SWE20F SERVICE MANUAL

SUBTITLE

Fontas | 15/05/2021

Contents Guide

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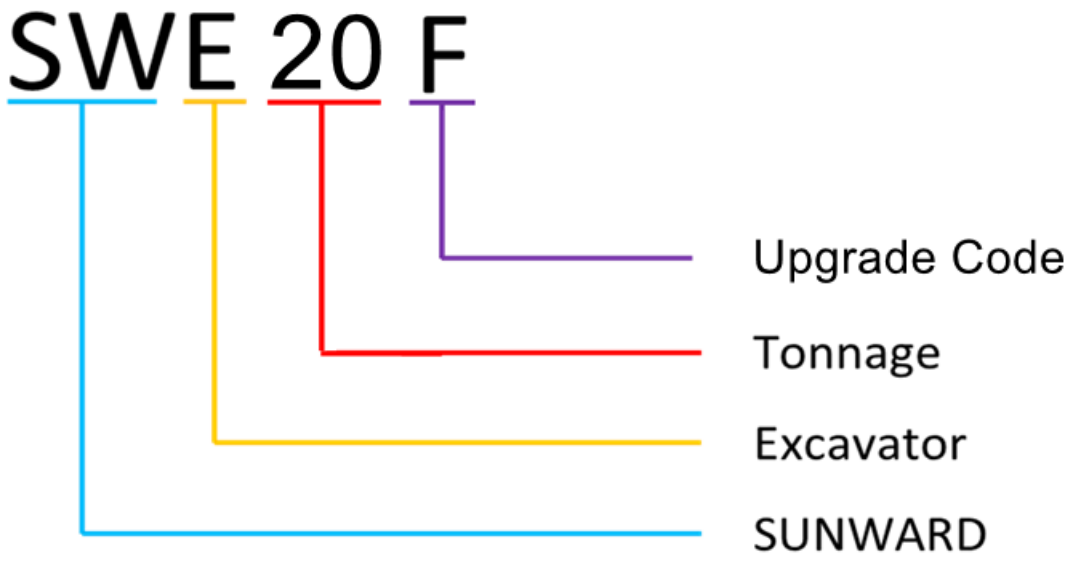
Ⅰ. Technical Parameters

1.Technical Parameters

1. 1 Model Explanation



1.Technical Parameters

1. 2 Performance & Fluid Capacity

Machine Weight (kg)	With rubber track	1940
	With steel track	N/A
Standard bucket capacity（m^3）		0.04
Max Bucket Digging Force（kN）		22.7
Max Arm Digging Force(kN)		9.83
Max. Traction Force(kN)		16.7
Boom swing angle（°）		75/50
Travel Speed （km/h）		3.5/2
Gradeability（°）		30

Ground Pressure（kPa）	30
Swing speed (rpm)	10
Engine Model	3TNV80F-SSSU
Emission Tier (EU)	Stage V
Power (kw/rpm) *	13.4/2200
Torque (N.m@rpm)	67@1800
Int./Exh. valves (mm)	/
Cylinder Compression at 250 (bar)	23.1
Engine displacement (L)	1.267

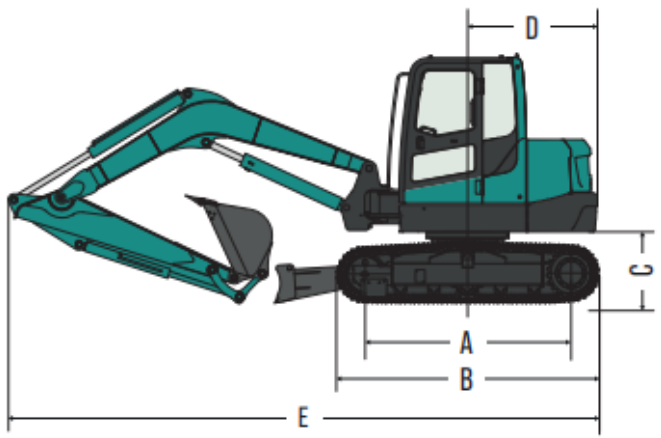
1.Technical Parameters

1. 3 Service Refill Capacity (L)

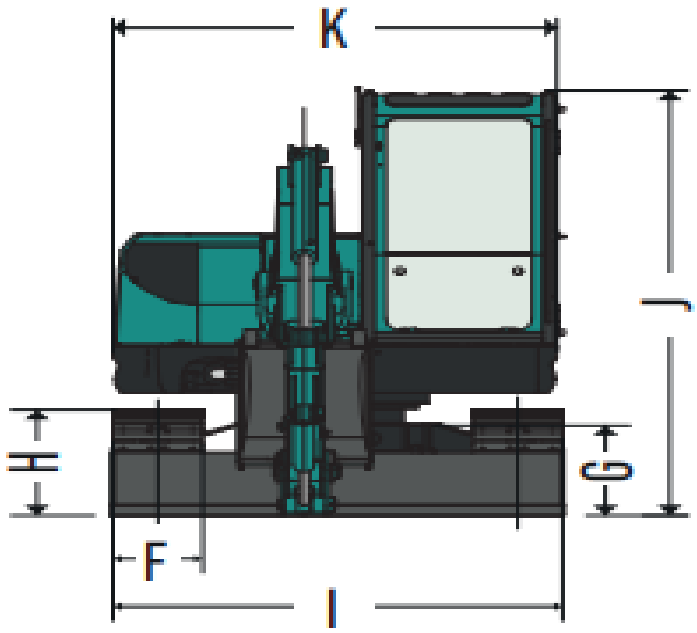
Diesel	23
Engine Oil	3
Coolant	5
Hydraulic Oil (Tank + Circuit)	37
Gear Oil (Travel)	2x0.33
Gear Oil (Slew)	Self-lubricated
Aircon Gas (g) R 134a	/

1.Technical Parameters

1. 4 Dimensions & Working Ranges



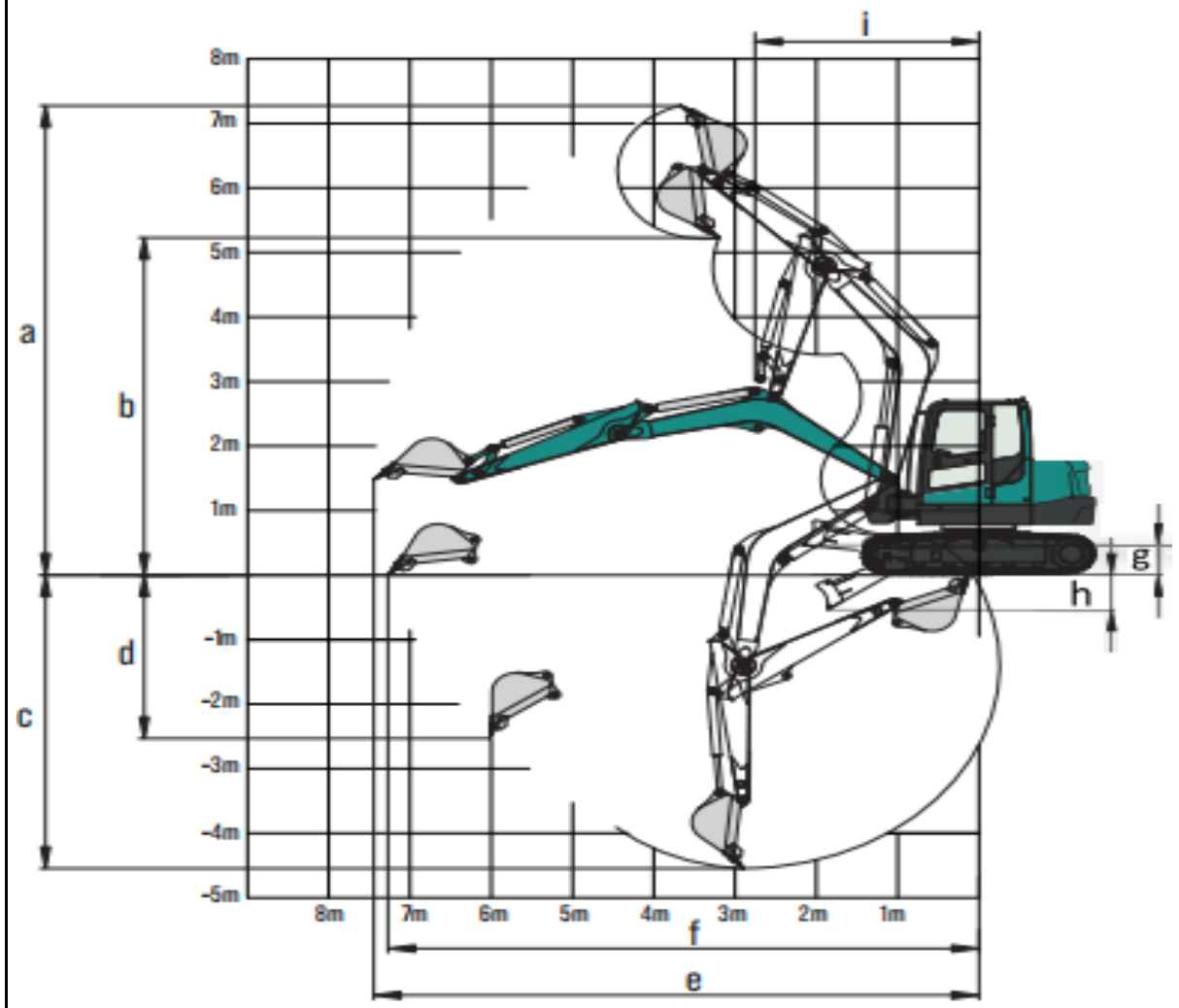
Dimension	mm
A	1210
B	1555
C	482
D	1120
E	3820



Dimension	mm
F	230
G	313
H	385
I	990/1360
J	2210
K	990

1.Technical Parameters

Dozer Blade Size (Width * Height)	1360X267
a	3770
b	2720
c	2380
d	1870
e	4040
f	3945
g	295
h	360
i	1565



1.Technical Parameters

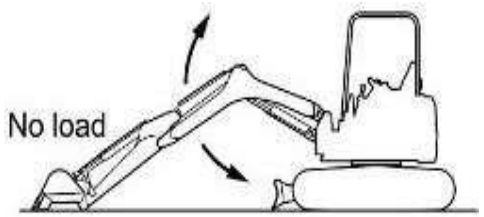
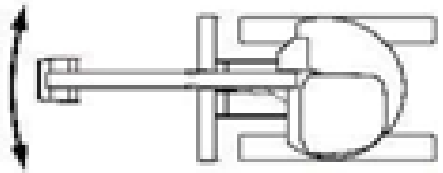
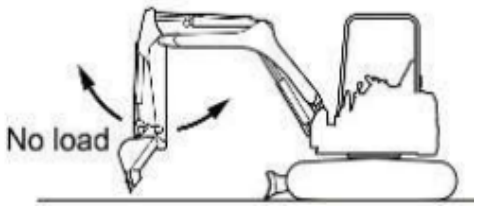
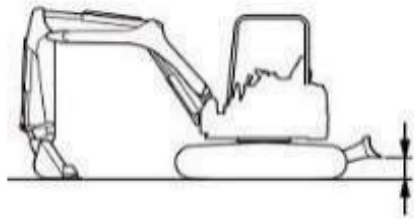
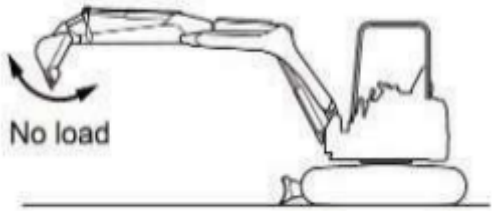
1. 5 Pressure & Flow

Pressure (Bar)	P1	210
	P2	210
	P3	190
	P4/Pilot	40
Boom Cylinder (Bar)	Rod/Bottom	240
Arm Cylinder (Bar)	Rod/Bottom	240
Bucket Cylinder (Bar)	Rod/bottom	240
B. swing (Bar)	Rod/bottom	210
Swing (Bar)	Hyd. Motor	190
Blade (Bar)	Rod	190

Travel (Bar)	Hyd motor	210
Track Expansion Cylinder (Bar)	Rod/Bottom	190
Flow Max. (L/min)	P1	20.9
	P2	20.9
	P3	13.2
	P4	5.9
Auxiliary Circuit Flow & Pressure (L/min & Bar)	Aux 1	35.6 / 240
	Aux 2	20.9 / 210
	Quick Hitch	13.2 / 190

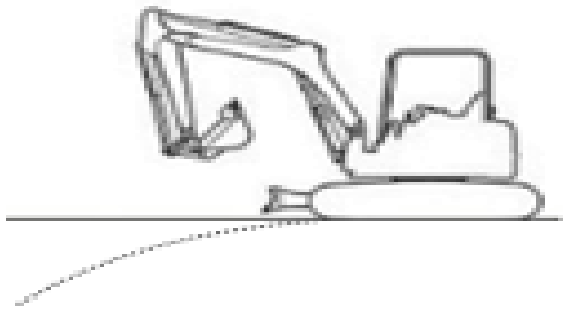
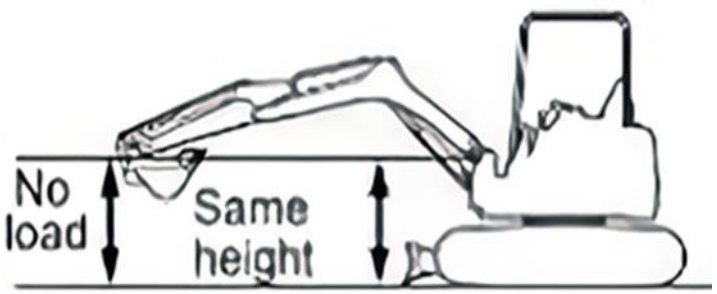
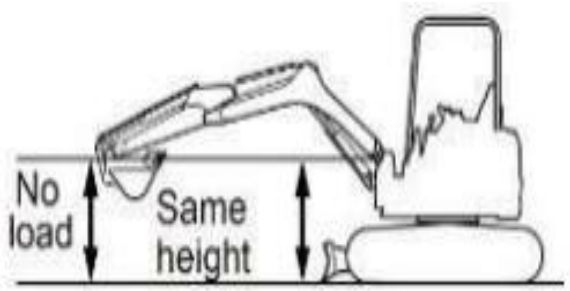
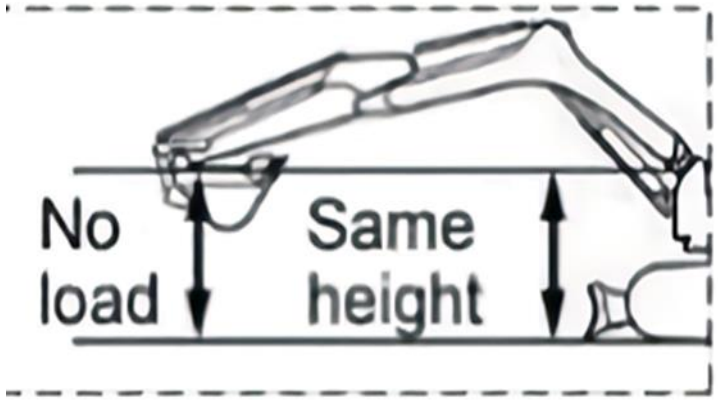
1.Technical Parameters

1. 6 Implements & Actuator Performance

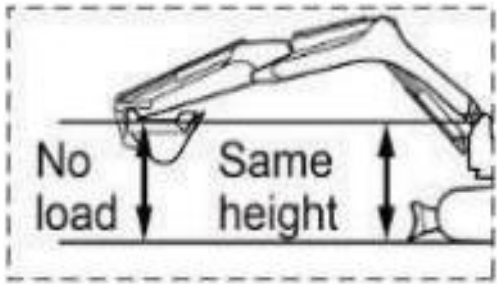
Item	Speed (sec)	Item	Speed (sec)
 Boom speed	1.4/1.3	 Boom swing speed	5.2/5.1
 Arm speed	2.6/2.5	 Blade speed	1.5/1.9
 Bucket Speed	2.3/1.5	 Travel Speed	34/20

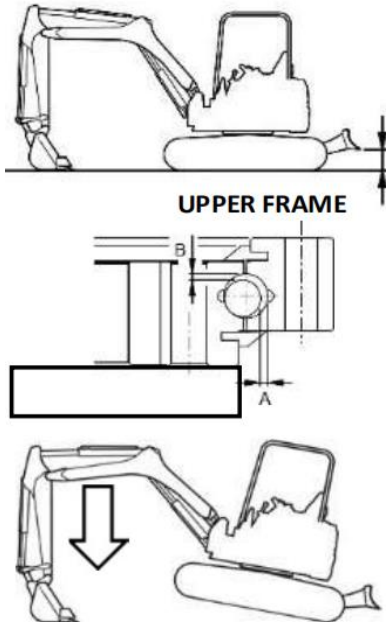
1.Technical Parameters

1. 6 Implements & Actuator Performance

Item	Speed (sec)	Drift		(mm or °)
 Travel Deviation	≤3500mm (within 50m travel)		Swing drift at stopping mm	70±20
 Swing speed (3 turns)	15.5/15.5	 On Slew Bearing		

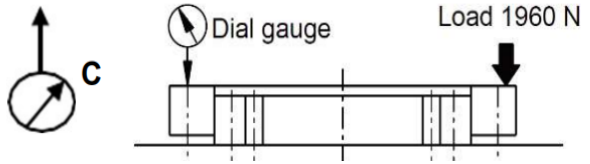
1.Technical Parameters

Drift (mm)		
	Boom	≤8
	Arm	≤8
	Bucket	≤8
Engine stopped Movement of cyl. rod after 10 min	Blade (Std Arm/ Long Arm)	15/18

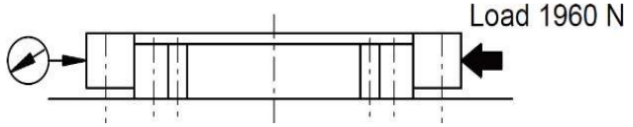


Standard	50mm
Max.	50mm

Clearance B



Clearance A



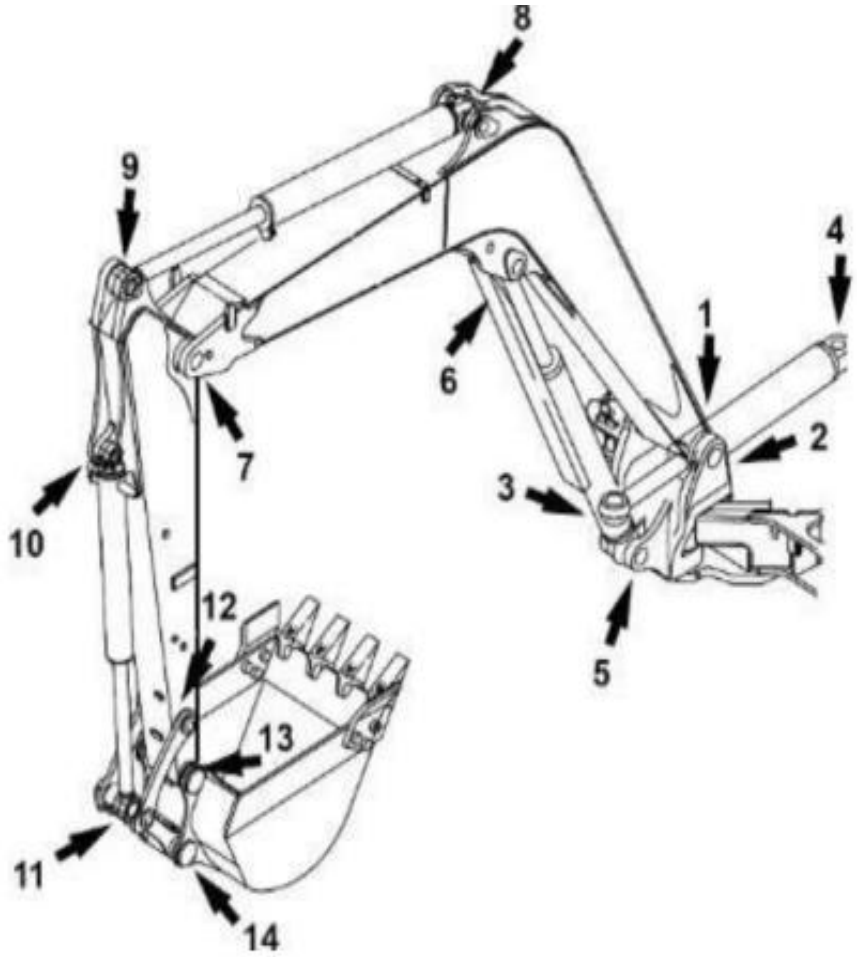
Swing bearing clearance = "C" in mm
(boom up & boom on ground & no bucket) ; $A^2 + B^2 = C^2$

1.Technical Parameters

1. 7 Front Implements Shaft Size

Shaft location	Size(mm)	Shaft location	Size(mm)
1-Boom swing knuckle	Φ50	8-Arm cyl. (bottom)	Φ30
2-Boom fulcrum	Φ35	9-Arm cyl. (rod)	Φ30
3-Boom swing cyl. (rod)	Φ30	10-Bucket cyl. (bottom)	Φ30
4-Boom swing cyl. (bottom)	Φ30	11-Bucket cyl. (rod)	Φ30
5-Boom cyl. (bottom)	Φ30	12-Link "A" arm	Φ30
6-Boom cyl. (rod)	Φ30	13-Bucket fulcrum	Φ30
7-Arm fulcrum	Φ35	14-Bucket link "A"	Φ30

Implements

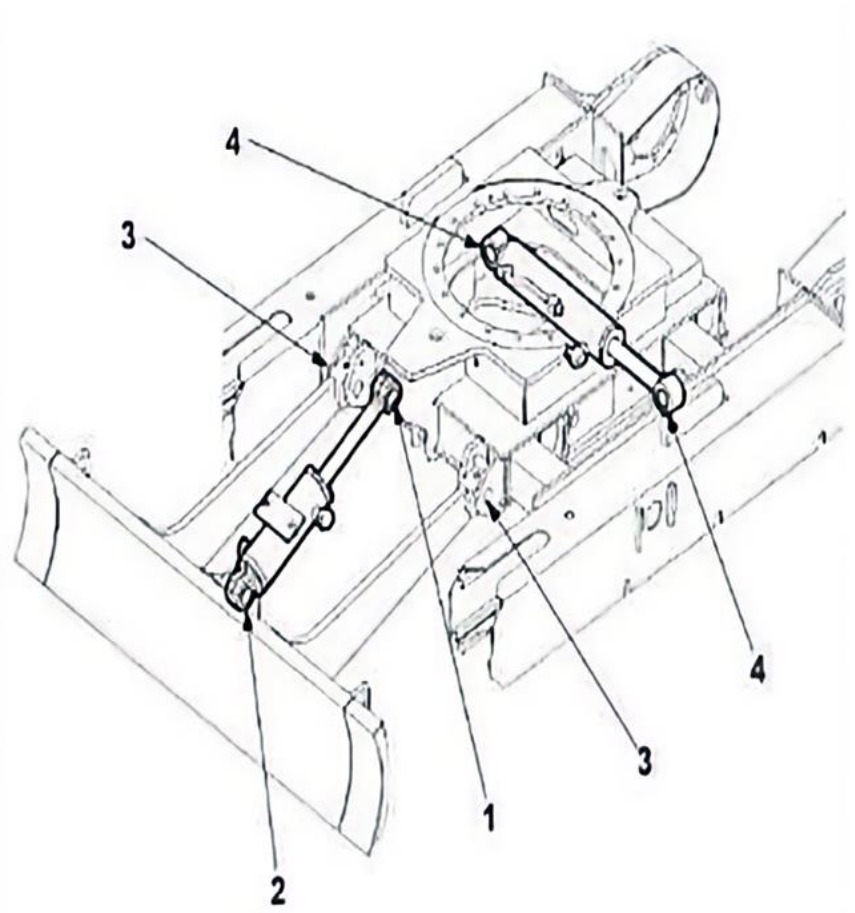


1.Technical Parameters

1. 7 Front Implements Shaft Size

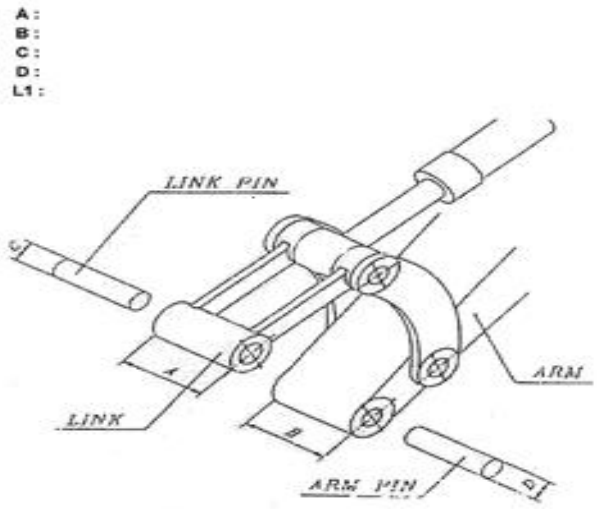
Shaft location	Size(mm)
1-Blade cyl. (rod)	Φ30
2-Blade cyl. (bottom)	Φ30
3-Blade fulcrum	Φ30
4-Track expansion cylinder	Φ35

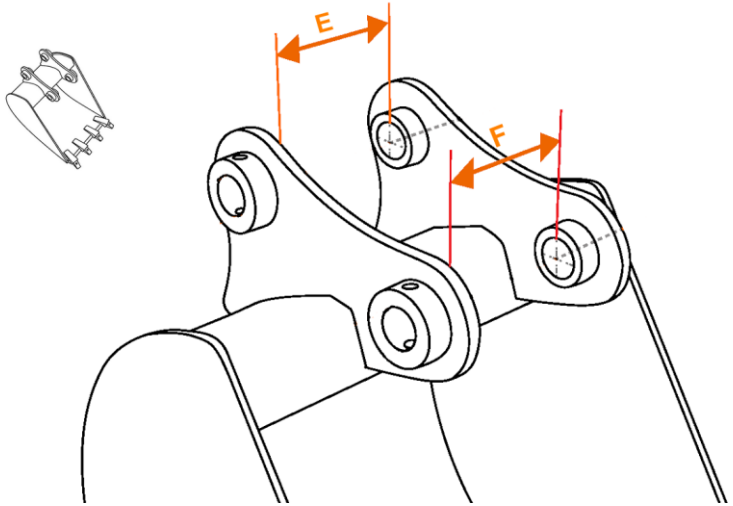
Undercarriage

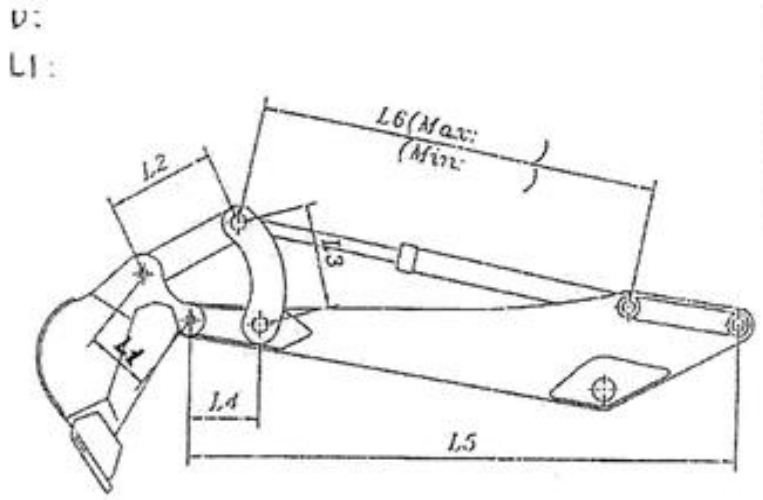


1.Technical Parameters

1. 8 Attachment Linkage Dimensions (mm)







A	106	**L1**	165
B	106	**L2**	172
C	Φ30	**L3**	215
D	Φ30	**L4**	140
E	106	**L5**	1368.5
F	106		

1.Technical Parameters

1. 9 Major Components Weight -Standard Machine (kg)

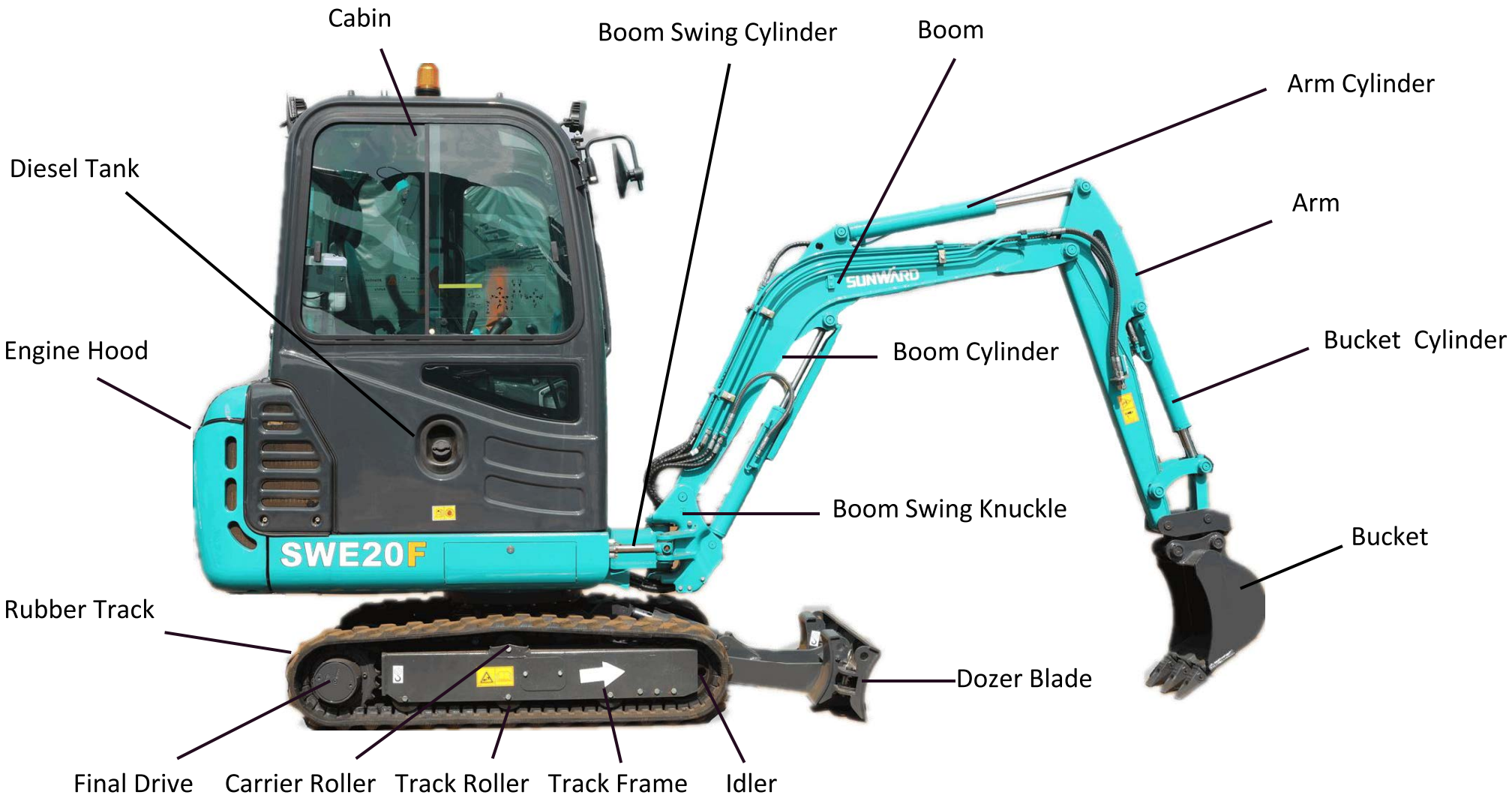
Base Machine	1940	**Track Adjuster**	5.4
Upper Structure	622	**Track Chain Ass'y**	324
Under Carriage	1101	**Final Drive**	25
Cabin	250	**Swing Motor**	23
Boom	68	**Counter Weight**	130
Arm	53	**Engine**	143
Bucket	50	**Hydraulic Pump**	39
Boom Cyl.	19	**MCV**	25
Arm Cyl.	14	**Diesel Tank**	25
Bucket Cyl.	14	**Hydraulic Tank**	31
Dozer Blade	135	**Radiator**	13

Ⅱ. Components Recognition & Locations

2.Components Recognition & Layouts

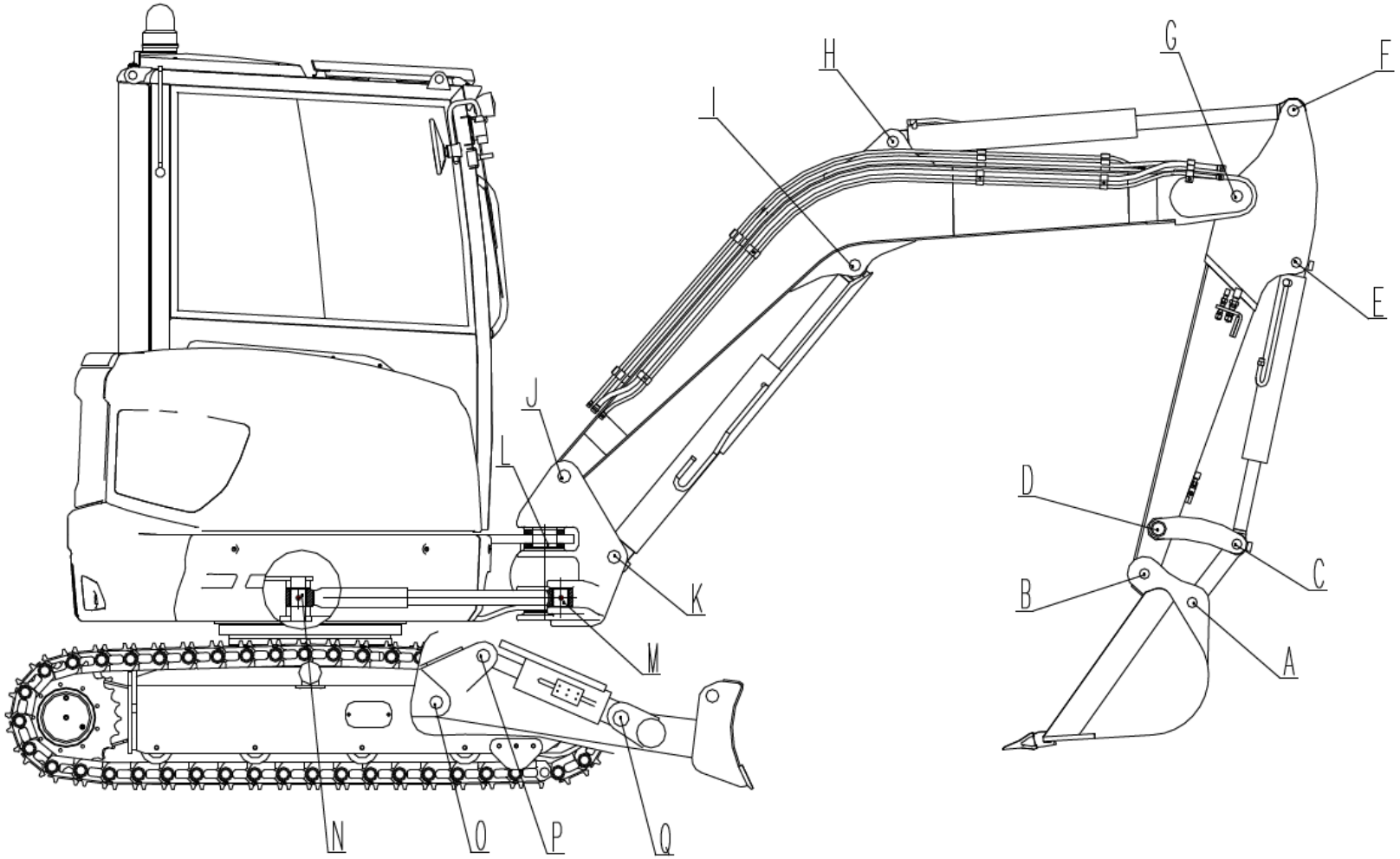
2. 2 OVERALL Layouts

2.Components Recognition & Location



2.Components Recognition & Location

Implements Fit Clearance



2.Components Recognition & Location

Item	Articulate Shaft	Standard				
		Dimension	Tolerance		Standard Fit Clearance	Permissible Fit Clearance
			shaft	hole		
A	Bucket-Connecting Rod					
B	Bucket-Arm					
C	Bucket Cylinder-Connecting Rod					
D	Arm-Connecting Rod					
E	Bucket Cylinder-Arm					
F	Arm-Arm Cylinder					
G	Boom-Arm					
H	Arm Cylinder - Boom					

2.Components Recognition & Location

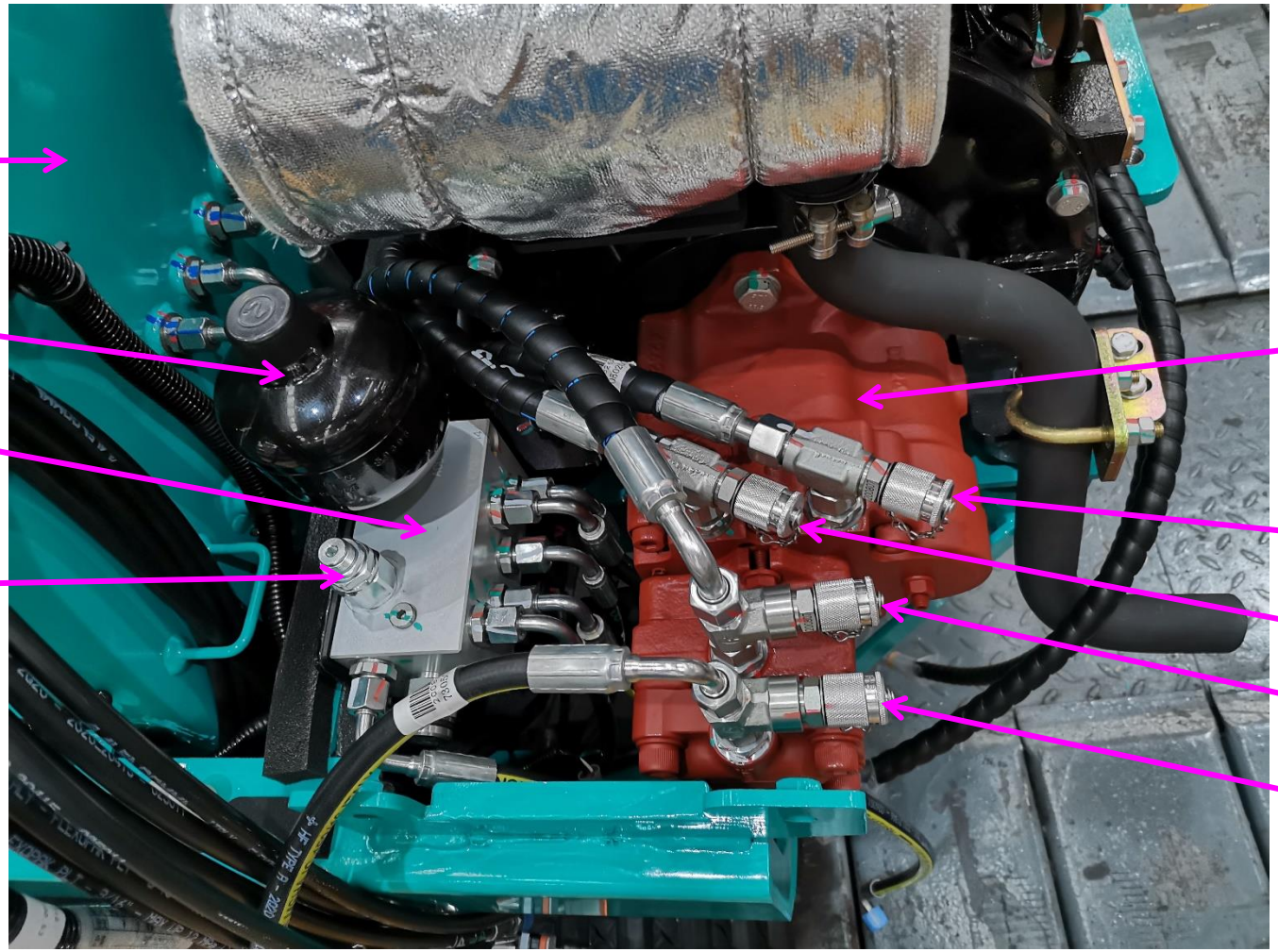
Item	Articulate Shaft	Standard				
		Dimension	Tolerance		Standard Fit Clearance	Permissible Fit Clearance
			shaft	hole		
I	Boom—Boom Cylinder					
J	Boom-Boom Swing Knuckle					
K	Boom Cylinder-Boom Swing Knuckle					
L	Boom Swing Knuckle--Turntable					
M	Boom Swing Cylinder-Boom Swing Knuckle					
N	Boom Swing Cylinder--Turntable					
O	Dozer Blade--Undercarriage					
P	Dozer Cylinder-Undercarriage					
Q	Dozer Cylinder-Dozer Blade					

2.Components Recognition & Location

2. 3 UPPERSTRUCTURE LAYOUTS

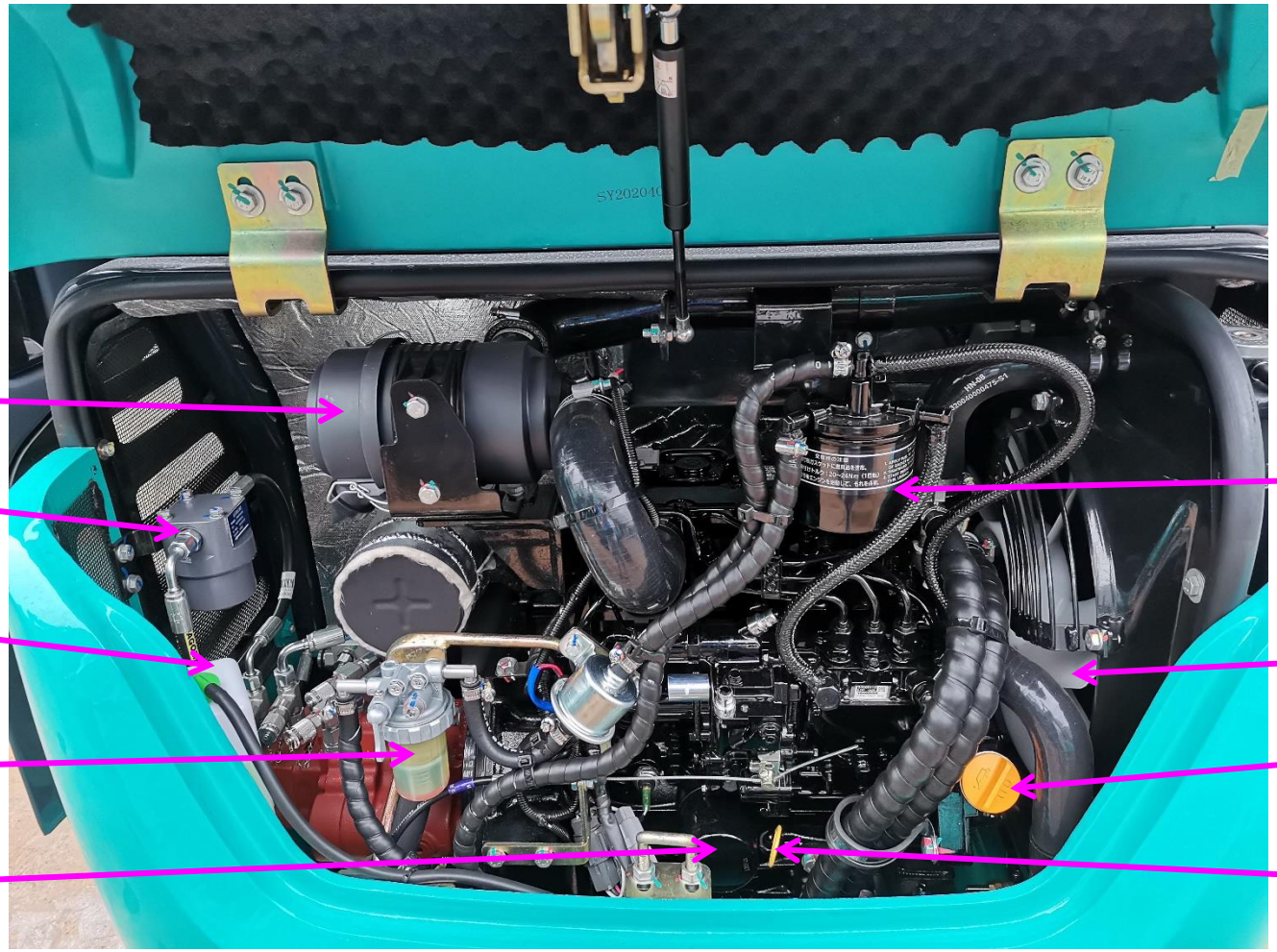
2.Components Recognition & Location

Hydraulic Pump Compartment Arrangement



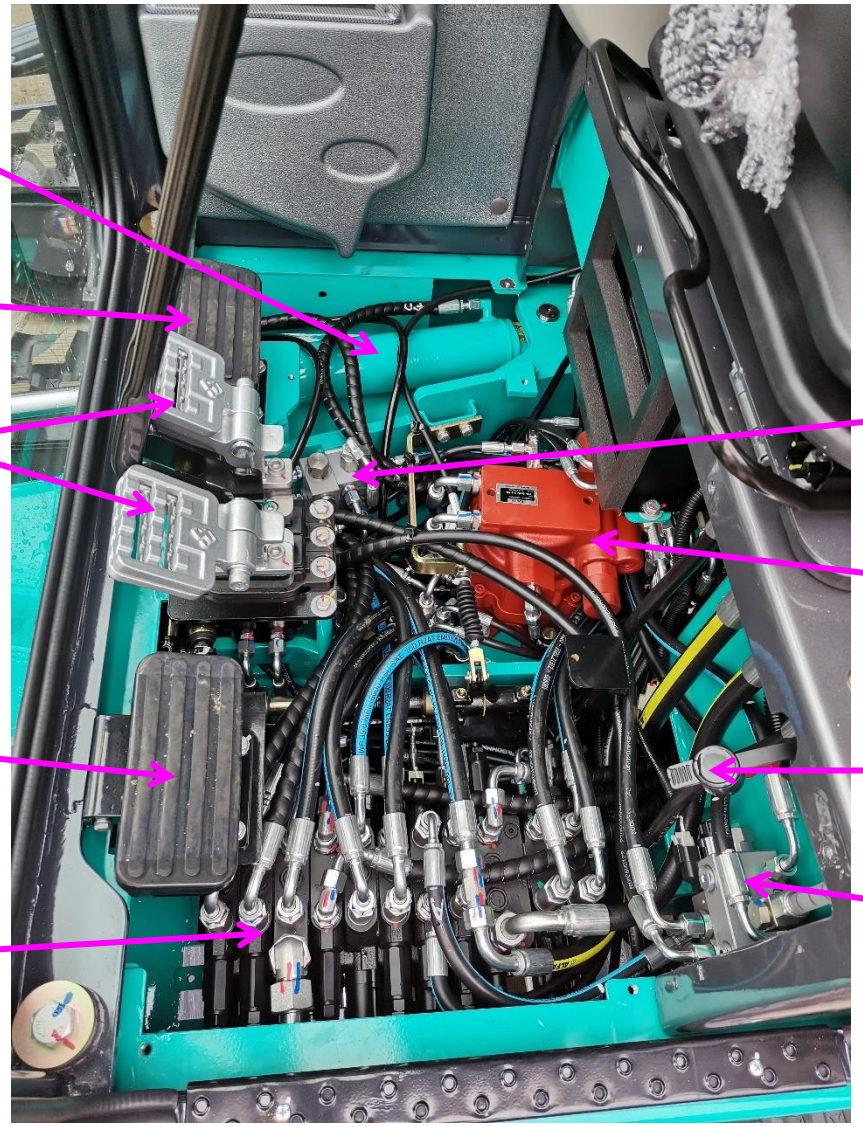
2.Components Recognition & Location

Engine Compartment Arrangement



2.Components Recognition & Location

Underneath Rubber Mat



Boom Swing Cylinder

Boom Swing / Auxiliary Control Pedal Valve

LH & RH Travel Control Valve

Breaker Control Pedal Valve

Main Control Valve

Quick Hitch/ Dozer Alternating Solenoid Valve

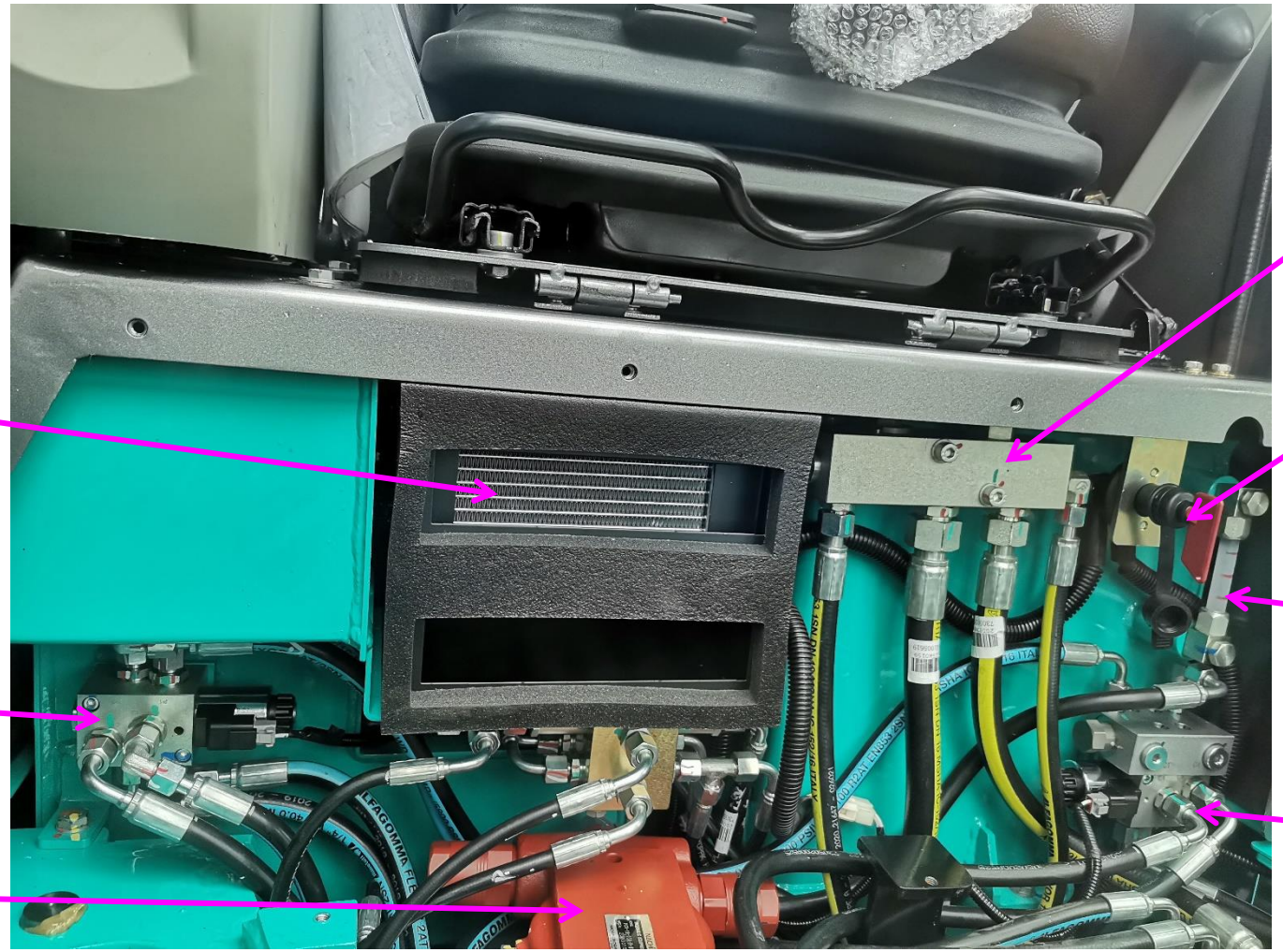
Swing Drive

Battery Switch

Auxiliary / Boom Swing Alternating Solenoid Valve

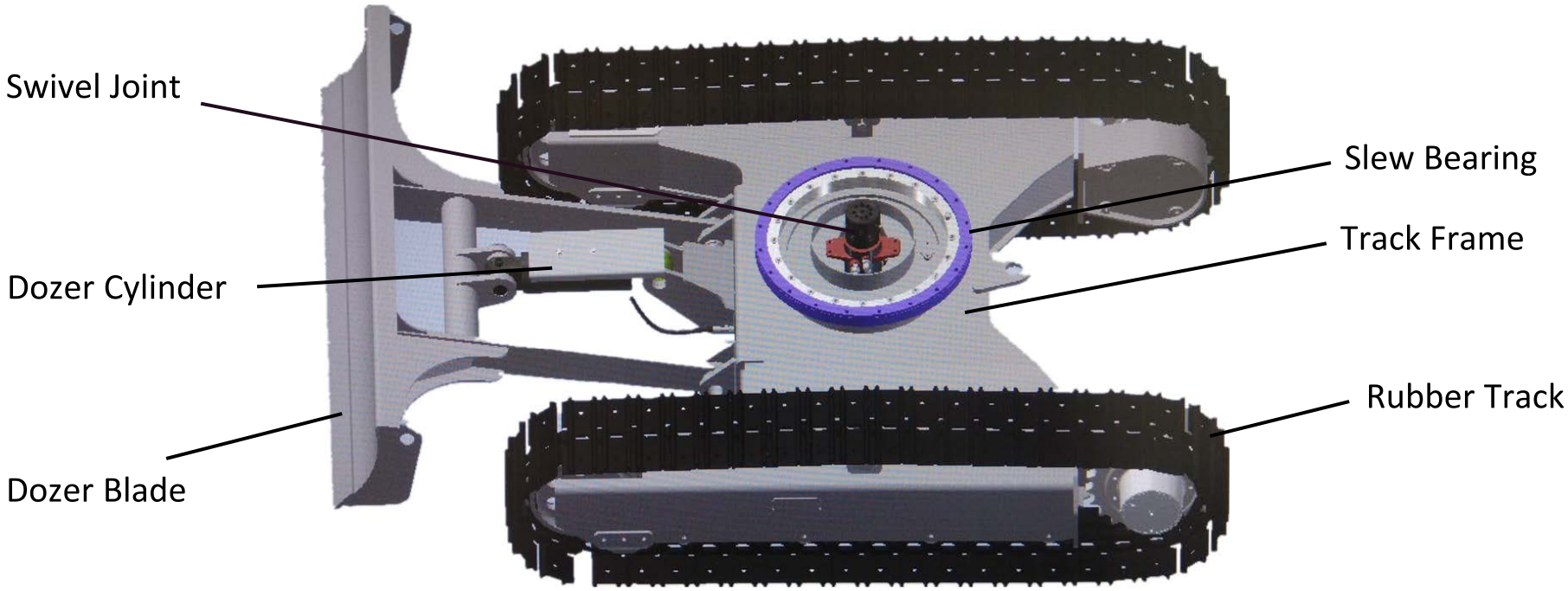
2.Components Recognition & Location

Compartment Underneath Operator's Seat



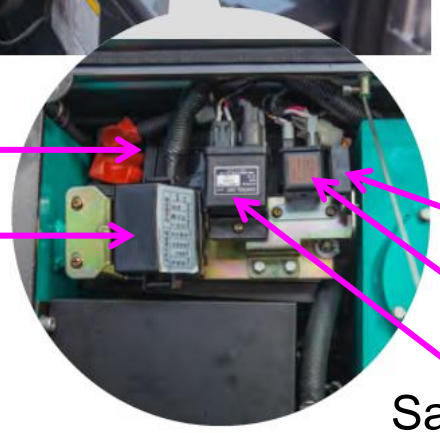
2.Components Recognition & Location

2. 4 Undercarriage LAYOUTS



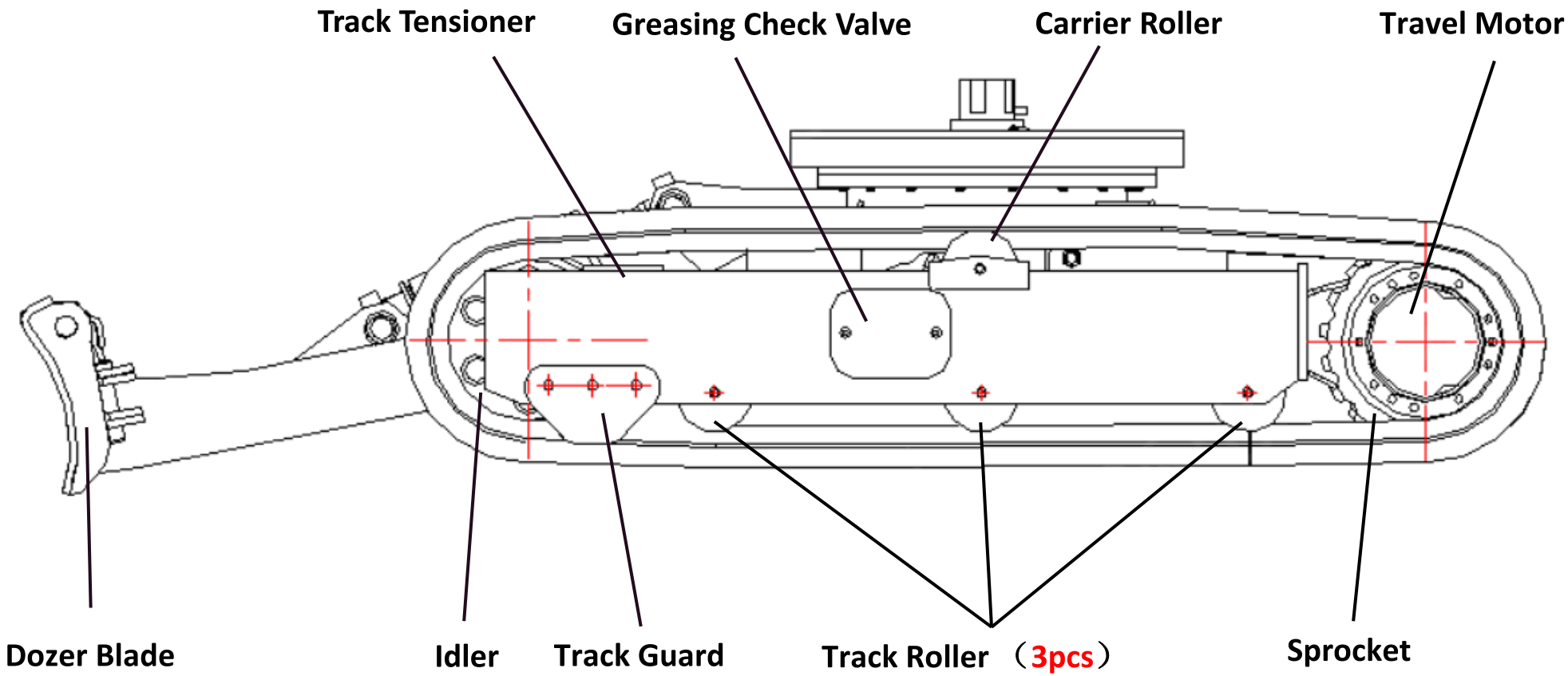
2.Components Recognition & Location

2. 4 Electrical Parts Location

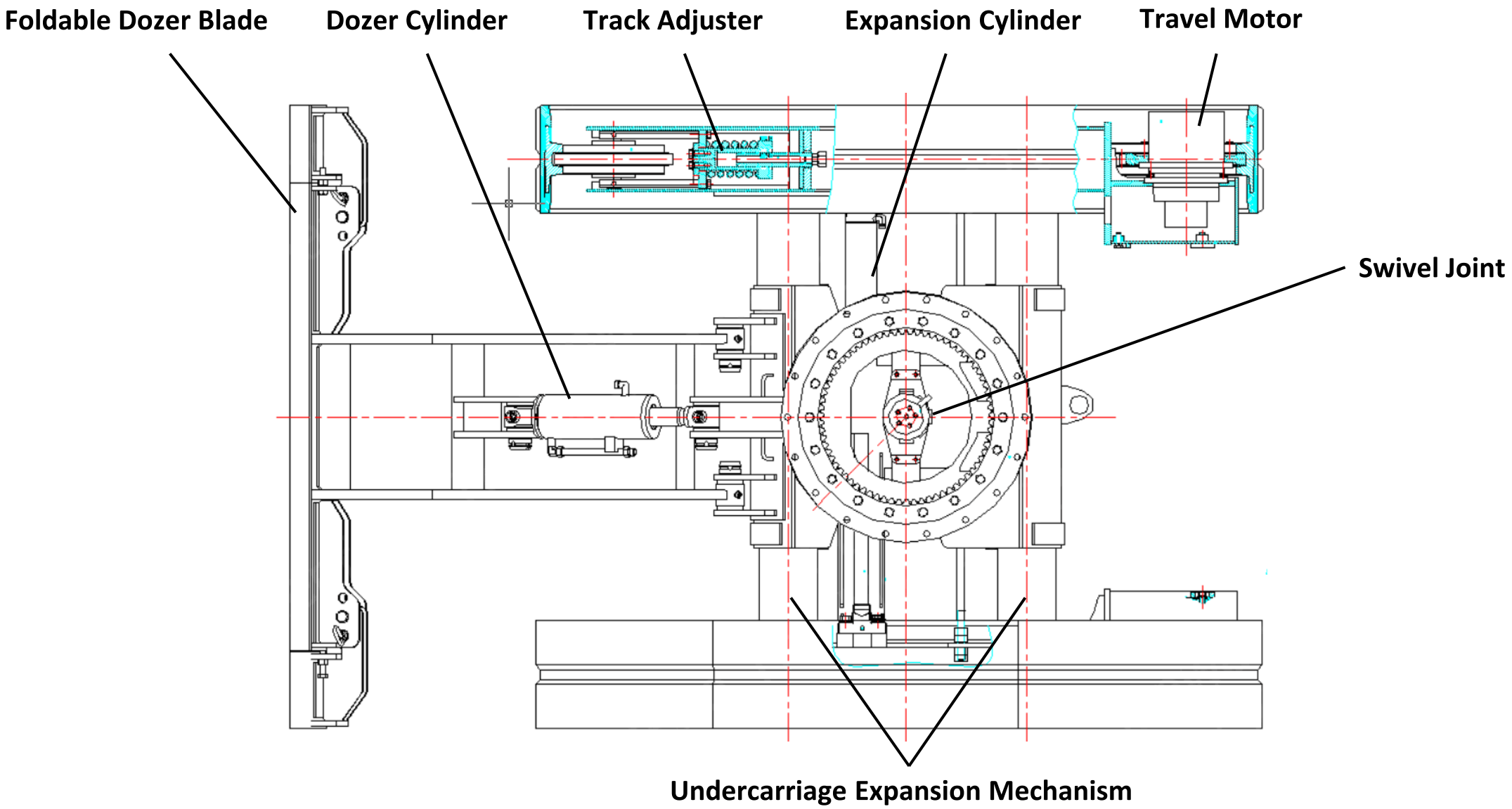


Underneath Operator's Seat

2.Components Recognition & Location



2.Components Recognition & Location

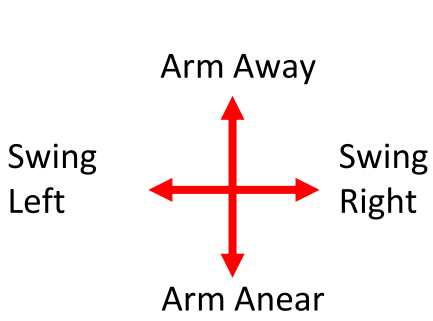


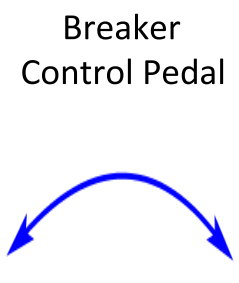
Ⅲ. Operation Guide

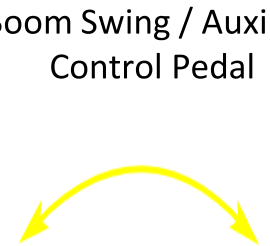
3.Operation Guide

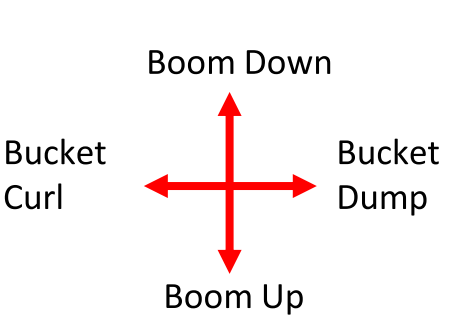
3. 1 LH & RH Console Arrangements

3.Operation Guide









3.Operation Guide

1. Quick Hitch Locking Switch
2. Wiper Switch
3. Washer Spray Switch
4. Heating System Switch
5. Undercarriage Expansion Enable Switch
6. Beacon Light Switch

3.Operation Guide

Breaker Operation

- Put the left console box down to enable pilot control
- Turn the cover of Braker (left) control pedal to open position, and use the braker control pedal to operate breaker circuit.
- When you don’t want to operate the breaker any more, please turn the cover of braker control pedal to closed position in case of any unintentional operation.

Auxiliary Circuit Operation

- Put the left console box down to enable pilot control,
- Turn the cover of Boom Swing / Auxiliary (right) control pedal to open position,
- Press down the switch on top of left joystick and hold, so that it can switch the right control pedal from boom swing control mode to auxiliary control mode.
- Use right control pedal ④ as marked on previous page to operate auxiliary circuit.
- When you don’t want to operate the auxiliary circuit any more, please turn the cover of right control pedal to closed position in case of any unintentional operation.

3.Operation Guide

Quick Hitch Operation

- Put the left console box down to enable pilot control.
- Flip the undercarriage expansion enable switch to the status with icon side down,
- Release the locking latch on the quick hitch locking switch, and flip the switch to press its icon side down to enable quick hitch control mode
- Use the dozer/ quick hitch control lever to operate quick hitch.
- When you don’t need to operate quick hitch, please disable the quick hitch mode.

Undercarriage Expansion Operation

- Put the left console box down to enable pilot control
- Press the icon side of undercarriage expansion enable switch down to enable undercarriage expansion control,
- Use the dozer/ quick hitch control lever to activate undercarriage operation.
- After undercarriage expand to intended position.
- Usually, after finishing undercarriage expansion operation, please turn off the undercarriage expansion enable switch in case of unintentional operation.

3.Operation Guide

Boom Swing Operation

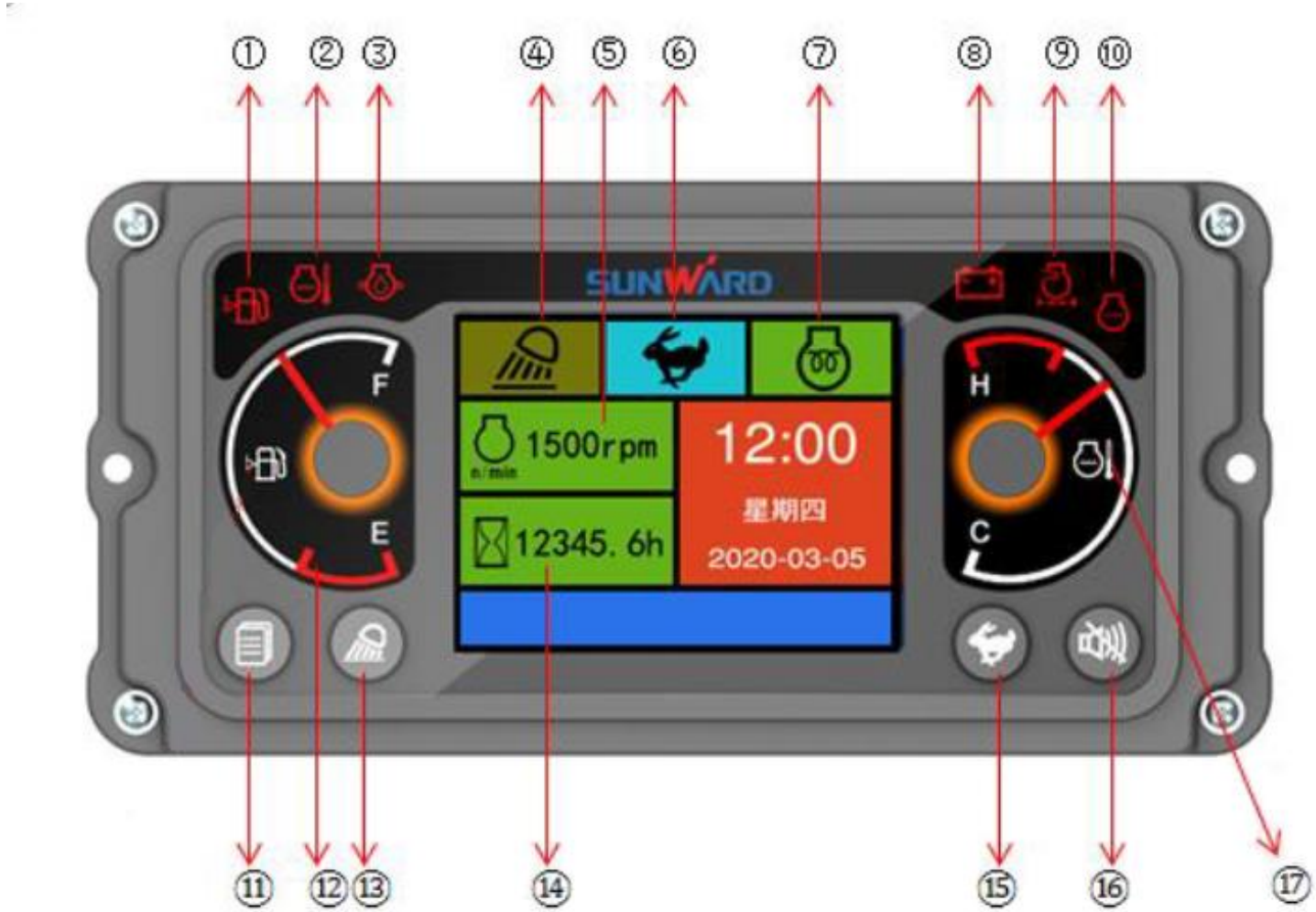
- Put the left console box down to enable pilot control
- Turn the cover of boom swing / auxiliary (right) control pedal to open position,
- Use right control pedal ④ to operate auxiliary circuit.
- When you don’t want to operate boom swing any more, please turn the cover of right control pedal to closed position in case of any unintentional operation.

Dozer Operation

- Put the left console box down to enable pilot control.
- Depress undercarriage expansion enable switch (icon side up) to switch to dozer control mode
- Use the dozer/ quick hitch control lever to operate dozer.

3.Operation Guide

① Fuel Level Warning Indicator
② Overheating Indicator
③ Engine Oil Pressure Warning Indicator
④ Work Lamp Indicator
⑤ Engine rpm
⑥ Two-speed Indicator
⑦ Preheating Indicator
⑧ Battery Charging Indicator
⑨ Air Filter Clogging Indicator
⑩ Engine Abnormal Indicator
⑪ Main menu button
⑫ Fuel Level Gauge
⑬ Work Lamp Switch
⑭ Work Hours
⑮ Two-speed Switch
⑯ Mute Button
⑰ Coolant Temperature Gauge



3.Operation Guide

Working light

Main menu

Two speed switch

Alarm sound mute

After you turn on power, You'll see left side page with basic machine information and these four button function as left column.

After you turn into Main menu, you will see right side page. Below four buttons will change his functions as right column.

Downwards

Upwards

Confirm

Cancel/back to upper lever

3.Operation Guide

Using password 402000 to enter Factory Set. From Factory Set, you will find Machine Model, Flywheel Set, Clear Hours, Machine No. set, Parameter set, Hours set.

You can enter Machine Model , Flywheel Set & Parameter Set only. Others will request for extra password.

3.Operation Guide

User Setting

There’s no password for User Set, and you can find Language Set , Date Time Set and Screen Brightness Set.

From language set, you’ll able to select Chinese, English , French, Dutch,

3.Operation Guide

Time， Date, Brightness Setting

From Date Time Set, you'll able to set the date and time with downside four buttons.

From Brightness, you'll able to change the screen brightness.

Ⅳ. Maintenance Guide

4. Maintenance Guide

SUNWARD ACADEMY

Maintenance & Lubrication Chart									
No.	Item	Maintenance Interval							Places
		8	50	100	250	500	1000	2000	
1	Display Screen and Indicating Lights	△							1
2	Battery（electrolyte）			□					1
3	Implements Shafts	□							18
4	Idler, Track Roller and Carrier Roller							□	12
5	Track Adjuster Cylinder		□						2
6	Slew Bearing		□						3
7	Swing Reduction Gear								1
8	Final Drive Gear Oil					□	○		2
9	Hydraulic Oil Level	□					○		1
10	Hydraulic Oil Return Filter						○		1
11	Hydraulic Oil Suction Filter						○		1
12	Pilot Filter					○			1
13	Air Breather				○				1
14	Radiator				△				1
15	Coolant	□					○		1
16	Fuel Level	□							1
17	Fuel Tank Strainer			△					1
18	Fuel Filter					○			1
19	Engine Oil	□	Initial ○		○（2nd）	○			1
20	Engine Oil Filter		Initial ○		○（2nd）	○			1
21	Fuel-water Separator	△							1
22	Air Filter			△		○			1

4. Maintenance Guide

1. Precautions Before Maintenance

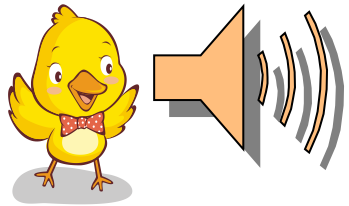
2. Daily Service & Inspection

3. Periodical Service

4. Non-periodical Service

4. Maintenance Guide

Precautions Before Maintenance



Be Careful!

1. Park the machine on flat ground.

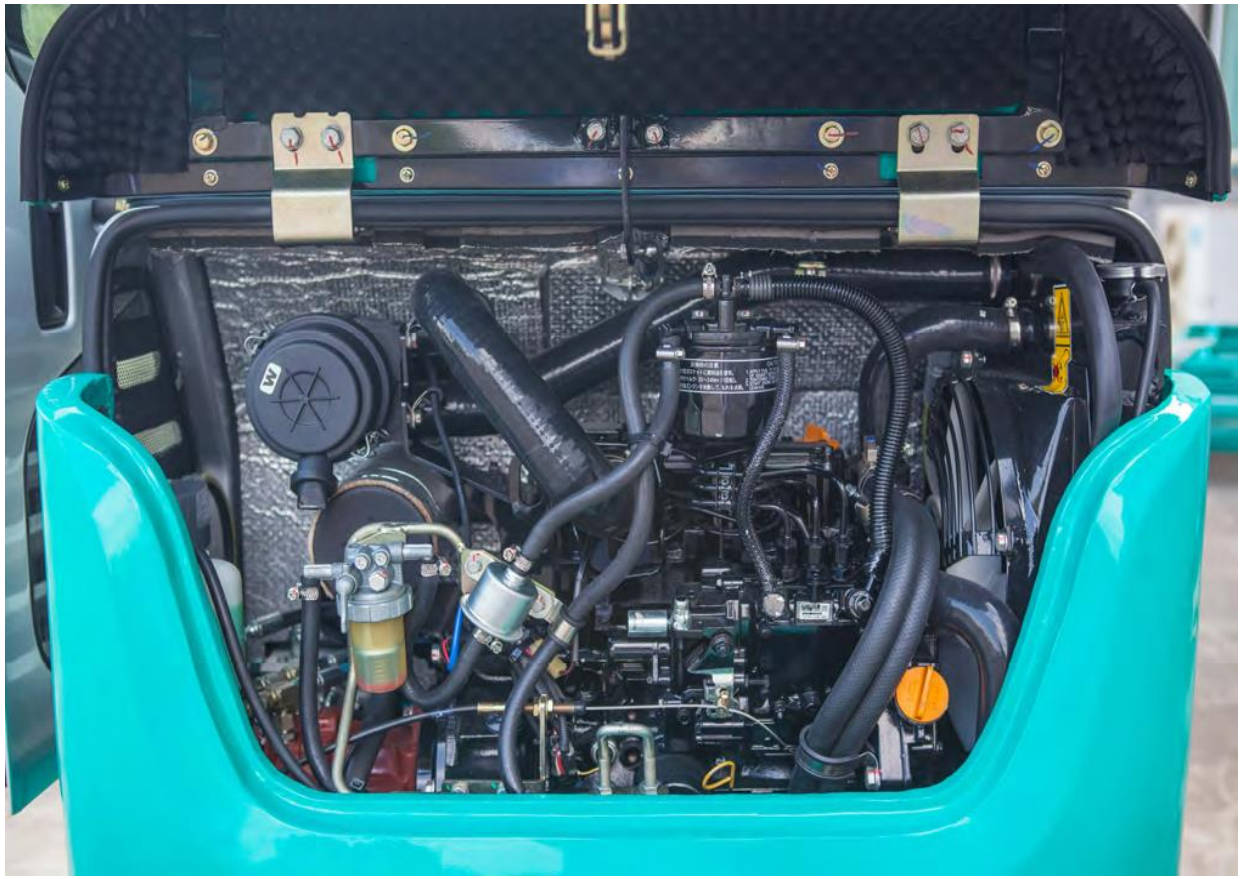
2. Lower down the bucket to ground as shown in next picture;

3. shut down engine, remove ignition key.

4. Pull up the safety lever, and hang a visible "Don’t start" tag on it.

4. Maintenance Guide

Periodic Maintenance Points



A. Air Filter

B. Electronic Fuel Supply Pump

C. Fuel Filter

D. Engine Oil Filling Port

E. Fuel-Water Separator

F. Fuel Separator

G. Radiator Cap

H. Battery

I. Breather

J. Hydraulic Return Filter K. Coolant Expansion Tank

L. Battery M. Fuel Filling Port N. Fuse & Relay Box

4. Maintenance Guide

4.1 Daily Service & Inspection

3.2.1 Park the machine as shown in the following picture, turn the ignition to “OFF” position, and remove the key.

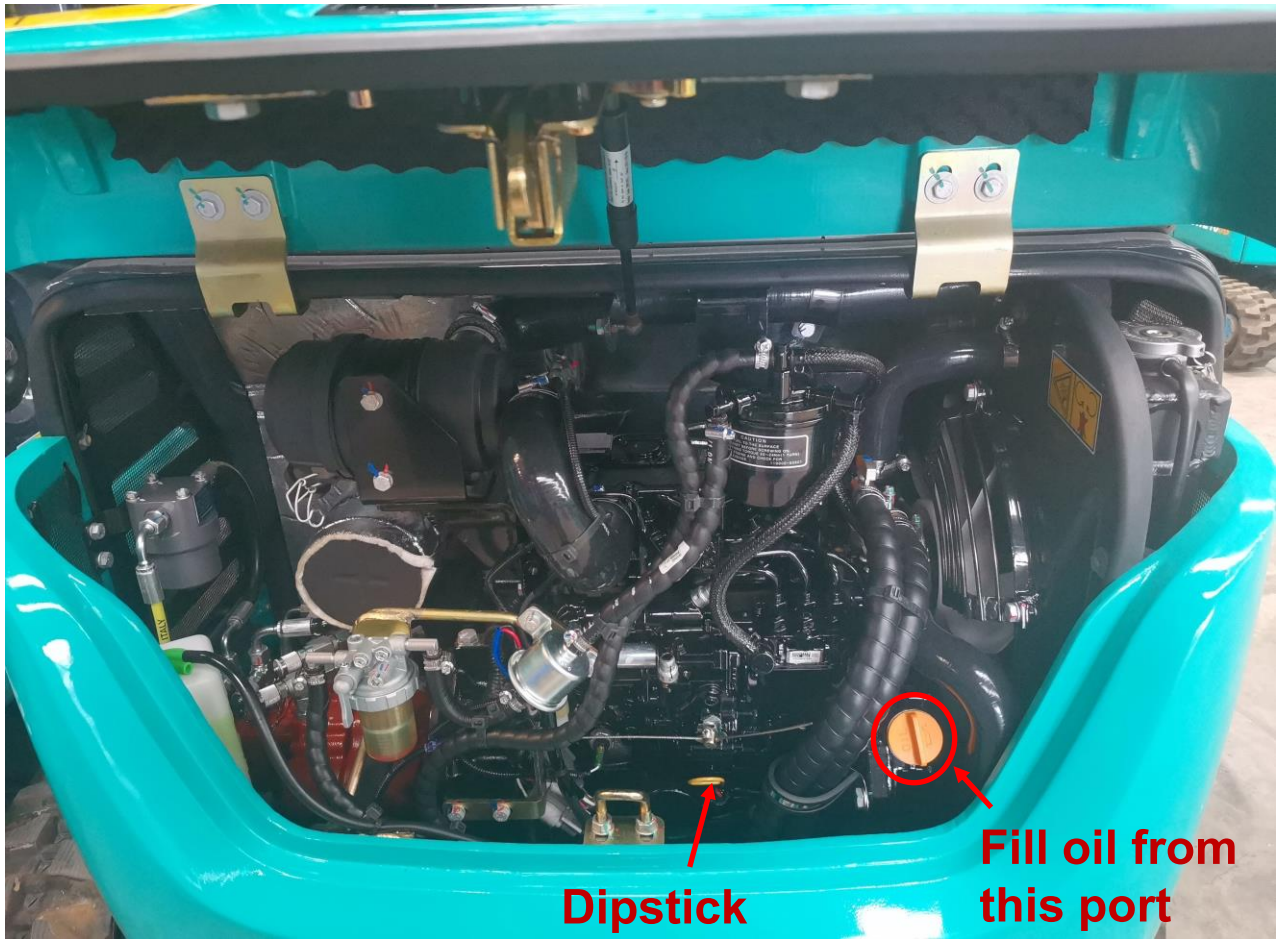
Park the machine as shown

Ignition key turn to “OFF” position, and then remove the key

4.Maintenance Guide

4.1.1 Check engine oil level.

Check Engine Oil Level, fill some to make it reach to standard level if necessary.

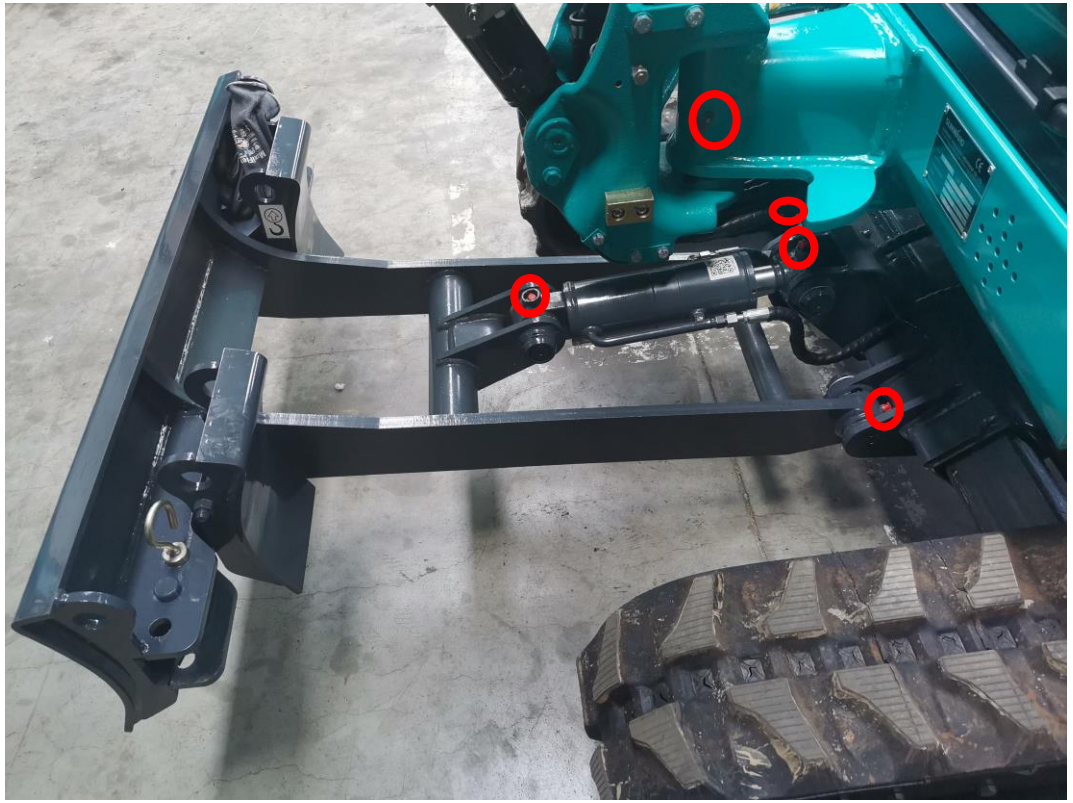


4.Maintenance Guide

4.1.2 Drain water separator if necessary.

4.Maintenance Guide

4.1.3 Grease nipples for all the hinge shafts



4.Maintenance Guide

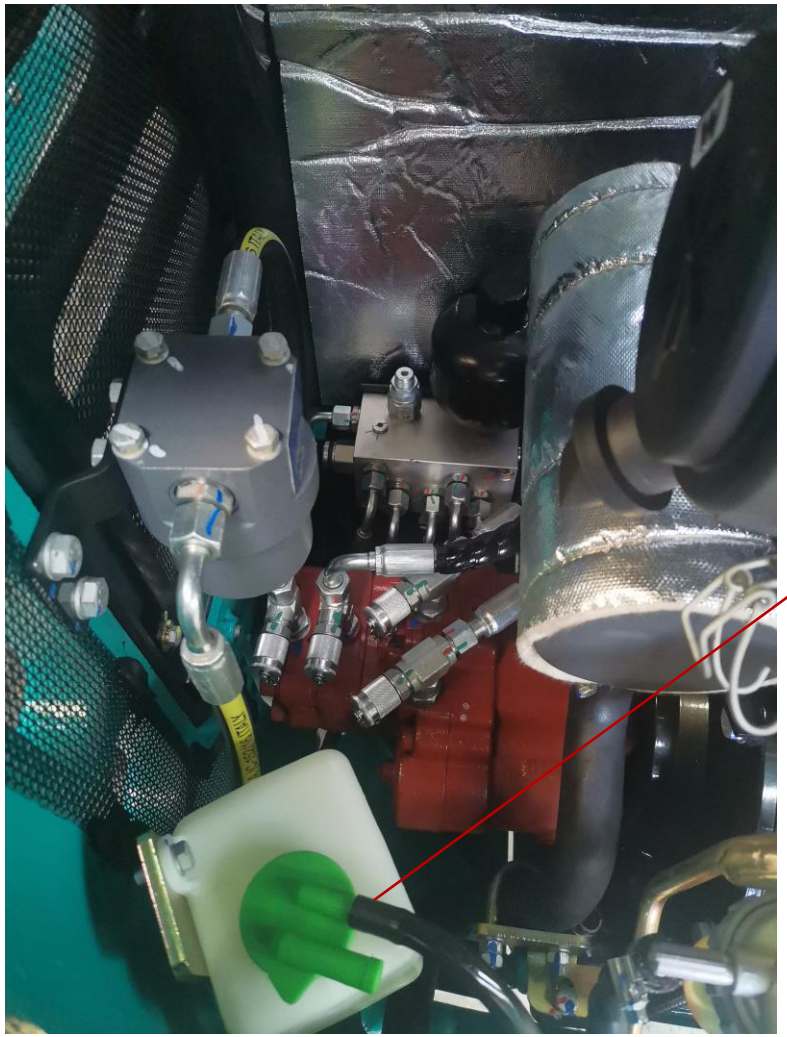
4.1.4 Check Hydraulic Level and fill some if necessary.

Fill hydraulic from here.

Check Hydraulic Level, ,fill some SUNWARD genuine hydraulic to make it reach to standard level range.

4.Maintenance Guide

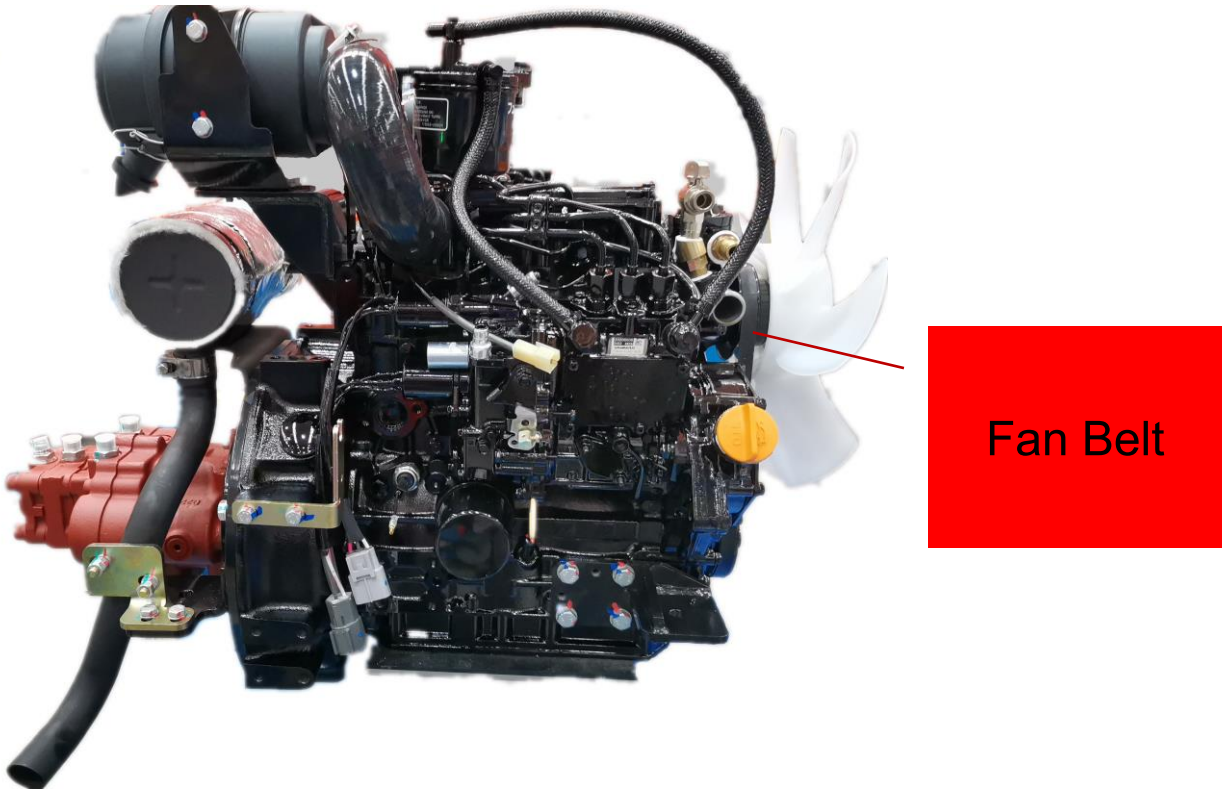
4.1.5 Check coolant level

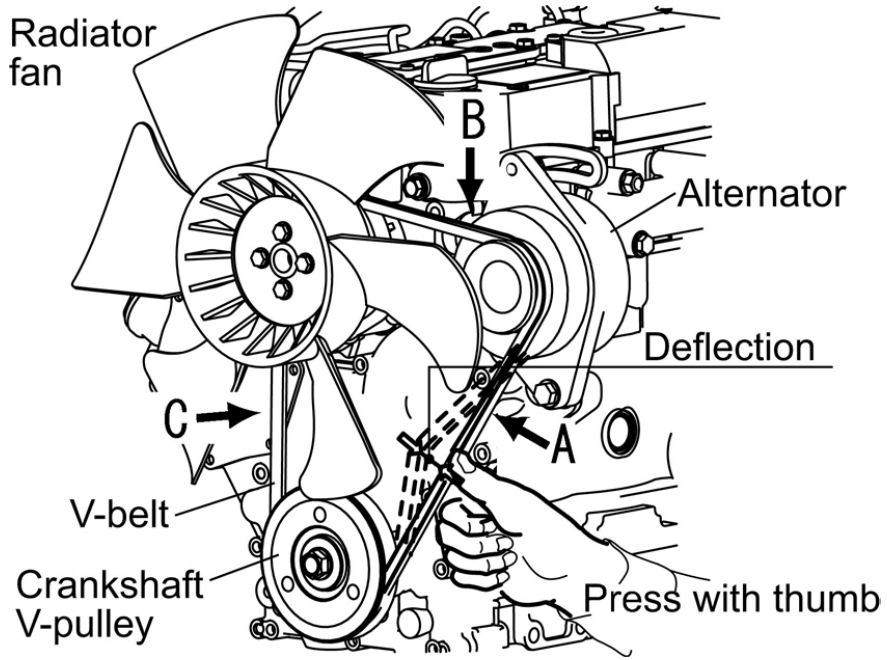


Check coolant level from here, make sure its level is between high and low mark, if not, please fill some coolant till the level reaches between high and low mark.

4.1.6 Check fan belt tension and damage

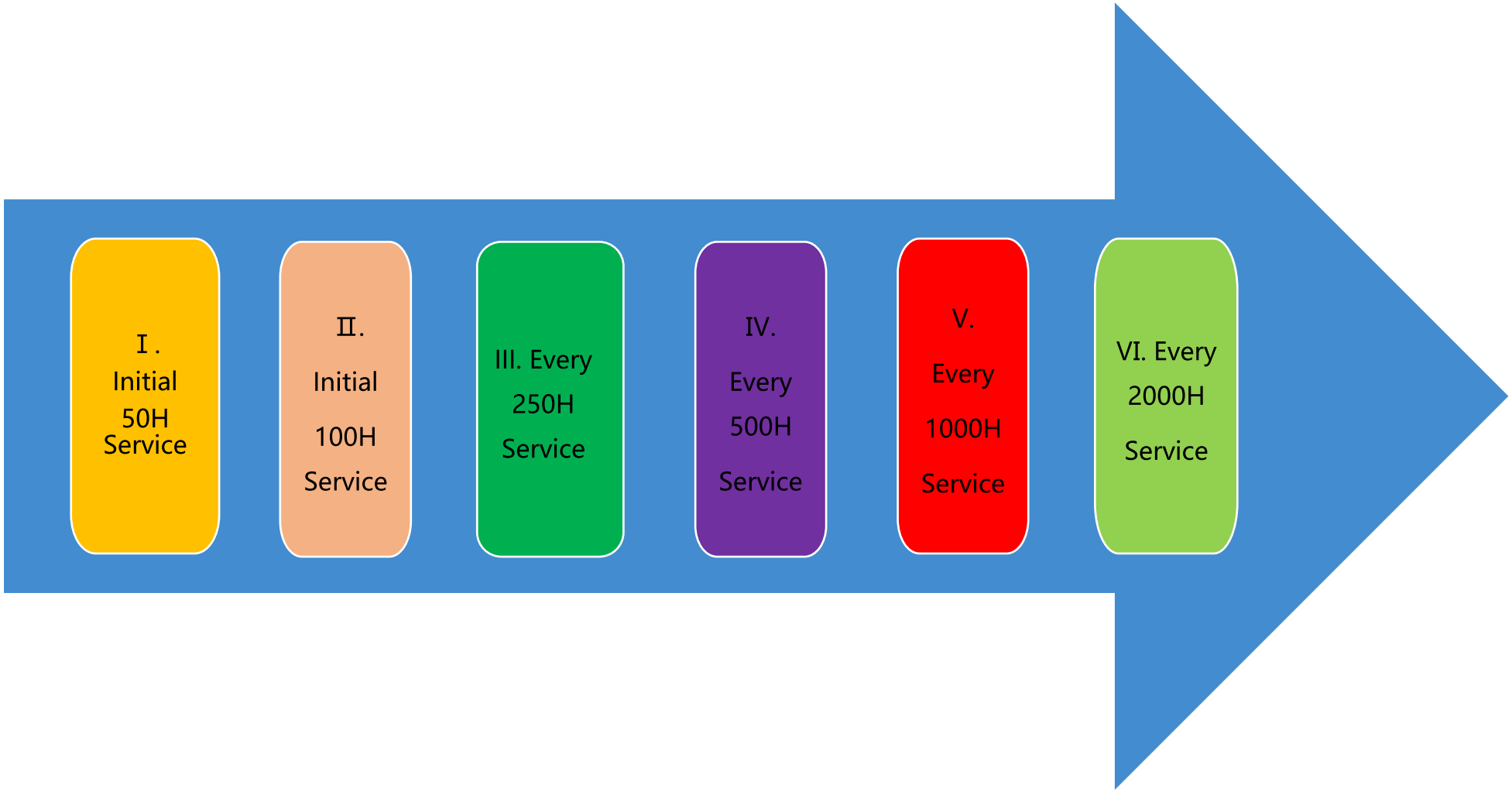
- Loose fan belt may cause engine over-heating, belt over-tightened may shorten belt service life.





Press Force: 98N
Play: approx. 9~13mm

4.Maintenance Guide



4.Maintenance Guide

4. Periodical Maintenance Overview

- 4.1.1 Initial 50 hours Service
- 4.1.2 Initial 100 hours Service
- 4.1.3 Every 250 hours Service
- 4.1.4 Every 500 hours service
- 4.1.5 Every 1000 hours service
- 4.1.6 Every 2000 Hours service

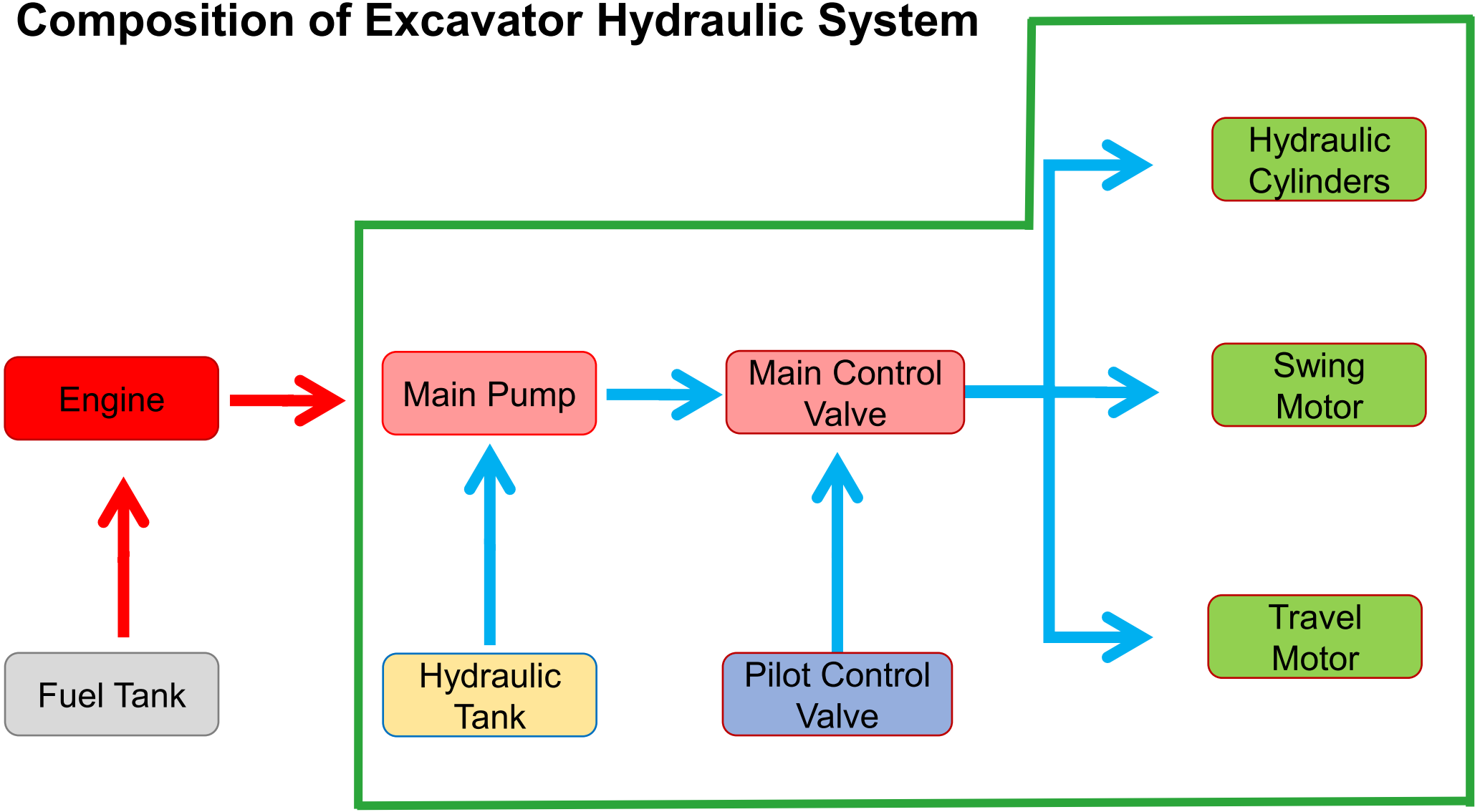
3.Maintenance

Model	Parts Code	Parts Description	Unit	Maintenance Intervals (when work with bucket)												
				50	100	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
SWE20F	730403000138	Fuel filter	pcs				1		1		1		1		1		1
	730405000005	Water Separator	pcs				1		1		1		1		1		1
	750201010253	Oil filter	pcs	1		1	1	1	1	1	1	1	1	1	1	1	1
	730403000072	Secondary air filter	pcs	depends on work environment													
	750201010252	Primary air filter	pcs														
	730403000079	Hydraulic return filter	pcs						1				1				1
	730401000051	Hydraulic suction filter	pcs						1				1				1
	730403010046	Pilot oil filter	pcs				1		1		1		1		1		1
	760301000017	Hydraulic oil (L)	L						37				37				37
	760305000023	Engine oil 15W-40 CF (L)	L	3		3	3		3		3		3		3		3
	760305000064	Gear oil (L)(Travel)	L			2*0.33			2*0.33				2*0.33				2*0.33
	760305000191	Coolant	L														
	when use breaker, hydraulic and hydraulic filters should be changed every 500h																

V. Hydraulic System

5.Hydraulic System

5.1 Composition of Excavator Hydraulic System



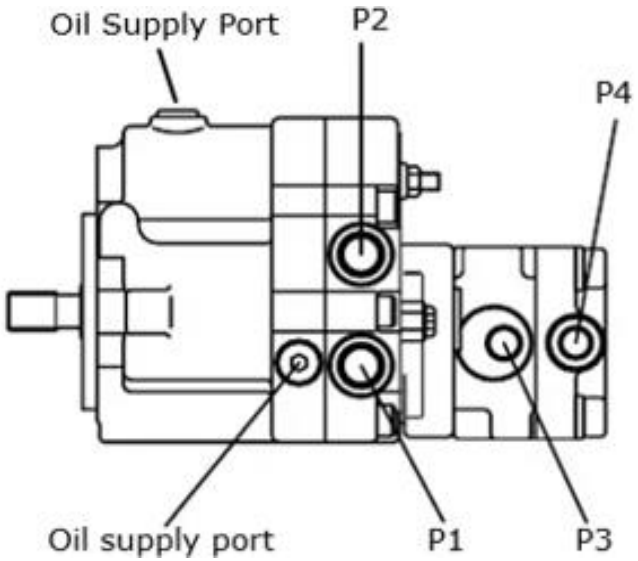
5. Hydraulic System

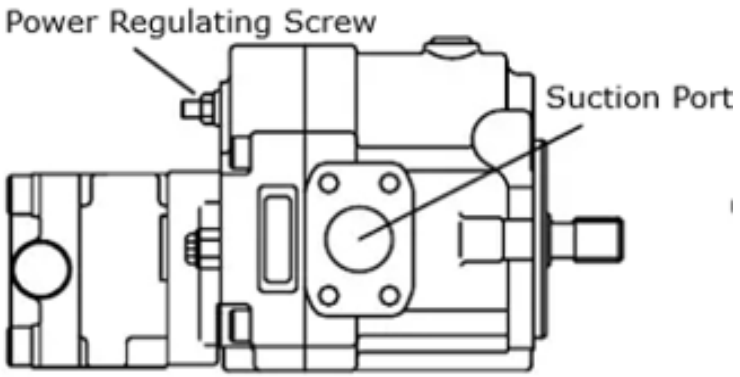
5. 1 Key Components Parameters

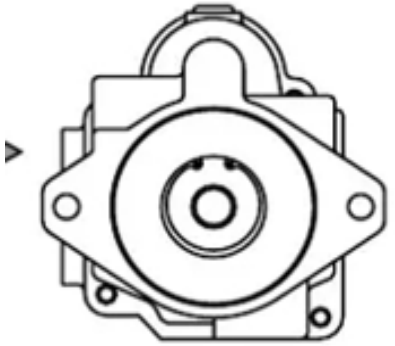
Item	Model	Remark
Engine	3TNV80F-SSSU	13.4kw @ 2200rpm 1.267L
Pump	PVD-0B-19P-6AG3-5807A	9.5*2+6+2.7 cc/rev 22.5*2Mpa+17Mpa+3.5Mpa
Main Control Valve	EV310198	35L/min,25Mpa
Swing Motor	PCR-1B-05A-P-9189A	469kN·m, 25.9Mpa, 14L/min, 236cc/rev
Travel Motor	PHV-2B-20A-PT-9775A	1668N·m, 24.5Mpa, 21L/min, 16.1/9.1 cc/rev

5. Hydraulic System

5.2 Hydraulic Pump



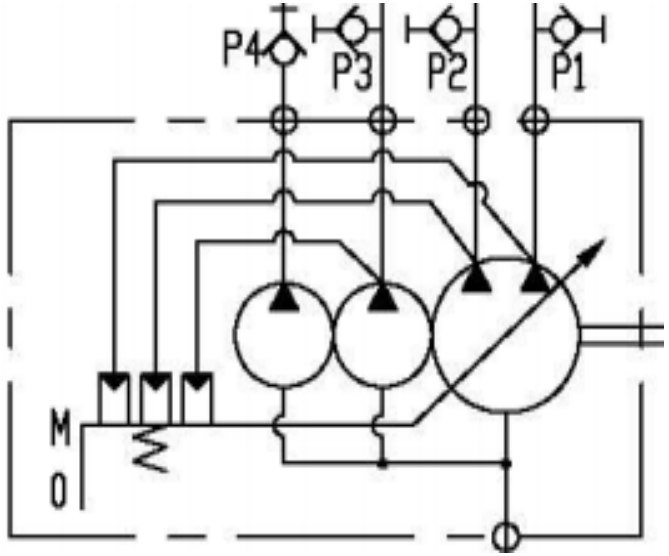


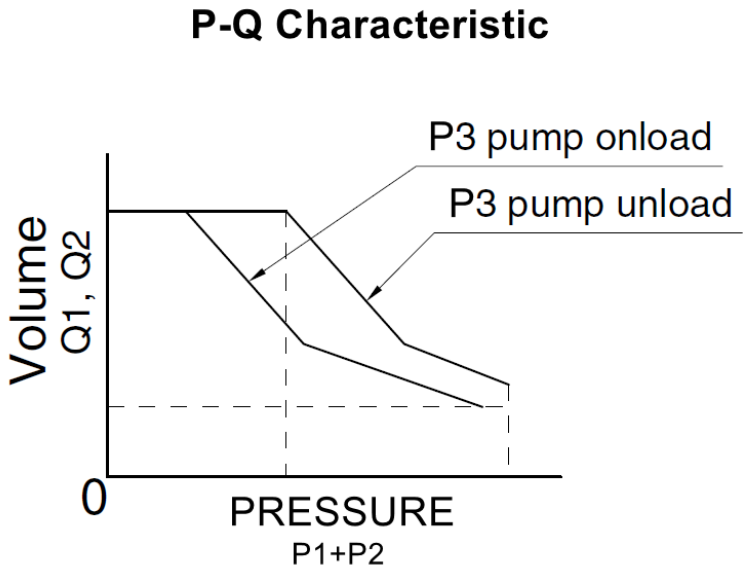


Model	PVD-0B-19P-6AG3-5807A
Type	Single variable pump with 2 press. ports +1 gear pump
Max Permissible Pressure	22.5*2Mpa+17Mpa+3.5Mpa
Max Displacement	9.5*2+6+2.7 cc/rev
Weight	17.5 kg

5. Hydraulic System

5.2 Hydraulic Pump

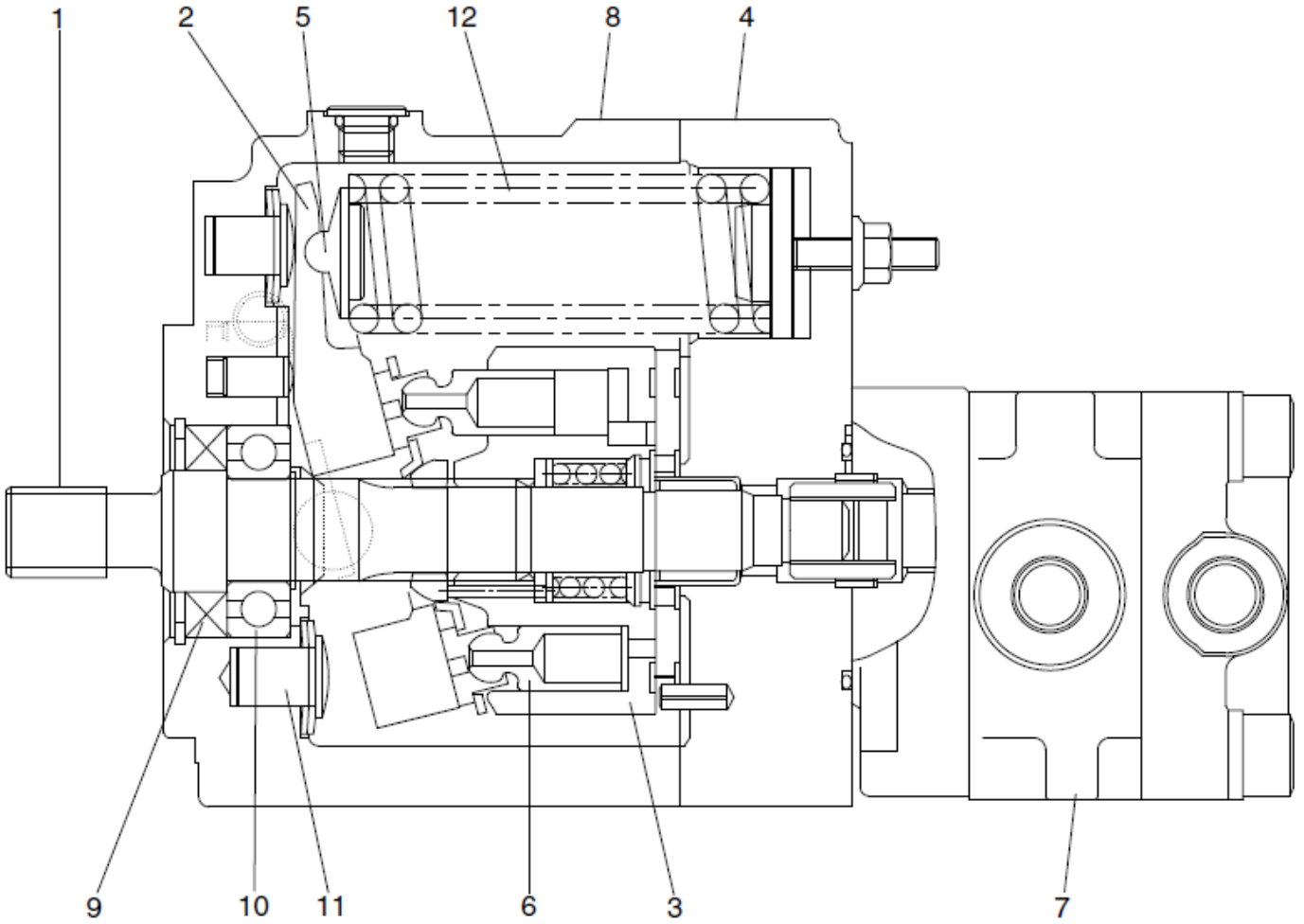




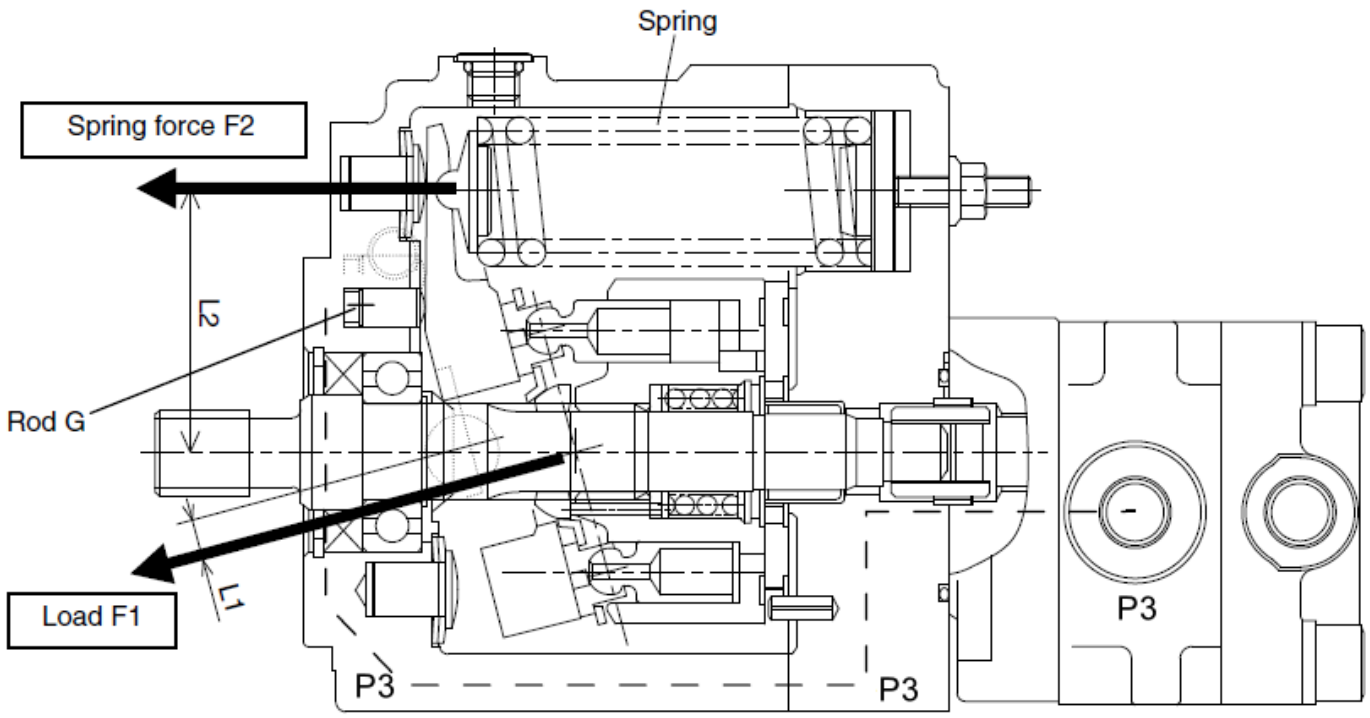
- This is a variable displacement double-piston pump which discharges two equal amounts of flow to ensure travel straightness. this pump is so compact as to appear a single pump, though this is actually a double pump with same displacement.
- Because these two pumps share the same swashplate, the inclination of the swashplate always keep the same for two pumps. Inclination of the swashplate in response to the total pressure of P1 + P2. Namely, the output torque is controlled to a constant value so that the relationship between the discharge pressure and flow rate Q becomes constant, **(A1 + A2) * Q =Constant.** Constant horsepower control with full use of engine horsepower, resulting in increased speed and power for mother machine.
- The third pump and pilot pump are connected to the same shaft via a coupling. Which makes the pump very compact.

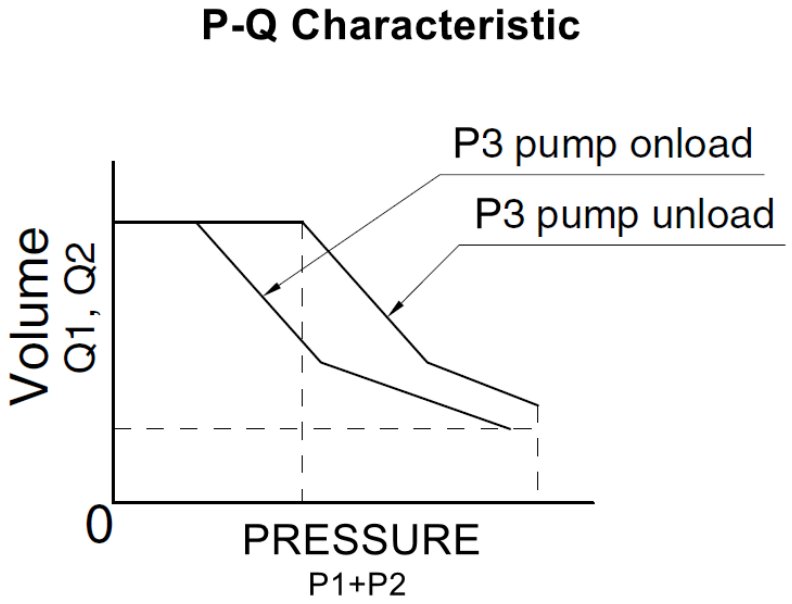
5. Hydraulic System

1. Drive shaft assembly
2. Swash plate assembly
3. Cylinder barrel
4. Port plate assembly
5. Spring seat assembly
6. Piston
7. Gear pump
8. Housing
9. Oil seal
10. Bearing
11. Stopper assembly
12. Spring



5. Hydraulic System





5. Hydraulic System

Constant horsepower variable structure

The pump output flow rate is variable depending on an angle of the swash plate which is controlled according to the pump output pressure. This control enables the pump consumption horsepower to be sustained at the maximum. The tilt point of the swash plate is the balls located behind the swash plate. The load F1 from the pistons is in the direction shown in the illustration and generates a clockwise moment against the swash plate. Against this force the spring (force F2) is located in the opposite direction to keep the horsepower constant and set at the appointed load.

As the pressure increases, the above clockwise moment increases, and when it overcomes the counter-clockwise moment created by the spring force, the spring is sagged and the swash plate angle gets smaller. Then the output flow rate is reduced to keep the horsepower constant.

This prevents engine stall and the engine horsepower can be utilized at the maximum.

Power shift mode (Reduced horsepower control by A3 pressure)

This control keeps the maximum value of the pump consumption horsepower including the third pump (gear pump) constant. When the A3 (gear pump) pressure acts on the rod G, a clockwise moment proportion to the pressure acts on the swash plate and the A-Q characteristic shifts so that the total pump consumption horsepower including the gear pump horsepower is kept constant.

5. Hydraulic System

- The pressure of P1, P2, P3 circuits are all applied on the power regulating servo piston of the variable displacement pump P1 and P2.

- When all of the directional control spool are at neutral position, P1+P2+P3 is very low, spring force of the displacement regulator will push the servo piston and let the pump discharge with full flow.

- Once any or all of the directional control spool in MCV shifted position, then the pressure applied on the power regulating servo piston will increase gradually, when the load is still light, P1+P2+P3 is still not strong enough to press power regulating spring, the pump will keep output full flow, so that the machine can work with light load more quickly and efficiently.

- As load increasing, pressure will increase as well, once P1+P2+P3 is strong enough, it will press the power regulating spring, and reduce displacement of P1 and P2, but the total power output will keep constant, so that the machine will not overload, and meanwhile it can maximize utilization of the power output by engine.

5. Hydraulic System

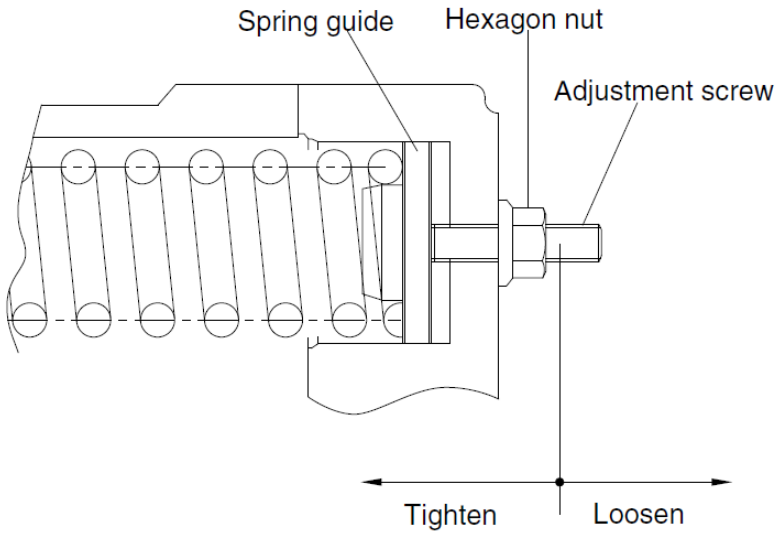
Pump Installation:

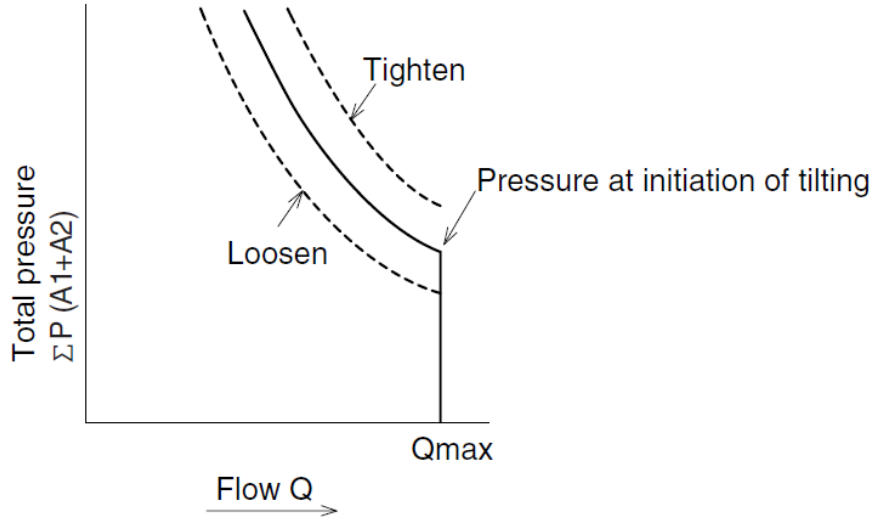
- Make sure the input shaft is horizontal when installing the pump.
- Install the pump at a position lower than the lowest oil level in the tank to allow oil flow smoothly and continuously into the pump.
- Clean all oil ports carefully before hose connection, so that no contaminants will intrude into the system.
- Since the pump is installed directly to the diesel engine, which is vibrating all the time when running, always use a flexible hose to connect between inlet port of the pump and tank. Install the suction pipe securely to prevent from sucking air, which will cause abnormal noise, and is very harmful to the pump.
- After installation, fill the pump housing with clean hydraulic oil to extrude air in the housing.
- Use high-pressure type flexible hoses for the discharge ports.

5. Hydraulic System

- **Pump Adjustment Method:**

1. Loosen the hexagonal nut.
2. Tighten or loosen the adjusting screw to set the power shifting line.

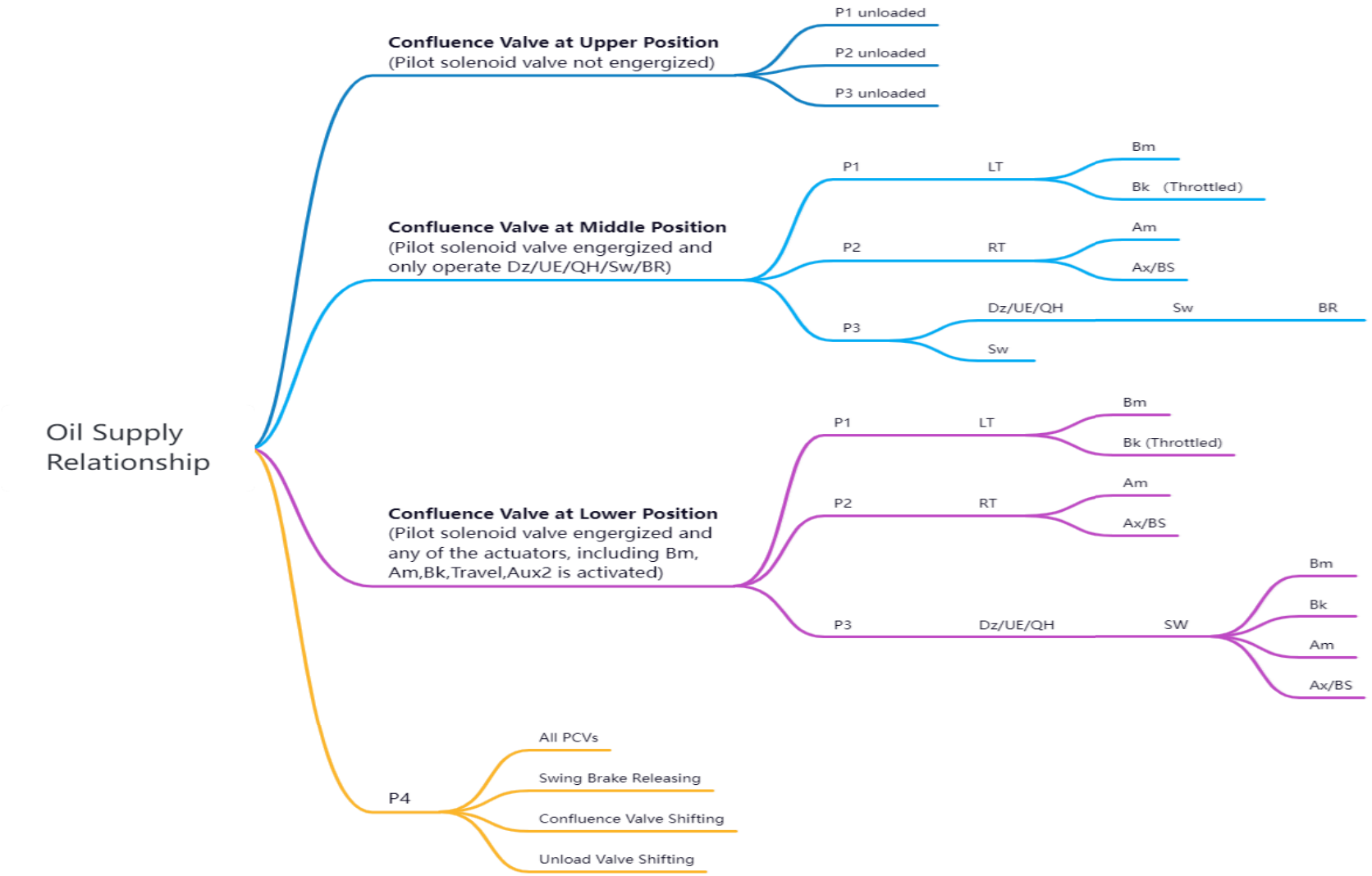




Notice: This hydraulic pump has been set and inspected according to specified input power and control. Readjustment of all the adjusting portions may lead to the loss of functions specified for each control and the pump may be excluded from the scope of warranty. Never attempt operating the adjusting screw, etc.

5. Hydraulic System

Oil Supply Relationship of the pump



5. Hydraulic System

5.3 Main Control Valve

Dz/UE/QH	Sw	P3&Cf	Br	Ax/BS	Am	RT	P1P2	LT	Bm	Bk

Dz/UE/QH: Dozer / Undercarriage Expansion / Quick Hitch

Sw: Swing

P3&Cf: P3 & Confluence

Br: Breaker

Ax/Bs: Auxiliary / Boom Swing

Am: Arm

RT: Right Travel

P1P2: Inlet for P1 & P2

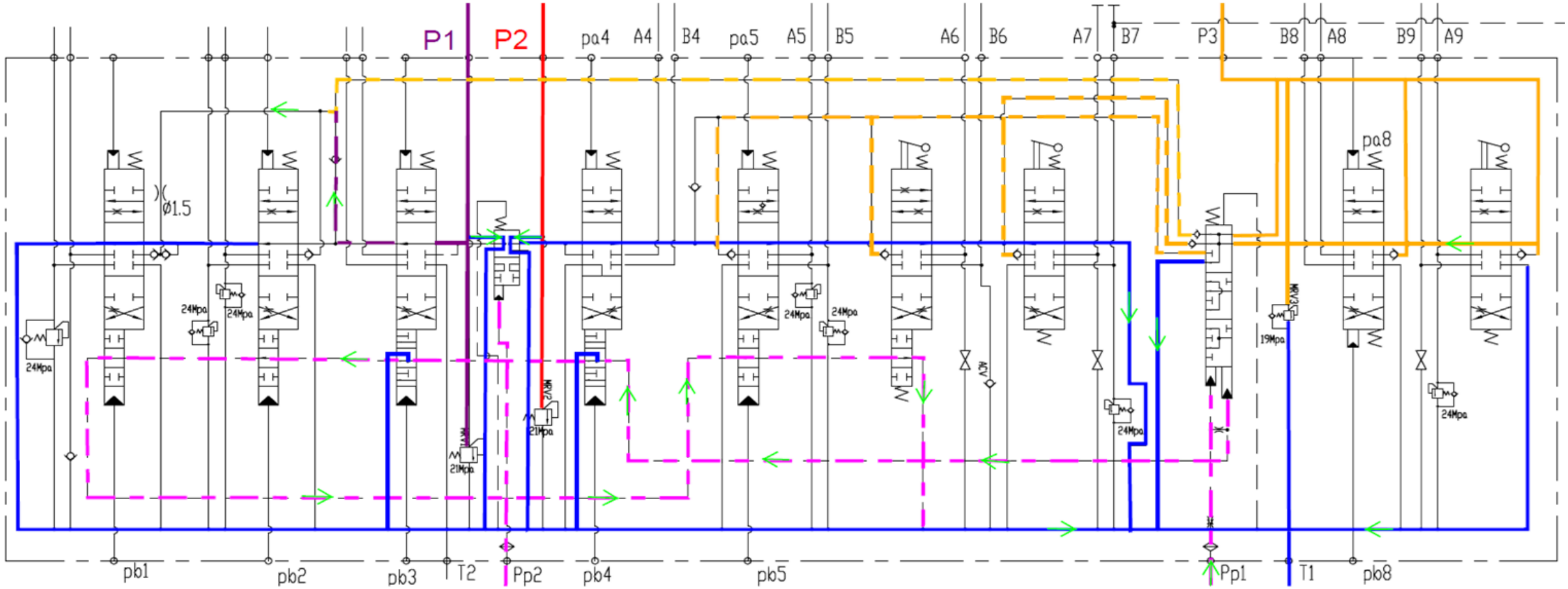
LT: Left Travel

Bm: Boom

Bk: Bucket

5. Hydraulic System

Bk	Bm	LT	P1P2	RT	Am	Ax / BS	Br	P3 & Cf	Sw	Dz/UE/QH

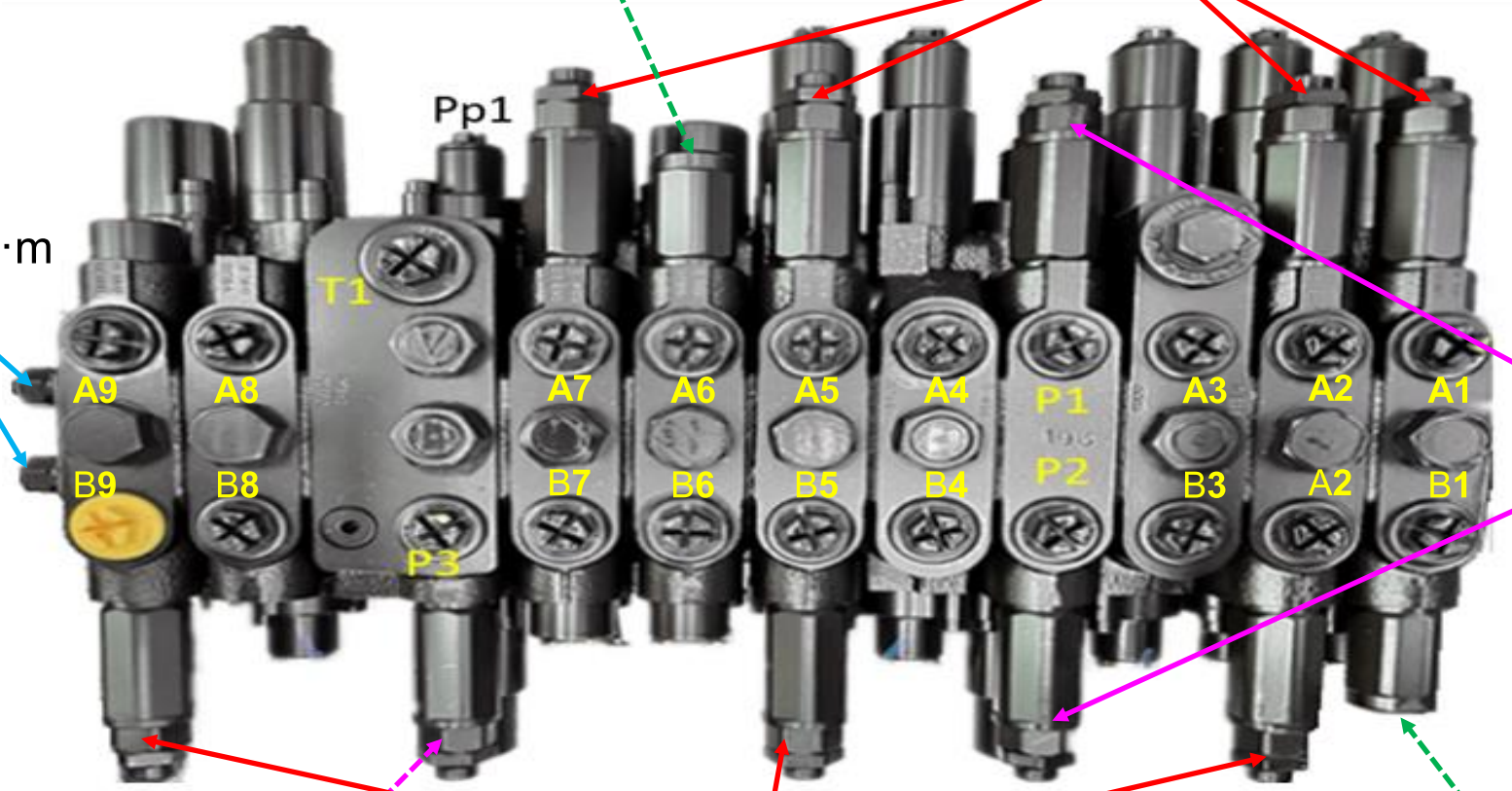


5. Hydraulic System

Features Of Main Control Valve

- **Confluence:** Direct oil flow from two pumps to feed the same actuator, so that the machine speed and efficiency is increased, and improve operation experience.
- **Overload Protection & Anti-cavitation:** Protect the actuators and structural members.
- **Straight Travel:** Ensures the machine won't deviate during combined operation.
- **Boom Priority:** Endue the operator with better operation experience
- **Return Oil Regeneration:** Increase work speed and avoid from cavitation
- **Load Check Valve:** prevent cylinder from dropping (head-nodding) during an initial period of spool position shifting Hydraulic pilot control

5. Hydraulic System



Anti-cavitation Check Valve (ACV)

Secondary Relief Valve

BULLONE
T-16.6-17.6 N·m

Main Relief Valve

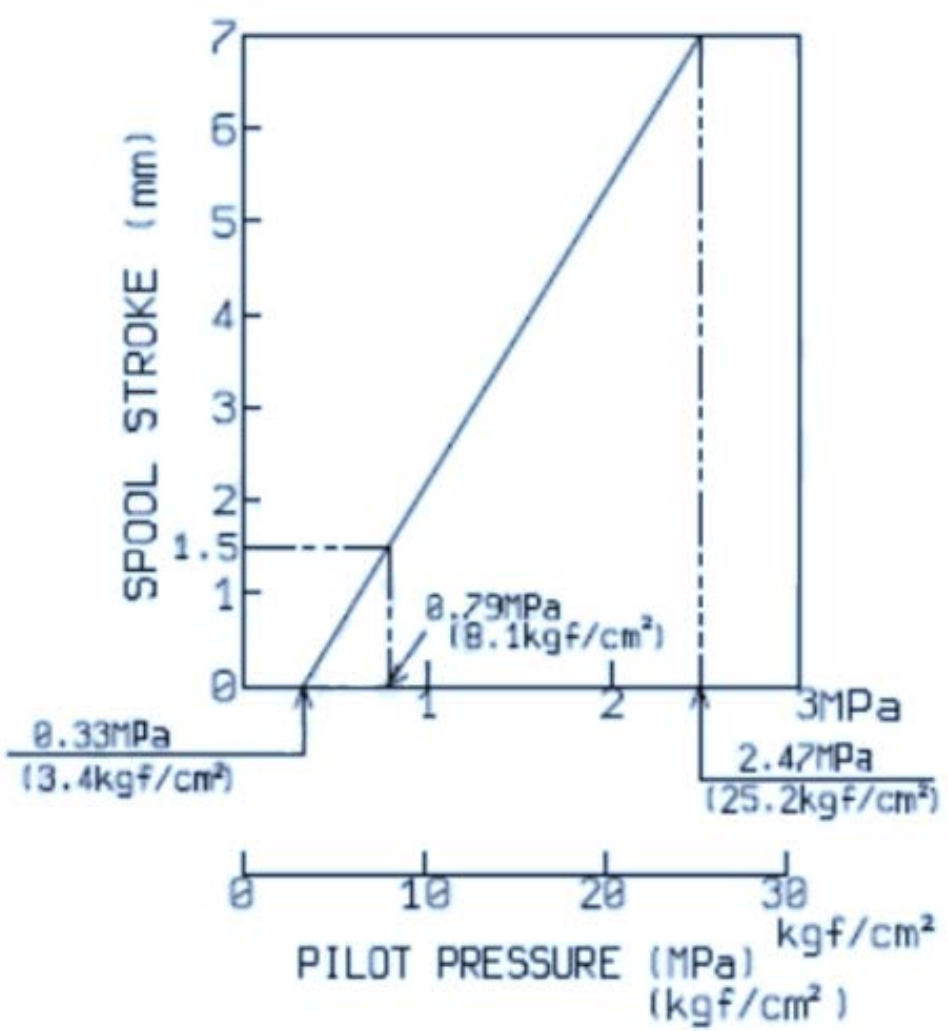
Main Relief Valve P3

Secondary Relief Valve
& Anti-cavitation Valve

Anti-cavitation Check Valve (ACV)

5. Hydraulic System

Main Control Valve Specification		
Flow	P1	21 L/min
	P2	21 L/min
	P3	15 L/min
Main Relief Pressure	MR1	$21.0\ ^{+0.49}_{0}$ Mpa @ 21 L/min
	MR2	$21.0\ ^{+0.49}_{0}$ Mpa @ 21 L/min
	MR3	$16.0\ ^{+0.49}_{0}$ Mpa @ 15 L/min
Secondary Relief Pressure	A1,A2,B2,A5,B5 ,B9,	$24.0\ ^{+0.49}_{0}$ Mpa @ 5 L/min
	A7	$12.0\ ^{+0.49}_{0}$ Mpa @ 15 L/min
Hydraulic Fluid		ISO VG46
Operating Temperature Range		-28/+115℃

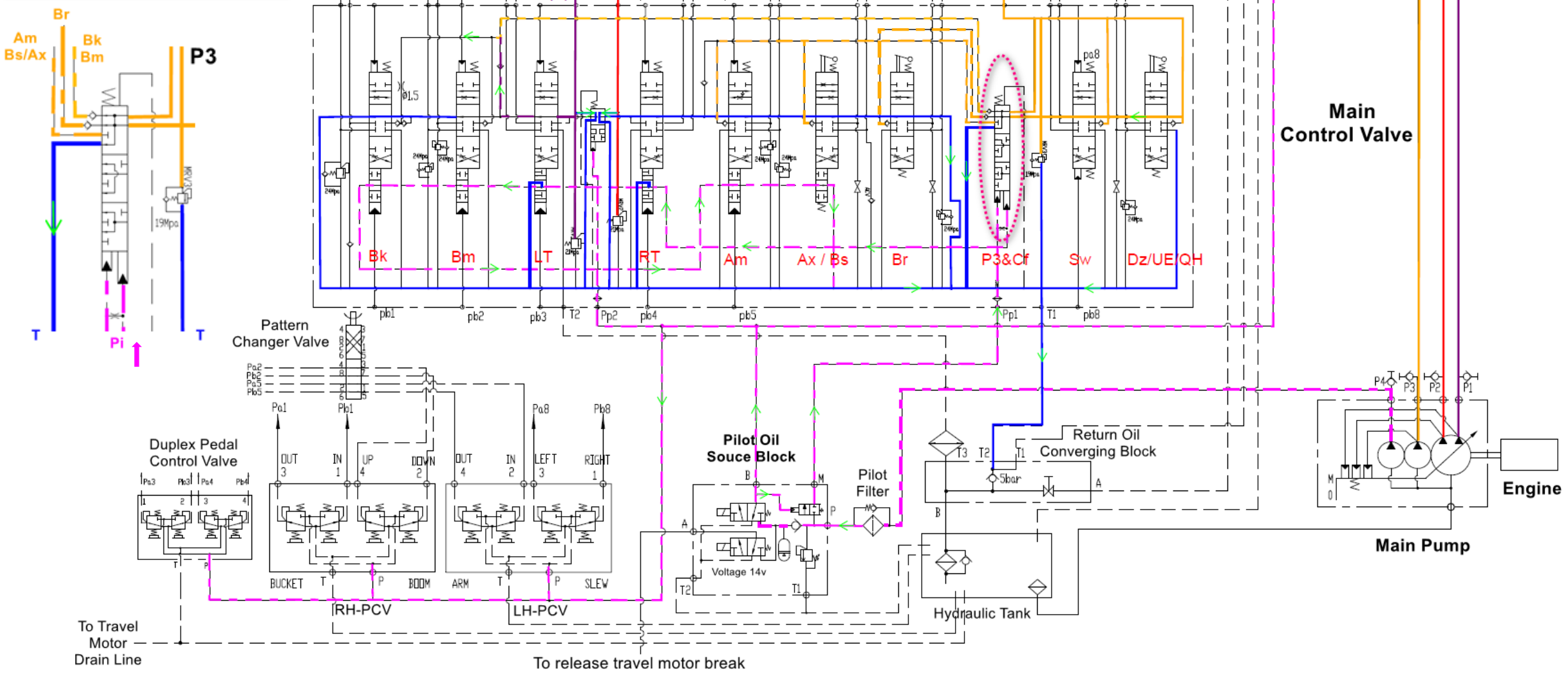


5. Hydraulic System

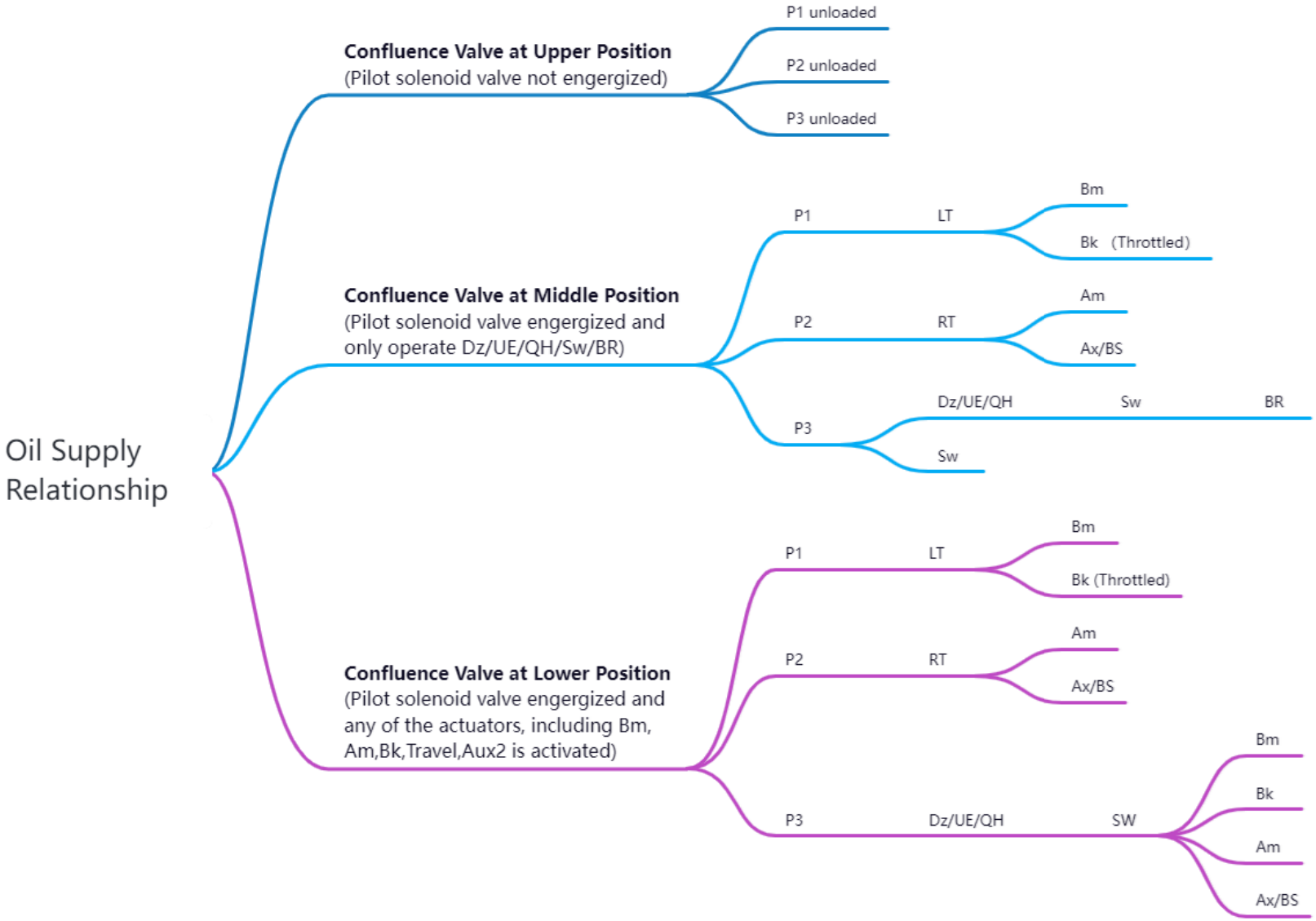
Main Control Valve Specifications	
Rated Pressure:	24.5Mpa
Rated Flow:	35L/min
Relief Valve Adjustable Range:	4.98-24.5Mpa
Secondary Relief Valve Set Pressure:	Max: 27.4Mpa
Spool Leakage at 9.81Mpa (37cst):	
Port B2:	Less than 1 ml/min
Port A6,B6,A9,B9:	Less than 3 ml/min
Port A8,B8:	Less than 4 ml/min
Other Ports:	Less than 7 ml/min
Hydraulic Fluid:	Mineral Type Oil
Pilot Port Pressure:	Max. 4.98Mpa
Tank Line Pressure:	Max. 0.98Mpa
Contamination Level:	Less than NAS9 class

5. Hydraulic System

Confluence



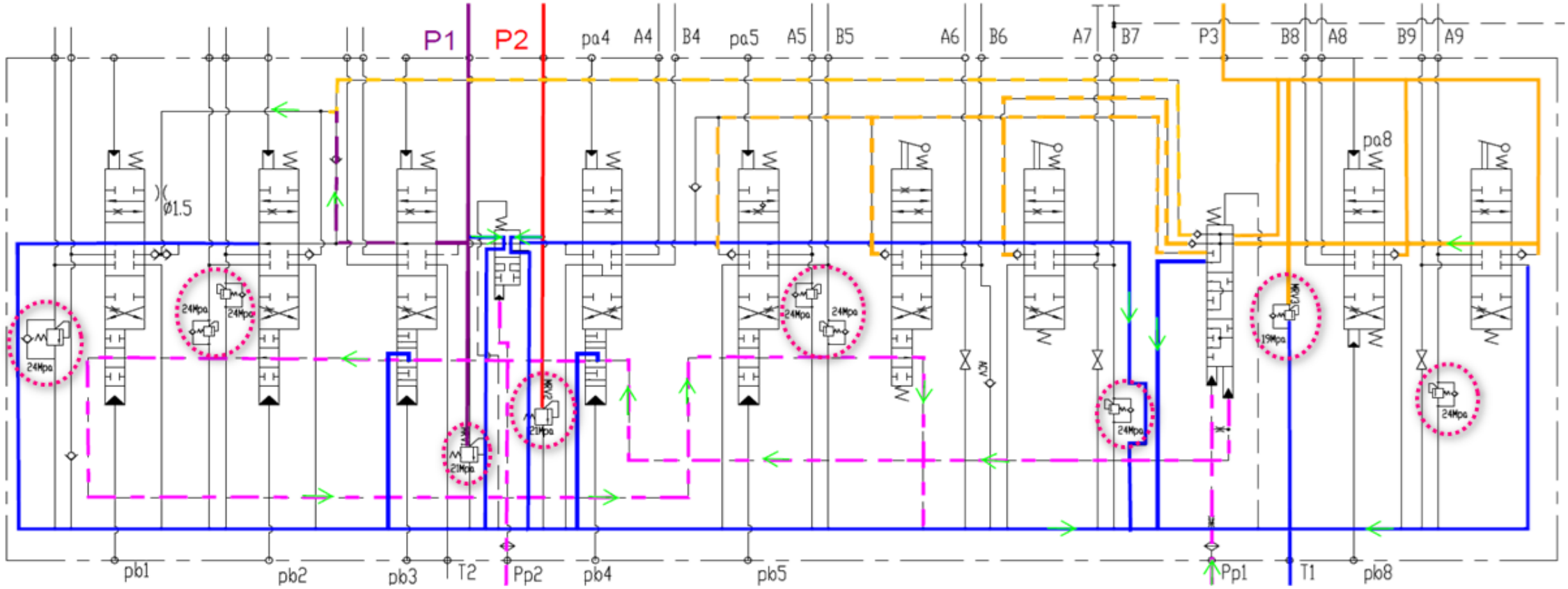
5. Hydraulic System



5. Hydraulic System

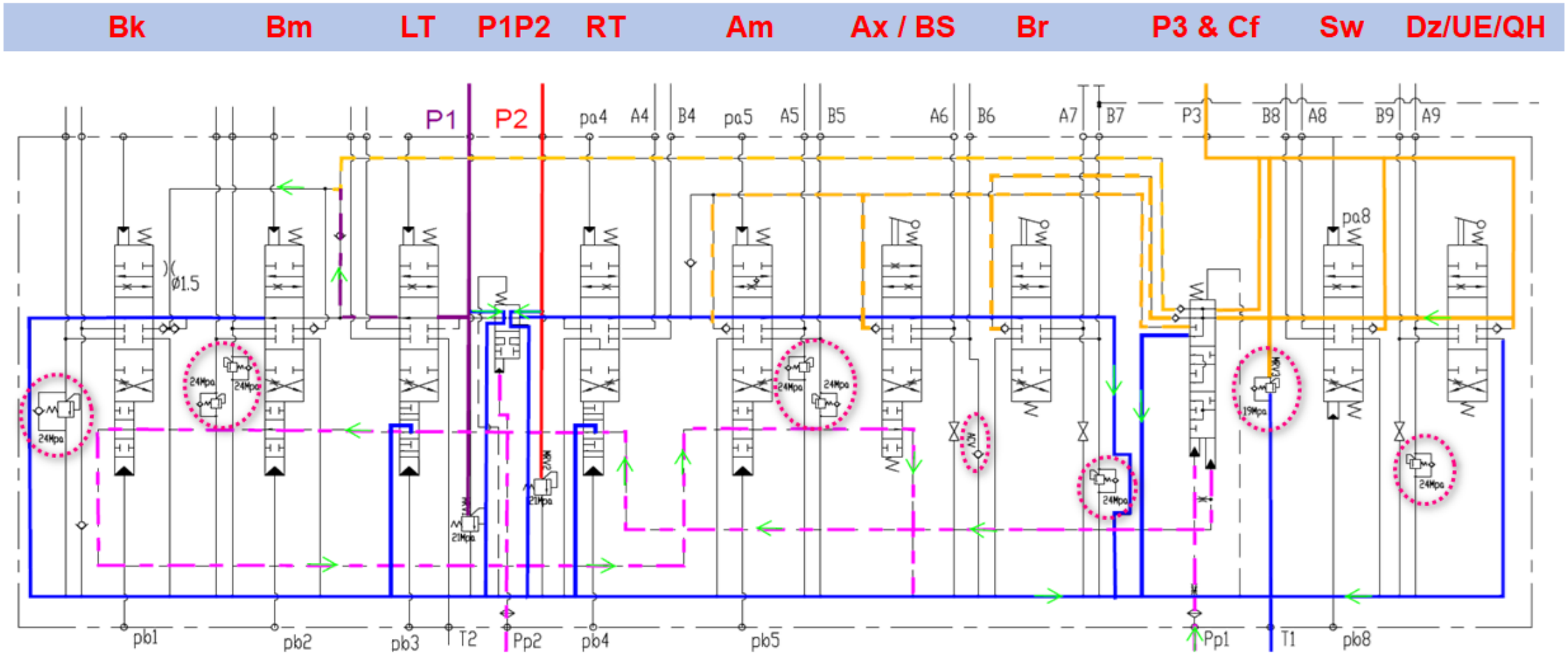
Overload Protection

Bk | Bm | LT | P1P2 | RT | Am | Ax / BS | Br | P3 & Cf | Sw | Dz/UE/QH



5. Hydraulic System

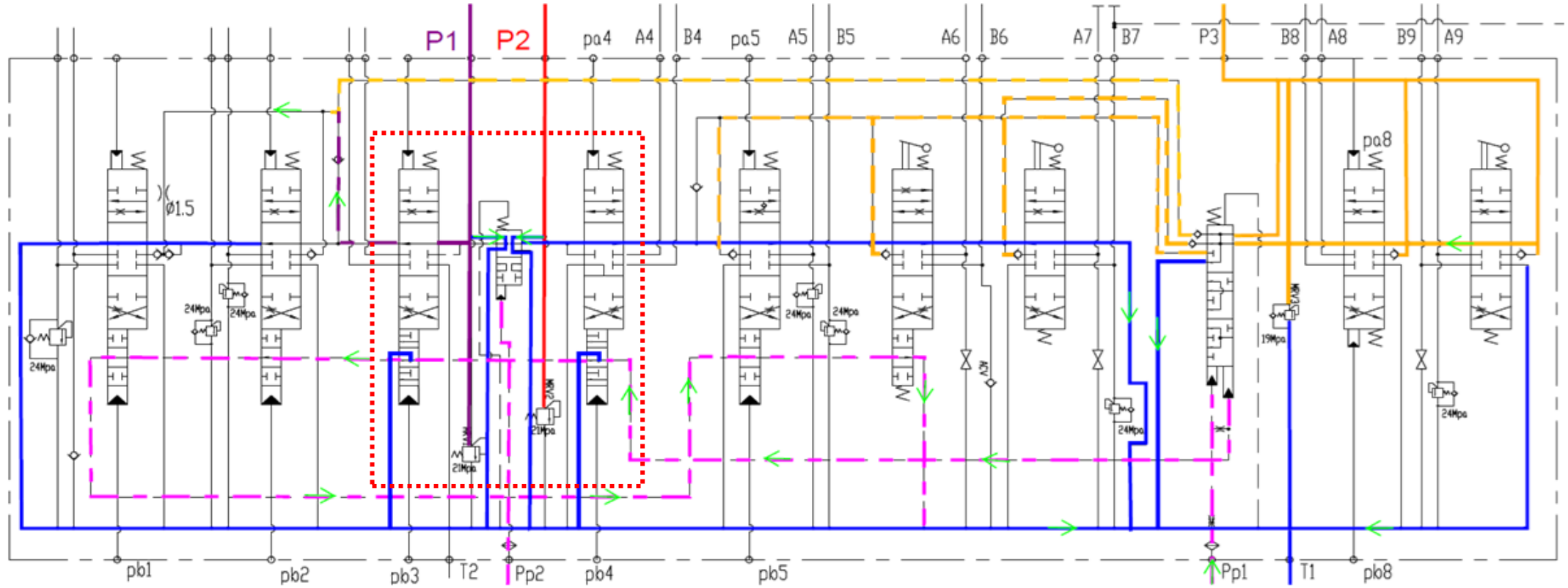
Anti-cavitation Valve



5. Hydraulic System

Straight Travel

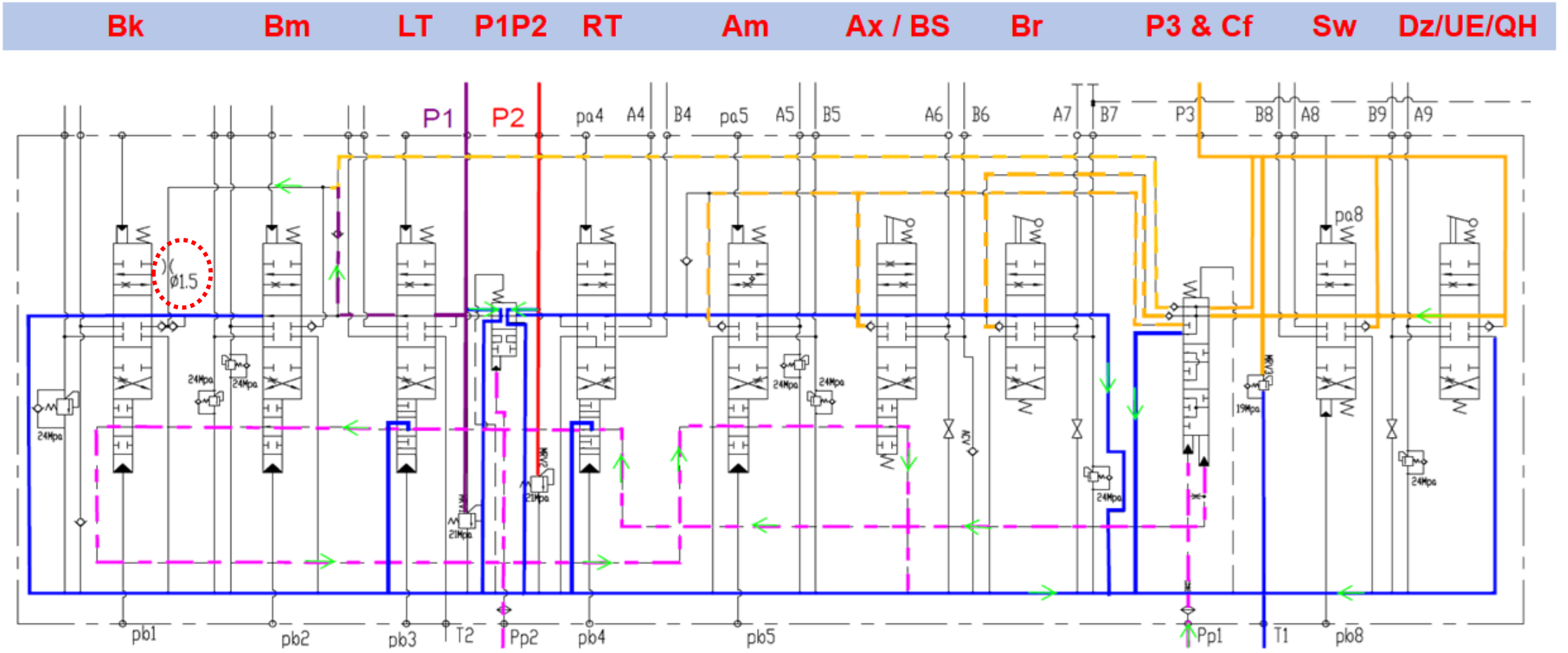
Bk | Bm | LT | P1P2 | RT | Am | Ax / BS | Br | P3 & Cf | Sw | Dz/UE/QH



Once both spools valve for travel circuit shifted position, all flow discharged by P1 and P2, which is same in amount, will be fully delivered to left and right travel motor respectively, as a consequence the two travel motors will rotate at the same speed, and the machine will go straight.

5. Hydraulic System

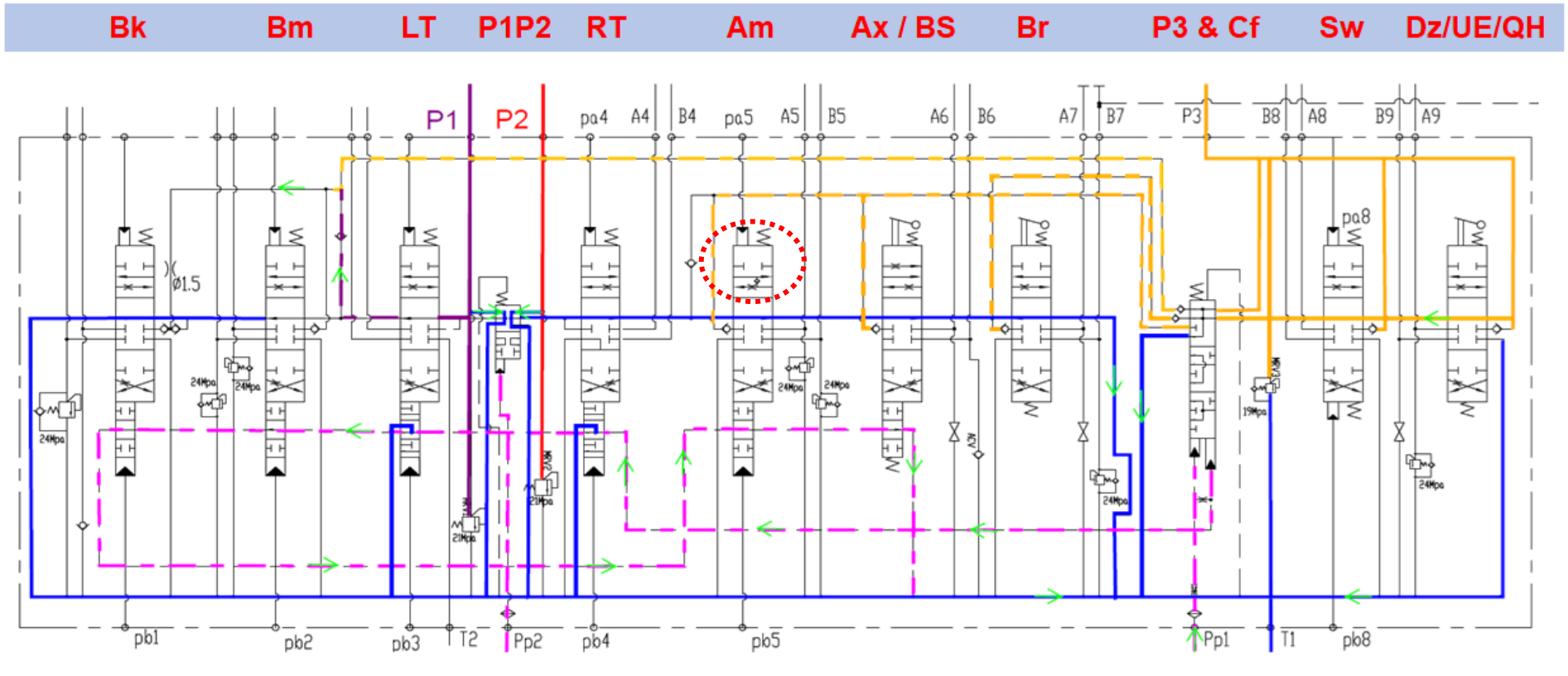
Boom Priority

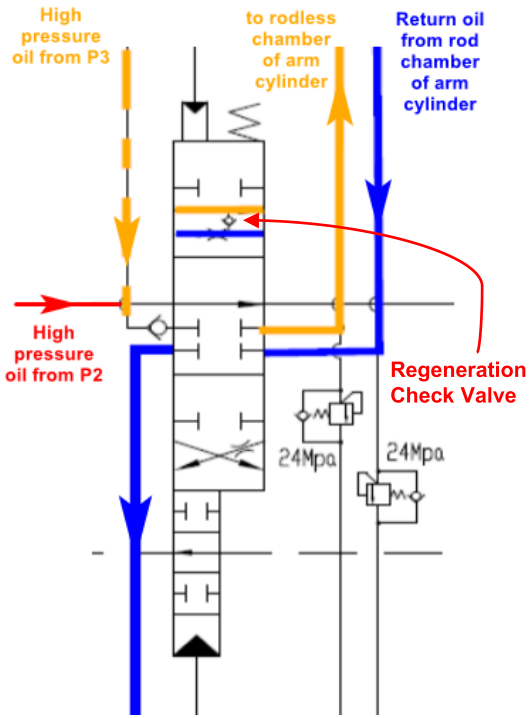


The orifice can restrict amount of flow to go to bucket cylinder, and let more oil flows to boom cylinder, therefore boom cylinder get priority, and as a result the operation experience will be improved.

5. Hydraulic System

Return Oil Regeneration

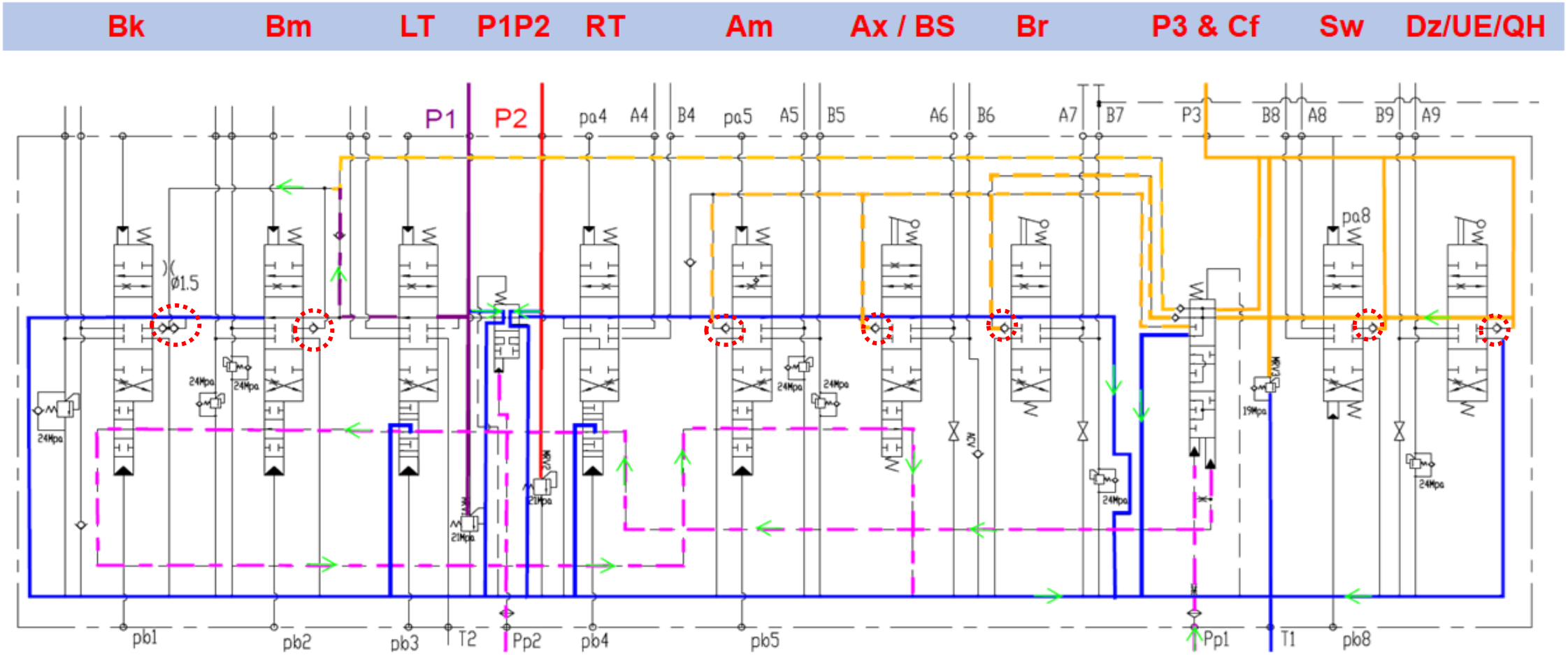




When arm crowding, due to gravity of arm, arm cylinder tends to extend faster and faster, which will cause vacuum in rodless chamber, and the inlet side pressure will become very low, return oil will open the check valve and feed to rodless chamber directly, which will avoid from vacuum, and increase arm crowding speed.

5. Hydraulic System

Load Check Valve



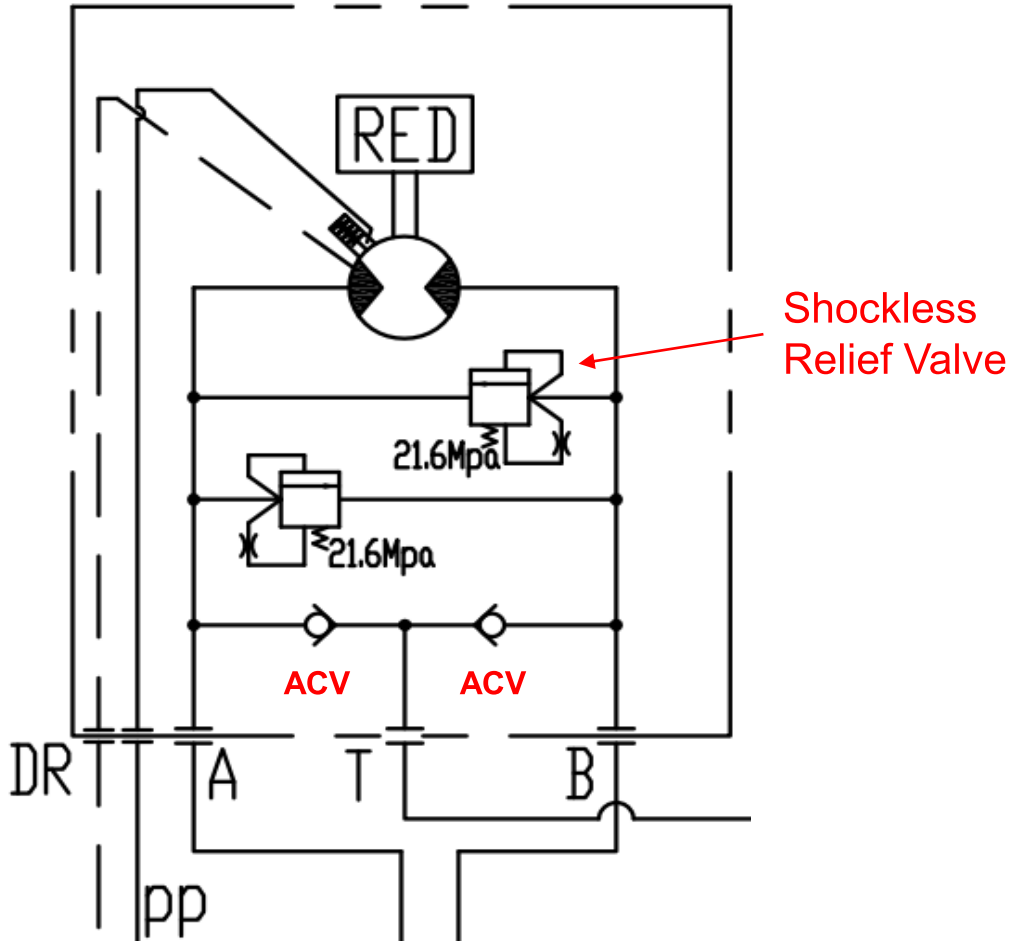
Load check valve can avoid from unintended reverse movements caused by gravity or other external forces at the initial stage of control spool shifting, during which the pressure is still low, it may still not be strong enough to get over the load.

5. Hydraulic System

5. 4 Swing Drive

Motor Model	PCR-1B-05A-P-9189A
Max Flow	14L/min
Displacement	23.6 Cm3/rev
Max. Output Torque	469 N.m
Weight	23 kg
Max Permissible Pressure Pmax	259 Bar
Max Permissible Drain Pressure（Bar）	3
Reduction Gear Lubricant Capacity (L)	Lubricate with drain oil

5. Hydraulic System



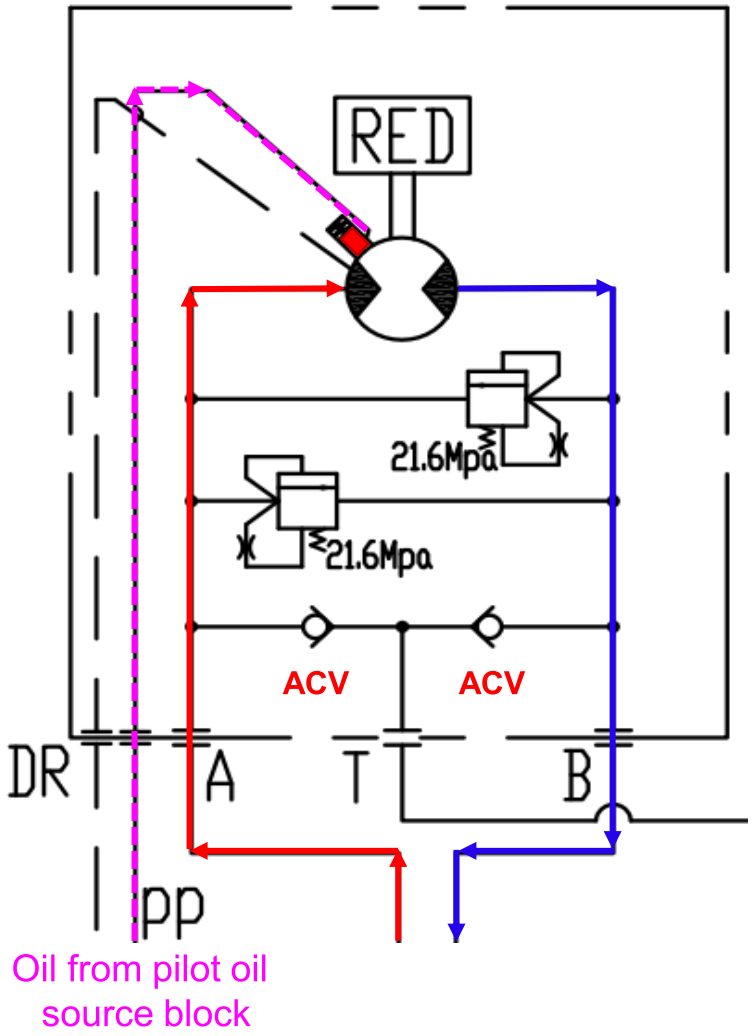
Swing Motor Work Principle

When the operator operate left joystick leftward or rightward, oil from pilot oil source block will go through left joystick to one end of swing spool in main control valve, it will push the swing spool to the other end, and then passage for oil from P3 to go to swing motor and return oil in swing motor to go back to tank will be opened, then high pressure oil from P3 will go through swing spool to reach port A of swing motor, and enter into swing motor, drive the swing motor to rotate, return oil of the swing motor will go through the swing spool to go back to tank.

At the mean time when operator operate left joystick, there is another stream of pilot flow will be directed to PP port of swing motor, and enters into park brake piston to release park brake, then the swing motor can rotate freely.

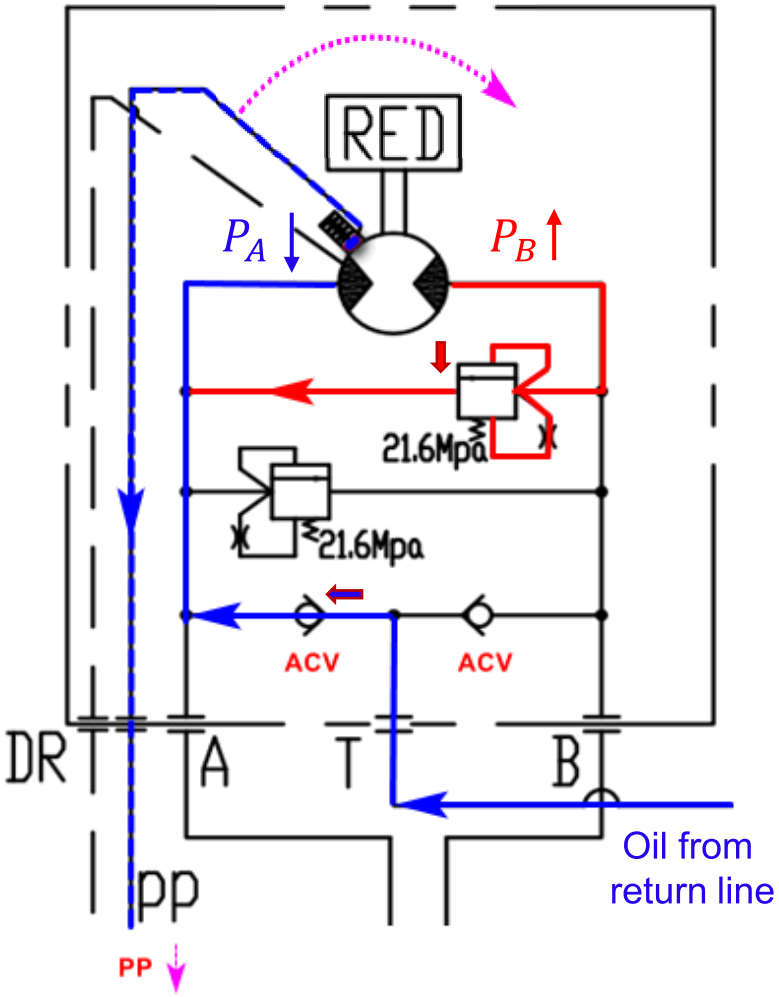
Four prerequisites to drive swing motor to rotate smoothly must be met:

1. There must be enough continuous oil flow delivered to swing motor.
2. The pressure of oil delivered to swing motor can built up to a high level that can get over the resistance or load.
3. Oil in return line can go back to tank smoothly.
4. There must be pressurized oil fed to park brake piston to release park brake.



Swing Motor Stop Principle

Once the operator stop operating left joystick, swing spool in main control valve will be pushed back to neutral position under spring force from the other end, then both the passage for oil from P3 to go to port A and return oil to go back to tank will be cut off, then there will be no oil fed to the swing motor, however, due to inertia, the swing motor will not stop immediately, but keep rotating for a while, so the inertia of the machine will keep driving oil in outlet chamber of swing motor, however the return oil has nowhere to go, because its return passage has been cut off, therefore pressure at port B will increase, the increasing pressure at port B will exert a backing force on the motor to stop it from rotating, and pressure at port A will decrease because of no oil feeding, it tends to become vacuum at port A, once pressure at port A is too low, the anti-cavitation check valve will be opened by back pressure in the return line, oil from return line will go through the anti-cavitation check valve to port A to feed the vacuum, which can avoid from cavitation and therefore protect the swing motor.



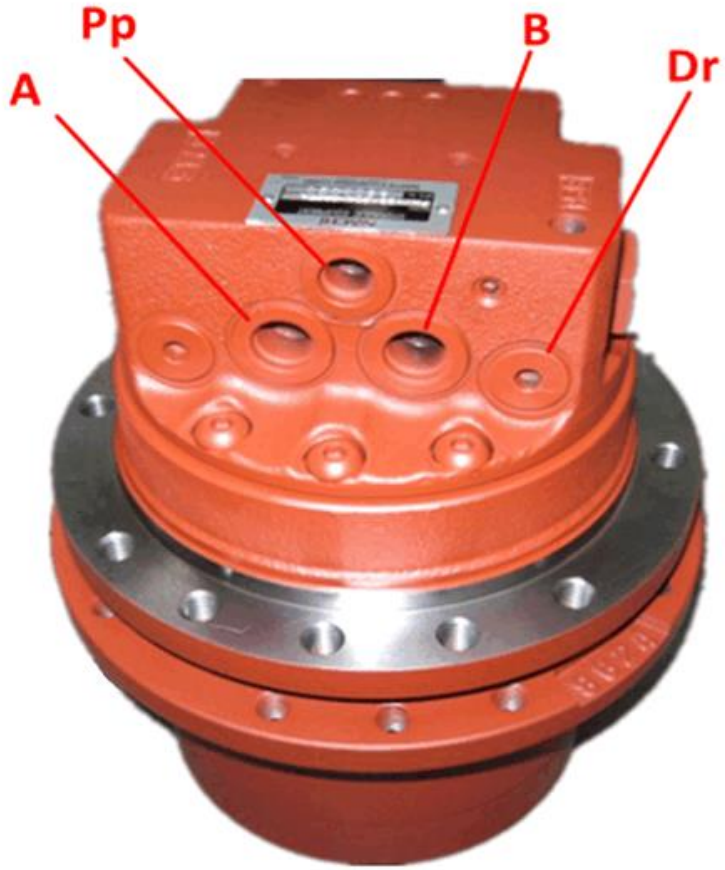
5. Hydraulic System

And at the mean time, as pressure increasing at port B, once its high enough to open the relief valve, then the return oil will be driven to port A to feed the vacuum as well. Due to the orifice in the shockless relief valve, pressure at port B will increase gradually rather than sharply, because as pressure at port B increases, the relief pressure is increasing as well, which will cause the relief valve be opened slowly rather than quickly, which will absorb the shock and stop them machine smoothly，endue the operator with better operation experience.

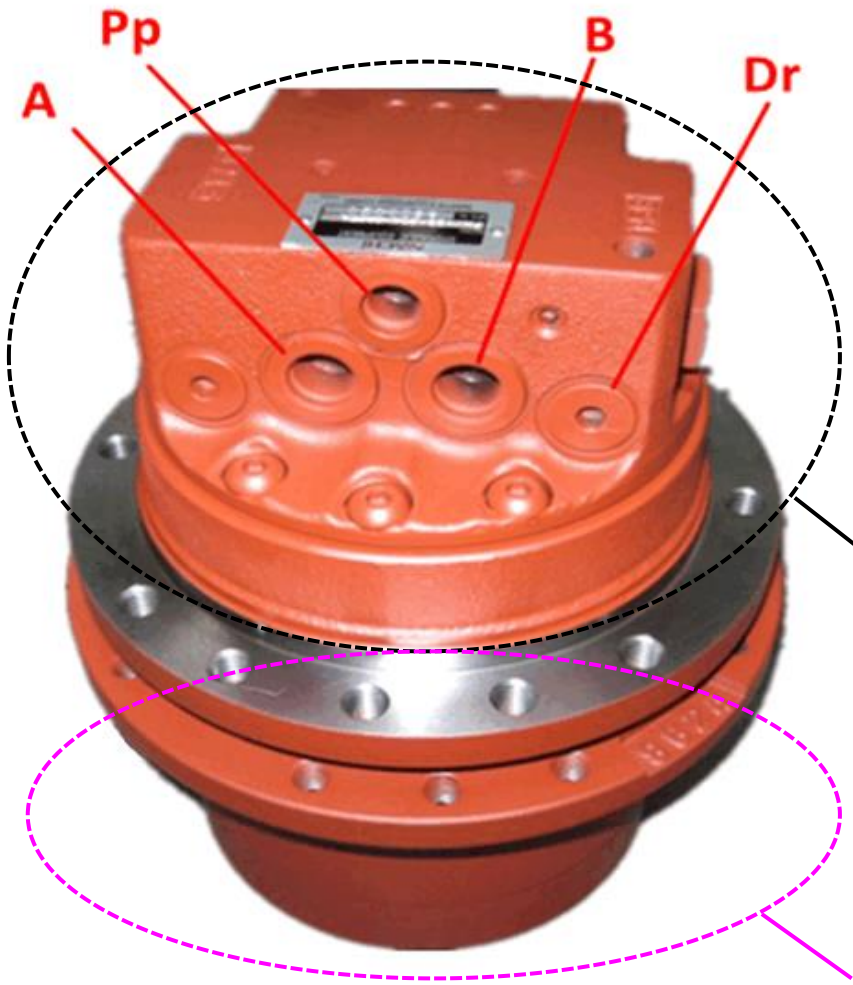
Beside these, once the operator stop operating joystick, pressure at PP port will drop to zero as well, then oil in the park brake piston will be driven back to tank by the spring force, and the brake will be engaged again, and machine will be stopped securely.

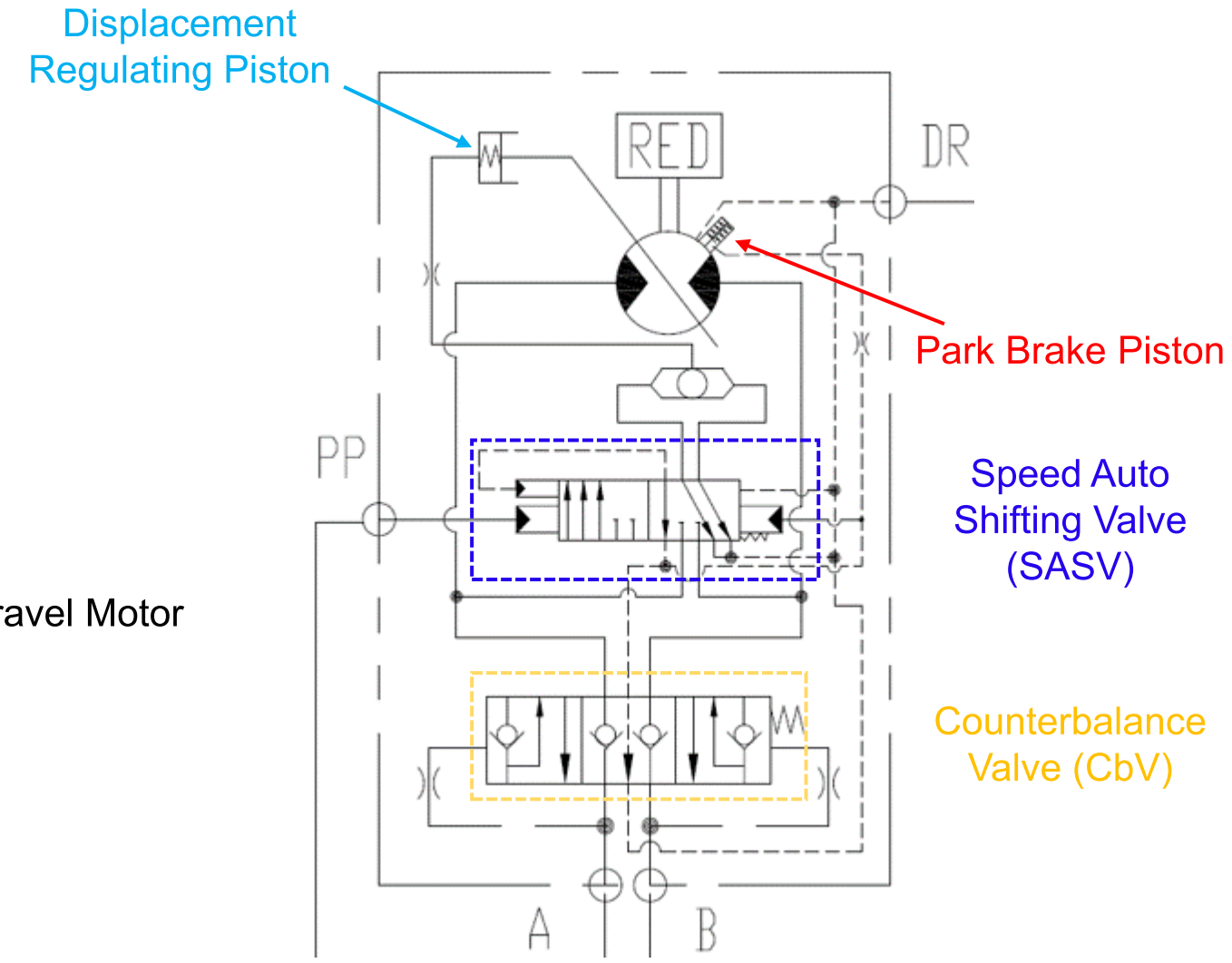
5. 5 Final Drive

Motor Model	PHV-2B-20A-PT-9775A
Max Flow	21 L/min
Displacement	16.1 / 9.1 cm3/rev
Max. Output Torque	1668 N.m
Weight	27 kg
Max Permissible Pressure Pmax	245 Bar
Max Permissible Drain Pressure（Bar）	10 Bar
Reduction Gear Lubricant Capacity (L)	0.33 L



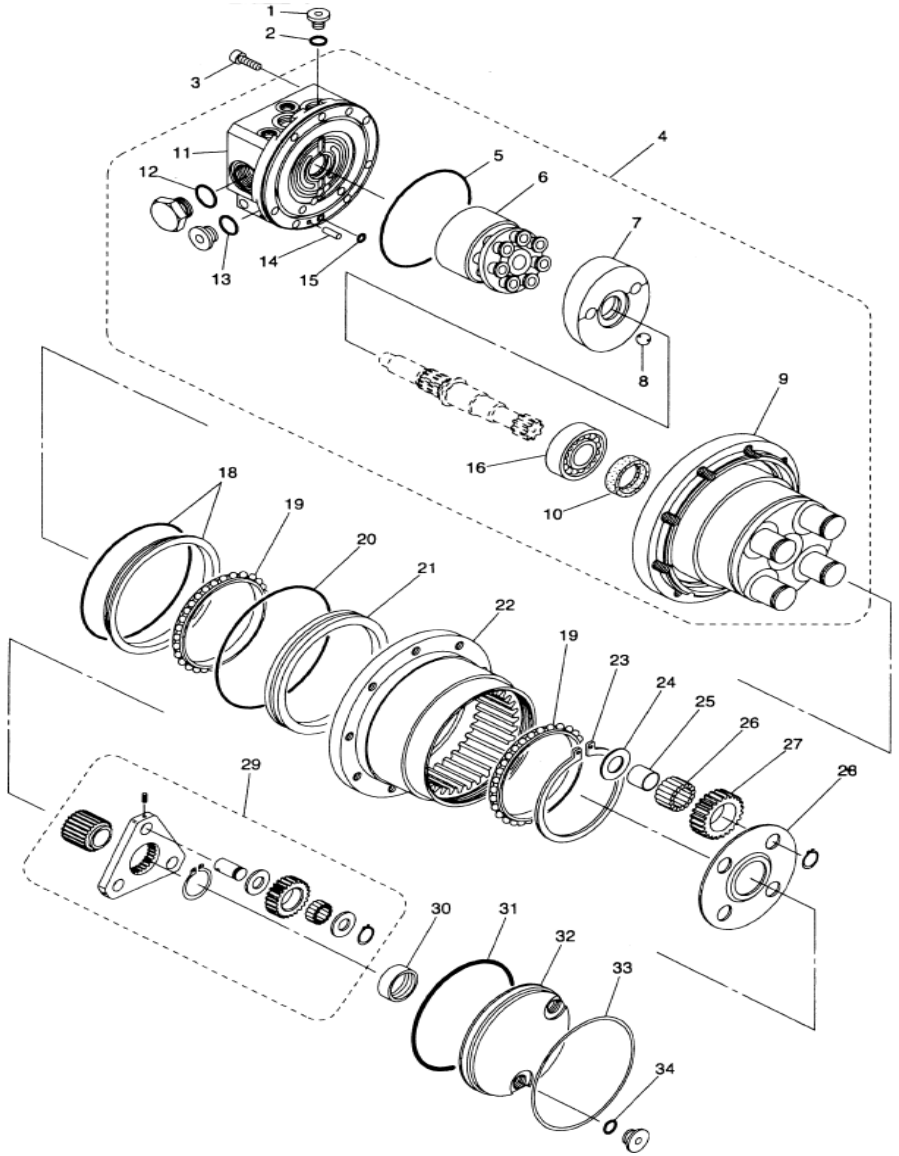
5. Hydraulic System





5. Hydraulic System

Ref	Parts Description	Ref	Parts Description	Ref	Parts Description
1	Plug	13	O-ring	25	Shaft
2	Seal	14	Pin	26	Bearing, Needle
3	Blot	15	Retainer	27	gear
4	Motor	16	Bearing	28	Gear
5	Seal	17	Spline Shaft	29	Planetary Carrier GP
6	Piston GP	18	Seal, Floating	30	
7	Swashplate	19	Bearing	31	Seal
8	Retainer	20	Seal	32	Cover
9	Spindle	21	Ring, Seal	33	
10	Seal	22	Housing	34	O-ring
11	Rear Flange Cover	23	Retainer		
12	O-ring	24	Collar, Thrust		



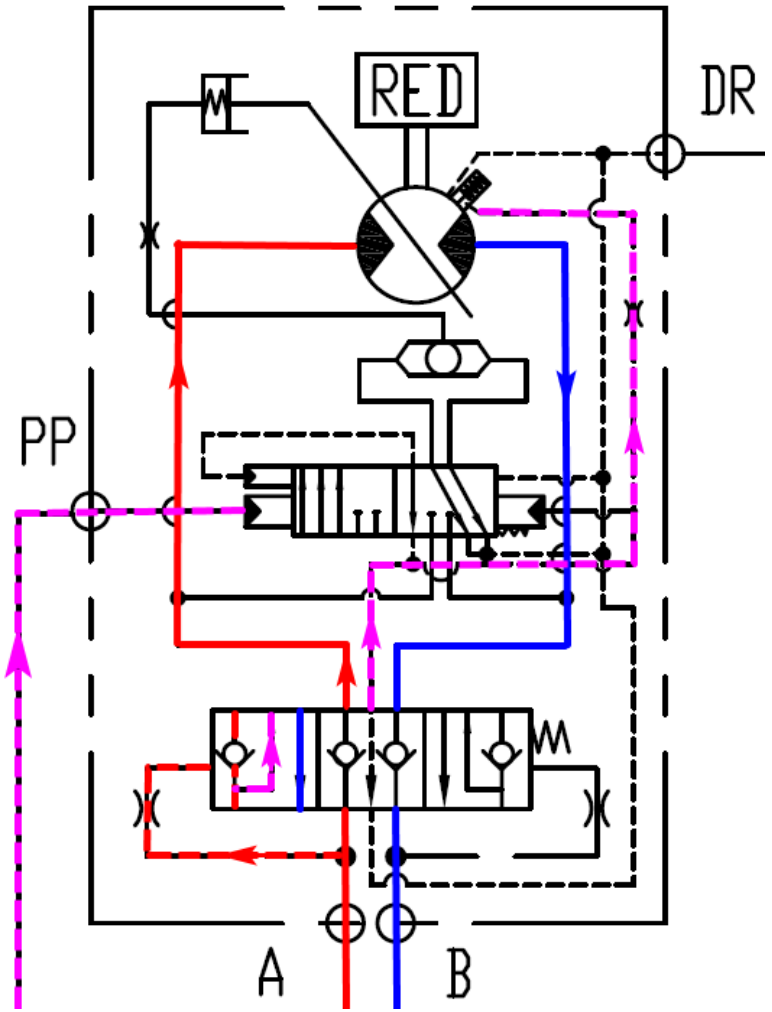
Travel Motor Work Principle

When the operator operate any of the travel control lever, oil from pilot oil source block will go through travel pilot control valve to one end of LH/RH travel spool in main control valve, it will push the travel spool to the other end, and then passage for oil from P1 or P2 to go to travel motor and return oil in travel motor to go back to tank will be opened, then high pressure oil from P1/P2 will go through travel spool to reach port A of travel motor, and enter into travel motor, drive the travel motor to rotate, return oil of the travel motor will go through the travel spool to go back to tank.

At the mean time after counterbalance valve shift to one end, there is another stream of flow will go through counterbalance valve to brake piston, and release park brake when operator operate travel pilot control lever, there is another stream of pilot flow will be directed to PP port of travel motor, and enters into one end of park brake piston to release park brake, then the travel motor can rotate freely.

Similarly with swing motor, there are four prerequisites as well to drive travel motor to rotate smoothly must be met:

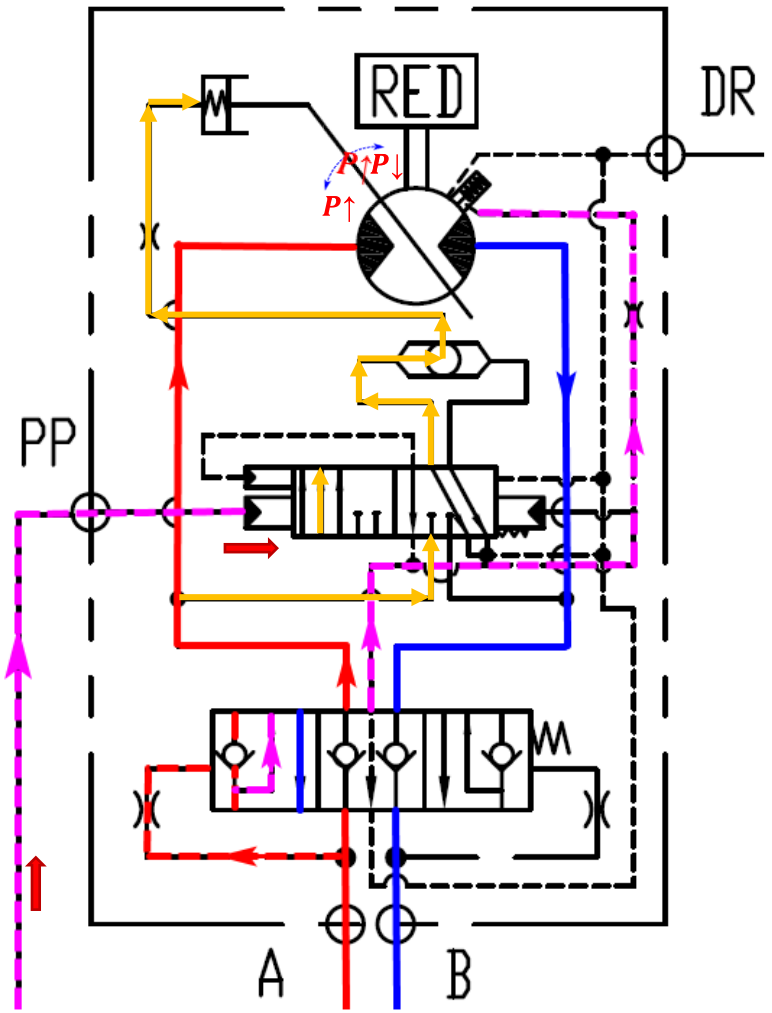
1. There must be enough continuous oil flow delivered to swing motor.
2. The pressure of oil delivered to swing motor can built up to a high level that can get over the resistance or load.
3. Oil in return line can go back to tank smoothly.
4. There must be pressurized oil fed to park brake piston to release park brake.



Travel Speed Auto Shifting Principle

At the mean time when the operator operates any of the travel control lever, the pressure in pilot circuit will increase, PP port of travel motor is connected with pilot circuit, so this increasing pilot pressure will also be applied on the speed auto shifting valve, and it will shift the valve to its left position, then it will open the passage for high pressure oil from port A to go to displacement regulating piston, namely, when the operator is operating travel control lever, the high pressure at port A will always be applied on displacement regulating piston of travel motor. So the motor displacement will be regulated automatically according to pressure at port A.

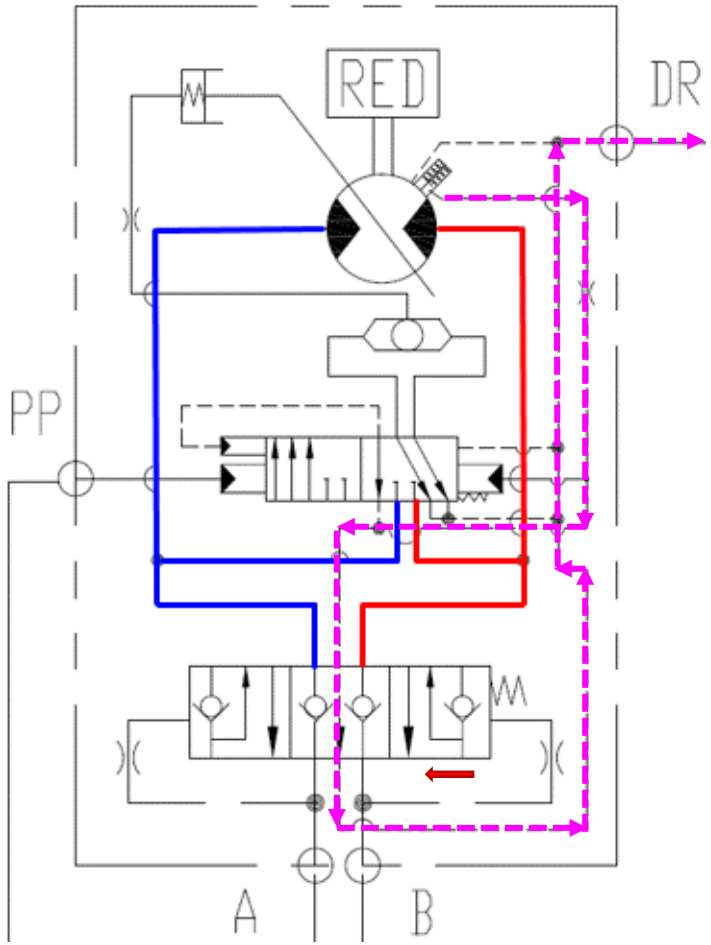
When the travel resistance is high, for example the travel motor encounters an obstacle, pressure at port A will increase, then the increasing pressure will push the displacement regulating piston to increase pump displacement, so that the motor can output more torque to get over the obstacle, and the travel speed will decrease, once it pass through the obstacle, pressure at port A will drop, then the displacement regulating piston will be driven to reduce motor displacement by spring force, and then the machine can travel with higher speed.



Travel Motor Stop Principle

Once operator stop operating travel control lever, travel control spool in main control valve will be pushed back to neutral position by spring force, and passage for oil from P1/P2 to go to travel motor will be closed, pressure at port A will drop to 0, counter balance valve will return to neutral position, then no oil feeding to travel motor any more, and because of inertia, the motor tends to keep rotating for a while ,and this inertia will compress oil in return chamber, and cause pressure in return chamber increase, because the passage for oil to go back to tank has been closed already, since hydraulic oil is incompressible, in increasing pressure will stop the machine.

After counterbalance valve return to neutral position, oil in park brake piston will be driven out of the piston by spring force, and go back to tank through neutral position of counterbalance valve, and then park brake will be engaged, and it will stop the machine securely.

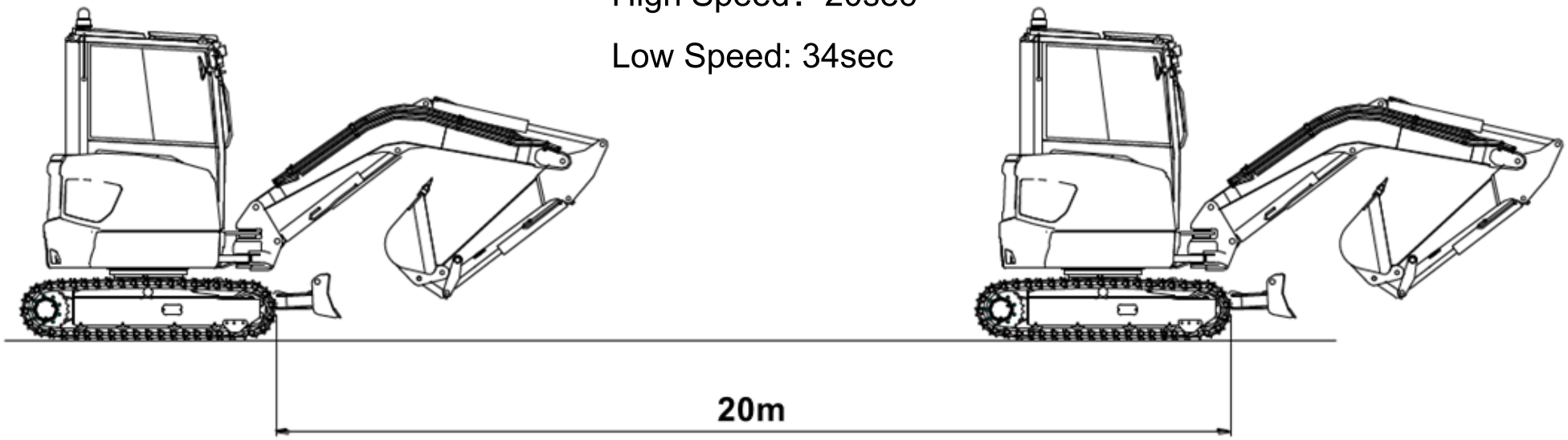


5. Hydraulic System

Travel Speed Testing

High Speed：20sec

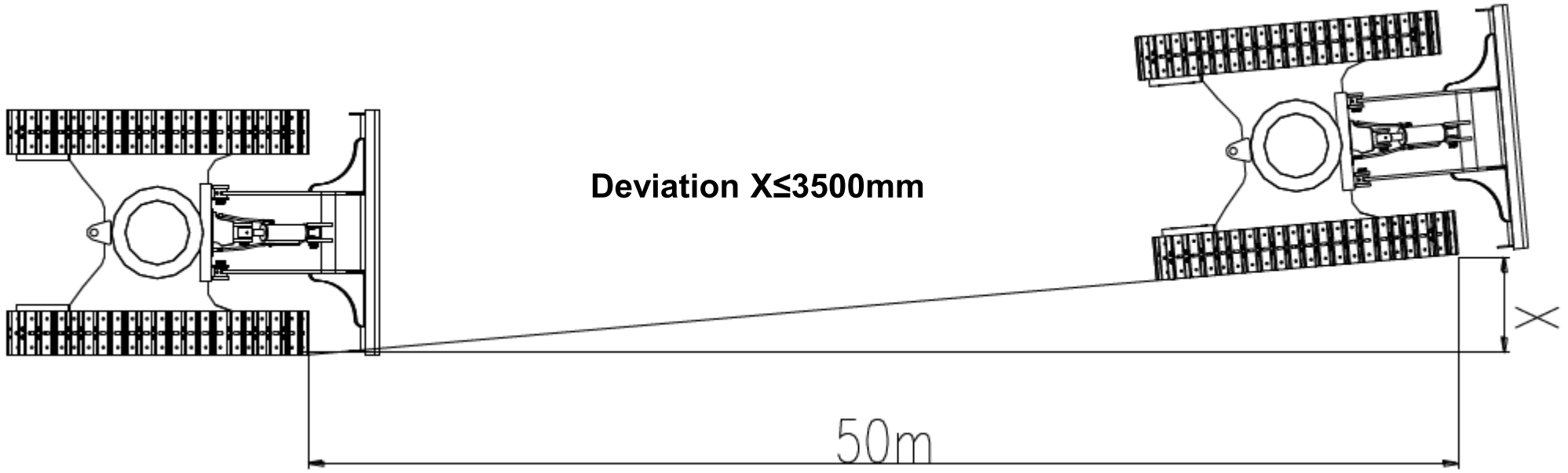
Low Speed: 34sec



- **Engine:** Maximum speed
- **Hydraulic oil temperature:** 45-80°C
- **Measuring posture:** Fully extend bucket cylinder and arm cylinder, let lowest point of implements be approx. 500mm above ground, and fully lift the dozer blade up. (as shown in picture above)
- **Measurement method:** adjust the walking to the slow gear, operate the walking joystick, repeat forward and backward, measure the time required for each 10m forward and backward respectively, and take the average value; adjust the walking to the fast gear, operate the walking joystick, and repeat forward and backward. Backward, after running for 3 minutes, the operation mode is the same as the slow gear.

5. Hydraulic System

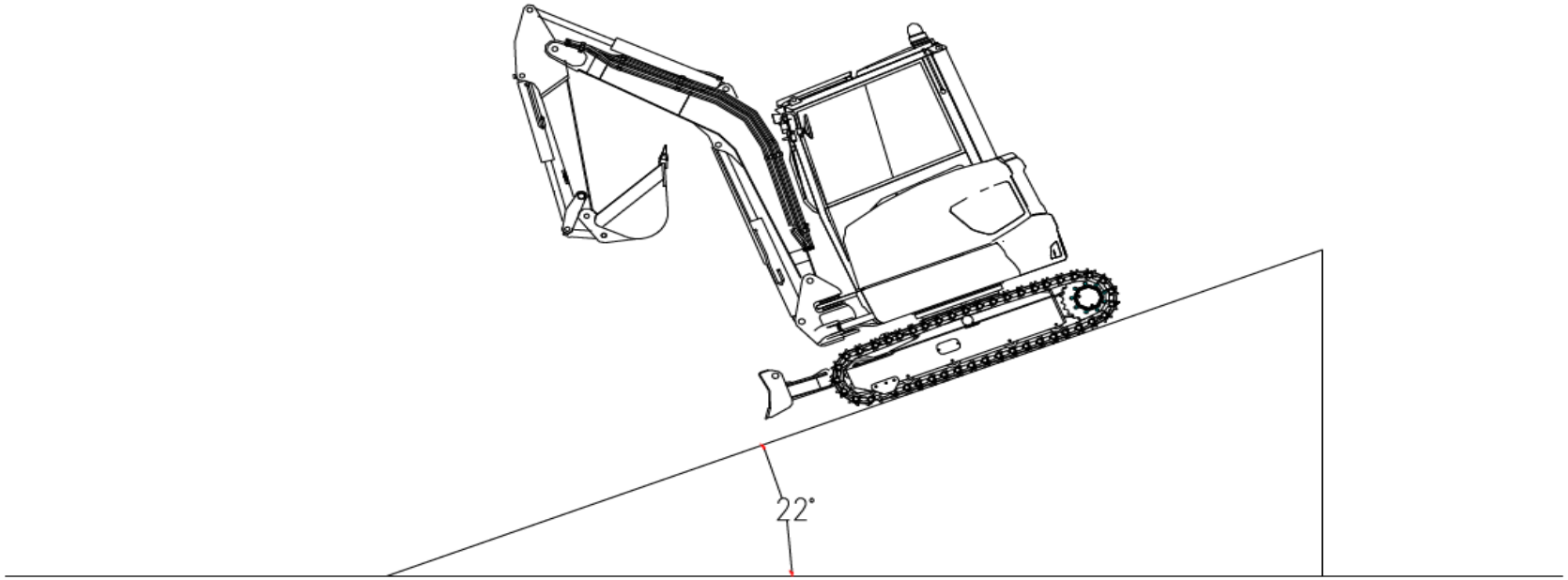
Travel Deviation (with 50m travel)



- **Engine:** Maximum speed
- **Hydraulic oil temperature:** 45-80°C
- **Measuring posture:** same as shown in figure of previous page
- **Measurement method:** Slow gear (fast gear), manipulate the walking joystick, move forward 50m, and measure the amount of deviation X and the direction of deviation. X
- **Standard X≤3500mm**

5. Hydraulic System

Travel Drift

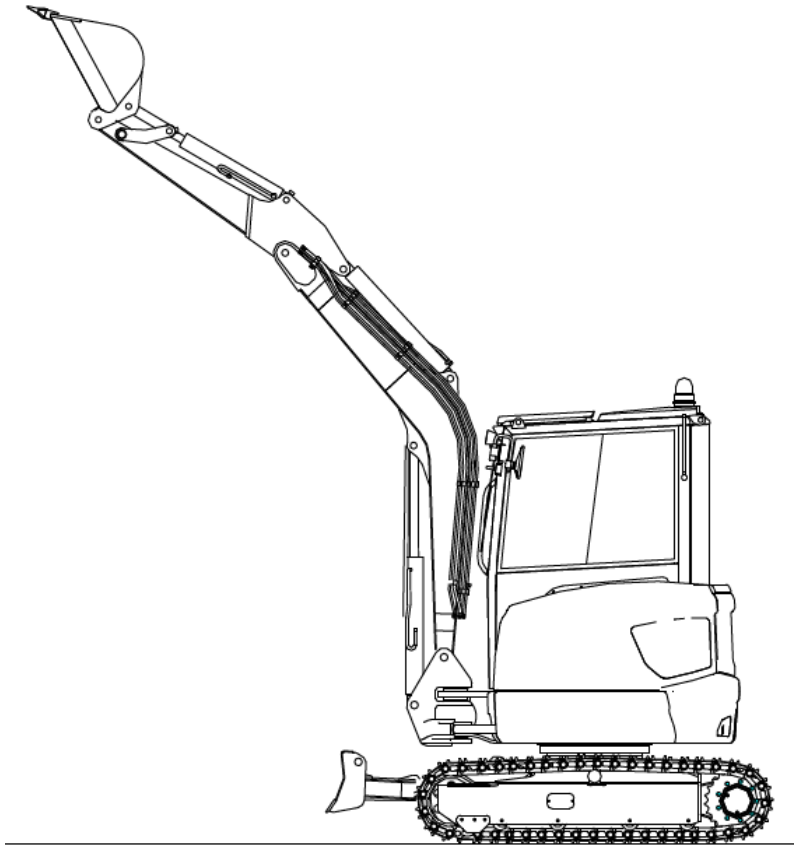


- **Engine:** Stop
- **Hydraulic oil temperature:** 45-80°C
- **Slope:** 22 degrees
- **Measuring posture:** Fully extend boom cylinder, arm cylinder, bucket cylinder , fully lift up dozer blade.
- **Measuring method:** stop the machine on the slope for 5 minutes, and measure the distance the machine drifts downwards.

5. Hydraulic System

Swing Speed

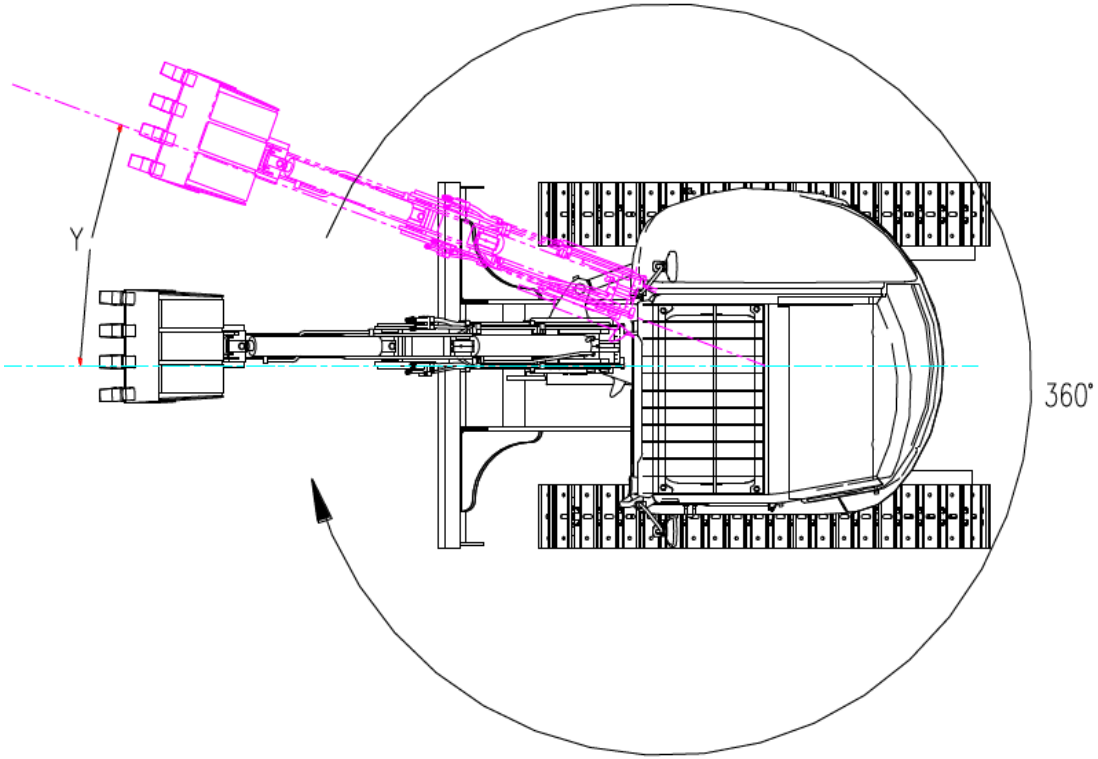
- **Engine:** Maximum speed
- **Hydraulic oil temperature:** 45-80°C
- **Measuring posture:** fully extend boom cylinder, fully retract bucket cylinder and arm cylinder;
- **Measurement method:** After operating the upper structure to turn around for two turns, measure the time it takes to turn 1080 degrees (three turns), test swing left and right once respectively. take the average value as drift value.
- **Standard speed: 15.5±1sec (3 turns)**



5. Hydraulic System

Swing Brake Distance

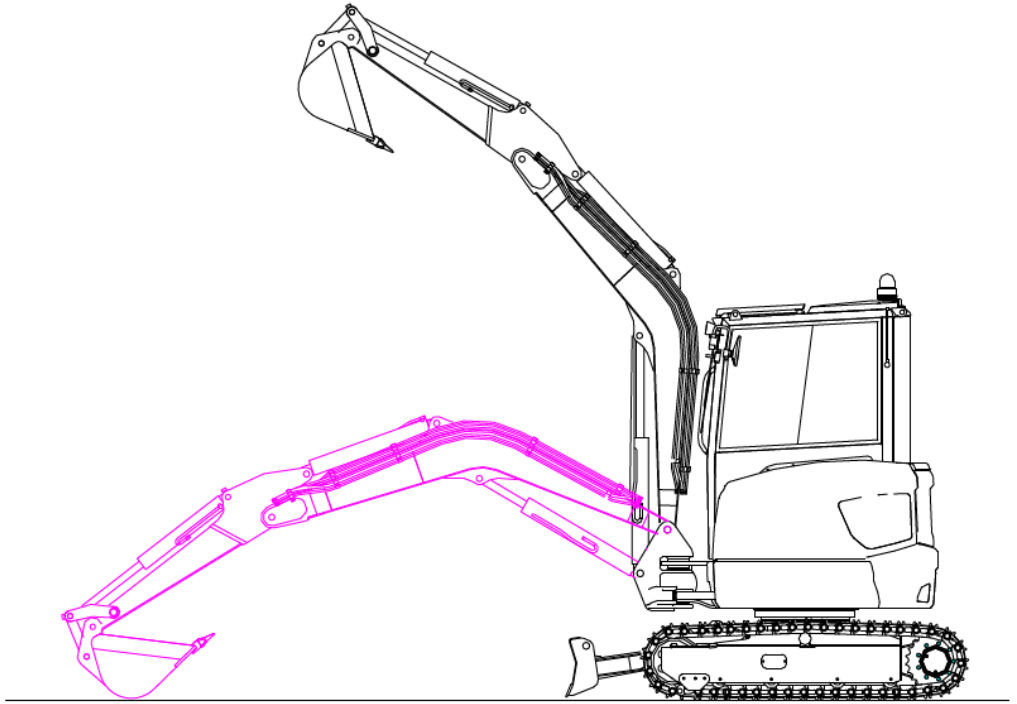
- **Engine:** Maximum speed
- **Hydraulic oil temperature:** 45-80° C
- **Measuring posture:** consistent with measuring the rotation speed posture
- **Measurement method:** Operate the left joystick fully to left or right to let the upper structure swing, brake immediately after the machine has slewed 360 degrees (one turn), and measure the slip arc length Y from the position where you start timer and the position where you stop timer;
- **Standard Brake Distance: 70±20mm**



5. Hydraulic System

Boom Cylinder Speed

- **Engine:** Maximum speed
- **Hydraulic oil temperature:** 45-80° C
- **Measuring posture:** Fully extend the bucket cylinder, and retract the arm cylinder fully
- **Measurement method:** Lift and lower down the boom repeatedly for 10 times, be cautious the bucket should not touch the ground and measure and make notes the time cost for each fully stroke boom lifting or boom lowering down respectively for three times.



Standard Speed:

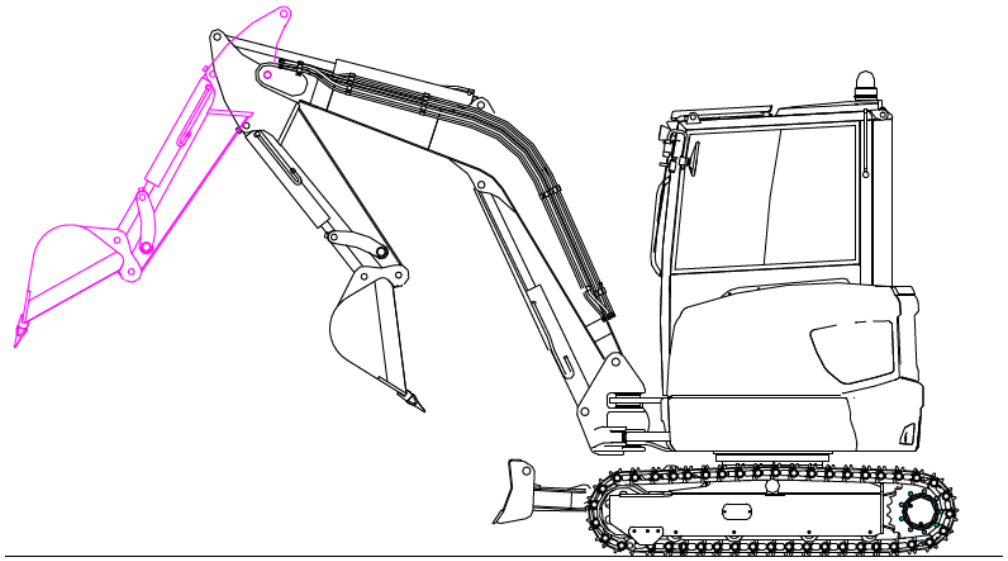
Boom Lifting : 1.4±0.3 sec

Boom Lowering : 1.3±0.3 sec

5. Hydraulic System

Arm Cylinder Speed

- **Engine:** Maximum speed
- **Hydraulic oil temperature:** 45-80° C
- **Measuring posture:** Fully retract the bucket cylinder, adjust the arm, and let the arm be vertical to the ground. make sure the lowest point of the bucket is at least 1000mm above the ground.
- **Measurement method:** operate the arm away or anear repeatedly for 10 times, measure and make notes the time cost for each fully stroke of arm cylinder extending or retracting respectively for three times.



Standard Speed:

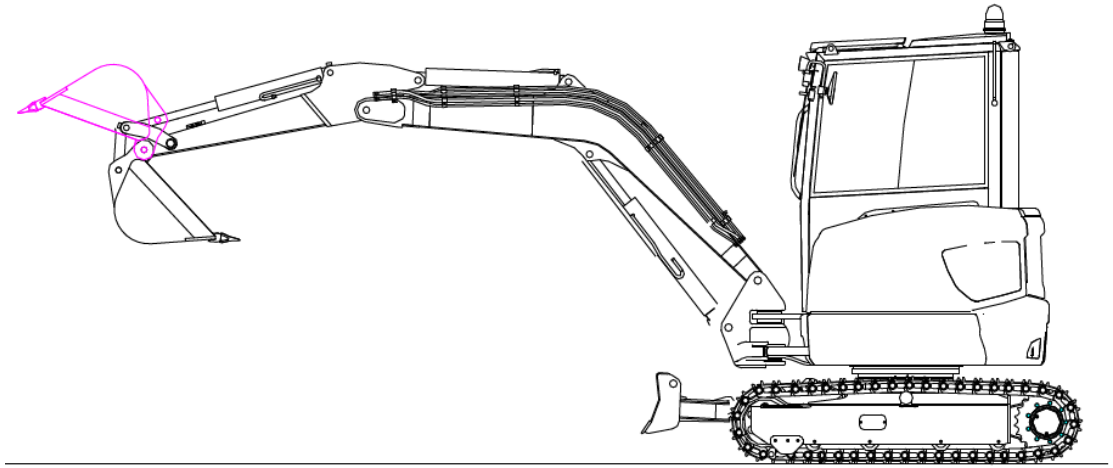
Arm Away : 2.6±0.3 sec

Arm Anear : 2.5±0.3 sec

5. Hydraulic System

Bucket Cylinder Speed

- **Engine:** Maximum speed
- **Hydraulic oil temperature:** 45-80° C
- **Measuring posture:** Fully retract the arm cylinder, adjust the arm, and let the arm be parallel with the level ground. make sure the lowest point of the bucket is at least 1000mm above the ground.
- **Measurement method:** operate the bucket curling or eversion repeatedly for 10 times, measure and make notes the time cost for each fully stroke of bucket cylinder extending or retracting respectively for three times.



Standard Speed:

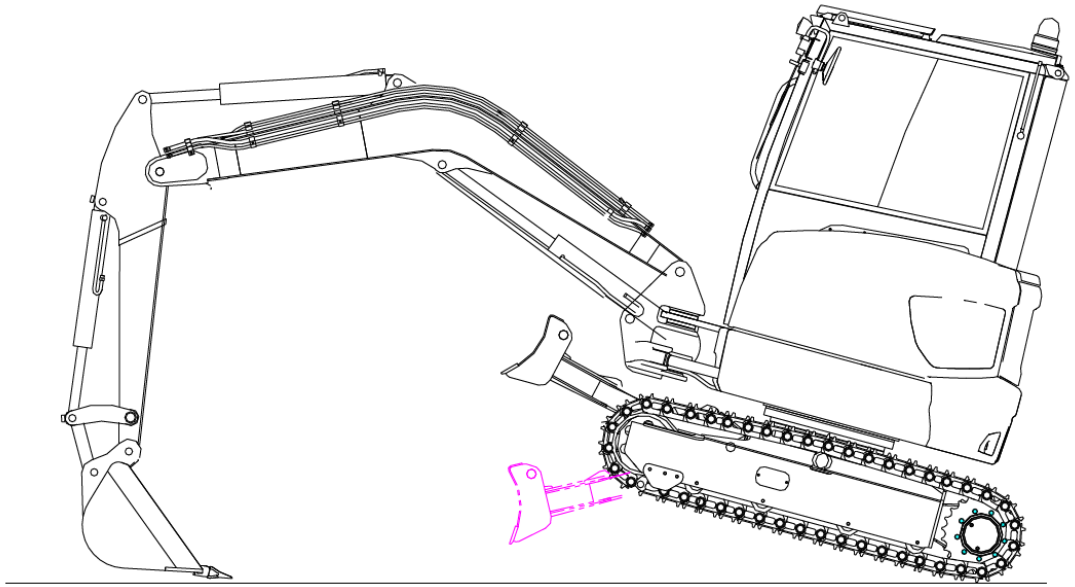
Bucket Curling : 2.3±0.2 sec

Bucket Eversion: 1.5±0.2 sec

5. Hydraulic System

Dozer Cylinder Speed

- **Engine:** Maximum speed
- **Hydraulic oil temperature:** 45-80° C
- **Measuring posture:** Use implements to prop up front end of the machine.
- **Measurement method:** Lift or lower down the dozer blade repeatedly for 10 times, measure and make notes the time cost for each fully stroke of dozer cylinder extending or retracting respectively for three times.



Standard Speed:

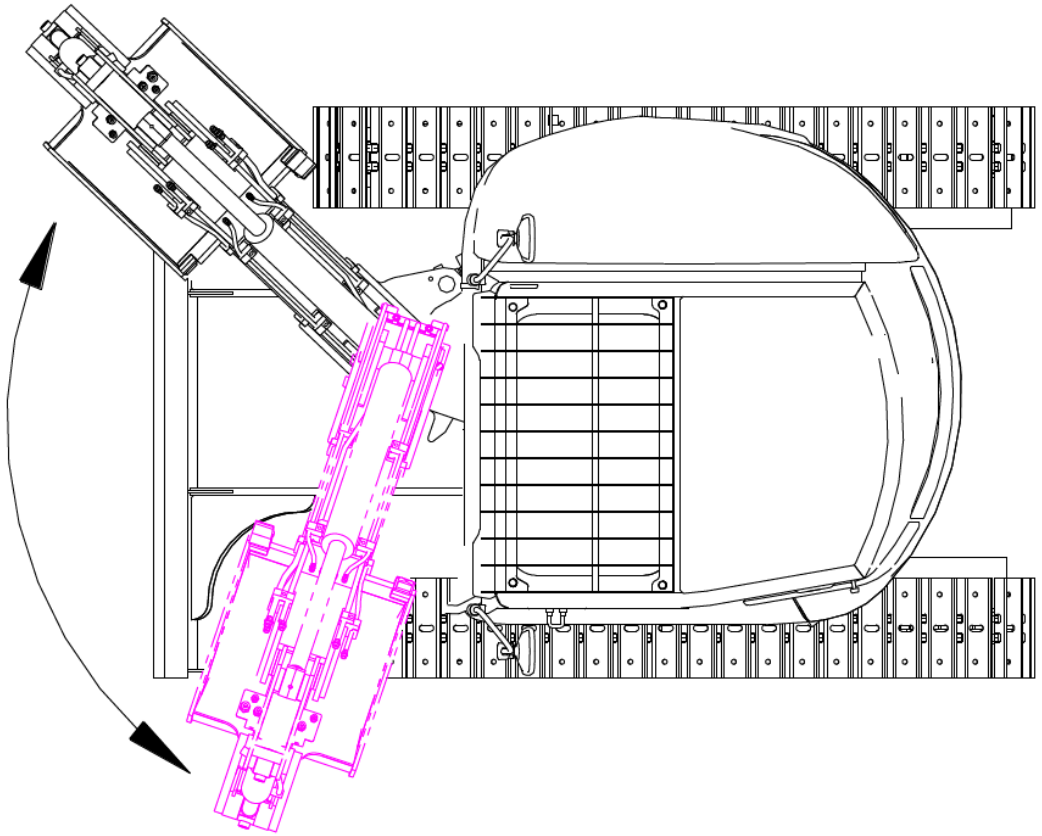
Blade Lifting: 1.5±0.3 sec

Blade Lowering: 1.9±0.3 sec

5. Hydraulic System

Boom Swing Speed

- **Engine:** Maximum speed
- **Hydraulic oil temperature:** 45-80° C
- **Measuring posture:** Fully extend arm cylinder and bucket cylinder. Lift the boom cylinder fully.
- **Measurement method:** Operate boom swing left or right repeatedly for 5 times, measure and make notes the time cost for each fully stroke of boom swing cylinder extending or retracting respectively for three times.



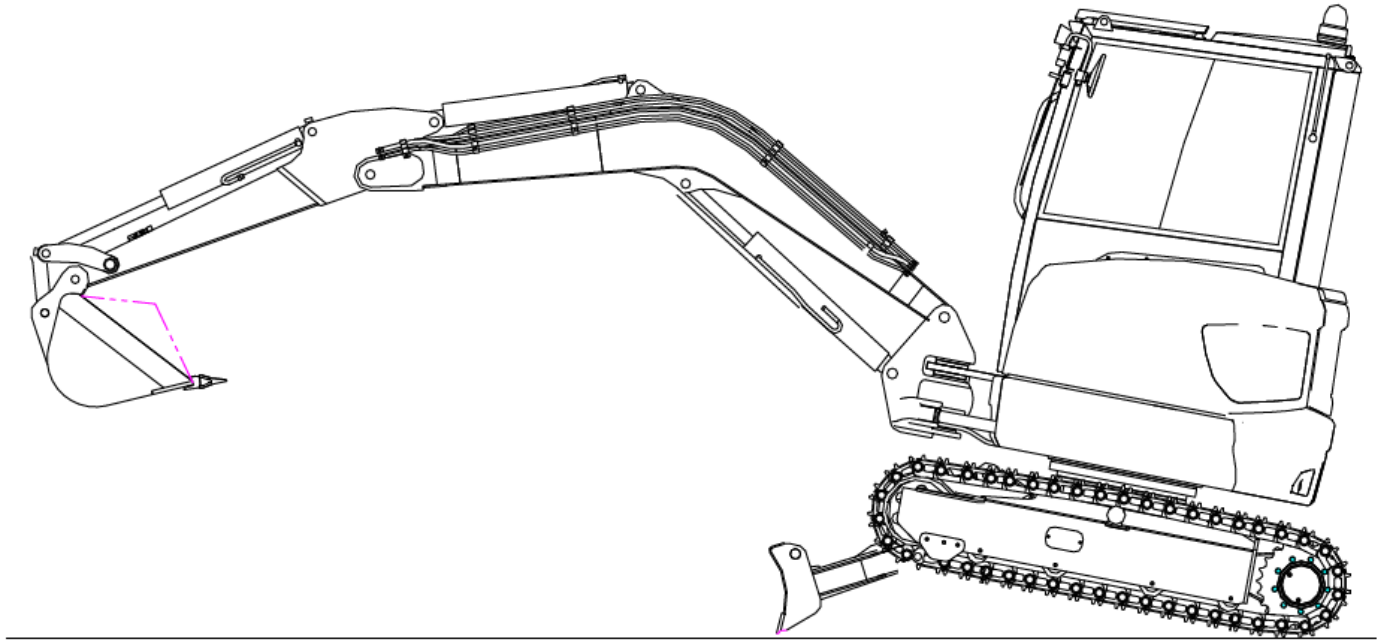
Standard Speed:

Boom Swing Left: 5.2±0.3 sec

Boom Swing Right: 5.1±0.3 sec

5. Hydraulic System

Cylinder Drift (Boom, Arm, Bucket, Blade, Boom swing)



Cylinder	Drift (mm)
Boom	8
Arm	8
Bucket	8
Dozer	15

5. Hydraulic System

Cylinder Drift (Boom, Arm, Bucket, Blade)

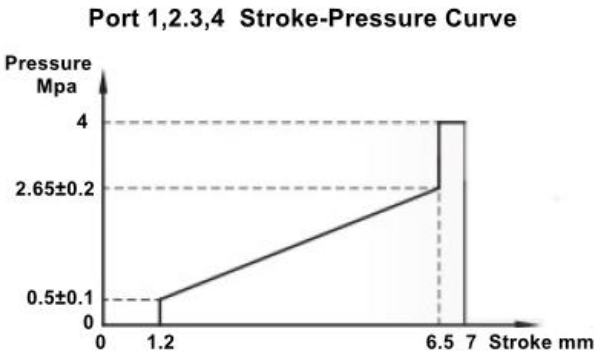
- **Engine Status:** Stop

- **Hydraulic oil temperature:** 45-80° C

- **Measuring posture:** Load the bucket full or lift an equivalent load, fully extend bucket cylinder, and fully retract arm cylinder, fully extend dozer cylinder to prop up the front end of the machine, operate boom cylinder to adjust bucket height from the ground, make sure the bucket is at least 1000mm above, and stop engine.

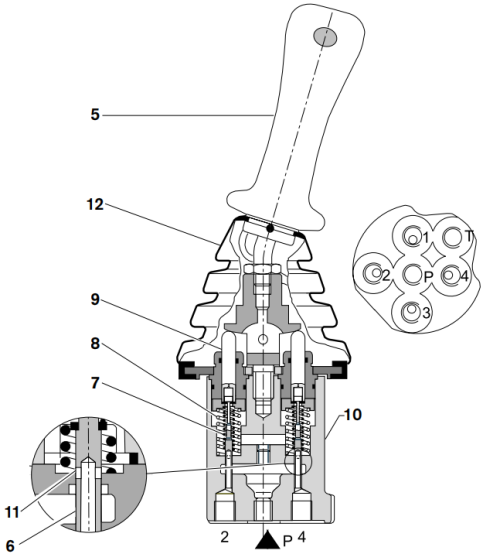
- **Measuring method:** Use mark pen to make a mark close to articulating ring side of cylinder rod of boom cylinder, arm cylinder, bucket cylinder and bucket cylinder. Measure the distance from the mark to the cylinder barrel end ,and write down the distances L1, L2, L3, L4 respectively. After 5 minutes, re-measure these distance L1, L2,L3, L4 respectively, and write down the measured distance as L1',L2',L3',L4', Then the drift for each cylinder will be L1-L1',L2-L2',L3-L3',L4-L4'.

5. 6 Control Valves Arrangement & Configuration

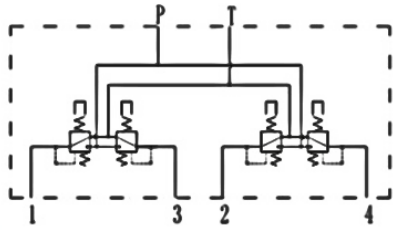


When not actuated the control lever is held in zero position by the four return springs (8). The control ports (1, 2, 3, 4) are connected to the tank port T via the drilling (11).

With deflection of the control lever (5) the plunger (9) pushes against the return spring (8) and the control spring (7). The control spring (7) firstly moves the control spool (6) downwards and closes the connection between the appropriate port and tank port T. At the same time the appropriate port is connected to the port P via the drilling (11). The control phase begins as soon as the control spool (6) has found its balance between the force of the control spring (7) and the force which results from the hydraulic pressure in the appropriate port (ports 1, 2, 3 or 4).

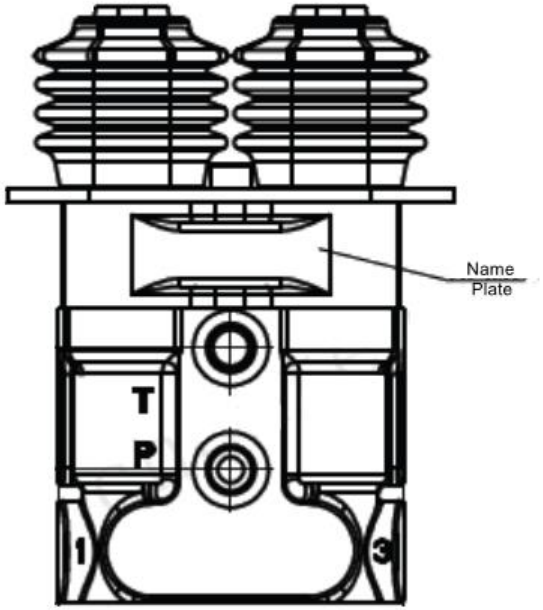


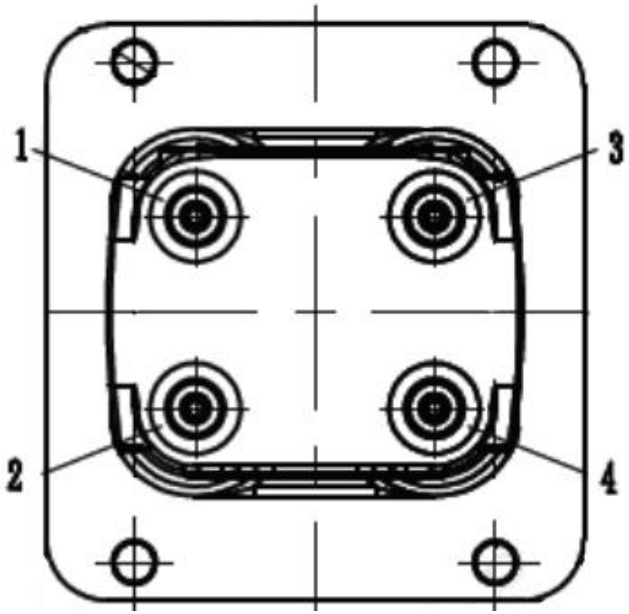
Through the interaction of control spool (6) and control spring (7) the pressure in the appropriate ports is proportional to the stroke of the plunger (9) and thus the position of the control lever (5). A rubber boot (12) protects the mechanical components of the housing from contamination.

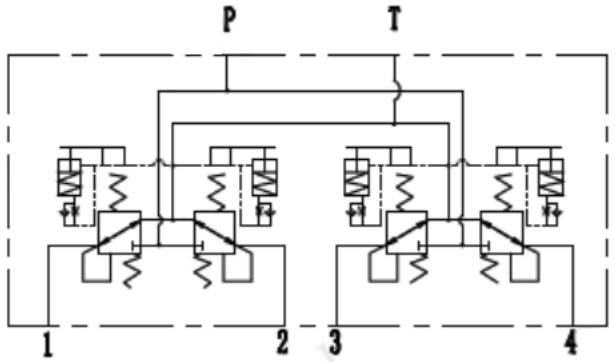


5. Hydraulic System

Duplex Travel Pilot Control Valve







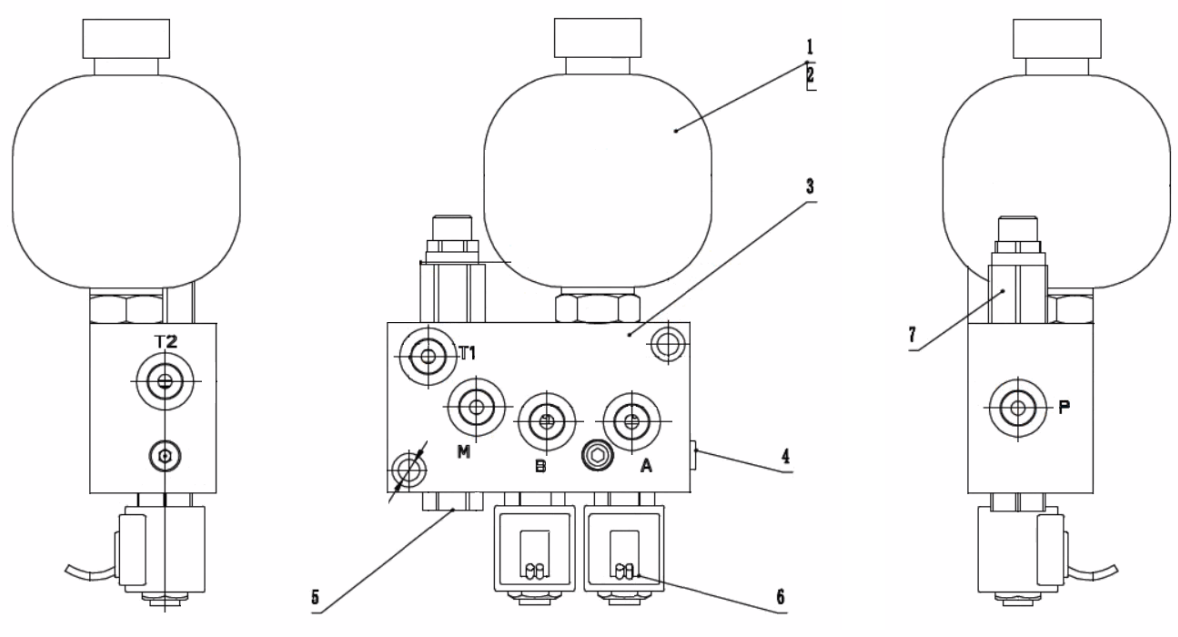
Maximum Permissible Inlet Pressure: 69 Bar

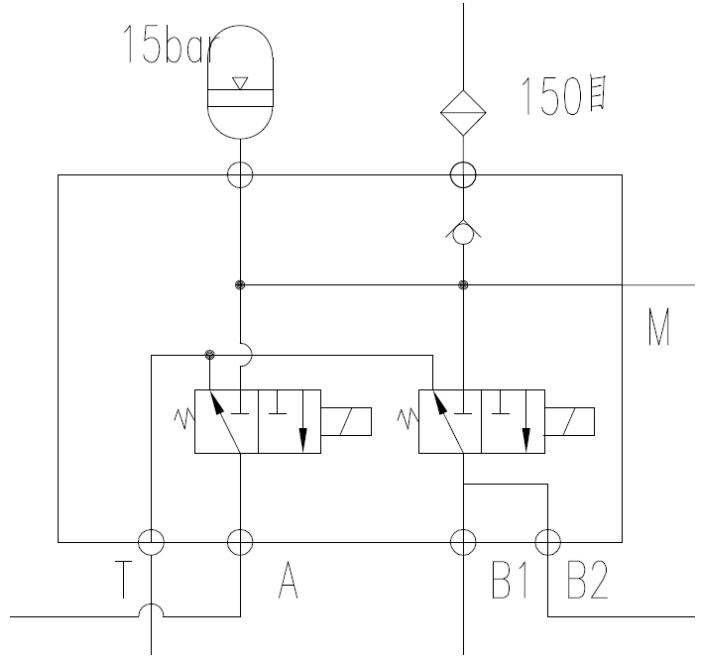
Max Back Pressure: 3 Bar

Displacement: 10L/min

5. Hydraulic System

Pilot Distribution Valve Block



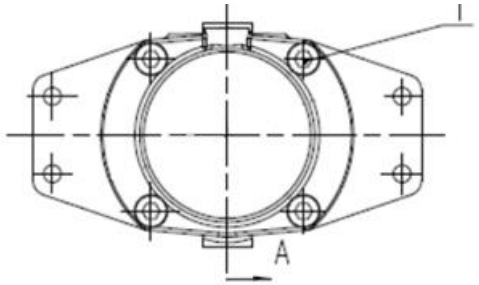


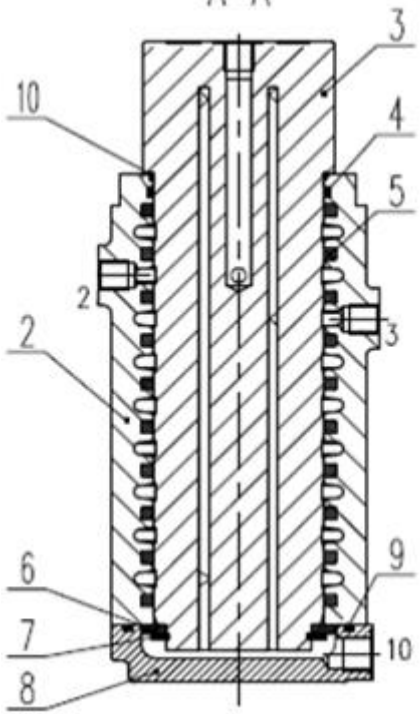
Rated flow:15L/min
Max Permissible Pressure: 150bar
Rated Voltage: 12V
Accumulator Volume: 0.32L,
Charging pressure: 10bar
Port Size: all port G ¼ ED

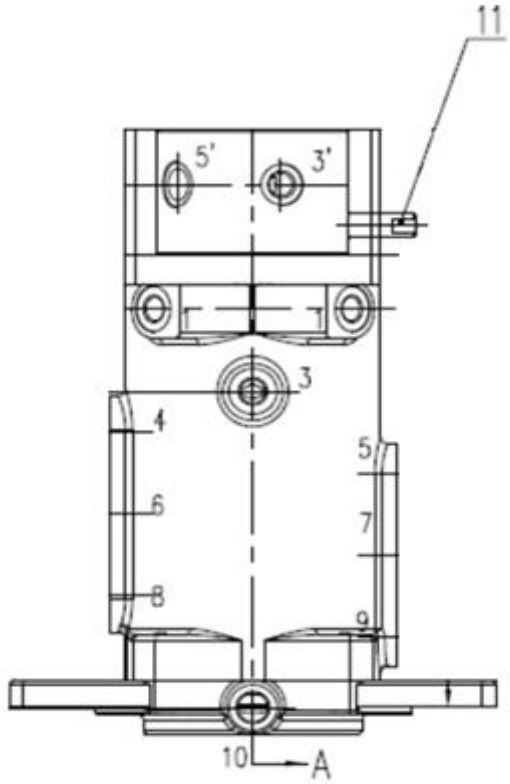
1.Accumulator
2.O-ring Φ13.8×2.4mm
3.Valve Block
4.Plug M8×1mm
5. Check Valve
6.Solenoid Valve
7. Relief Valve (optional)

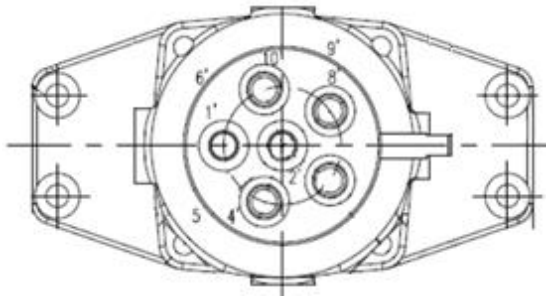
5. Hydraulic System

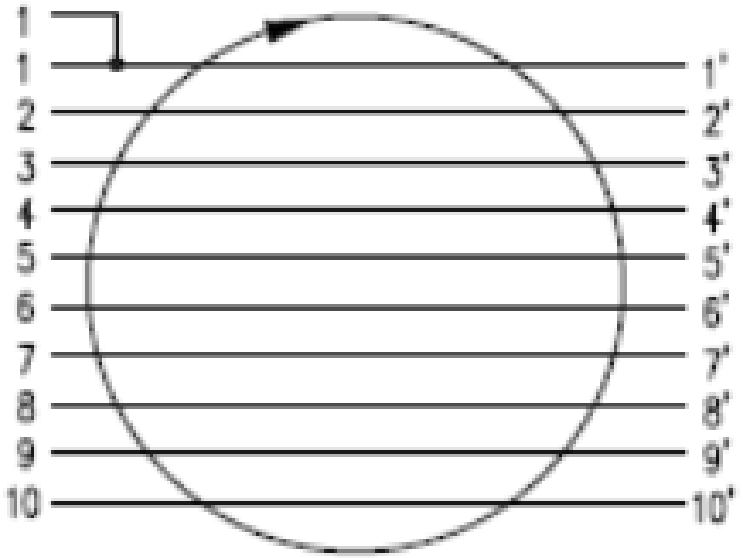
Swivel Joint







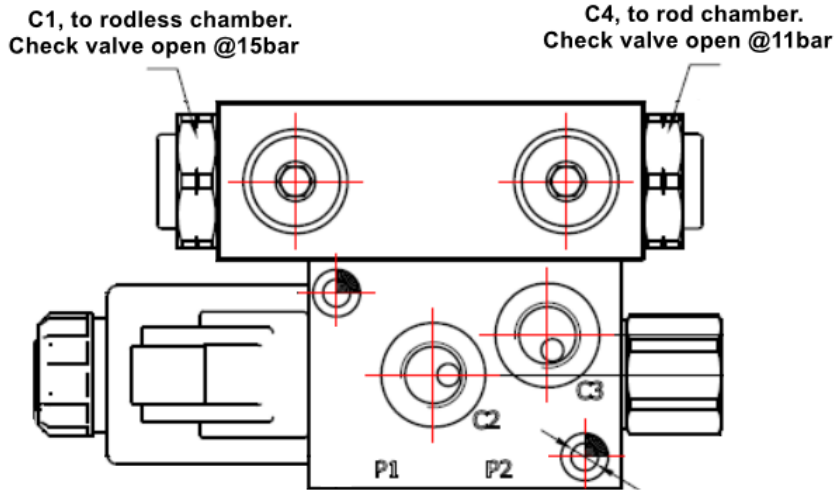


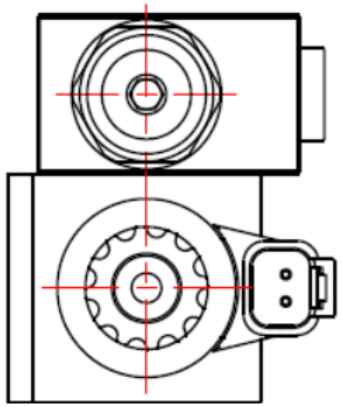


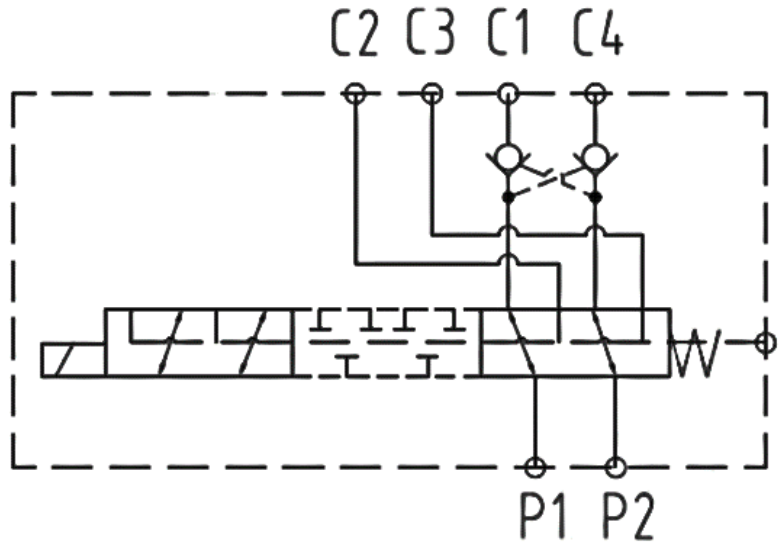
Oil Port	shaft	1'		2'	3'	4'	5'	6'	7'	8'	9'	10'
	Mounting	1	1	2	3	4	5	6	7	8	9	10
Port Size （mm）		φ6			φ10	φ10						
Port Thread （mm）	shaft	M12×1.5 ED				M14×1.5 ED						
	Mounting											
Work Pressure		25 Mpa										1.0
Test Pressure		35 Mpa										1.25
Actuator		PP		UE	Dz			Travel Motor				Dr

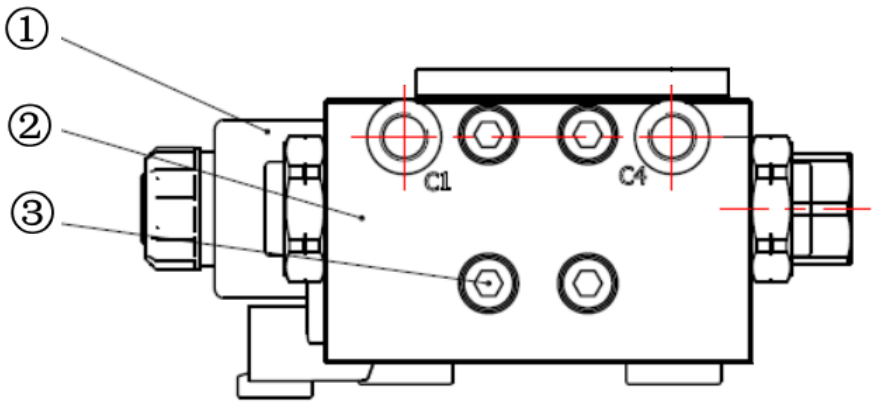
5. Hydraulic System

Quick Hitch / Dozer Alternating Solenoid Valve (Boom swing / Auxiliary Alternating Solenoid Valve is the same)







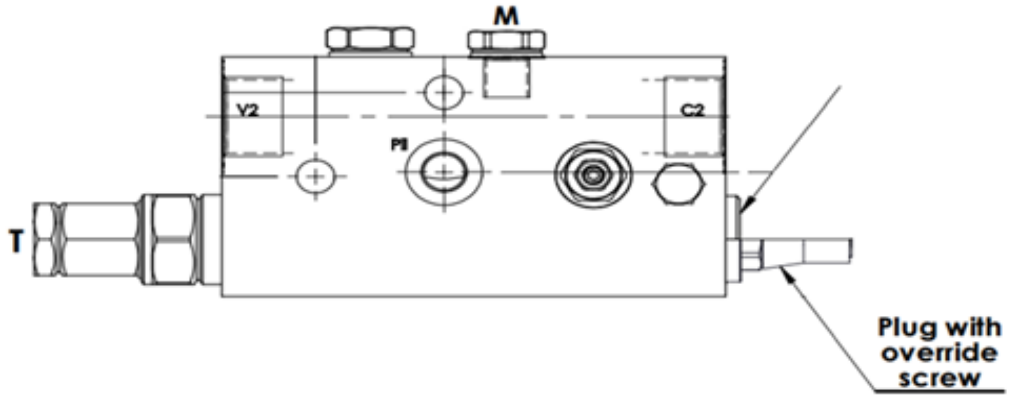


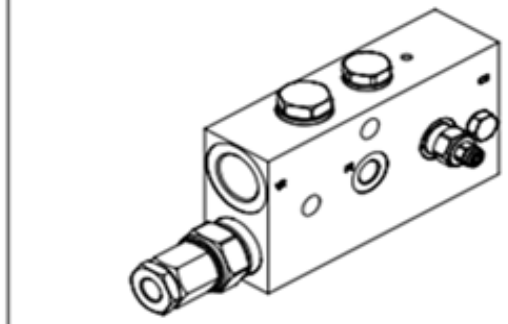
1. Solenoid KL710C2107ER13ERD1
2. Double pilot operated check valve KSXS06-20/250C2
3. Screw M6*30

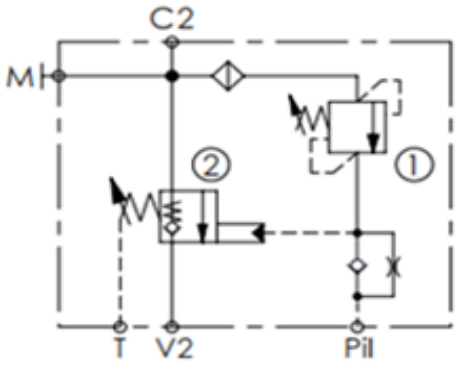
Rated Flow: 25L/min
Rated Pressure: 250bar
Voltage: 13V+15% DC, 25W
C1,C2:G 1/8, other ports: G 1/4

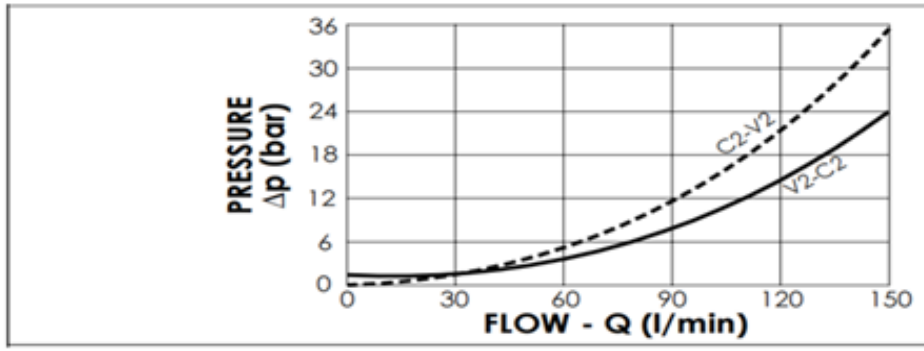
5. Hydraulic System

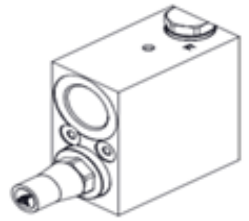
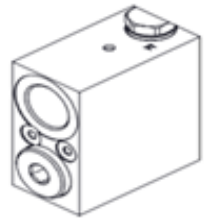
Check & Metering Valve (Boom Anti-Burst Valve)









Plug with override screw	Normal plug
	

SPECIFICATIONS	
Max. operating pressure:	420 bar
Rated flow:	150 l/min
Manifold:	Steel
Weight:	3,35 kg
Main ports size	① V2,C2: G 3/8" ② Pil,T,M: G 1/4"
Standard setting (bar)	① 350 Q=5 l/min ② 7.5 Crack. pr.
Adjust range (bar)	① 150-420 ② 3-15
Pressure increase (bar/turn)	① 236 ② 8

5. Hydraulic System

Solenoid Valve

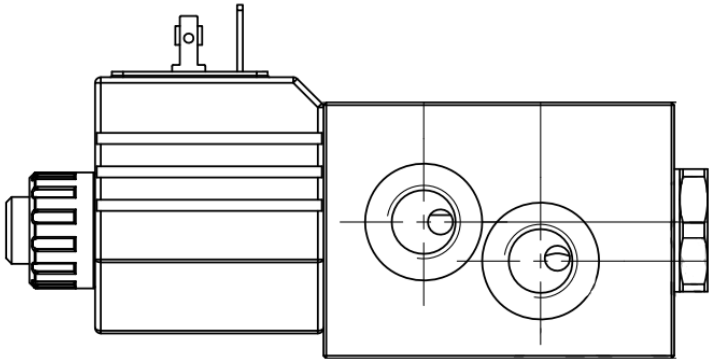
A valve basically consists of a housing (1), a control spool (2), a return spring (3) and a solenoid (4). It is designed to connect two inlet lines P1 – P2 (normally a set of hoses) and divert them to either the outlet ports (C1 – C4) with spool in position "0", when the solenoid is de-energized, or to the outlet ports (C2 – C3) with spool in position "1", when the solenoid is energized.

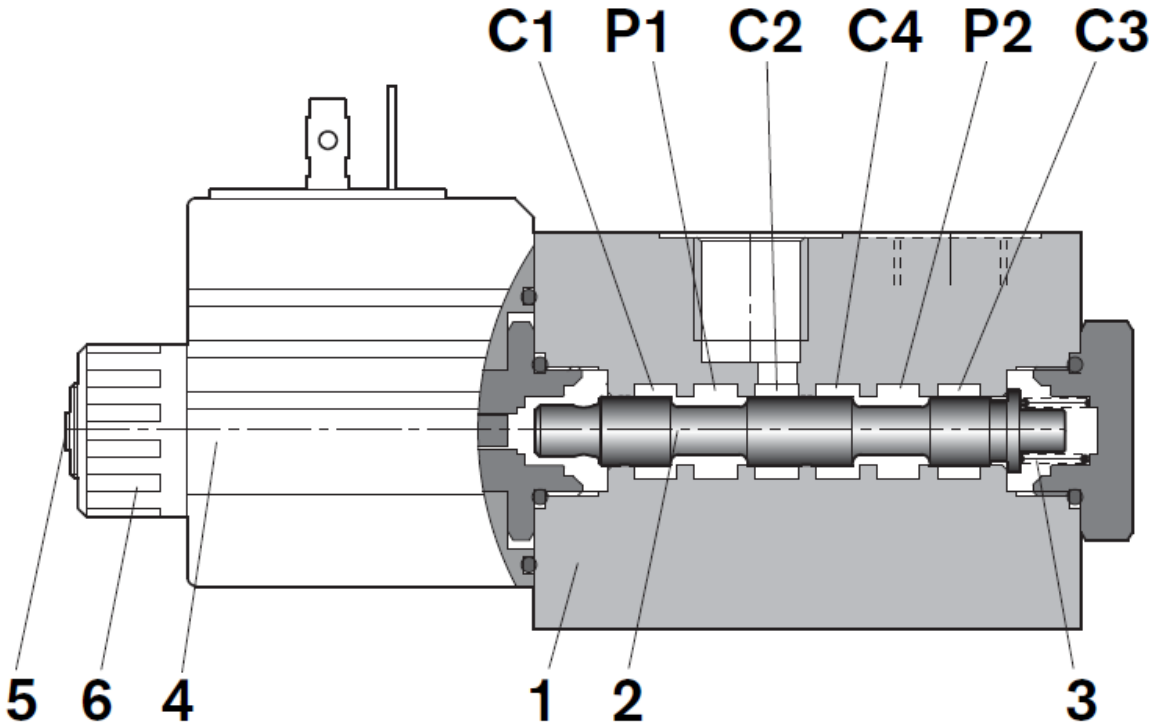
With the coil de-energized, the return spring (3) pushes back the spool (2) and holds it in position "0"

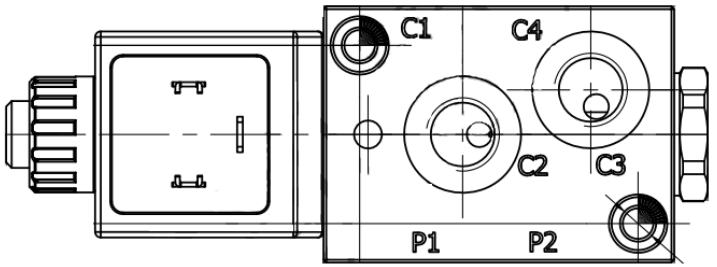
The coil (4) is fastened to the tube by the ring nut (6).

The manual override (6) allows to shift the spool (2) also in case of voltage shortage.

Hydraulic / pneumatic pilot control for spool shifting is available upon request.



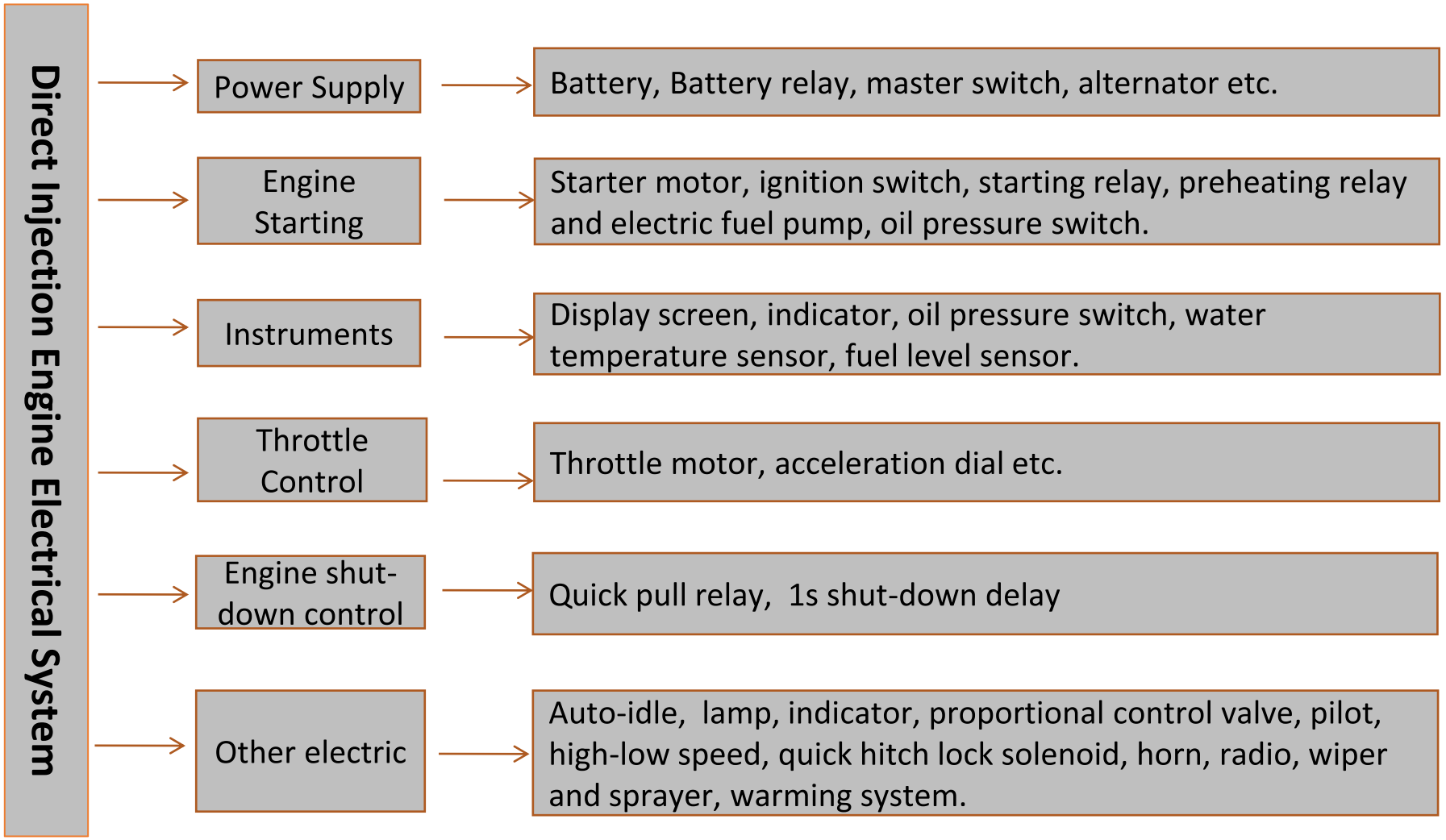




VI. Engine & Electrical System

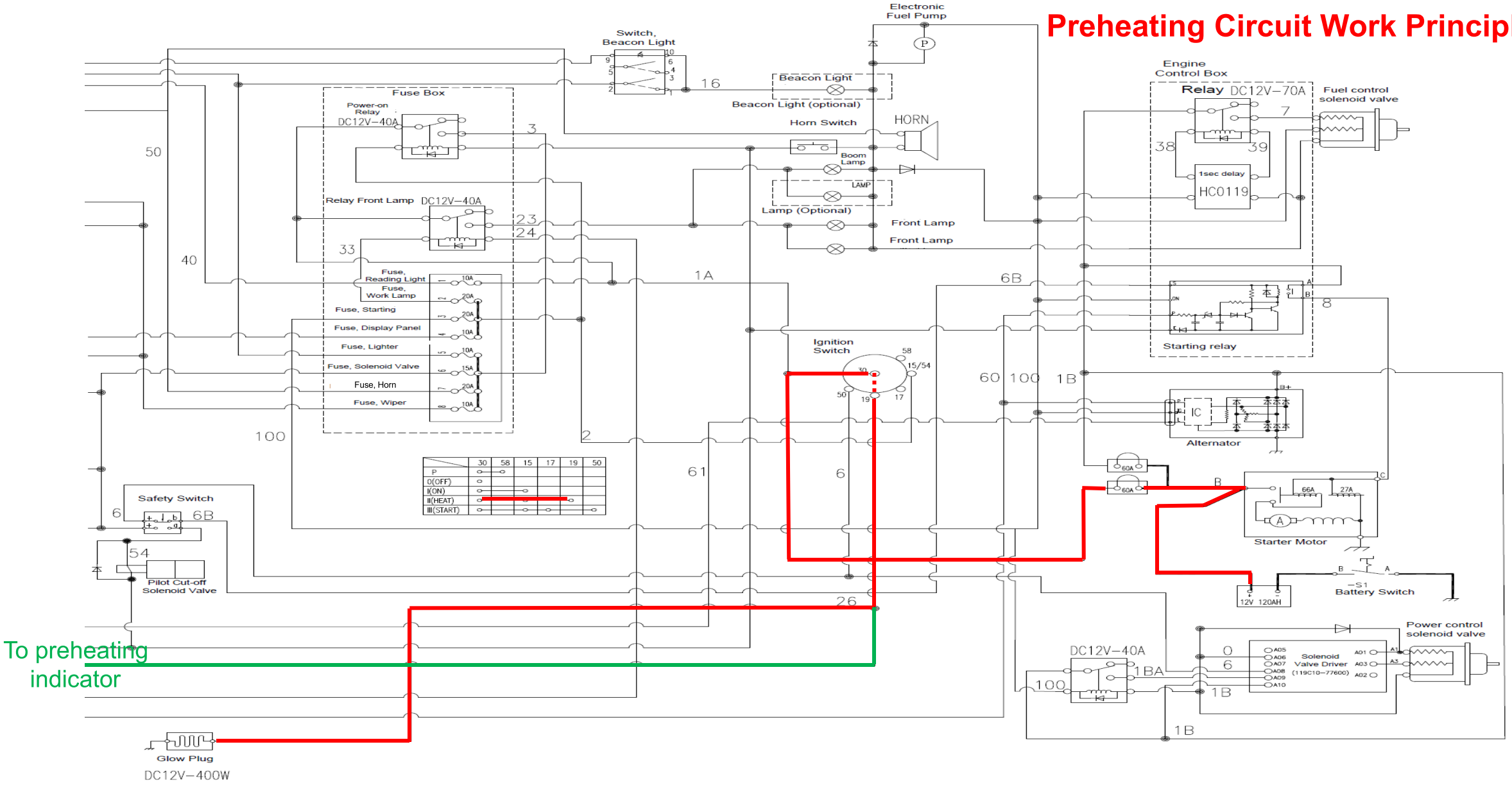
6. Engine & Electrical System

Composition of Electrical System



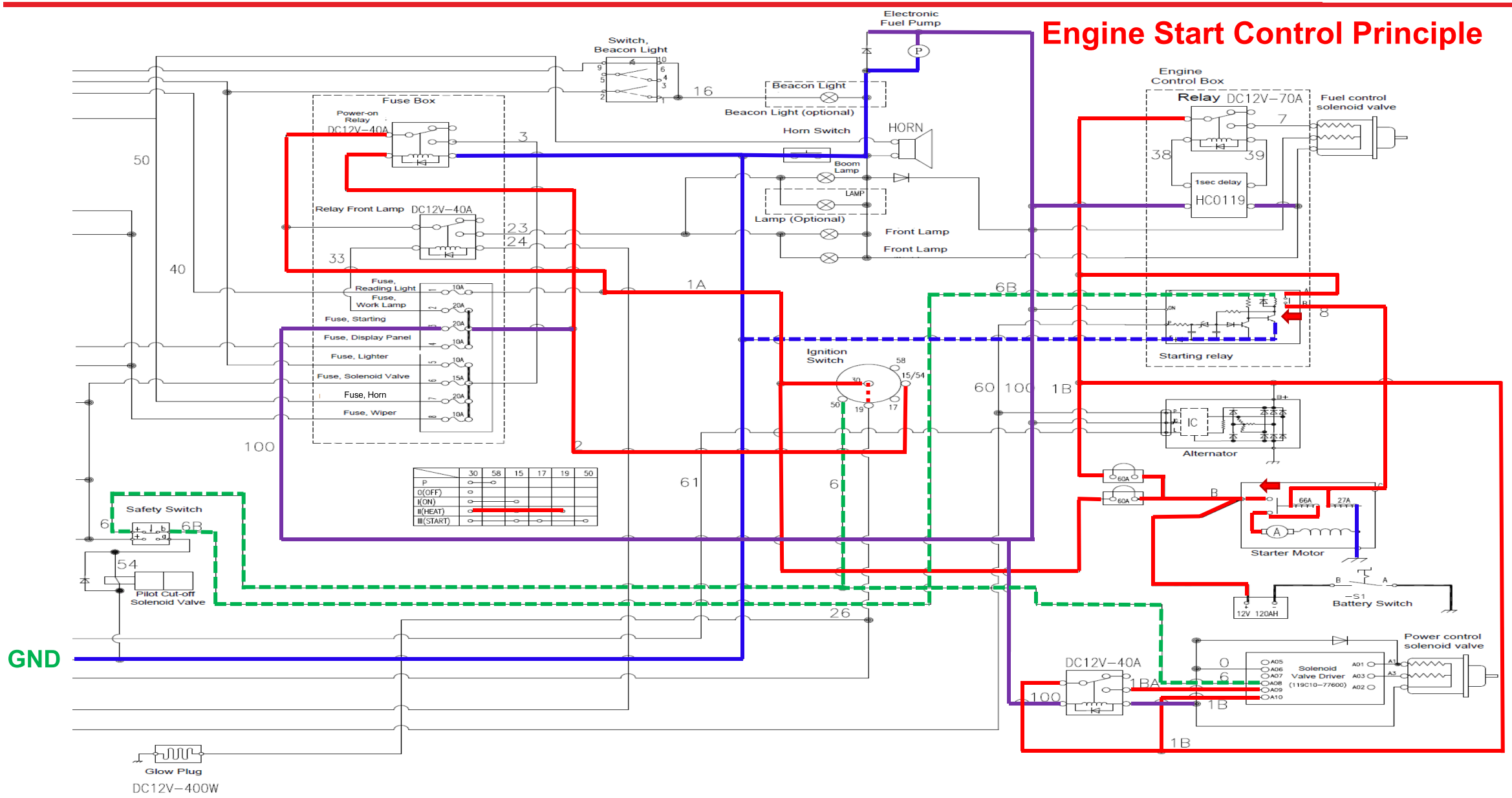
6. Engine & Electrical System

Preheating Circuit Work Principle



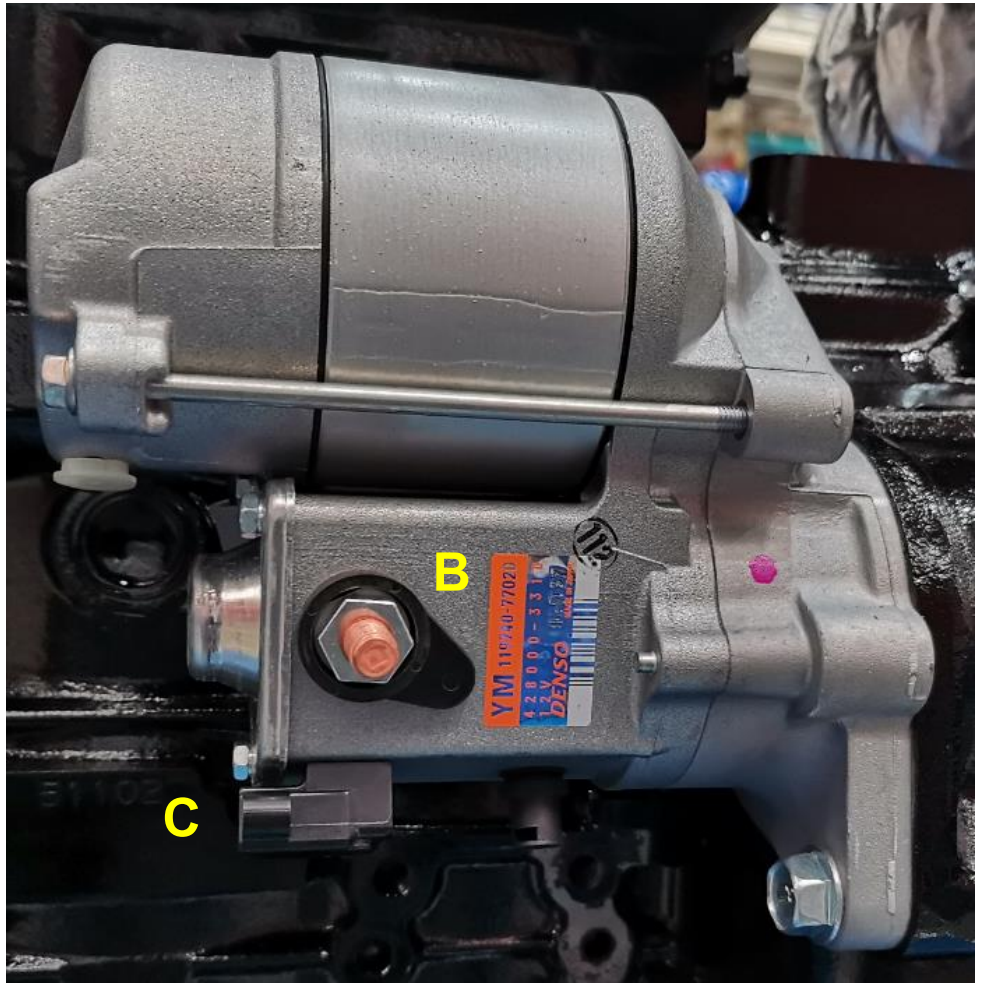
6. Engine & Electrical System

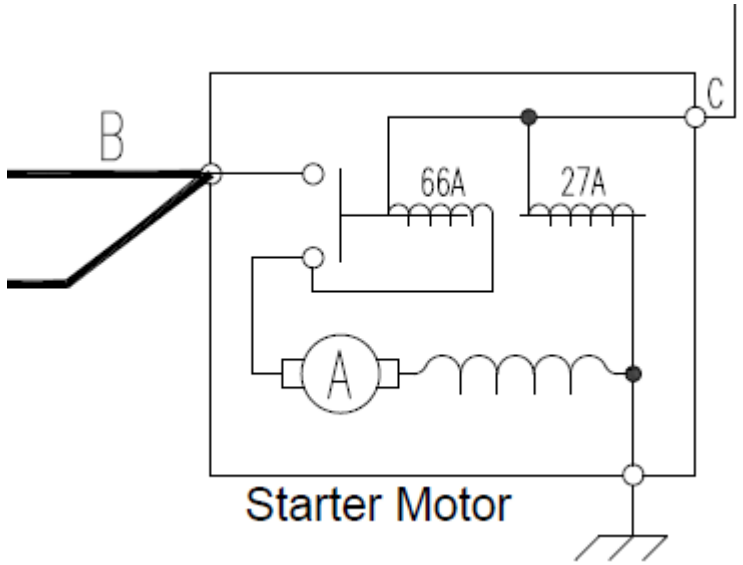
Engine Start Control Principle



6. Engine & Electrical System

Starter Motor

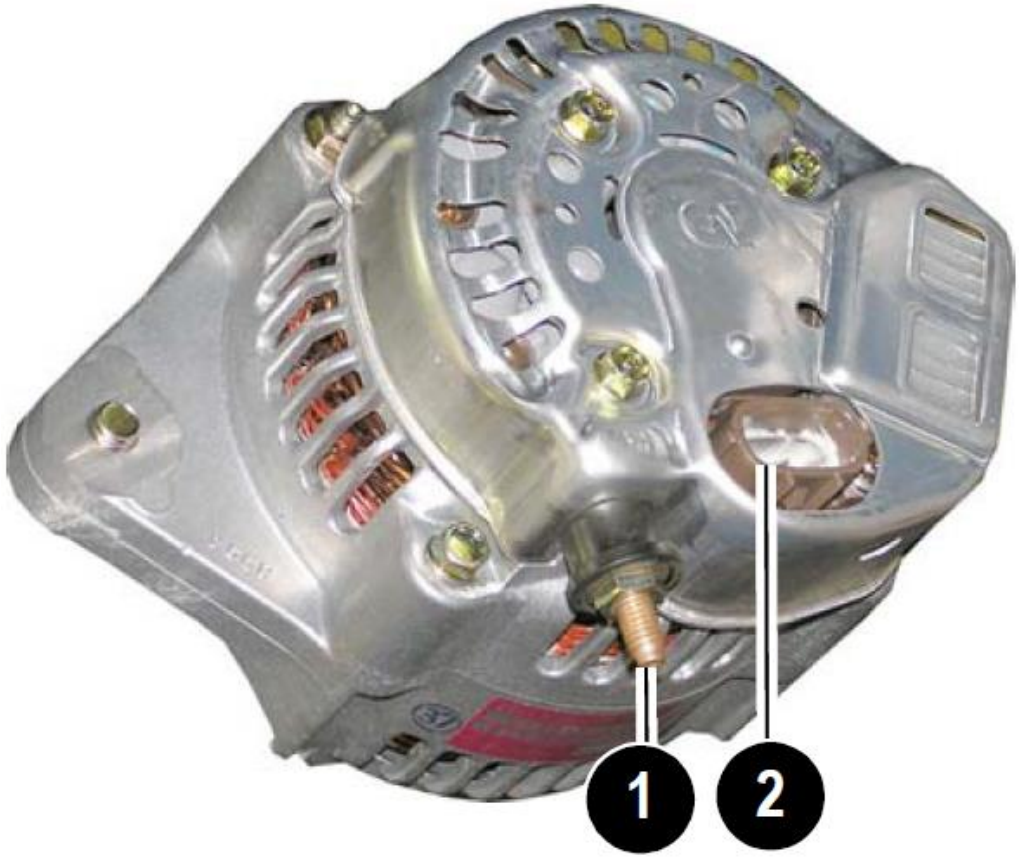


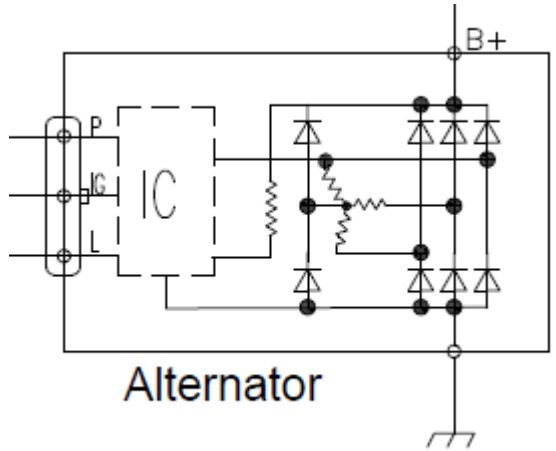


Position	Description
B	Connecting to Battery
C	Connect to Starting Relay

6. Engine & Electrical System

Alternator

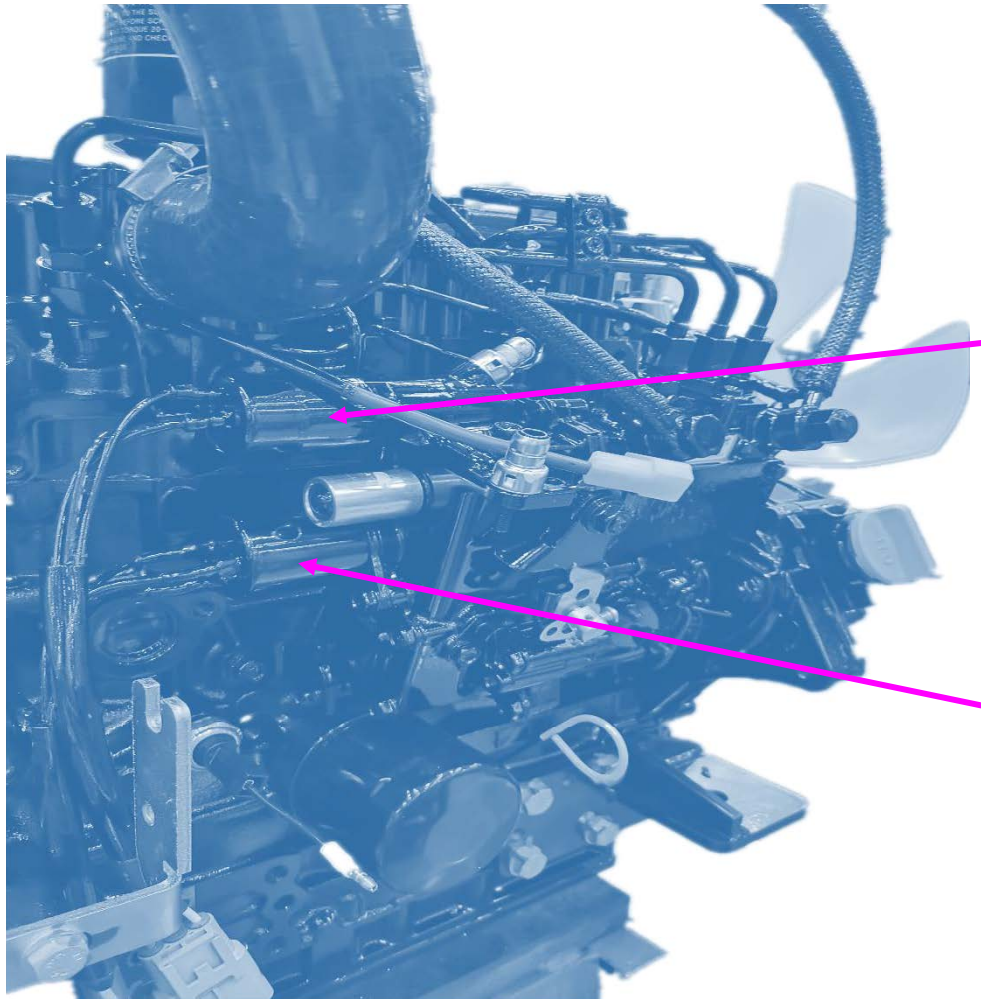




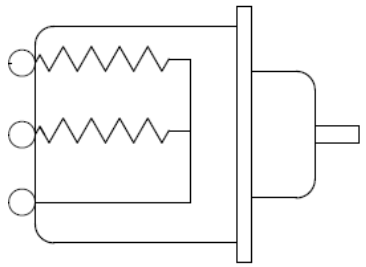
Position	Description
1	Connection B (for charging battery)
2	Connection P to starting relay
	Connection IG for Charing Indicator (12v)
	Port L indicator light (during service 12V, otherwise earth)

6. Engine & Electrical System

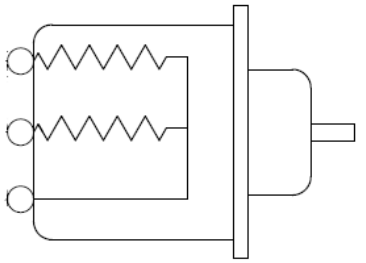
Fuel Shut-off Solenoid Valve & Power Control Solenoid Valve



Power control solenoid valve

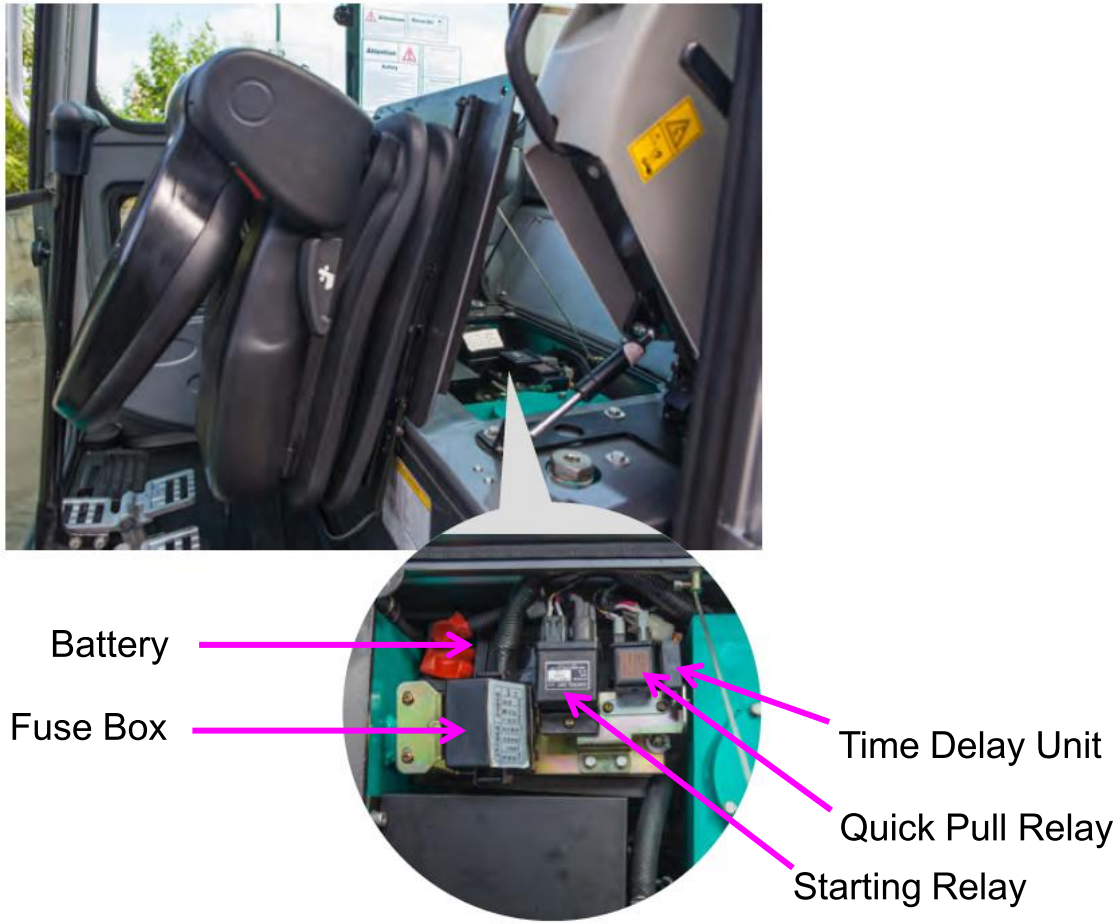


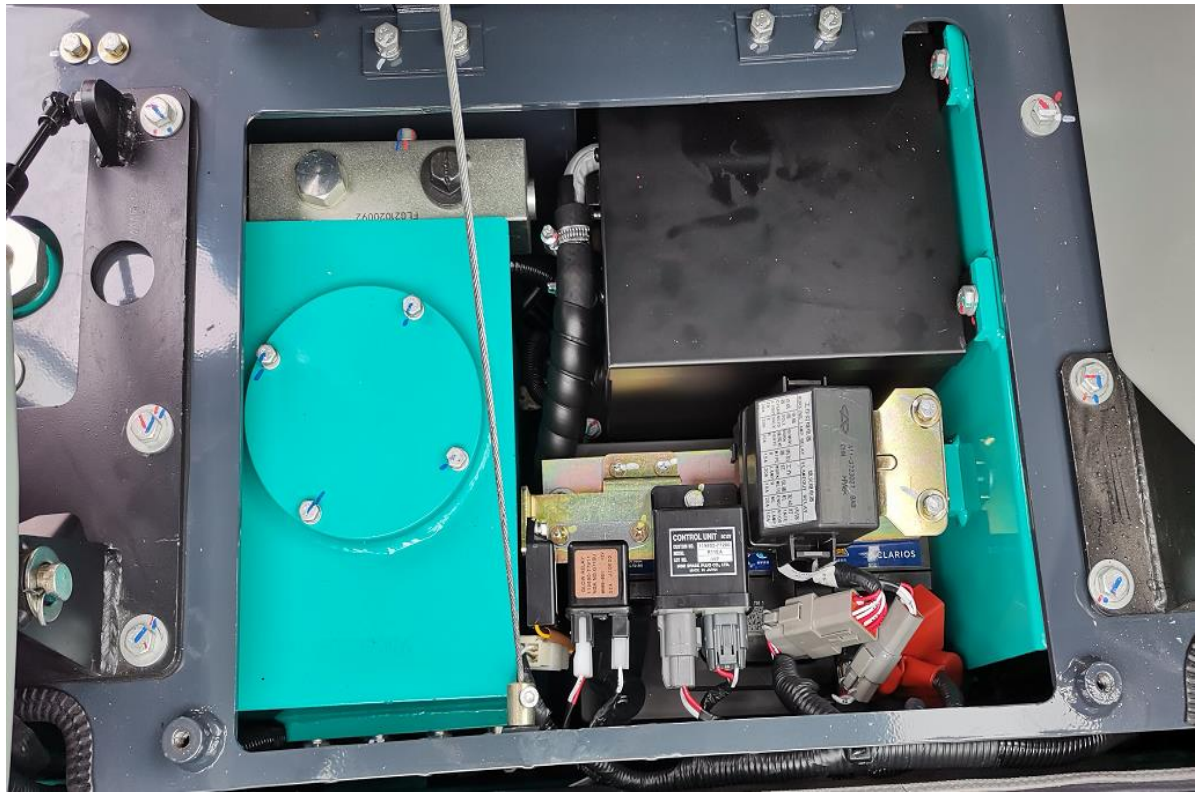
Fuel shut-off solenoid valve



6. Engine & Electrical System

Location of Fuses & Relays

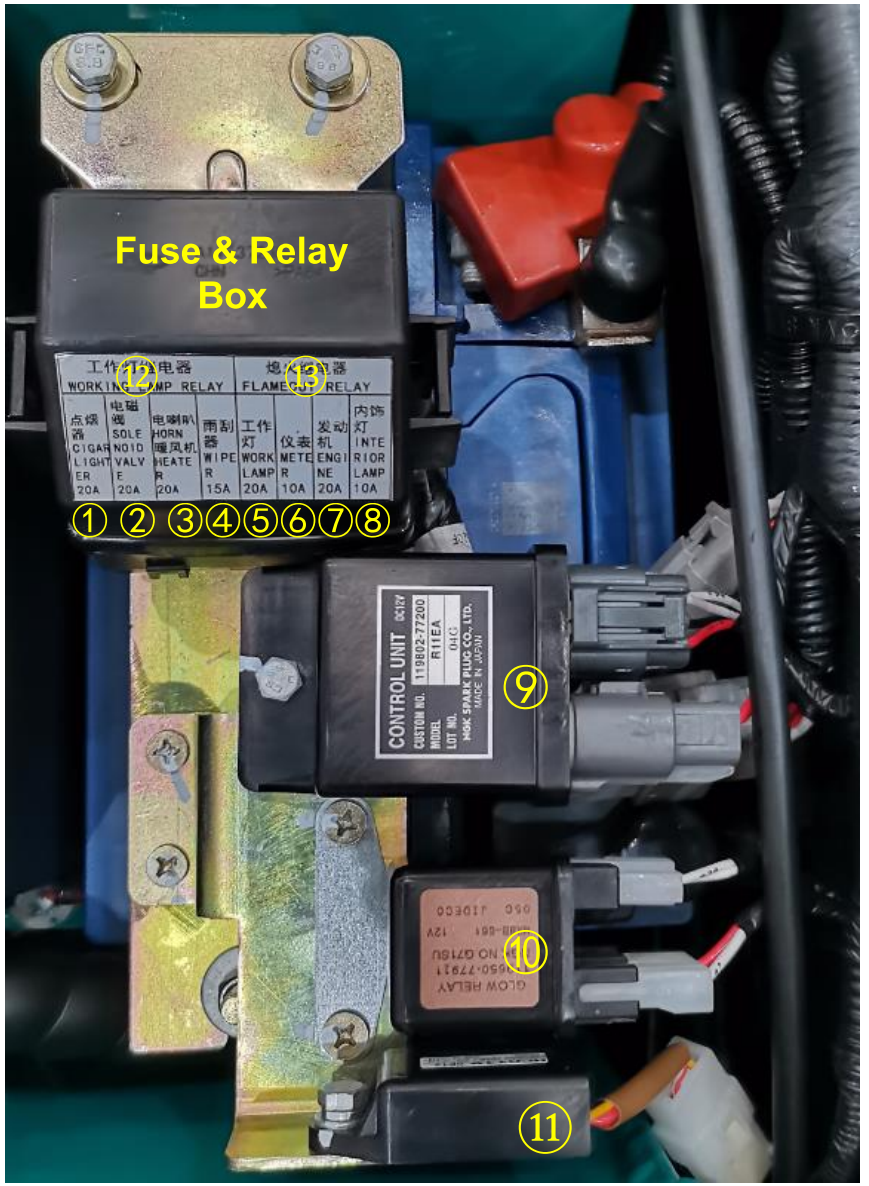




Underneath Operator's Seat

6. Engine & Electrical System

①	Fuse, Cigarette Lighter 20A
②	Fuse, Solenoid Valve Coil 20A
③	Fuse, Horn 20A
④	Fuse, Wiper 15A
⑤	Fuse, Work Lamp 20A
⑥	Fuse, Display Panel 10A
⑦	Fuse, Engine Starting 20A
⑧	Fuse, Reading Lamp 10A
⑨	Starting Relay
⑩	Quick Pull Relay
⑪	Time Delay Unit
⑫	Work Lamp Relay
⑬	Stop Solenoid Valve Relay



SUNWARD
ACADEMY