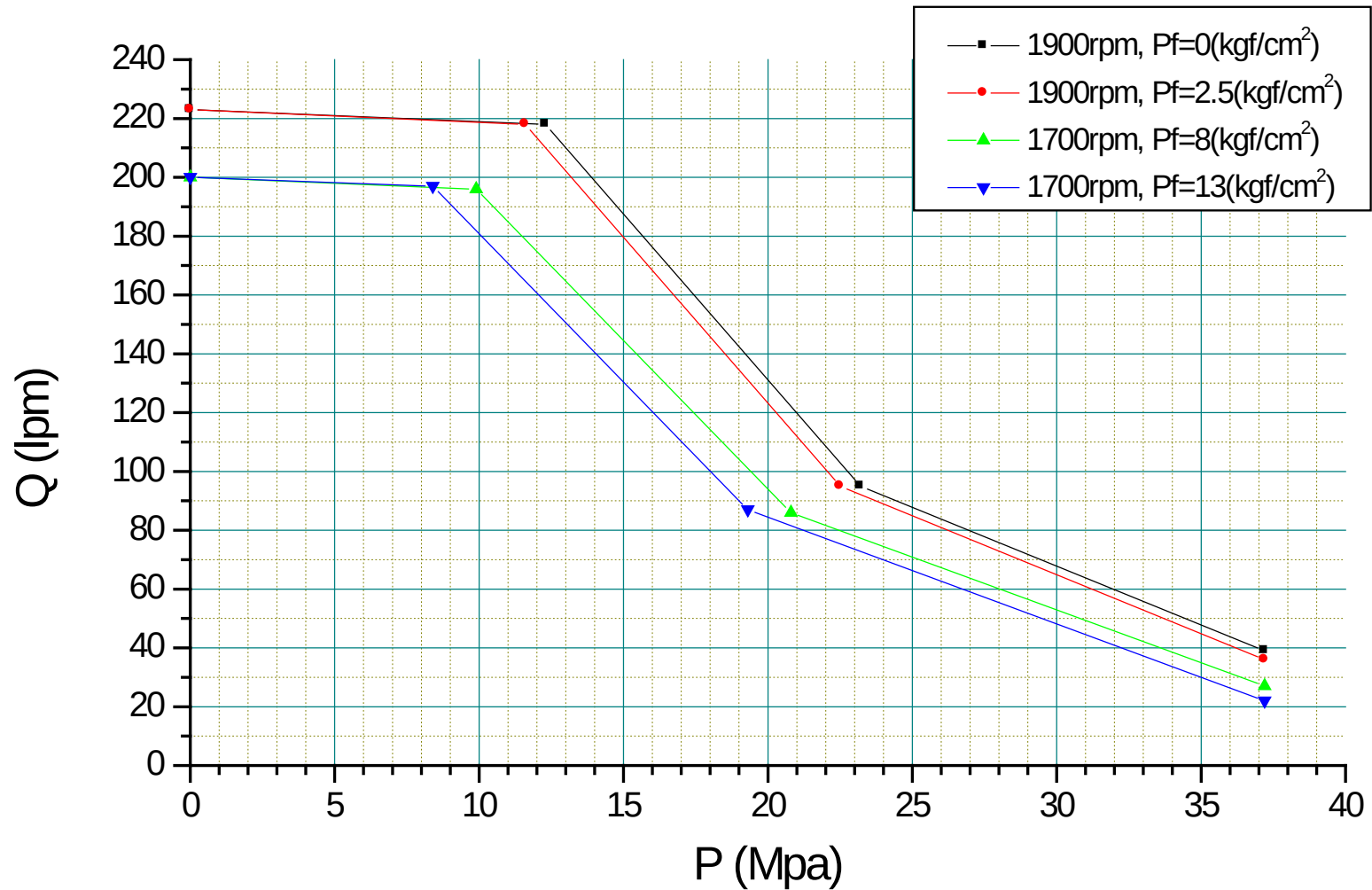
Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm ²)	Current (mA)	Pressure (kgf/cm ²)
P	Heavy duty power	1950±50	1900±50	1950±50	1900±50	185±30	2.5	160±30	0
S	Standard power	1750±50	1700±50	1850±50	1800±50	290±30	8±3	290±30	8±3
E	Economy operation	1600±50	1700±50	1700±50	1800±50	365±30	13±3	365±30	13±3

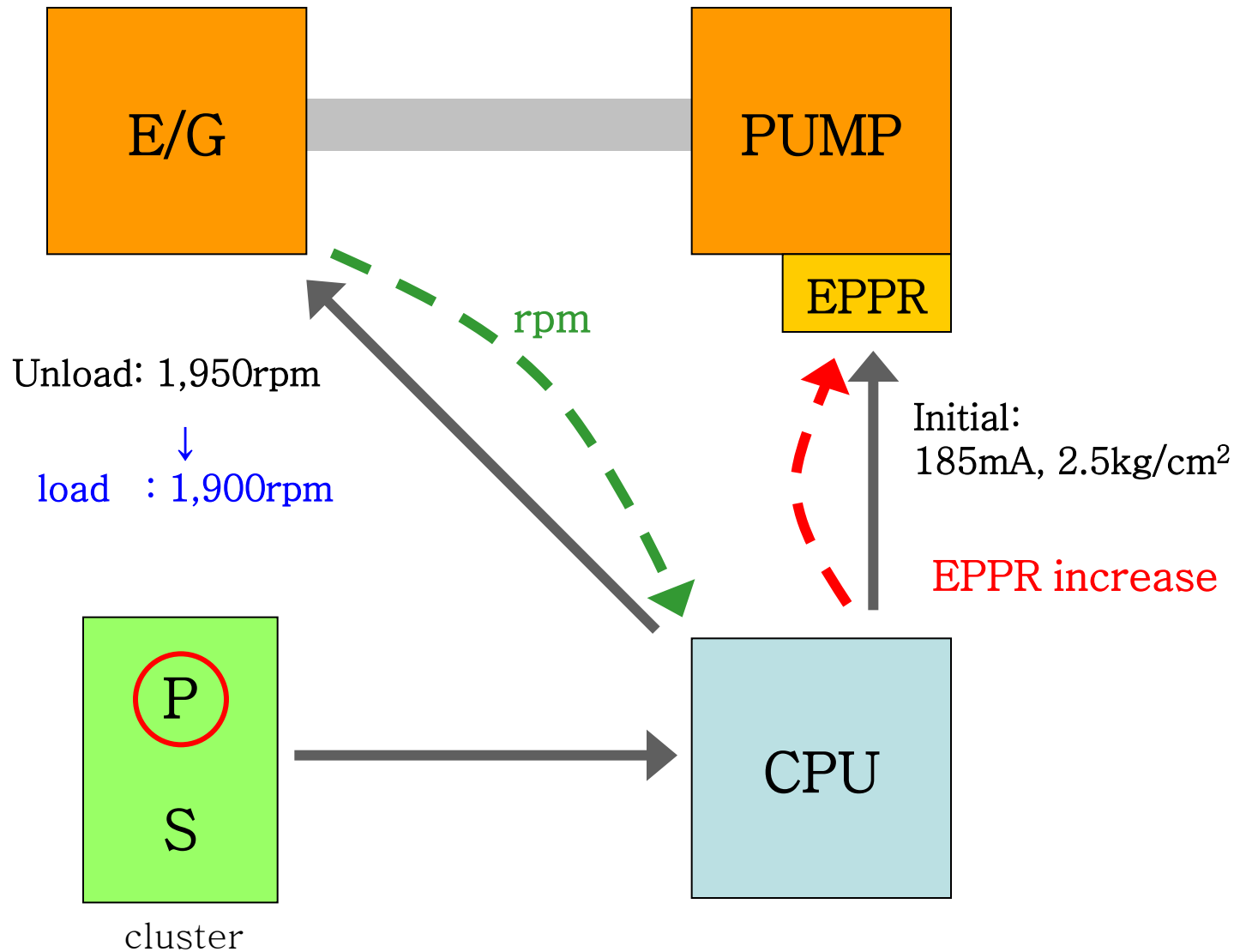
R290LC-9

Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm ²)	Current (mA)	Pressure (kgf/cm ²)
P	Heavy duty power	1850±50	1800±50	1850±50	1800±50	250±30	5	160±30	0
S	Standard power	1750±50	1700±50	1750±50	1700±50	335±30	10±3	225±30	4±3
E	Economy operation	1600±50	1700±50	1600±50	1700±50	400±30	15±3	330±30	9±3



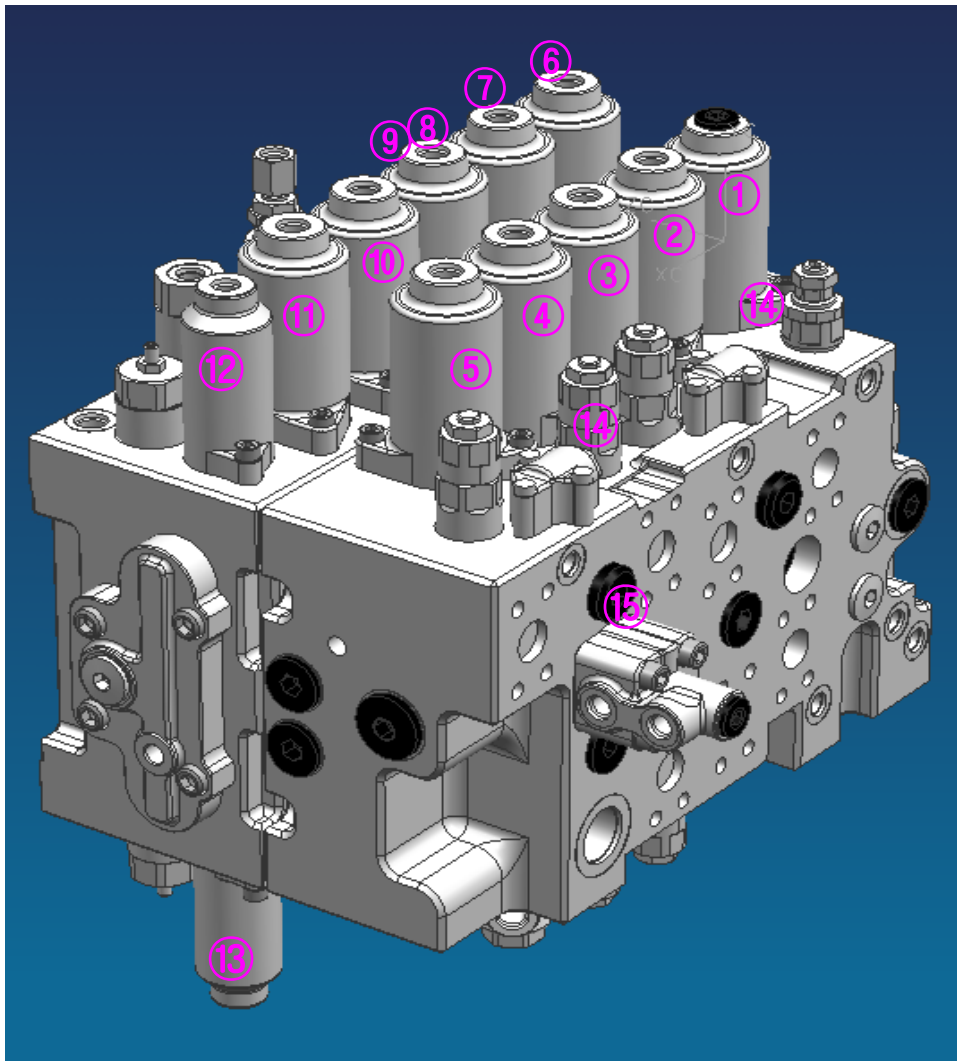
R210LC-9 P-Q curve



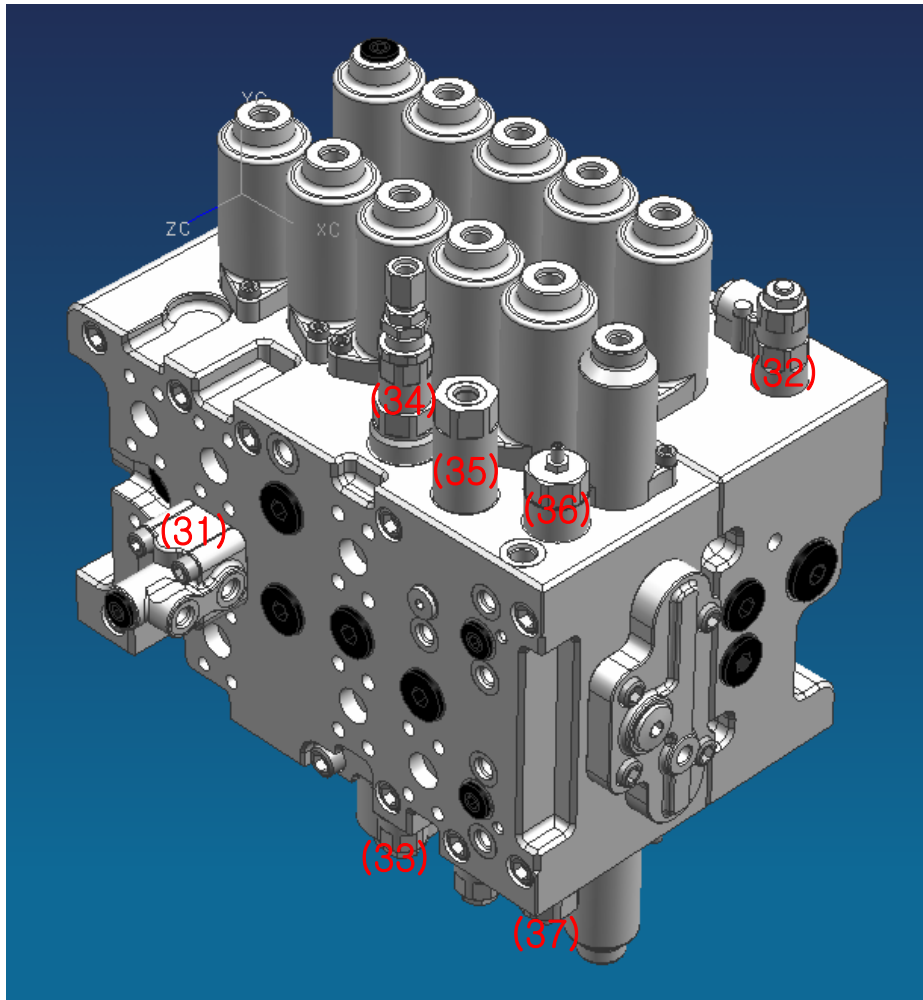


4. MCV

4-1. Spool Position-1



- ① TRAVEL STRAIGHT SPOOL
- ② TRAVEL LIFT SPOOL
- ③ BOOM-1 SPOOL
- ④ BUCKET SPOOL
- ⑤ ARM-2 SPOOL
- ⑥ TRAVEL RIGHT
- ⑦ SWING SPOOL
- ⑧ SWING PRIORITY SPOOL
- ⑨ BOOM 2 SPOOL
- ⑩ OPTION SPOOL
- ⑪ ARM 1 SPOOL
- ⑫ BYPASS CUT SPOOL
- ⑬ BYPASS CUT SPOOL
- ⑭ HOLDING VALVE
- ⑮ ARM2 LOGIC VALVE



(31) Swing Logic Valve

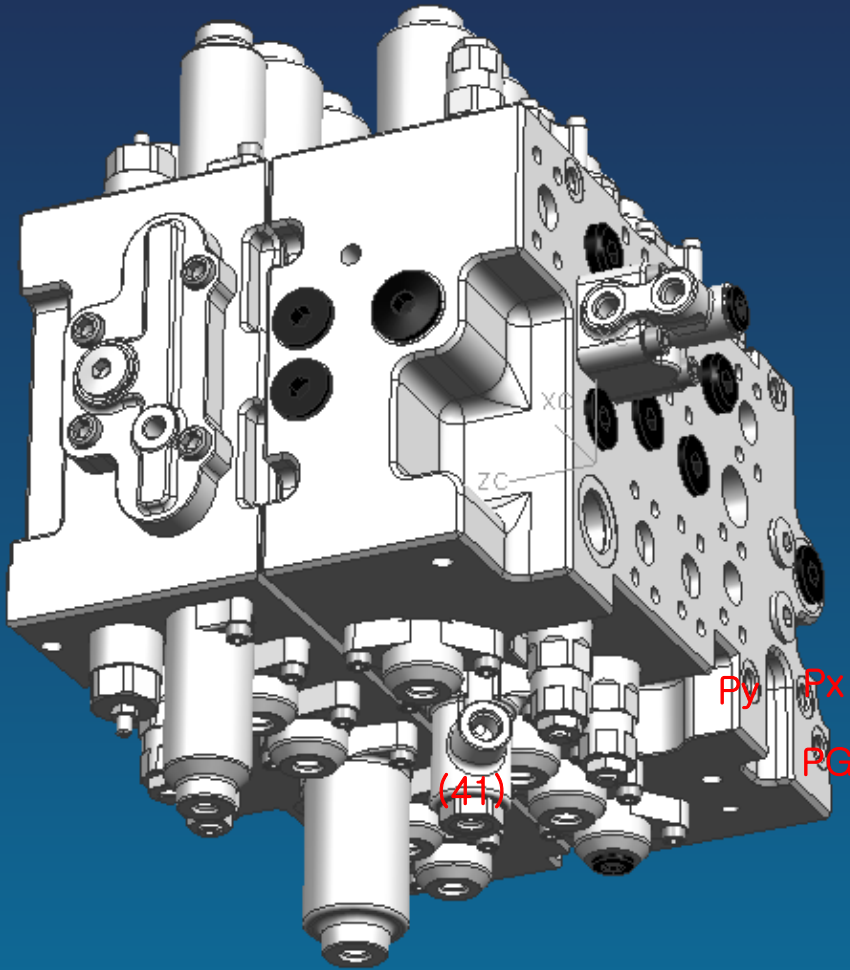
(32) Arm-Port Relief Valve

(37)(36) Posi-Nega Valve

(35) Arm Logic Valve

(34) 2-Stage Option Port Relief Valve

(33) Option Port Relief Valve



Px : Attachment Auto Idle Switch

Py : Travel Auto Idle Switch

(41) : Bucket Limit Stroke

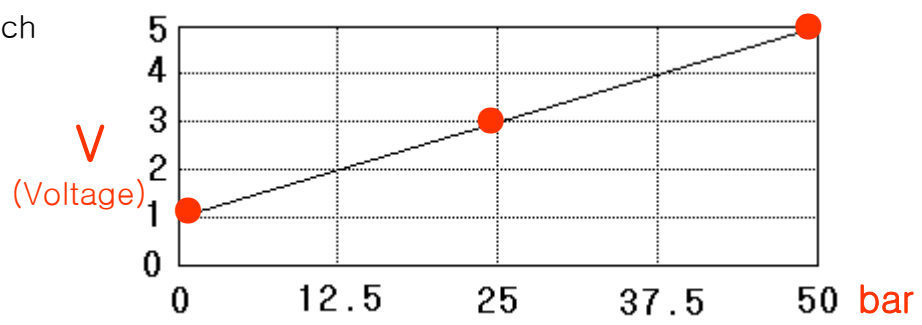


4-5. Pressure Sensor Specification

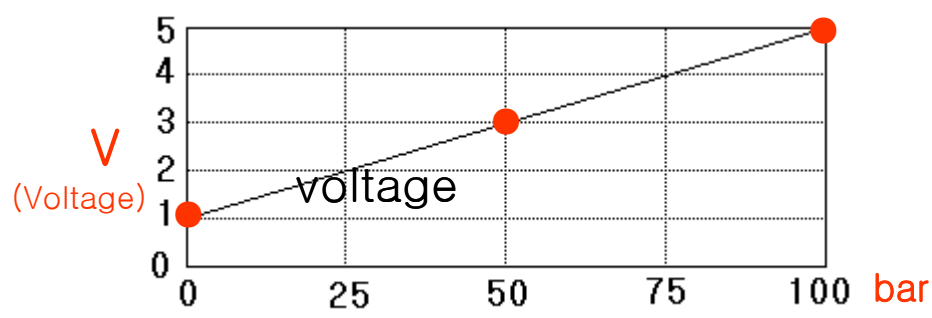
(Output Signal vs Pressure)

(Electrical Signal from Pressure Switch to CPU)

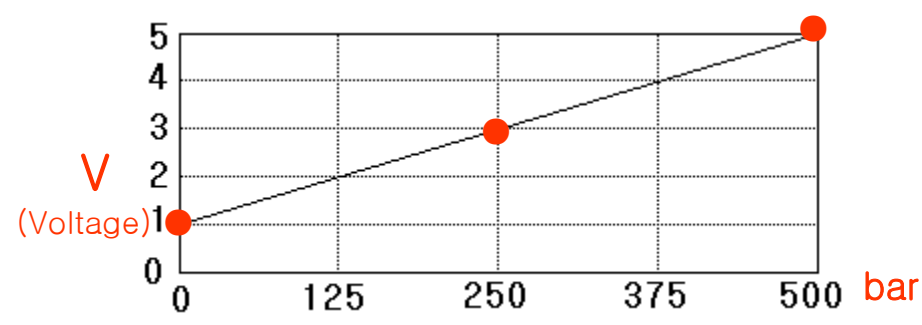
50 bar Pressure Sensor
(P/NO : 31Q8-40520)



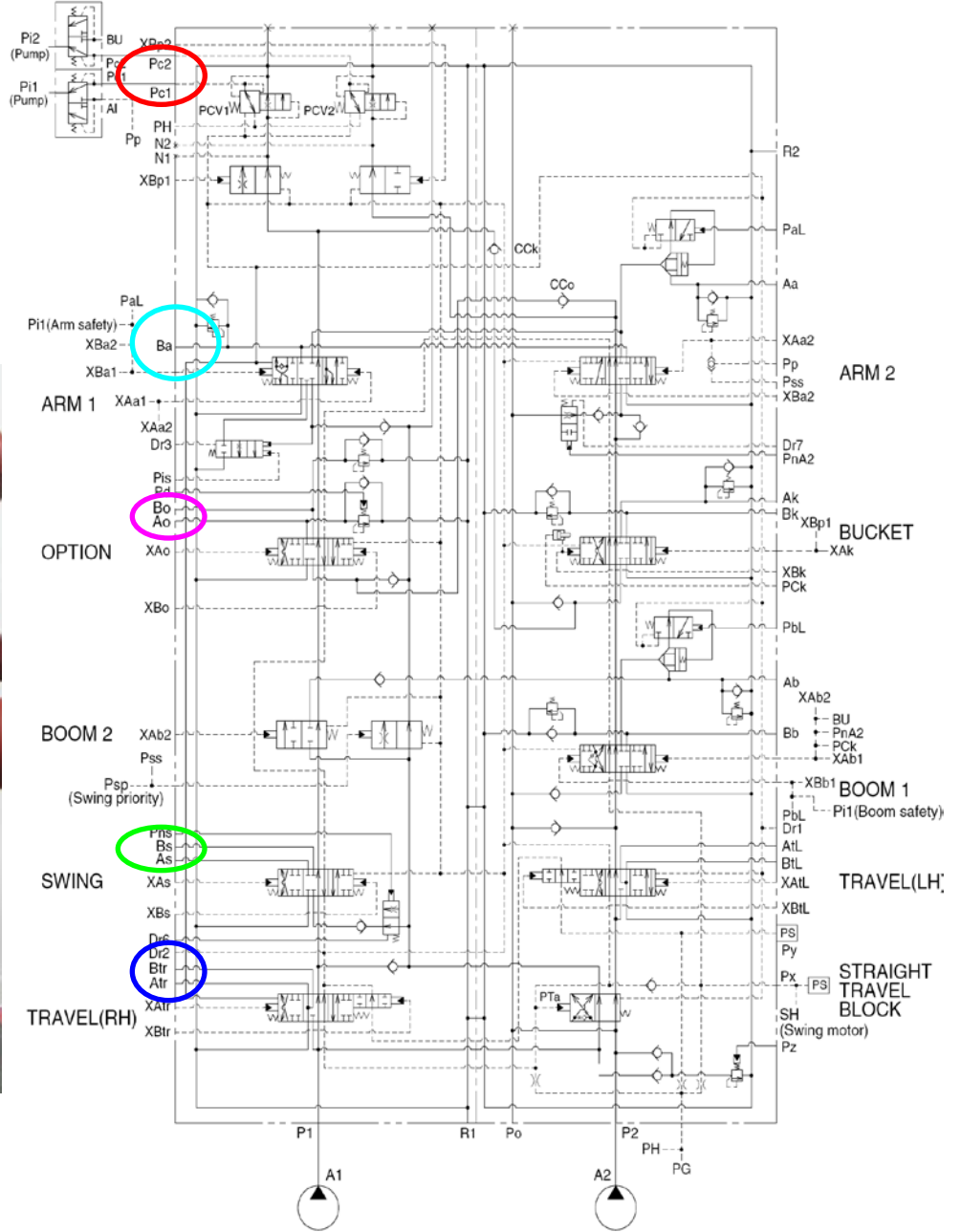
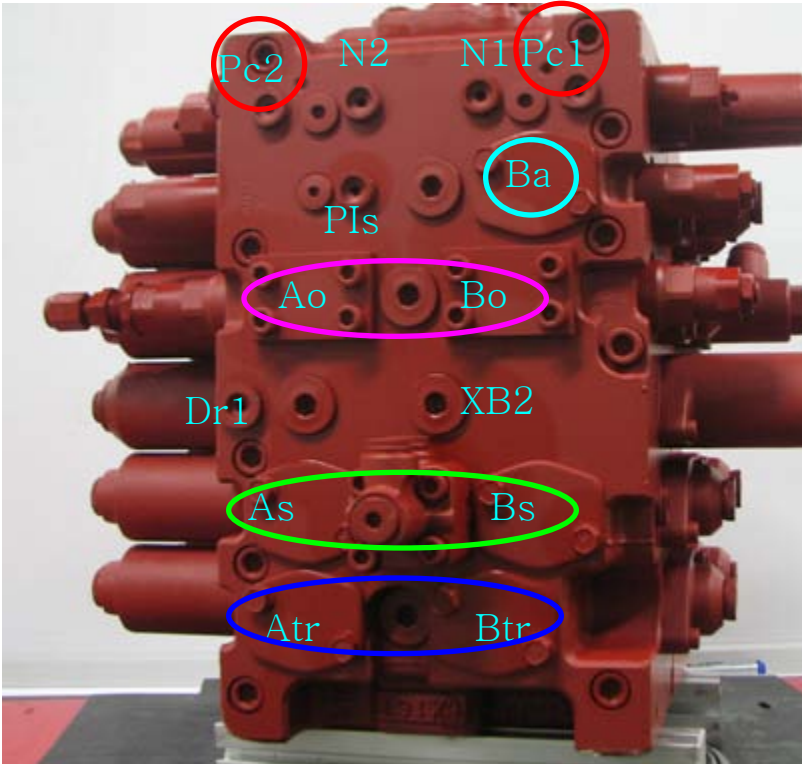
100 bar Pressure Sensor
(P/NO : 31Q8-40510)



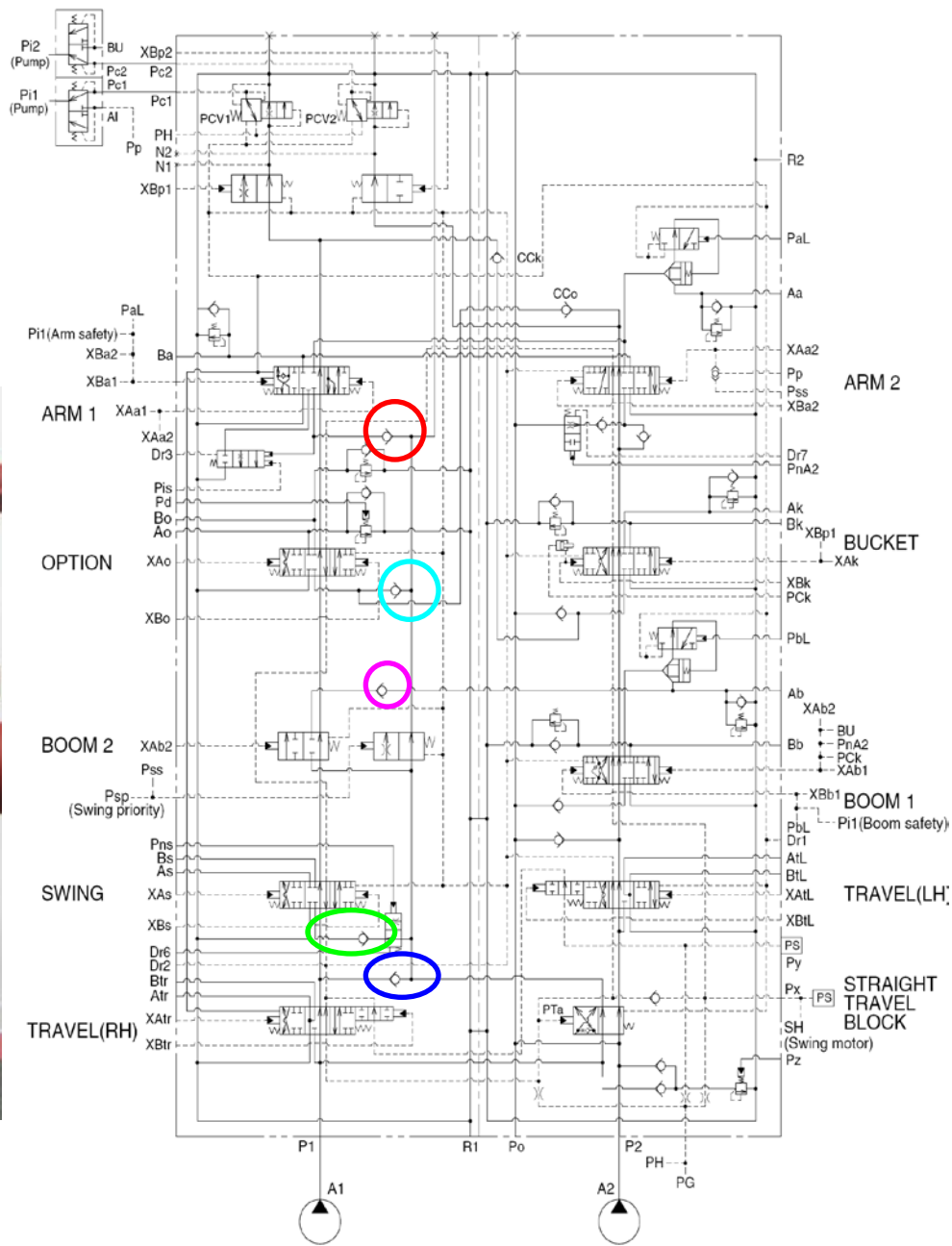
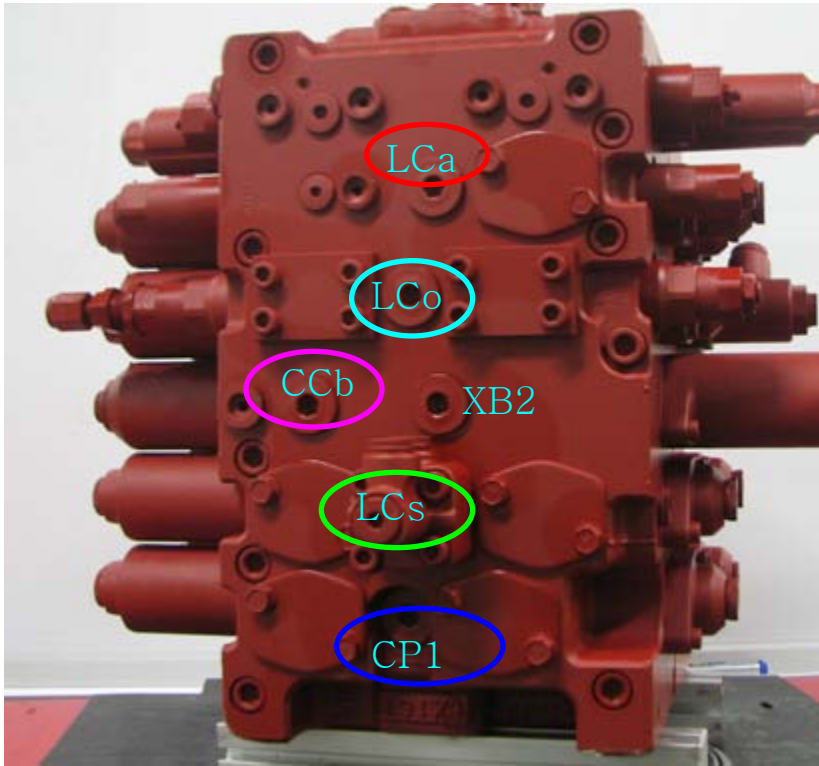
500 bar Pressure Sensor
(P/NO : 31Q8-40500)



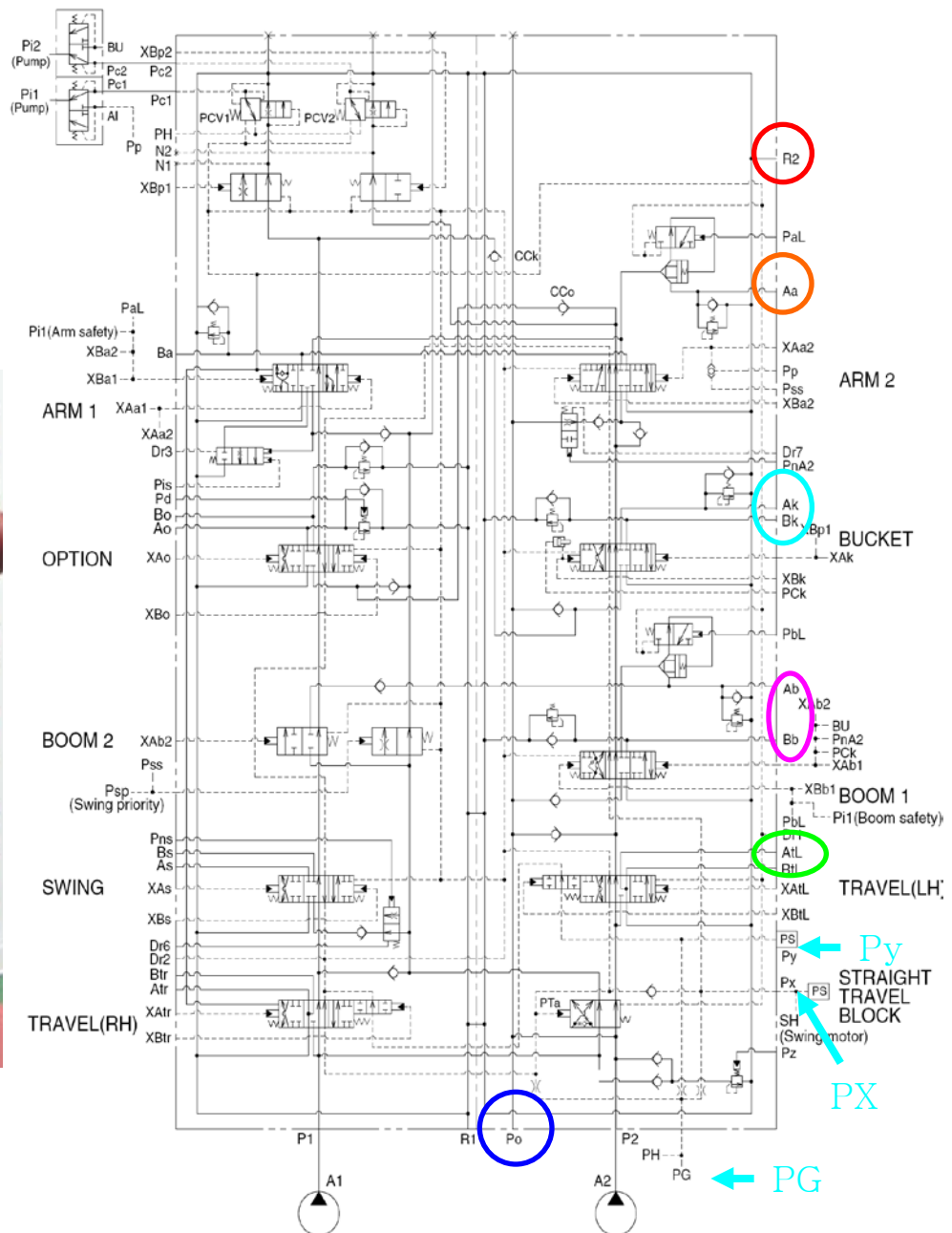
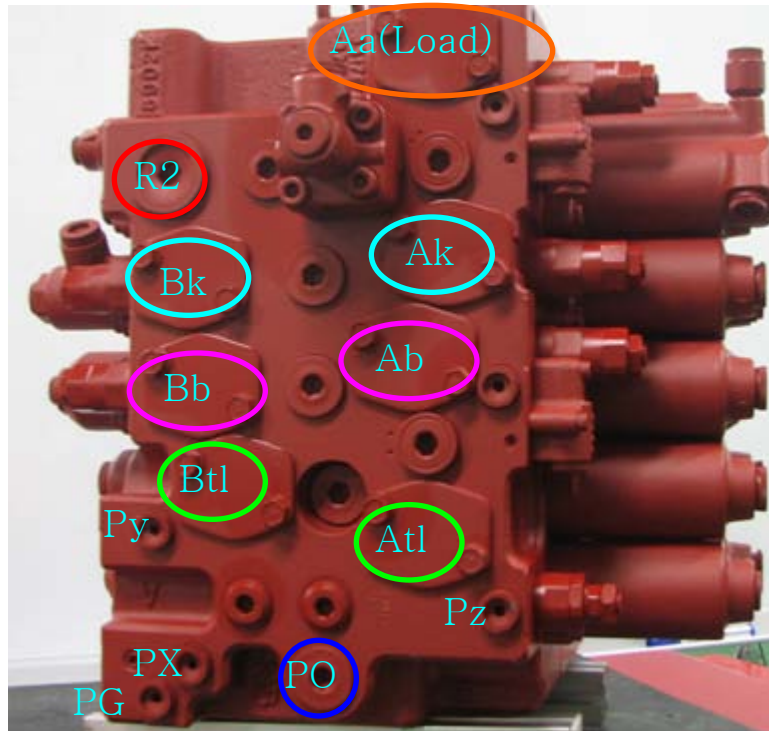
4-6. Main Port-1



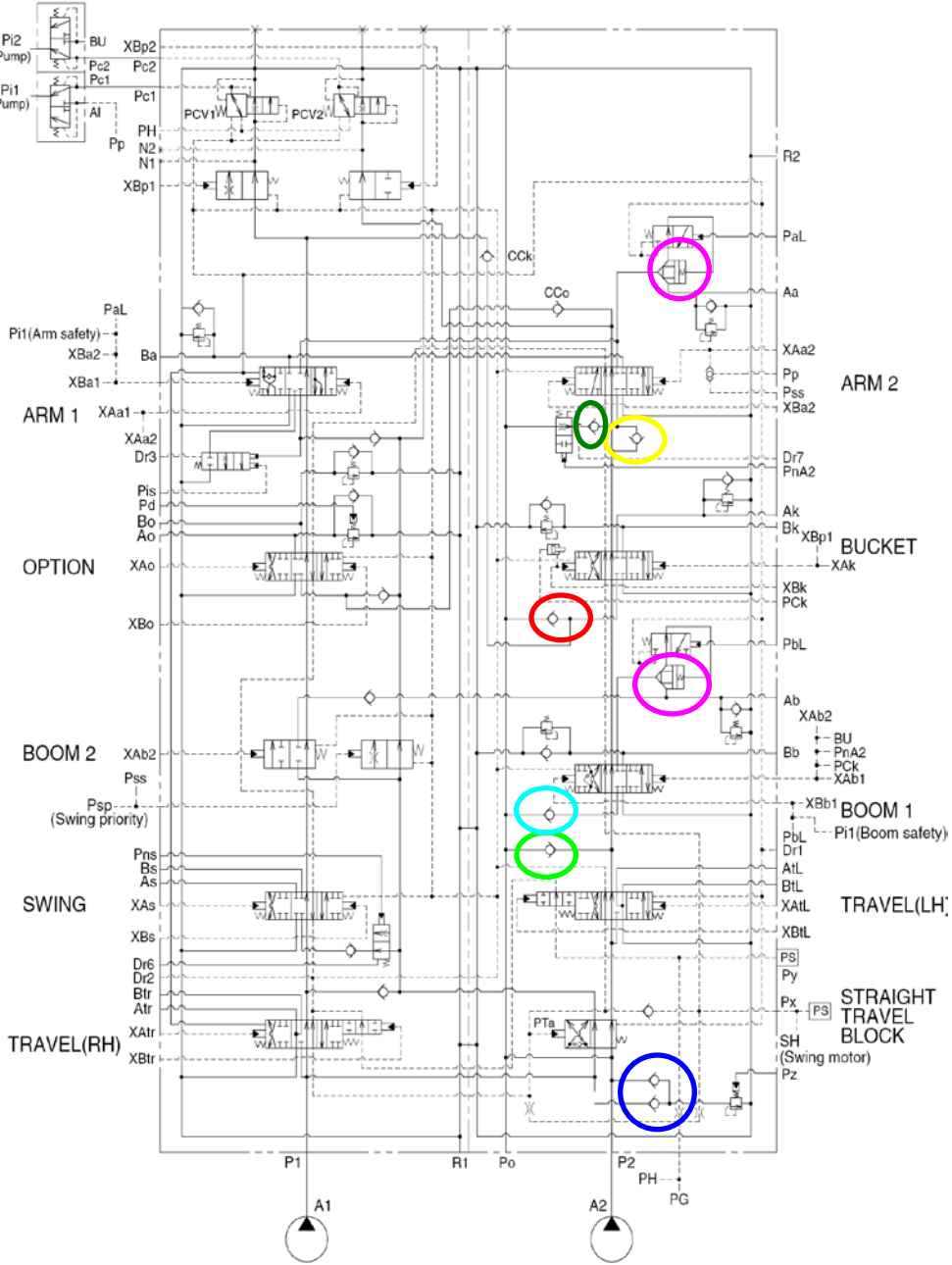
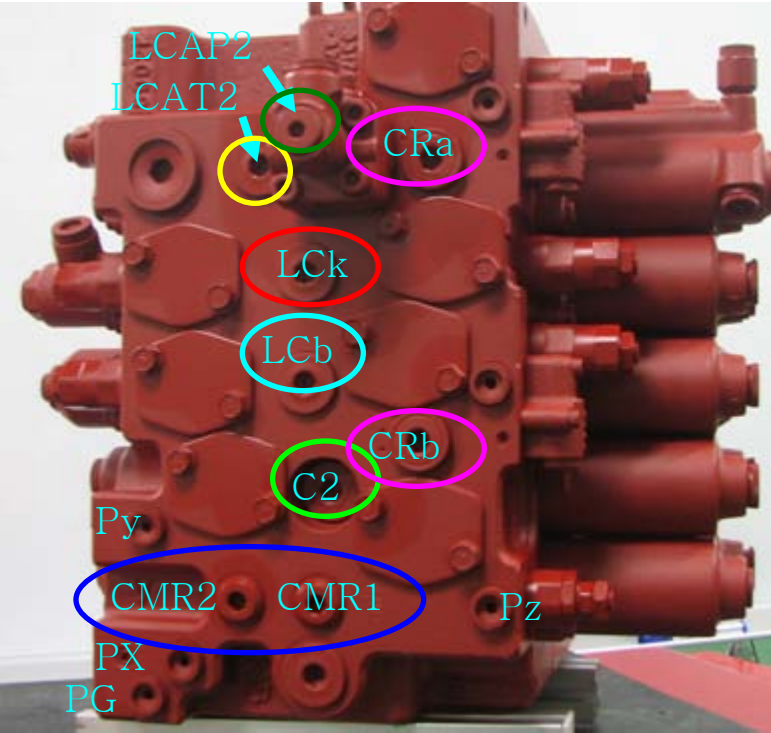
4-7. Check Valve Position-1



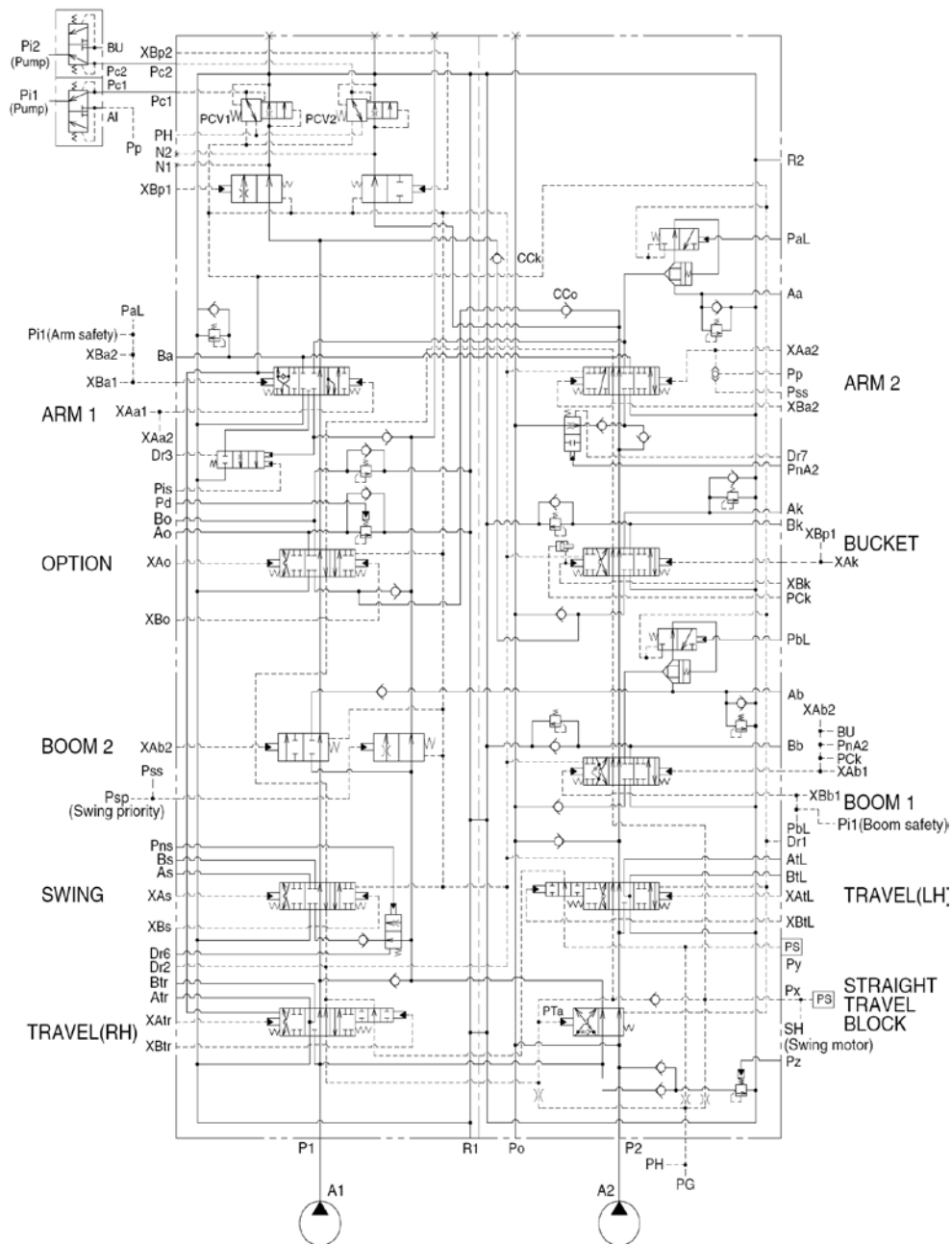
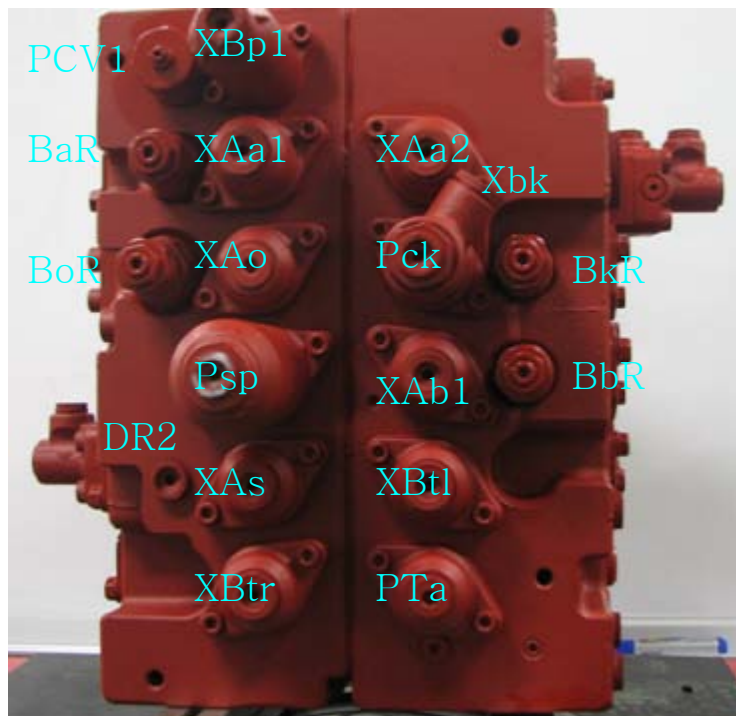
4-8. Main Port-2



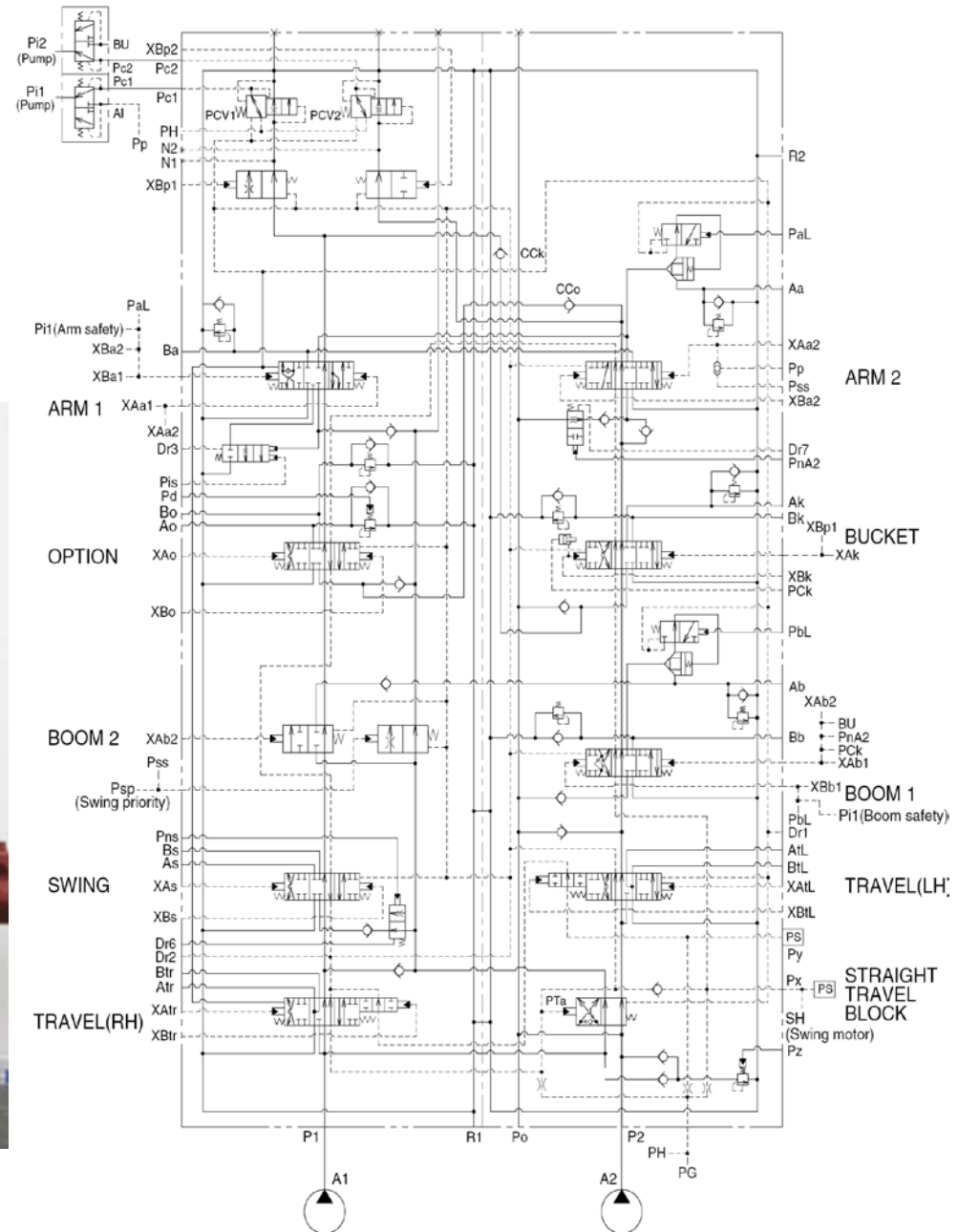
4-9. Check Valve Position-2



4-10. Pilot Port-1

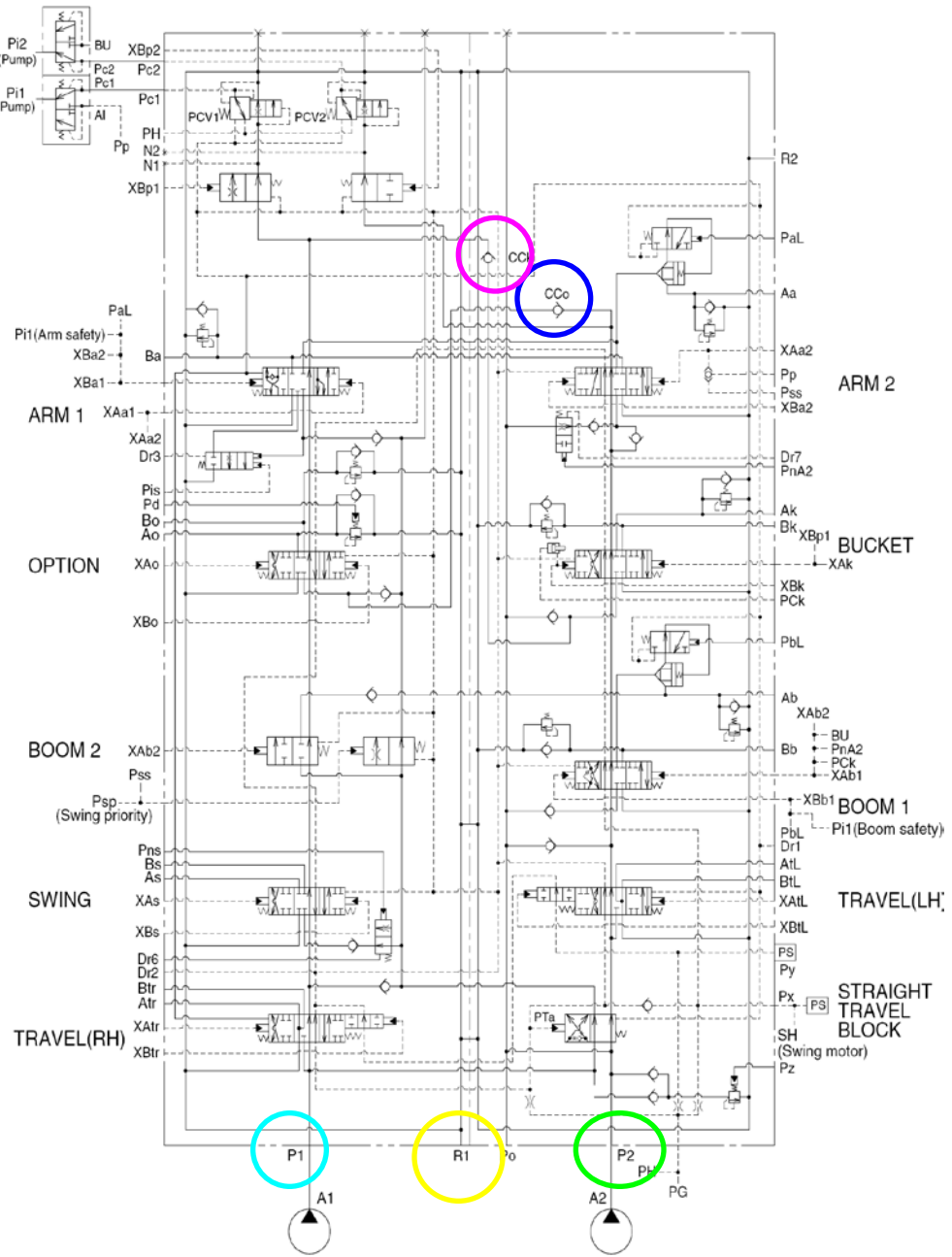
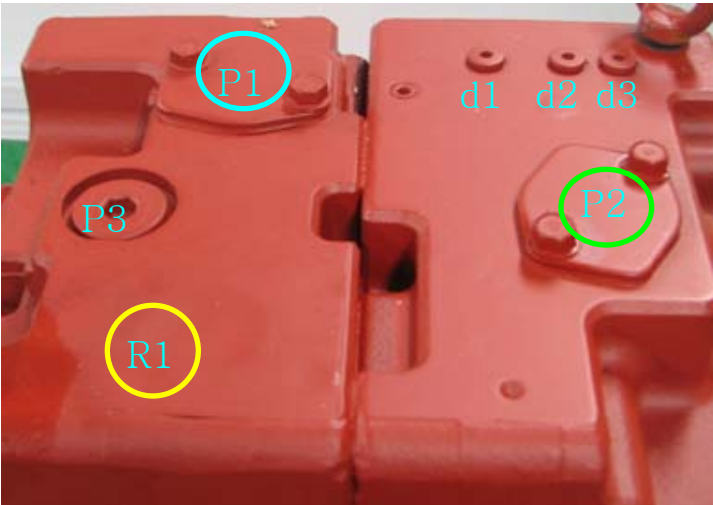


4-11. Pilot Port-2



4-12. P1, P2, R1 Position

P3,P4,P5 -> Plug
d1,d2,d3 -> drain



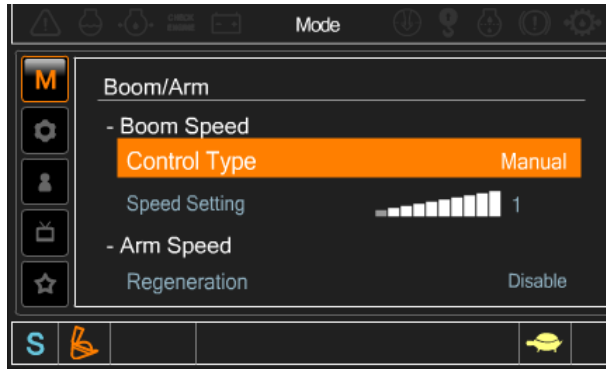
4-13. Port Name

XAttr	Travel right (reverse) pilot port
XBtr	Travel right (forward) pilot port
(XAo)	Optional pilot port
(XB0)	Optional pilot port
XAk	Bucket in pilot port
XBk	Bucket out pilot port
XAb1	Boom up pilot port
XBb1	Boom down pilot port
XAa2	Arm out confluence pilot port
XBa2	Arm in confluence pilot port
XAtL	Travel left (reverse) pilot port
XBtL	Travel left (forward) pilot port
XAs	Swing left pilot port
XBs	Swing right pilot port
XAa1	Arm out pilot port
XBa1	Arm in pilot port
PH	Pilot pressure port
Dr1	Drain port
Atr	Travel motor right side (reverse) port
Btr	Travel motor right side (forward) port
(Ao)	Optional port
(Bo)	Optional port
Ak	Bucket cylinder head side port
Bk	Bucket cylinder rod side port
Ab	Boom cylinder head side port
Bb	Boom cylinder rod side port
AtL	Travel motor left side (reverse) port
BtL	Travel motor left side (forward) port
As	Swing motor left port
Bs	Swing motor right port
Aa	Arm cylinder rod side port
Ba	Arm cylinder head side port
P1	Pump port (P1 side)
P2	Pump port (P2 side)

Px	Pressure port for attachment
Py	Pressure port for travel
Pz	Main relief pilot pressure port
PG	Pilot pressure port
Dr2	Drain port
Dr3	Drain port
Dr6	Drain port
Dr7	Drain port
Pns	Swing logic valve pilot port
PaL	Lock valve pilot port (arm rod side)
PbL	Lock valve pilot port (boom head side)
XAb2	Boom up confluence pilot port
Psp	Swing priority pilot port
XBp1	Bypass cut spool pilot port (P1 side)
(XBp2)	Bypass cut spool pilot port (P2 side)
(Pd)	Breaker high pressure pilot lamp
Pc1	Posi-nega pressure port (P1 side)
Pc2	Posi-nega pressure port (P2 side)
PCk	Bucket in stroke limiter pilot port
Pis	Arm regeneration cut pilot port
N1	Arm1 Nega-con pressure port
N2	Boom1 Nega-con pressure port
PnA2	Arm2 logic valve pilot port
Pss	Arm in or swing pilot signal
Pp	Swing pilot signal
R1	Return port
R2	Make up port for swing

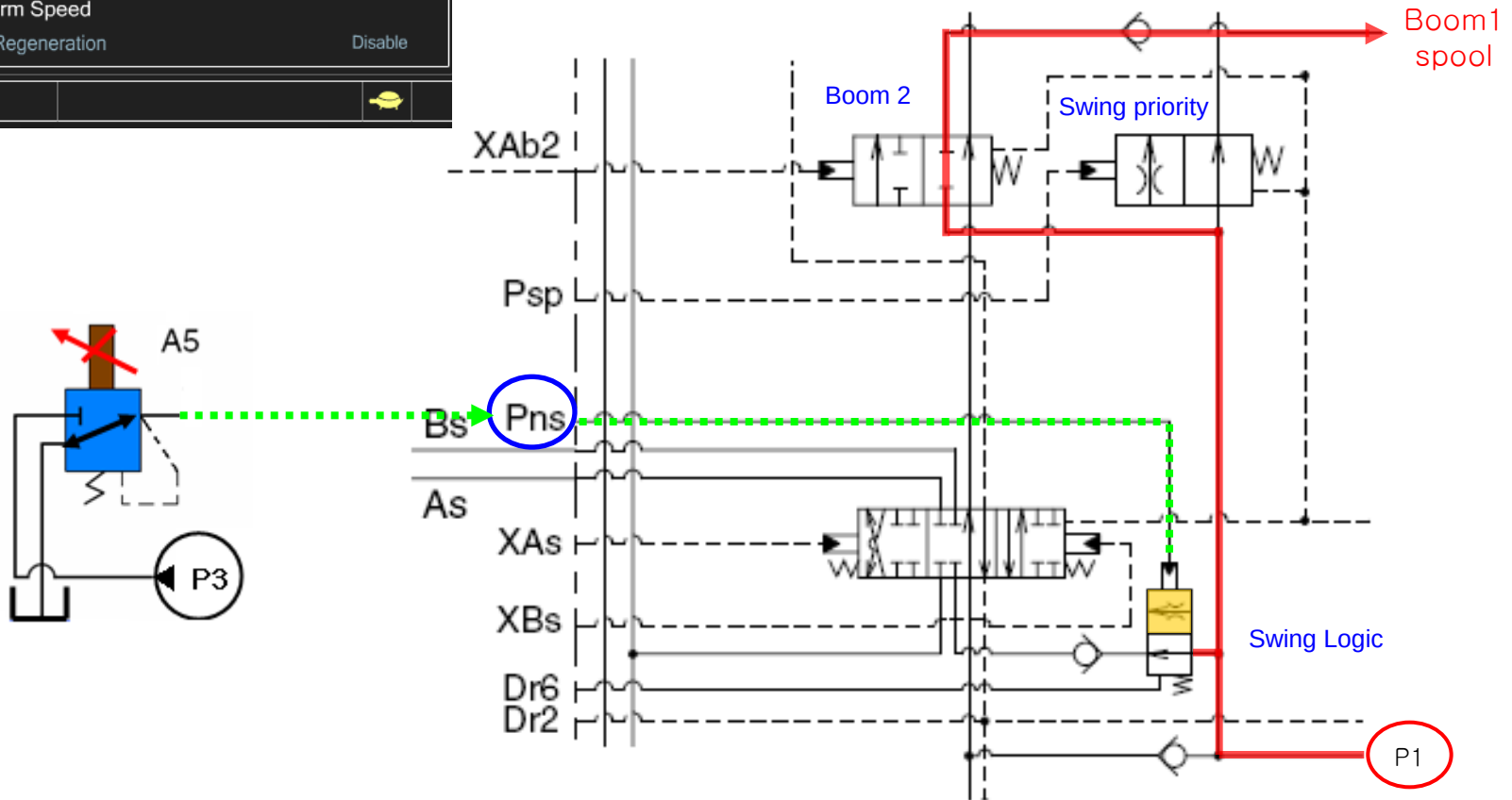
6. Boom Priority Function (Swing Logic Valve)

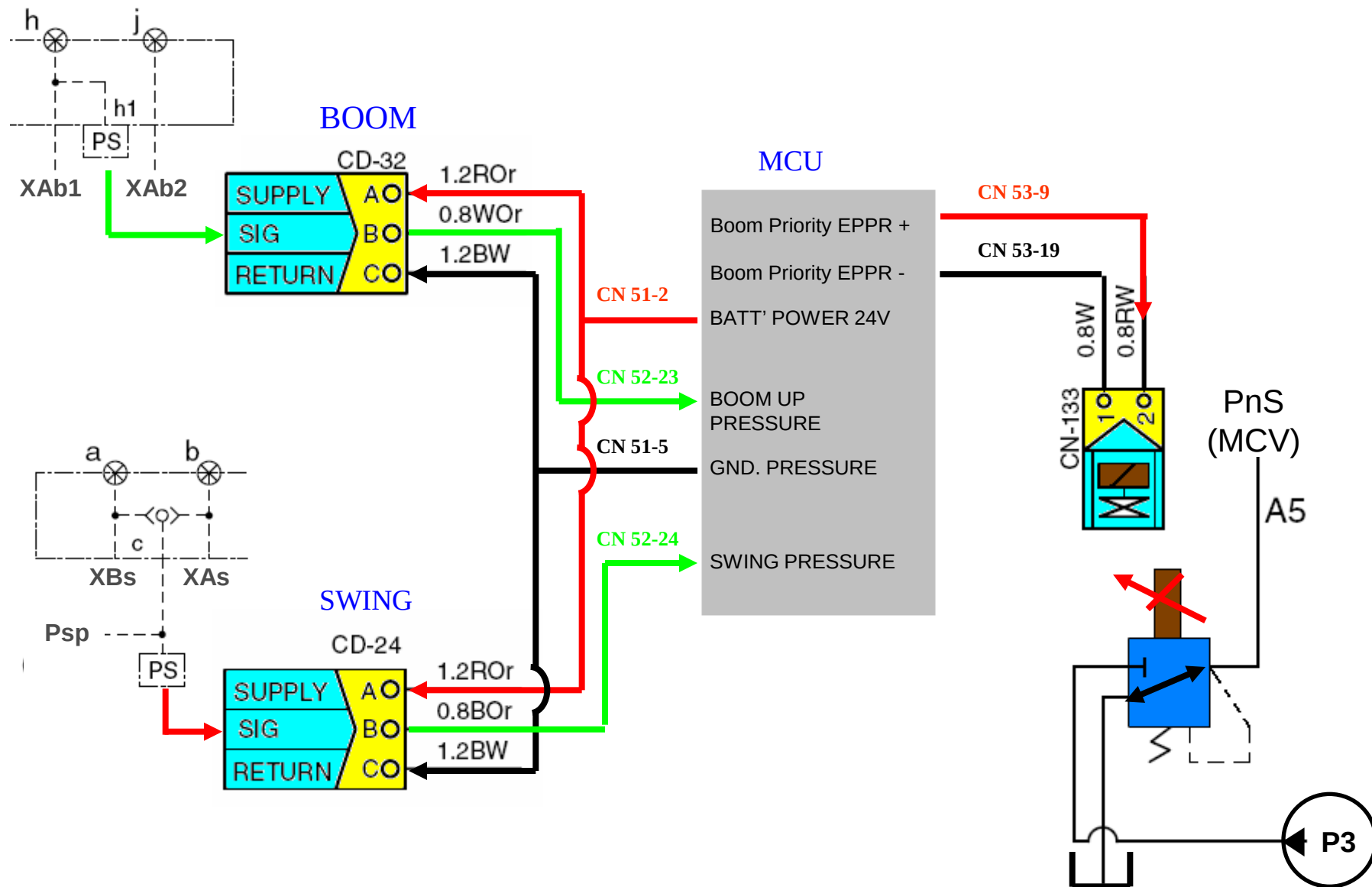
Swing logic valve is for boom priority when Boom up & Swing are operated simultaneously. The swing logic valve does not move in single swing operation.



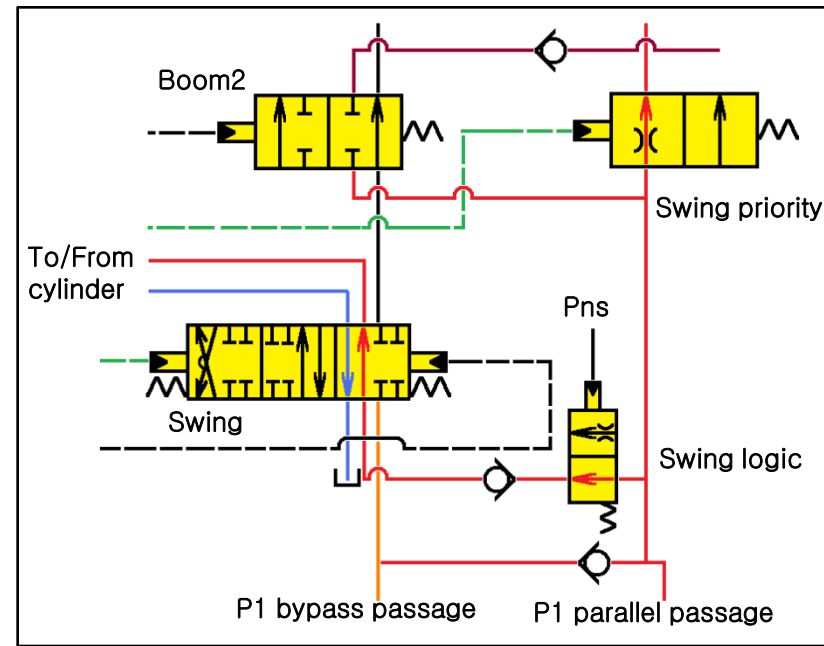
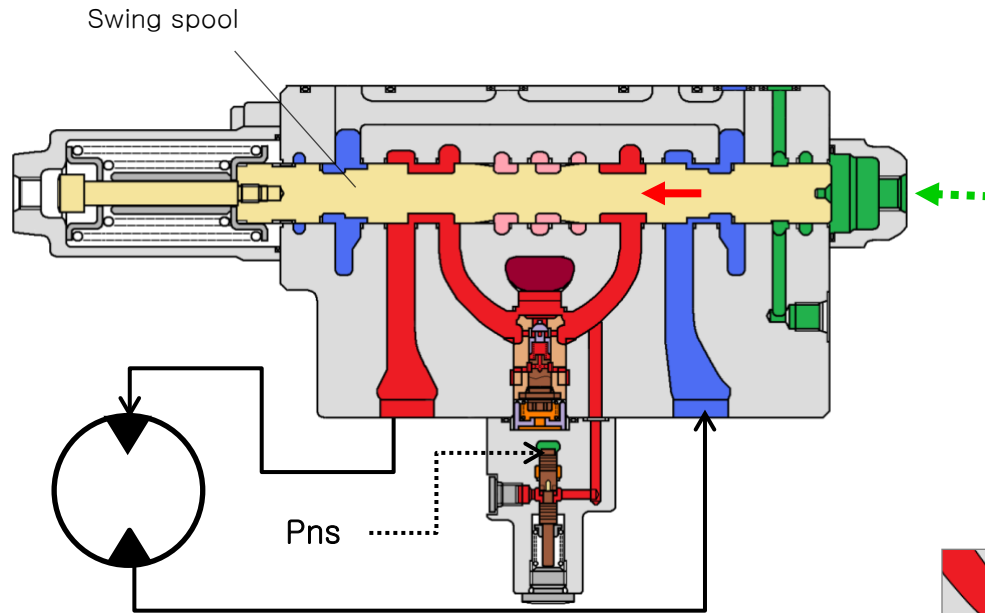
Manual : Fixed boom priority function

Auto : Pressure sensors sense the pilot pressure of boom up & swing. MCU sends the current to boom priority EPPR valve. Then, swing logic spool moves according to boom priority pilot pressure



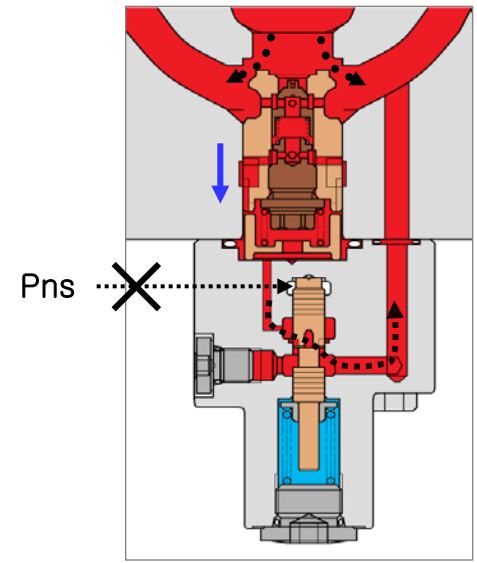
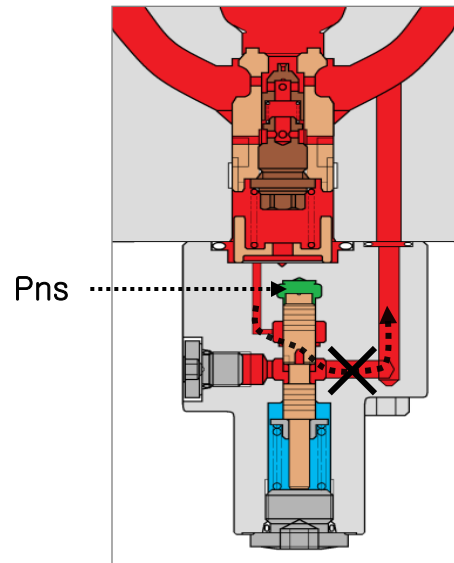


6-2. Swing logic valve operation



When boom priority pressure(Pns) is applied to swing logic valve, P1 parallel passage toward swing spool is restricted.

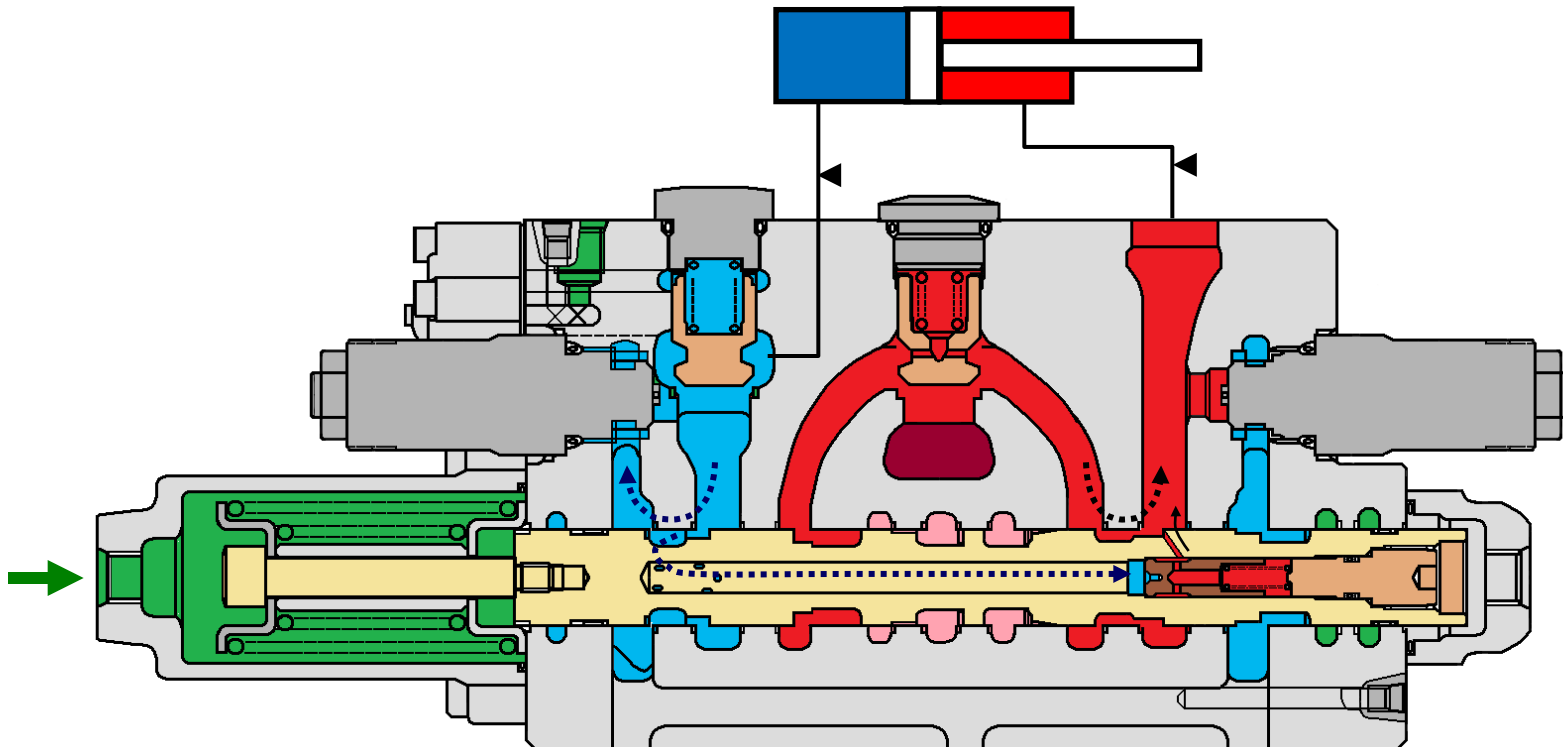
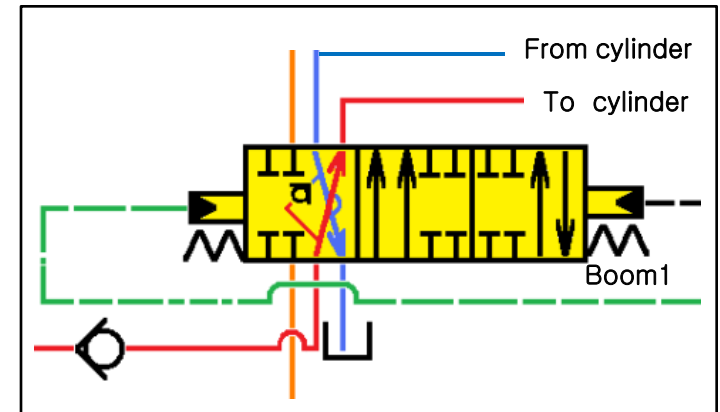
So, boom up operation has priority over swing operation.



7. Boom down operation

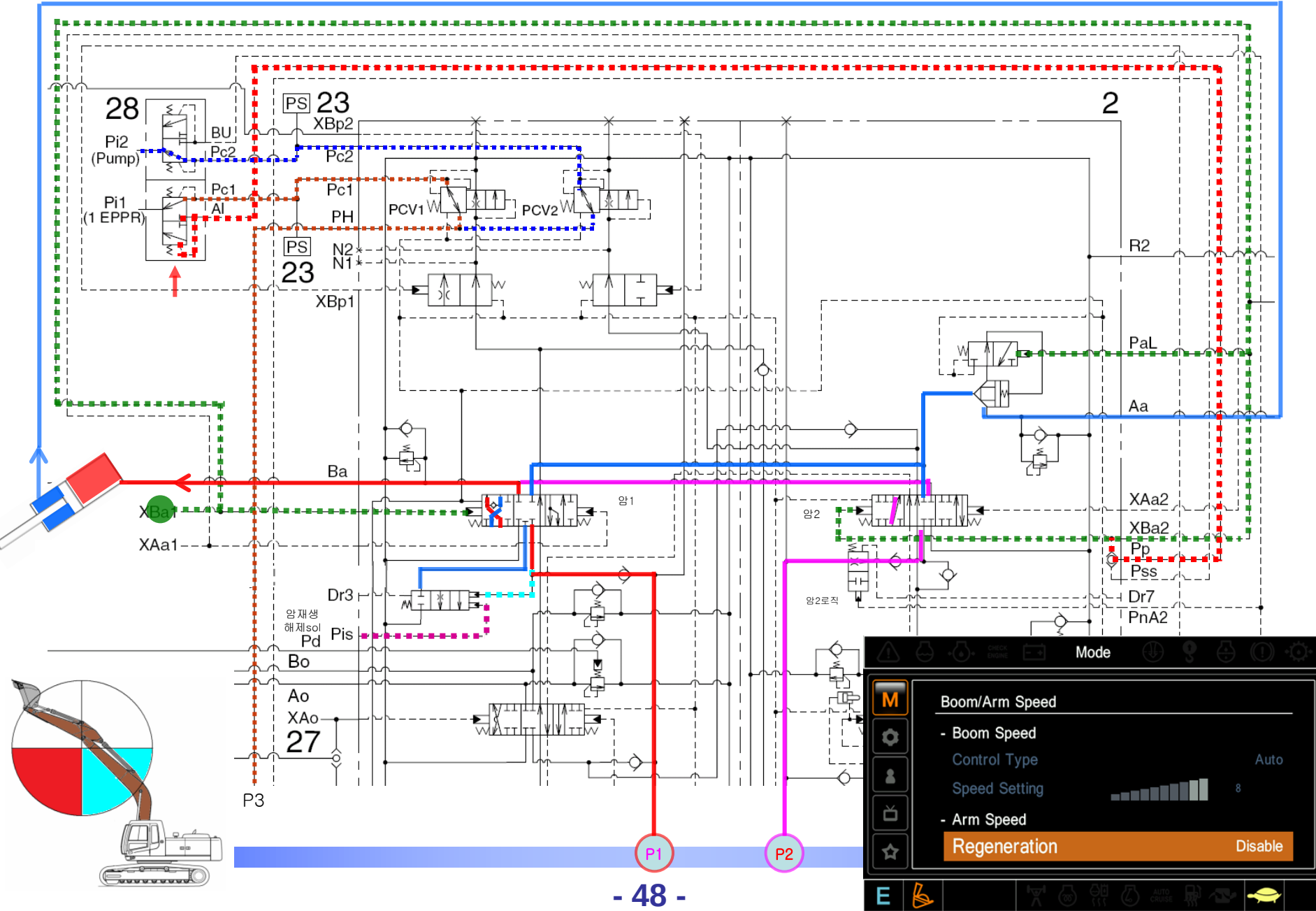
Check Valve is installed inside the spool for make up function (Boom Regeneration)

Cavitation is prevented by supplying the return oil from the check valve to supply line when the speed of boom down is faster than that by the oil supplied to large chamber of boom cylinder



8. Arm in Operation

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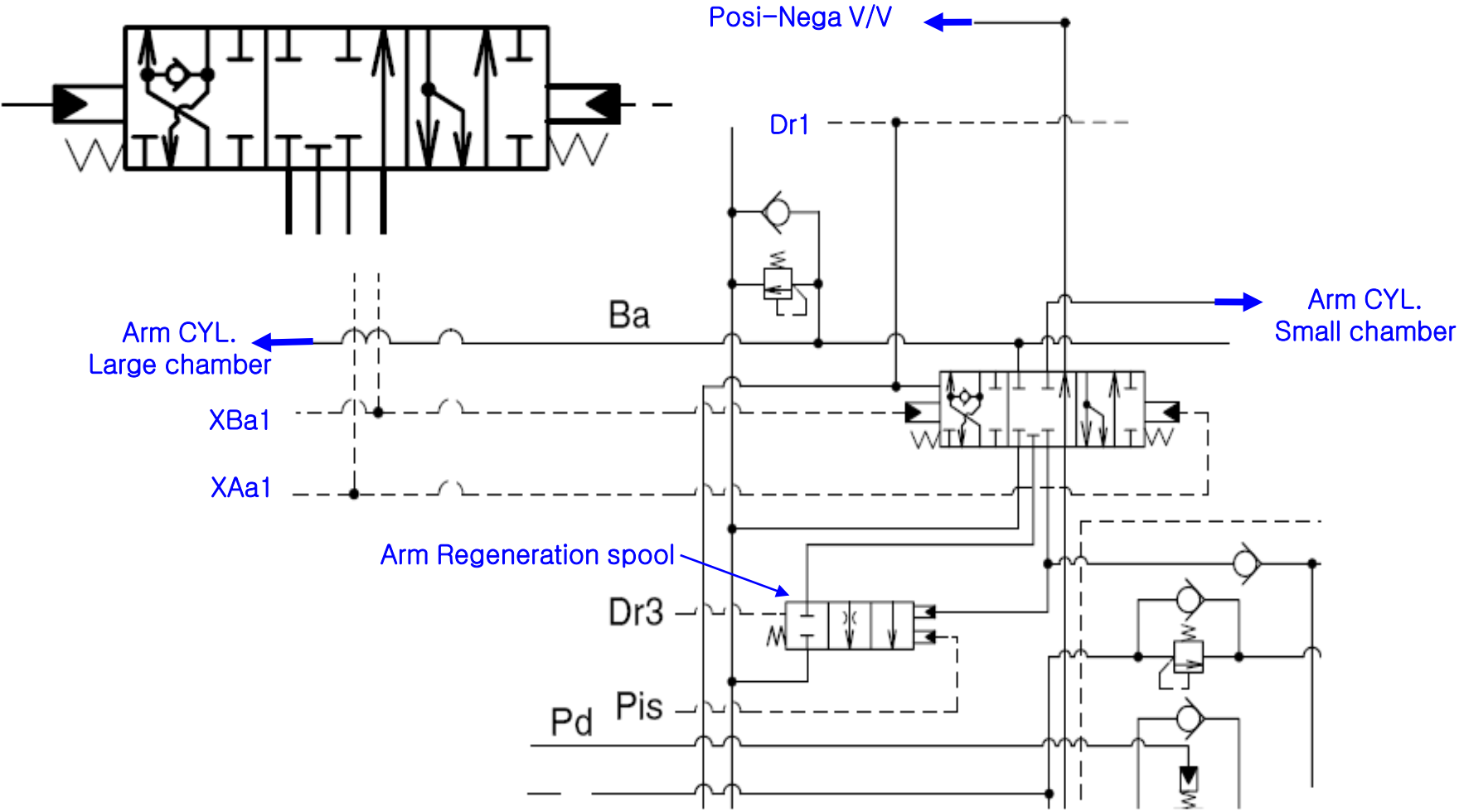


9. Arm regeneration

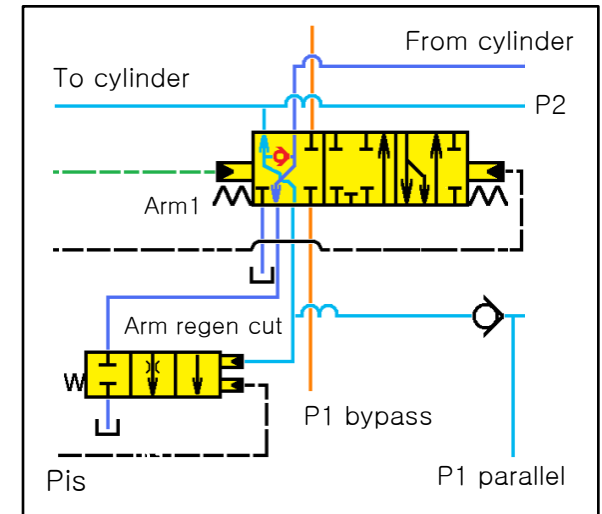
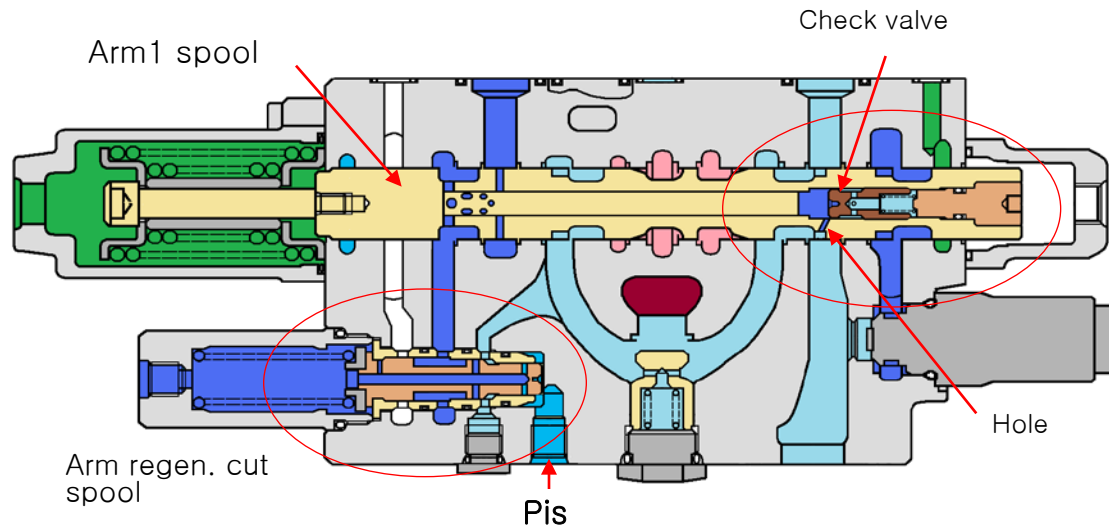
Arm speed control in the cluster

On : Power of A4 solenoid will be off. So, Arm regeneration will be started when “pis” is given up.

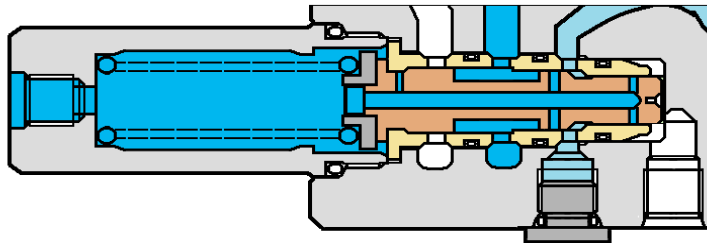
Off : A4 solenoid will be operated. So, Are regeneration will be given up when oil flow to “pis”



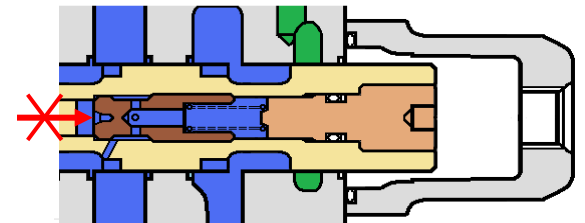
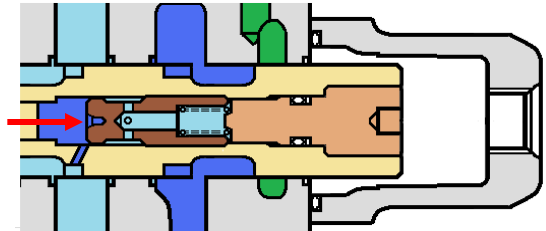
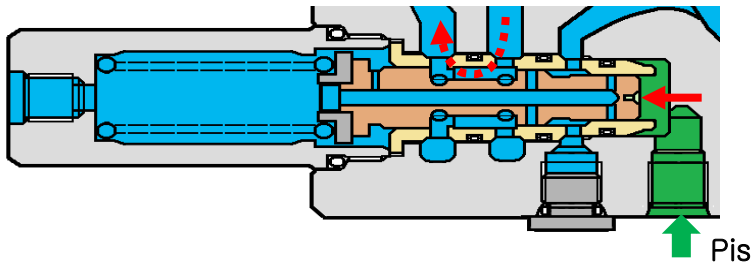
9-1. Arm regeneration operation

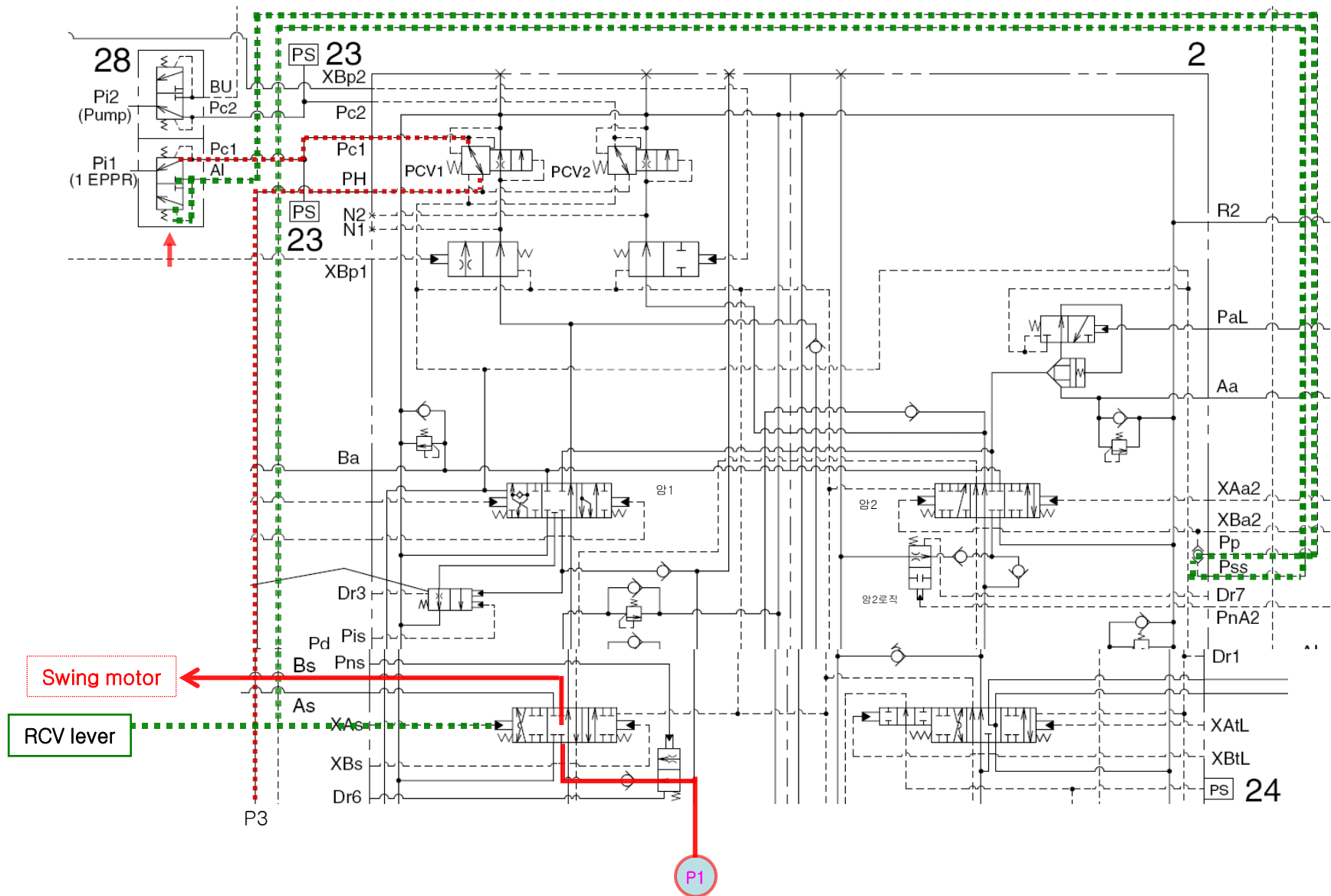


Arm regen.



Arm Regen. cut



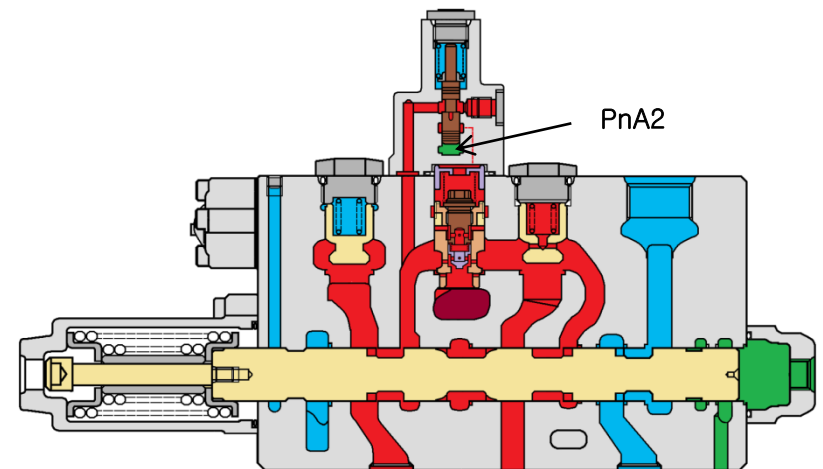
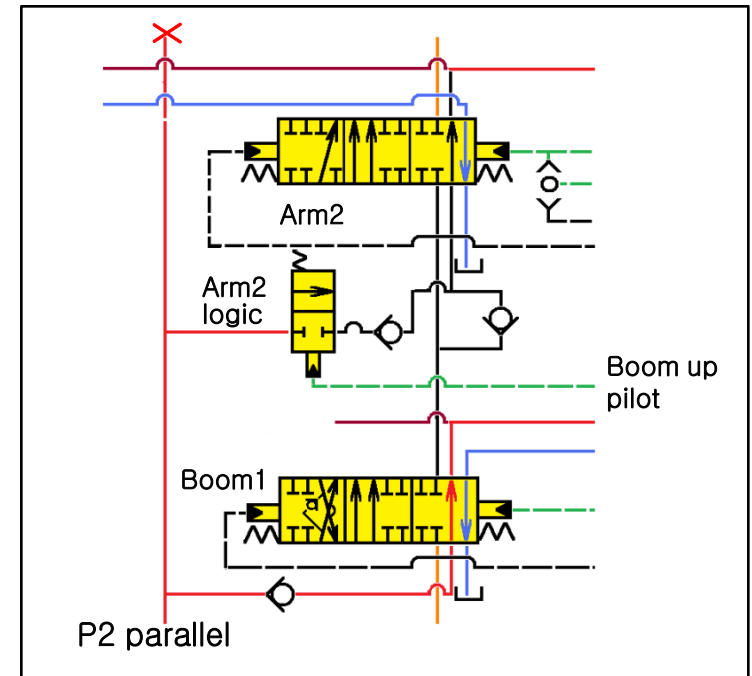
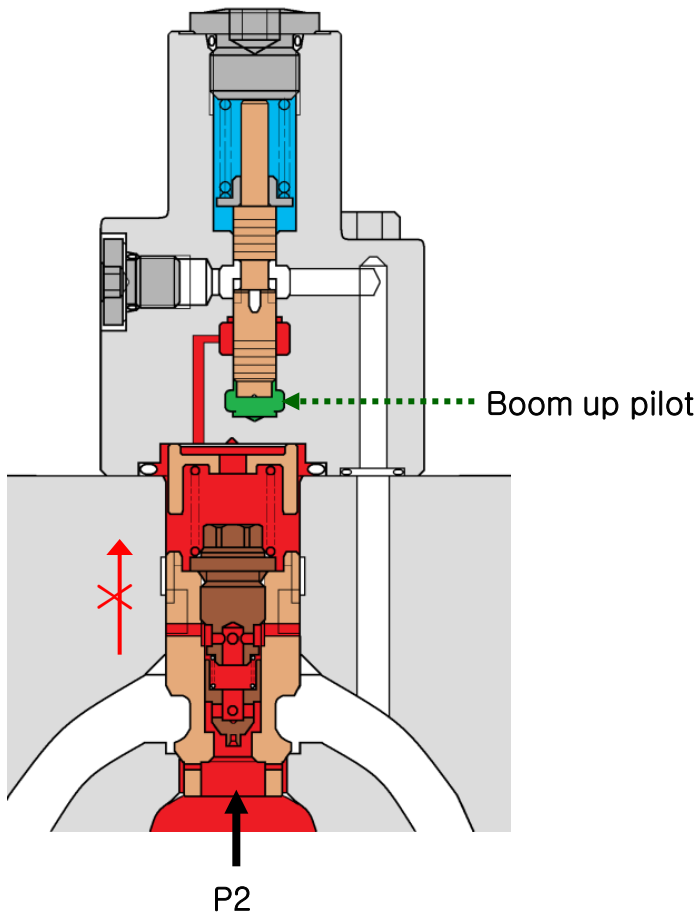




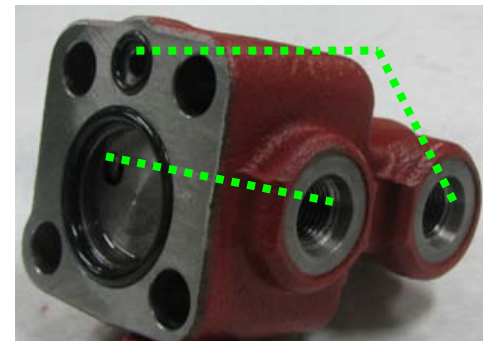
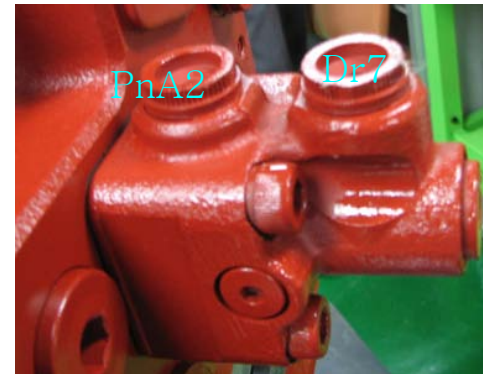
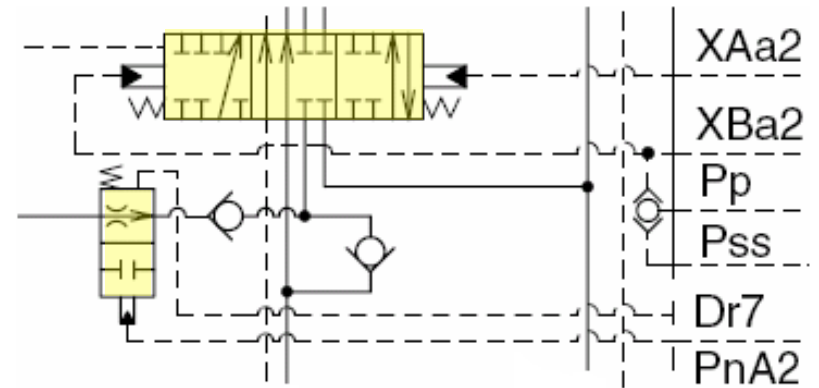
12. Arm 2 Logic Valve

When Boom up is operated, arm2 logic valve blocks the oil flow from P2 pump to the arm cylinder.

Combined operation of boom up and arm

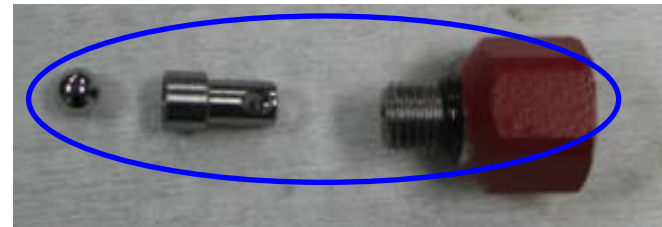
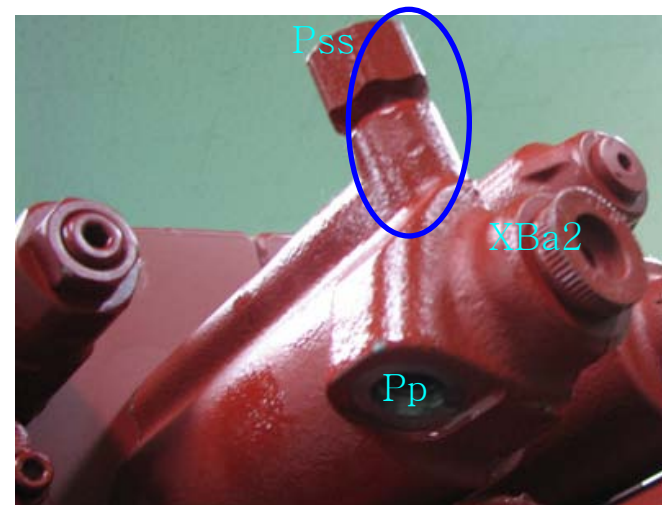
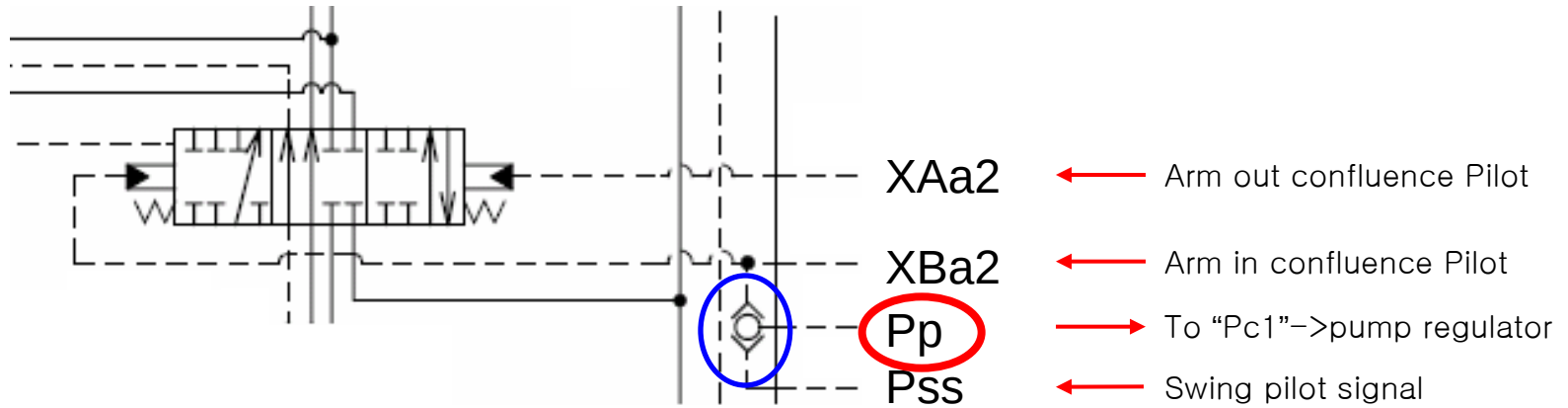


12-1. The Position of Arm 2 Logic Valve



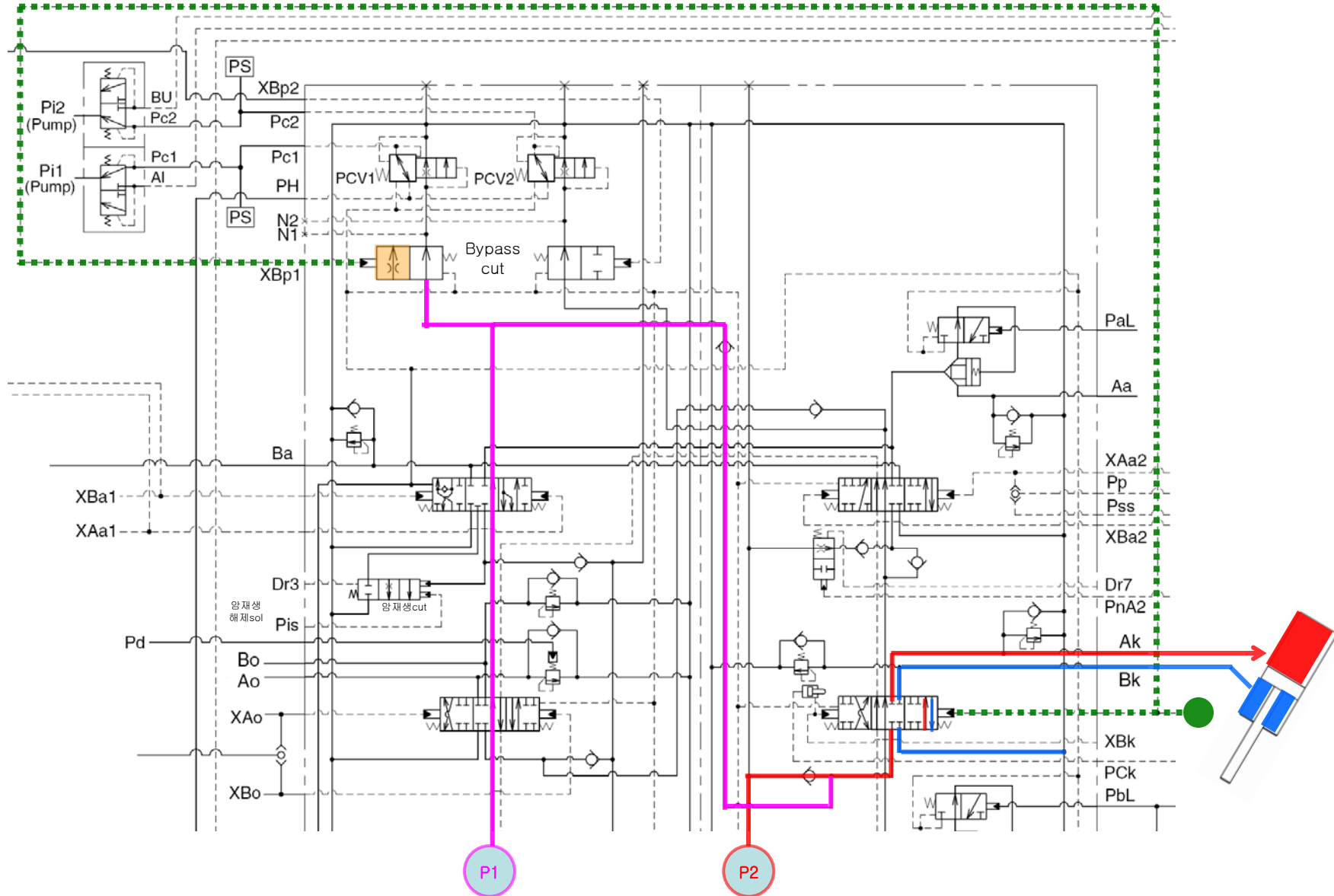
12-2. ARM-2 Spool Pilot Port

When an operator operates Arm in or Swing, it carry out positive control through “Pp”



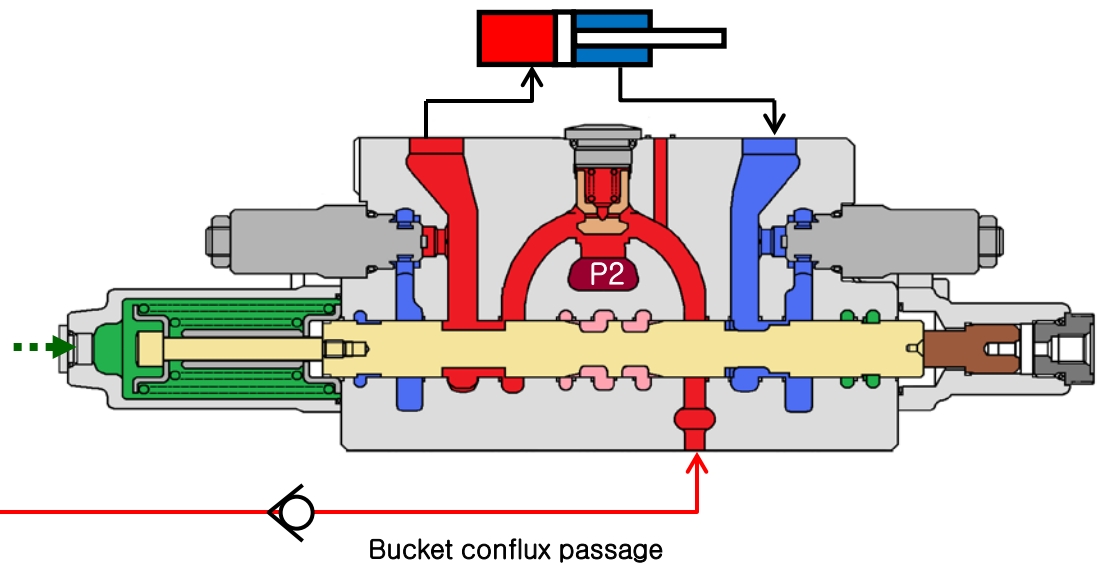
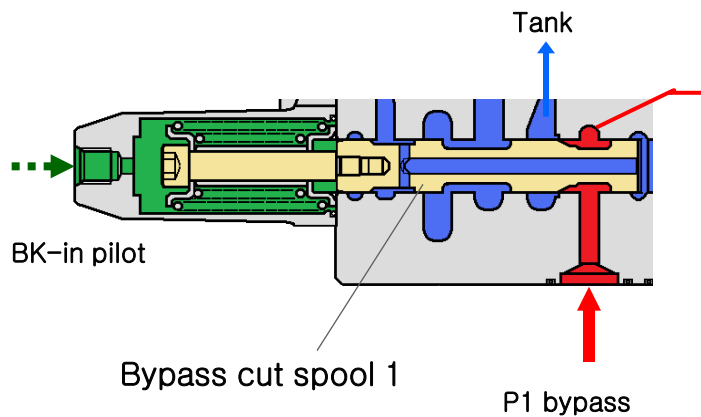
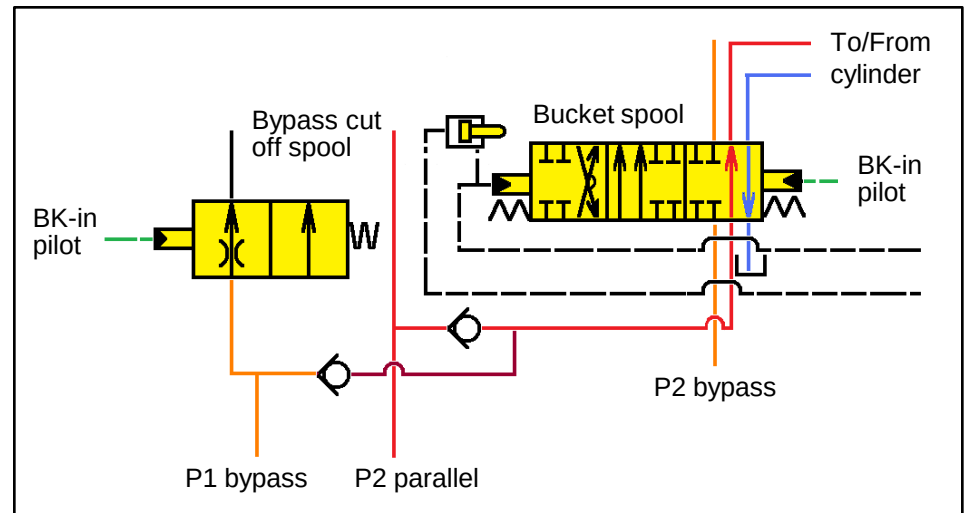
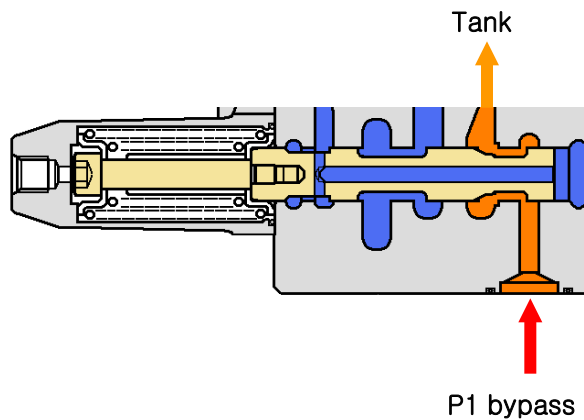
13. Bucket in operation

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13-1. Bucket-In confluence

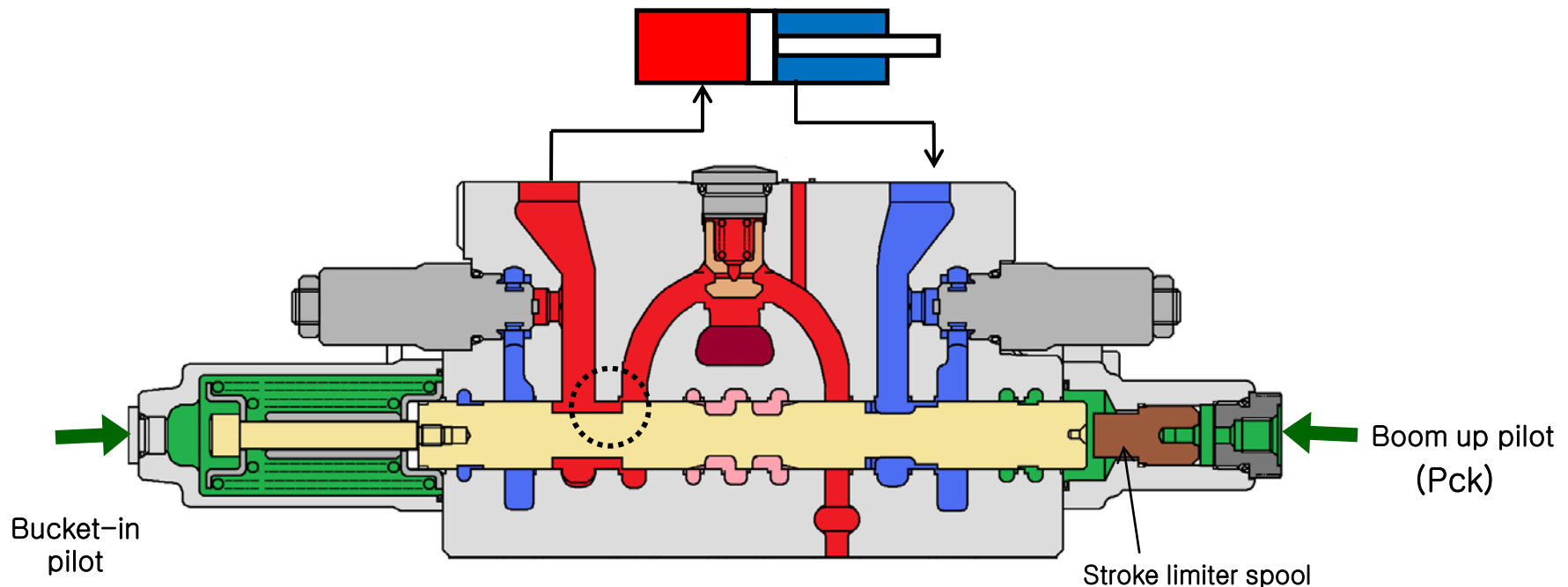
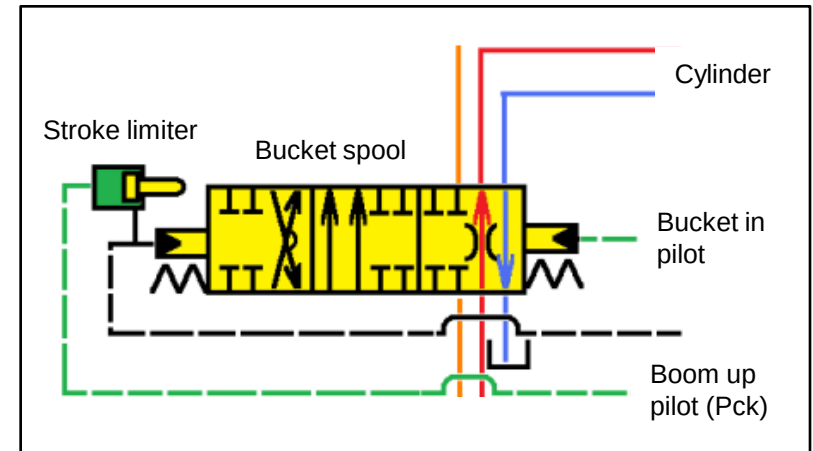
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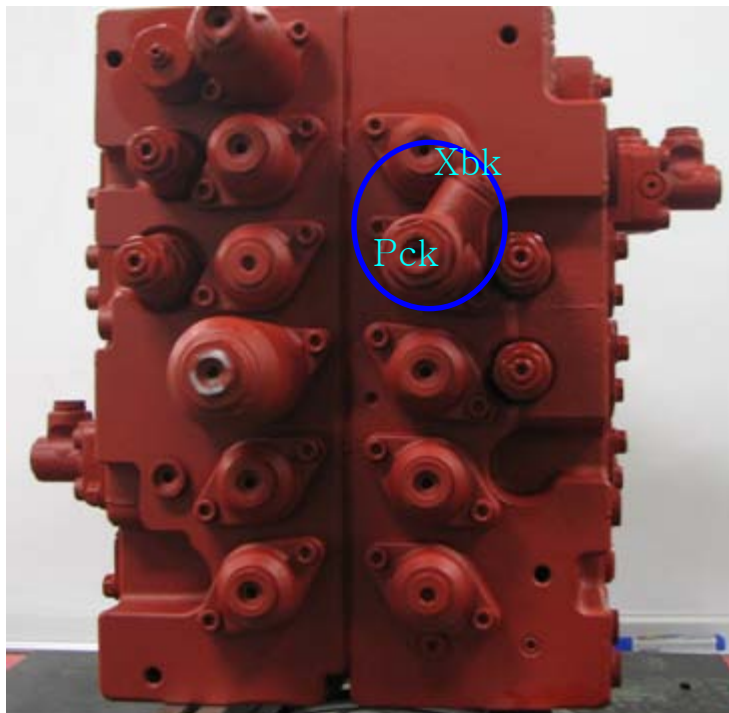
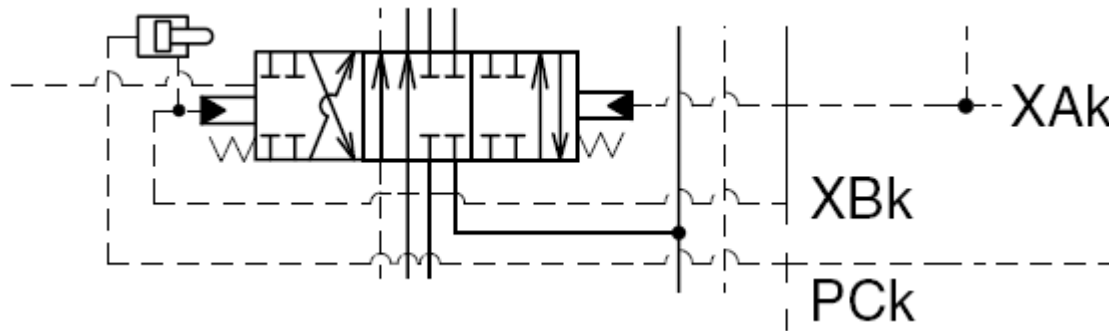
14. Bucket Stroke Limiter

During the combined operation of boom-up and bucket-in, boom-up pilot pressure moves the bucket spool to half stroke, not full stroke.

Flow to bucket cylinder is reduced and P2 pump oil is supplied to boom cylinder preferentially.



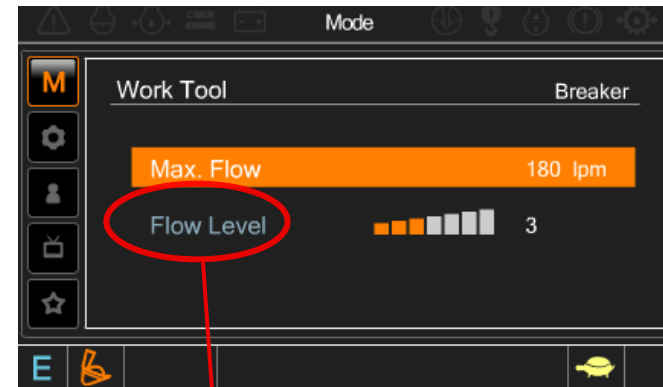
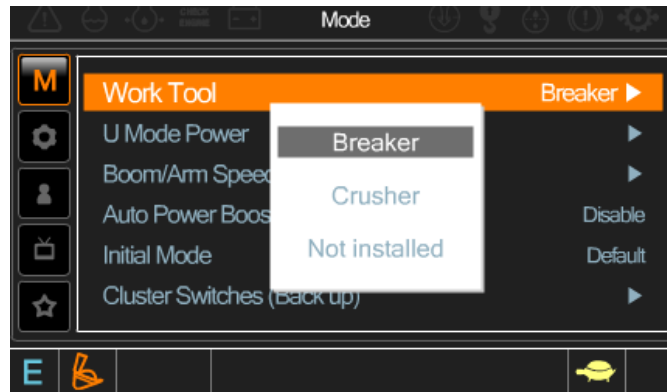
14-1. The Position of Bucket Stroke Limiter



15. Option Attachment

15-1. Breaker Mode

At breaker mode, CPU allows the current to ATT' Flow Control EPPR V/V to reduce the oil flow up to 7 Step.



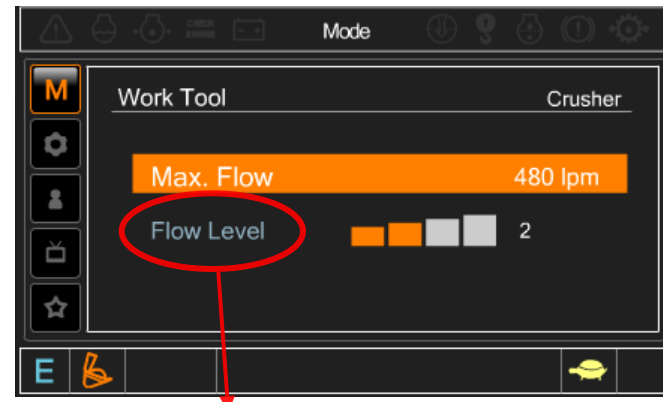
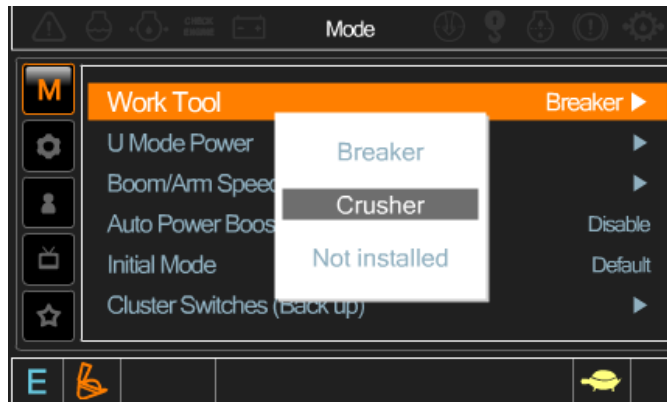
Max 7 step, reduced 10 lpm each step

Description	General mode	Work tool	
	Bucket	Breaker	Crusher
Attachment safety solenoid	OFF	ON	ON
Attachment pressure solenoid	OFF	OFF	ON
Attachment confluent solenoid	OFF	OFF	ON/OFF
Attachment flow EPPR current	100 mA	100~700 mA	0~700 mA

15-2. Crusher Mode

At crusher mode, CPU will send the current to ATT' Flow Control EPPR V/V and reduces the delivered flow to maximum 4 step.

210 bar → 280 bar

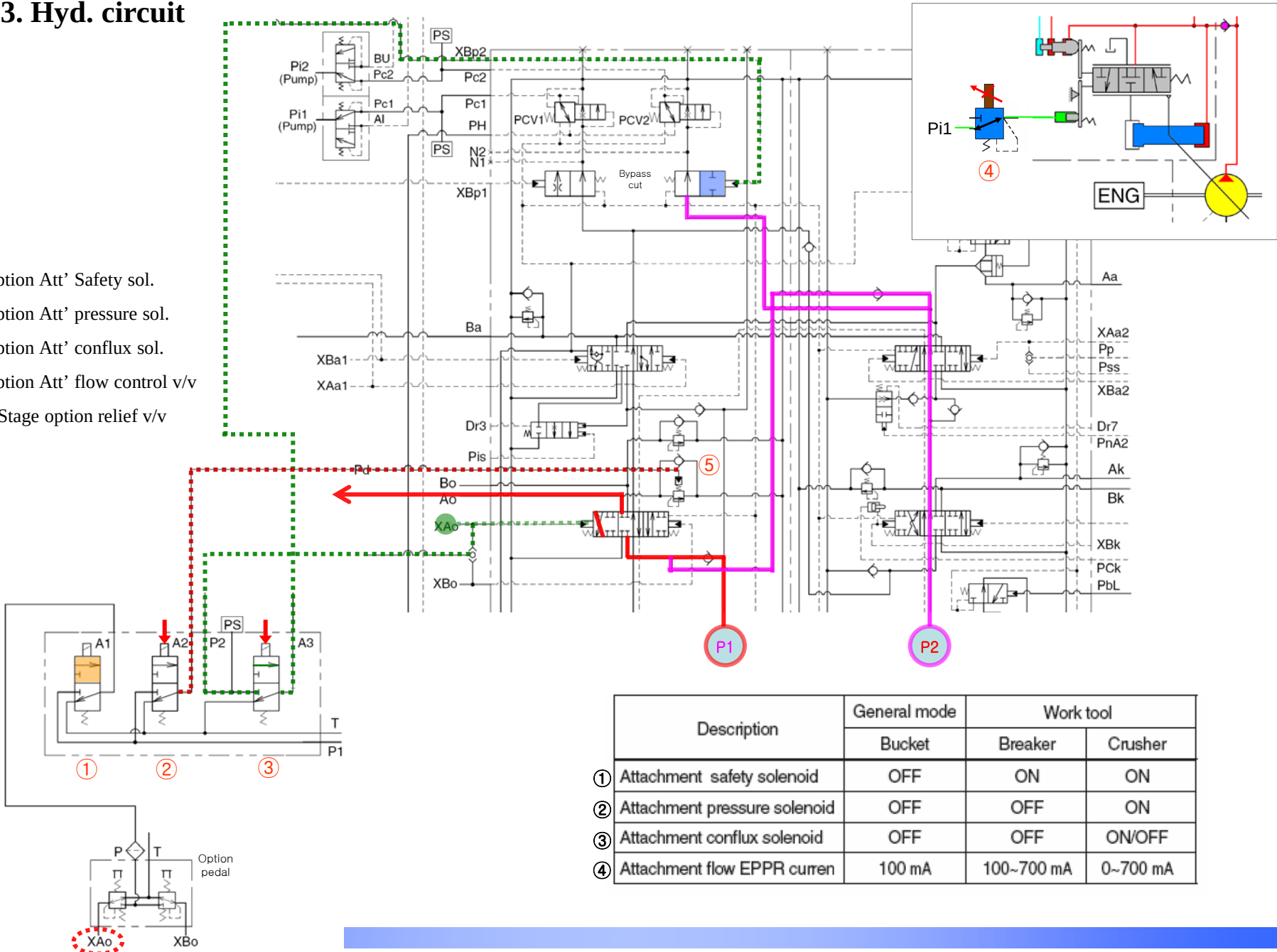


Max 4 step, reduced 20 lpm each step

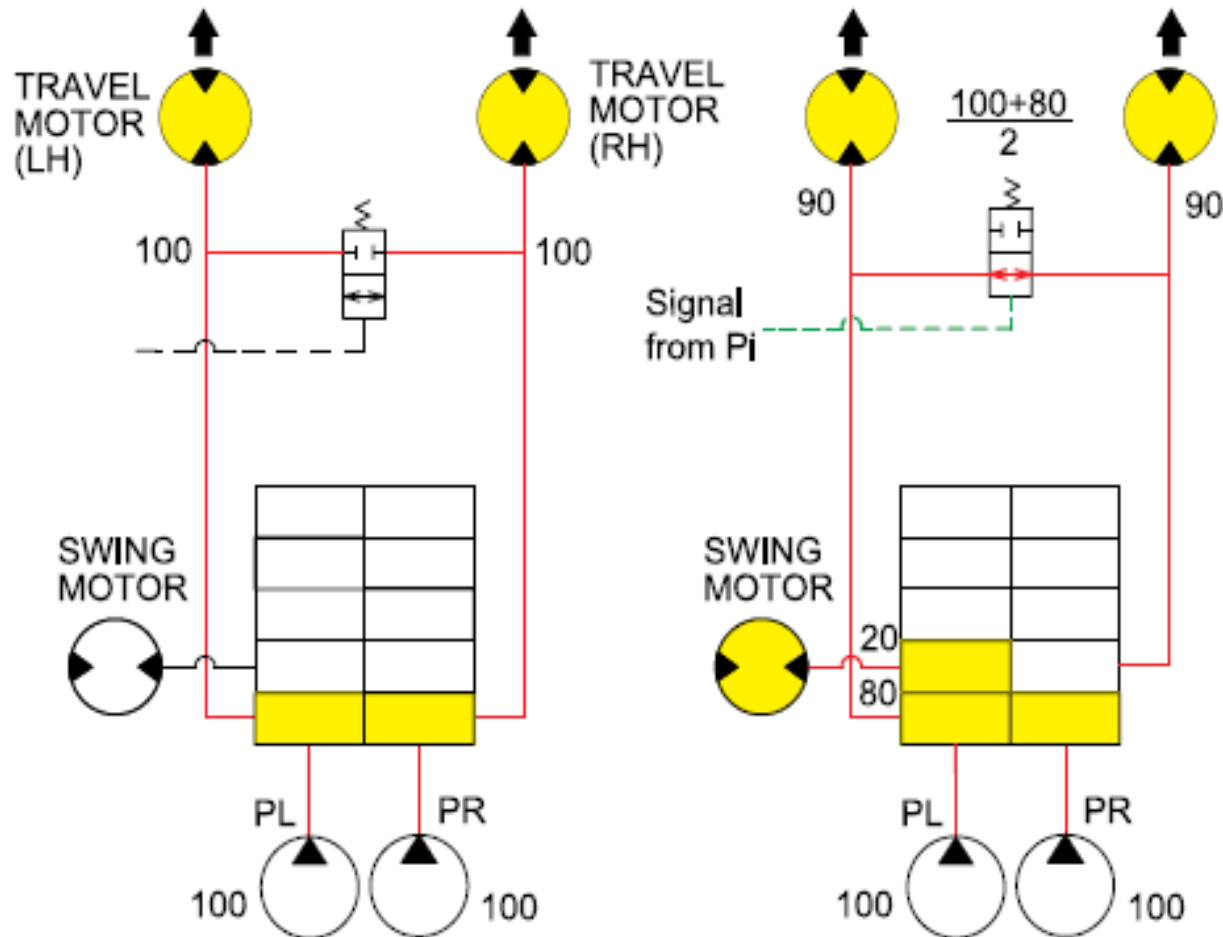
Description	General mode	Work tool	
	Bucket	Breaker	Crusher
Attachment safety solenoid	OFF	ON	ON
Attachment pressure solenoid	OFF	OFF	ON
Attachment conflux solenoid	OFF	OFF	ON/OFF
Attachment flow EPPR curren	100 mA	100~700 mA	0~700 mA

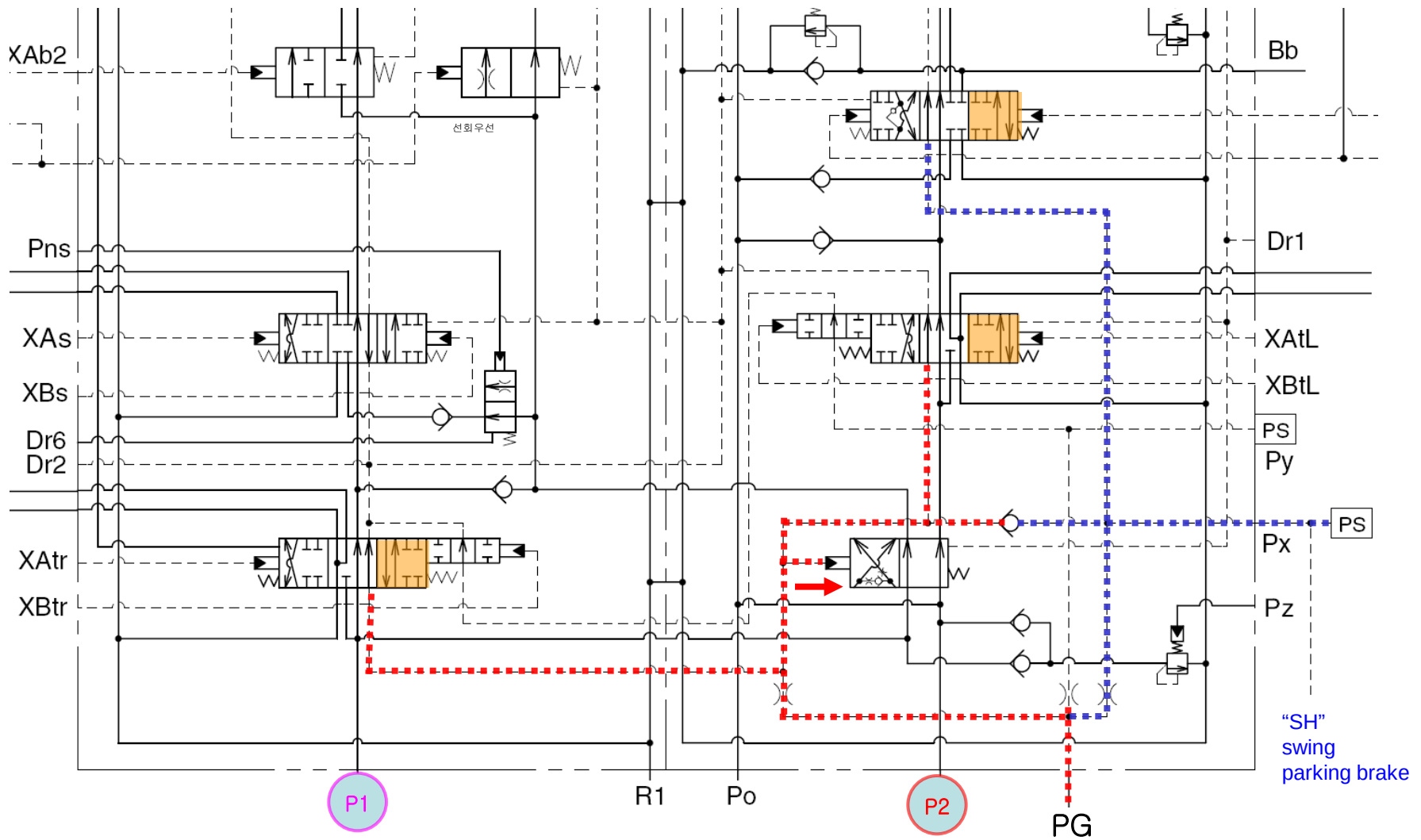
15-3. Hyd. circuit

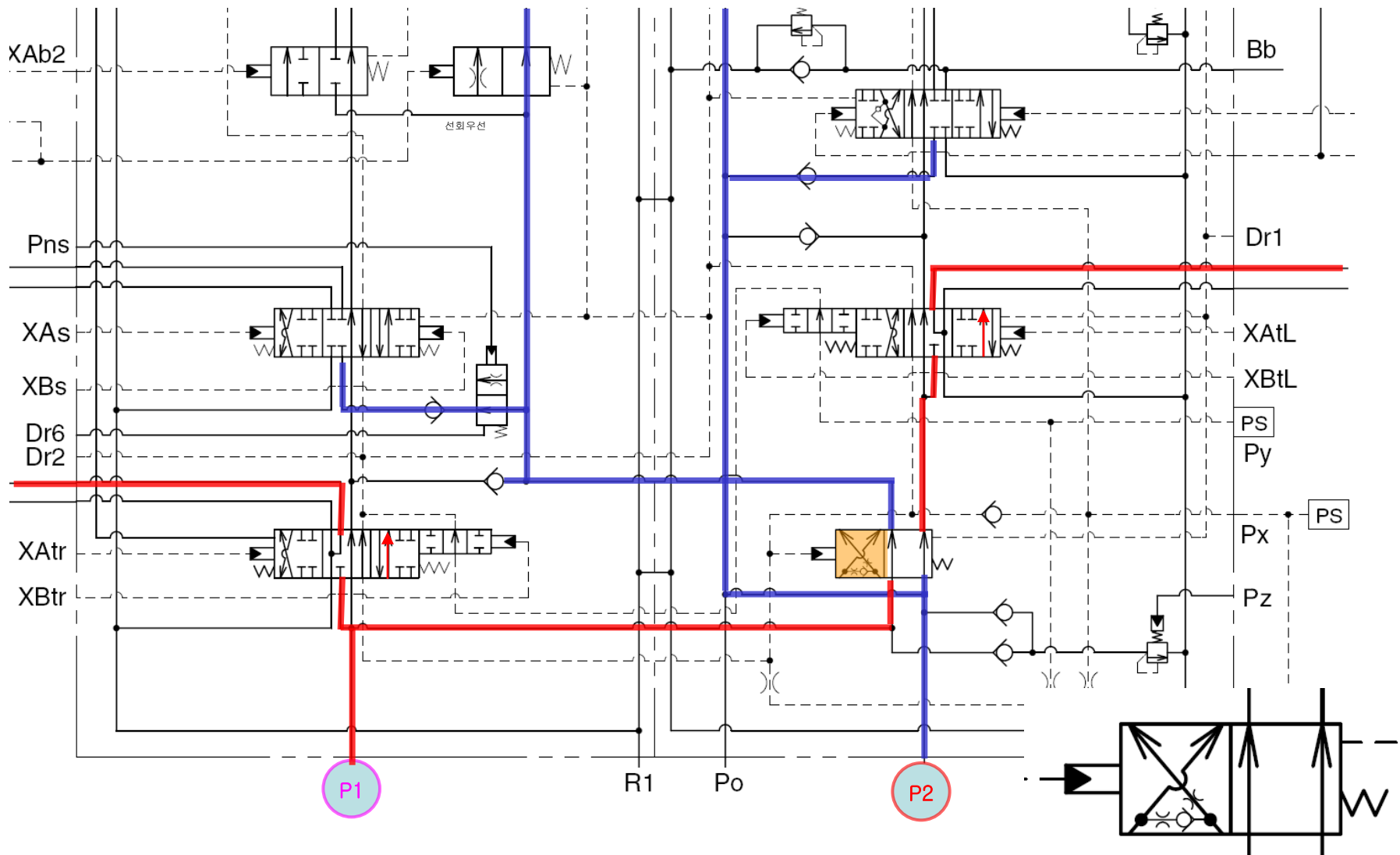
- ① Option Att' Safety sol.
- ② Option Att' pressure sol.
- ③ Option Att' conflus sol.
- ④ Option Att' flow control v/v
- ⑤ 2-Stage option relief v/v



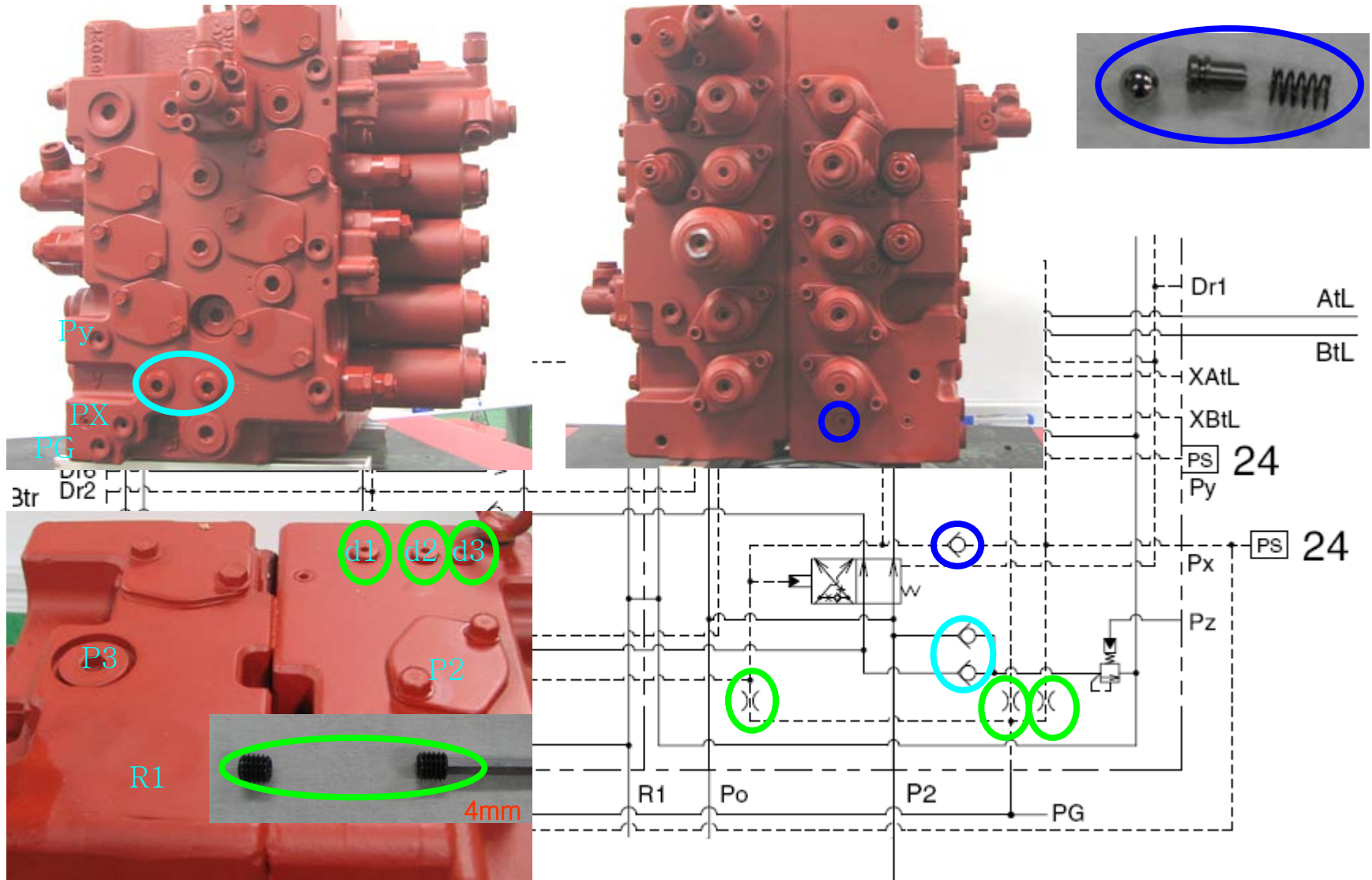
16. Straight Travel Function

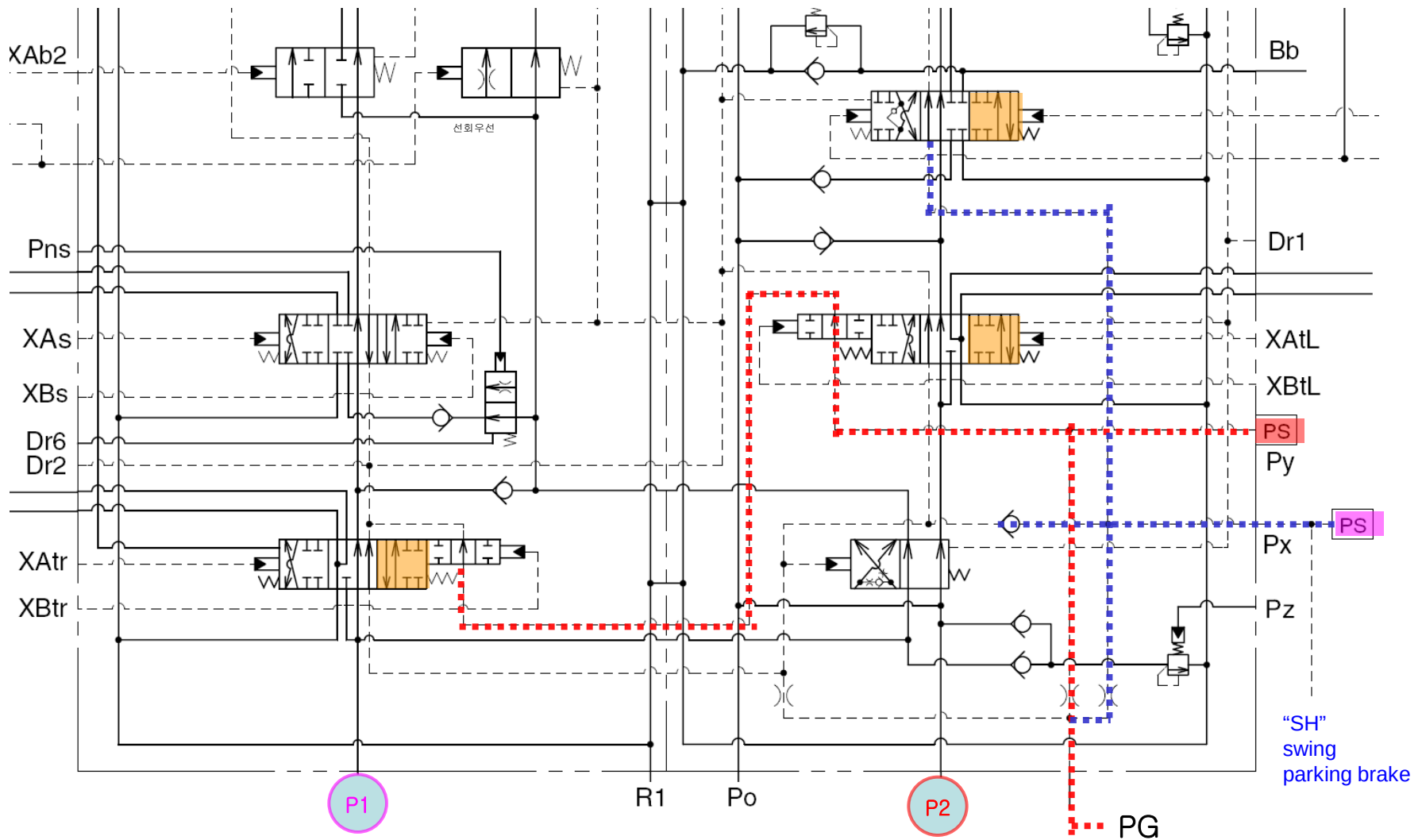






16-3. The position of straight travel straight circuit valve & orifice.





When travel and work equipments are not operated with other requirements, auto idle is activated

18. Holding Valve

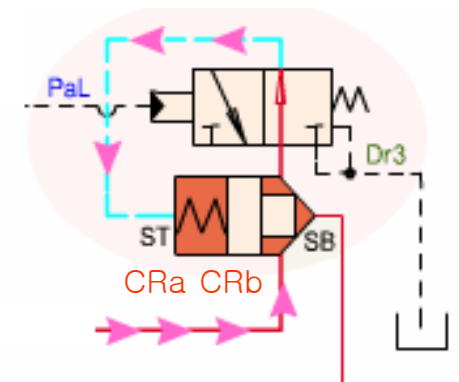
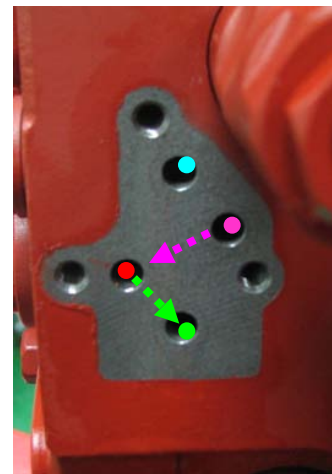
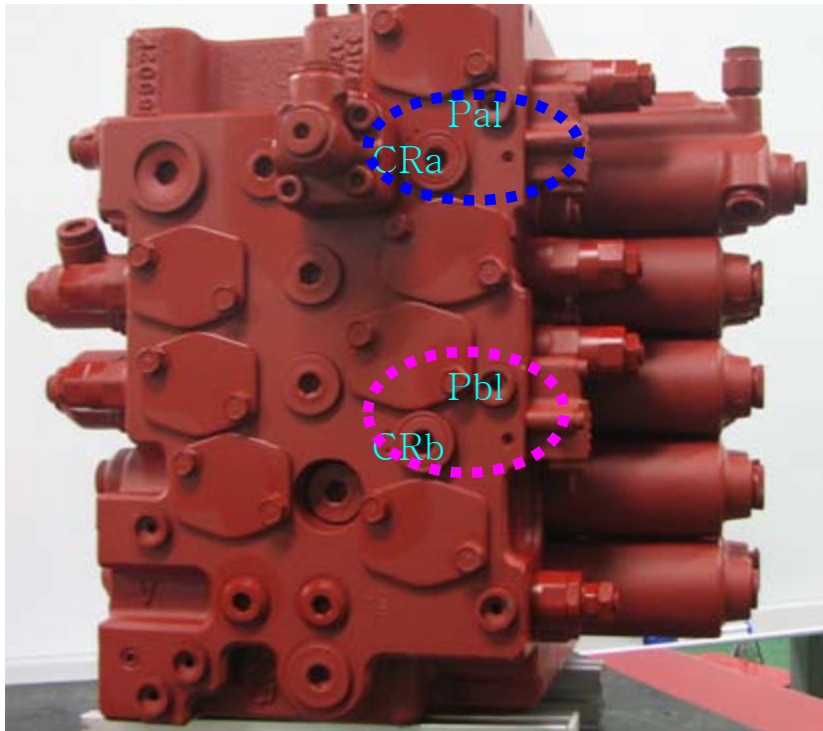
Holding Valve is applied both Boom down and Arm In

Pal : Arm holding release pilot port

CBa : Arm holding Check v/v

Pbl : Boom holding release pilot port

CBb : Boom holding Check v/v



● Holding release pilot port

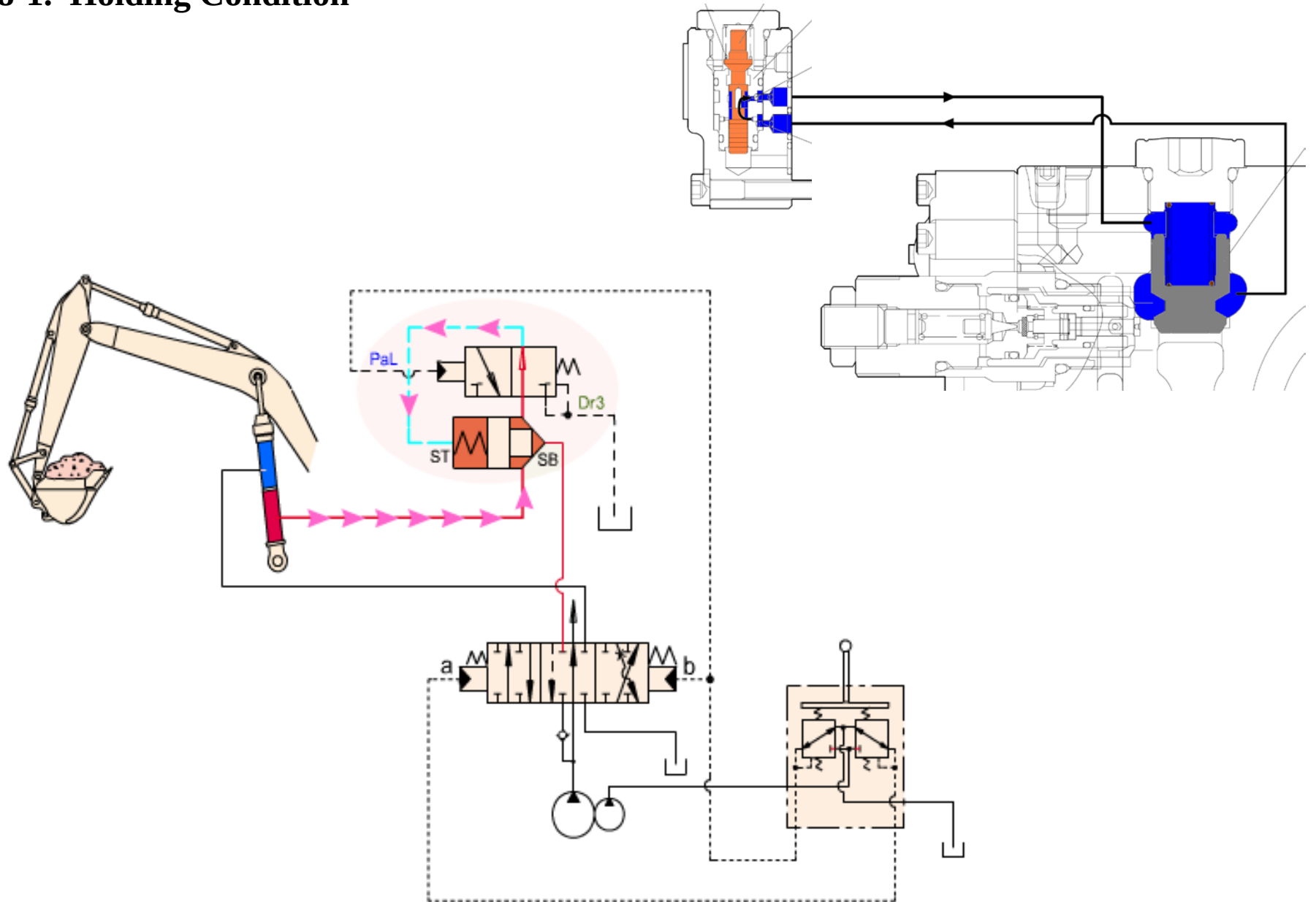
● From CYL. Chamber (Boom→Large ,Arm→Small)

● Check v/v Large chamber

● Dr3(drain)

18-1. Holding Condition

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