EC330B/EC360B/EC460B/EC700B SERVICE TRAINING

EC330B/EC360B/EC460B/EC70OB SERVICE TRAINING

This material is combined as below.

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  02-2_D12C Engine(EC330B-EC460B)
  02-3_D12D Engine(EC330B-EC460B)
  02-3_D16E Engine(EC700B)
03_Electric system
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  03-3_D12D Engine application(EC330B-EC460B)
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04_Power Transmission
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05_Brake System
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07_Frame & Undercarriage
08_Aircon
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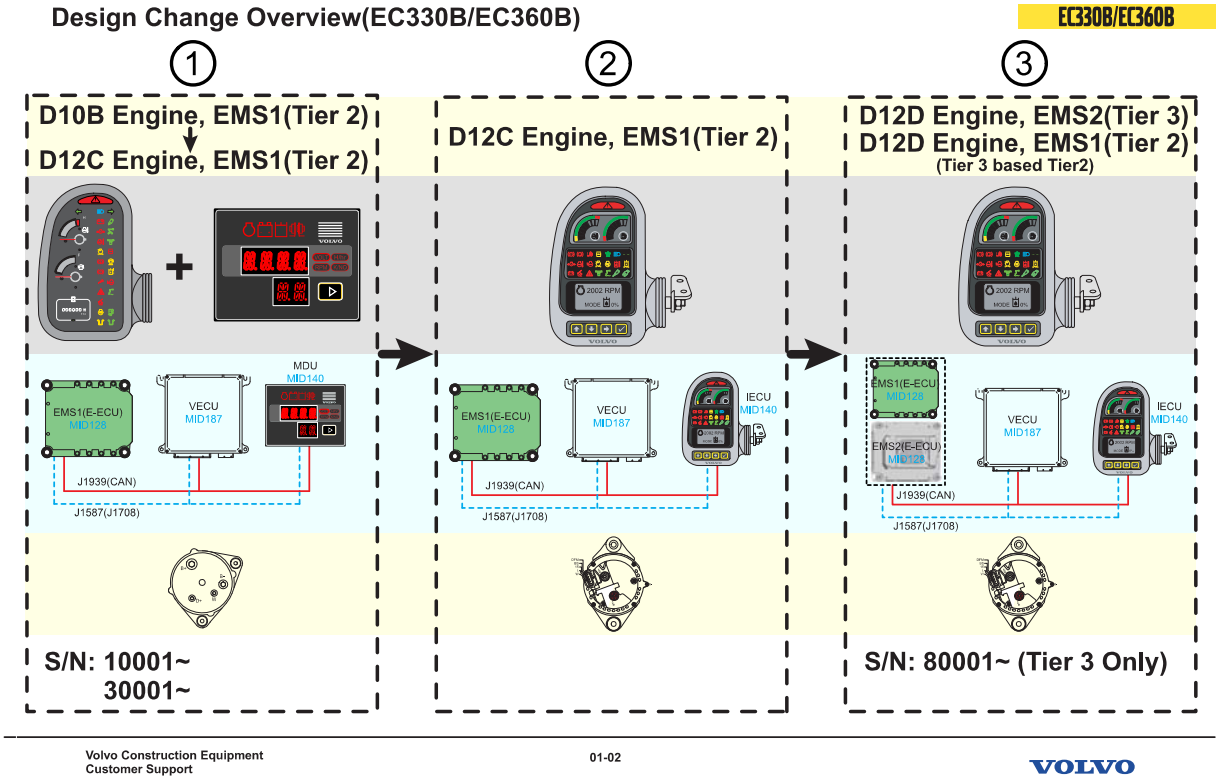
  09-2_Hydraulic_D12D(EC330B-EC360B)
  09-3_Hydraulic_D12C(E460B)
  09-4_Hydraulic_D12D(EC460B)
  09-5_Hydraulic(EC700B)
  09-6_Hydraulic common



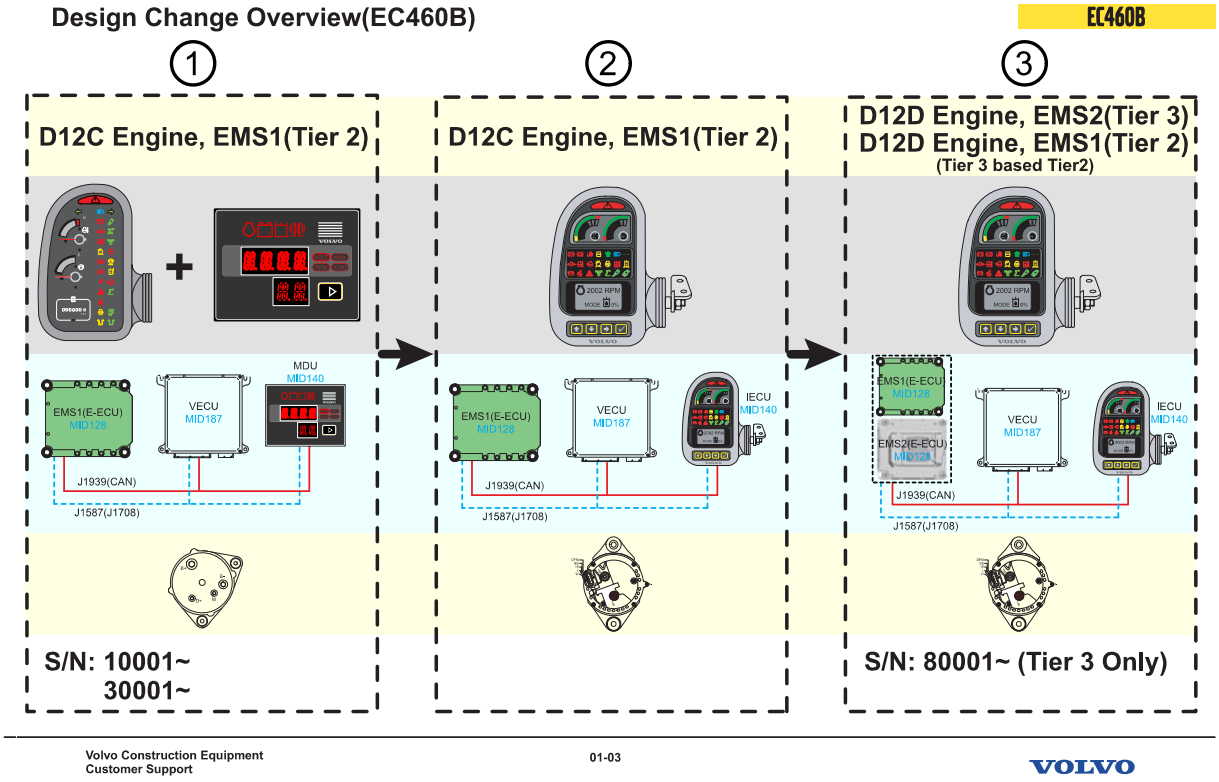
Design Change Overview(EC330B-EC360B)

1-Before I-ECU application
-D10B Engine, EMS1(Tier 2): Initial Production
-D12C Engine, EMS1(Tier 2)
-Instrument panel and MDU
-Old alternator

2-I-ECU application
-D12C Engine, EMS1(Tier 2)
-IECU(Programmable)
-New alternator

3-D12D application
-D12D Engine, EMS2(Tier 3): EU & NA only. Machine serial number starts from 80001
-D12D Engine, EMS1(Tier 3 based Tier 2): International region
-IECU(Programmable)
-New alternator

Picture text:



Design Change Overview(EC460B)

1-Before I-ECU application

-D12C Engine, EMS1(Tier 2)

-Instrument panel and MDU

-Old alternator

2-I-ECU application

-D12C Engine, EMS1(Tier 2)

-IECU(Programmable)

-New alternator

3-D12D Engine application

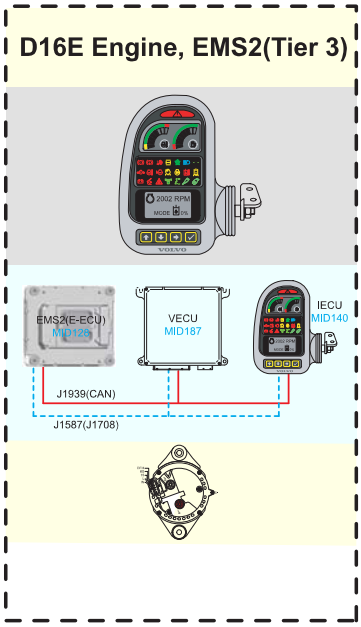
-D12D Engine, EMS2(Tier 3): EU & NA only. Machine serial number starts from 80001.

-D12D Engine, EMS1(Tier 3 based Tier 2): International region

-IECU(Programmable)

-New alternator

Picture text:

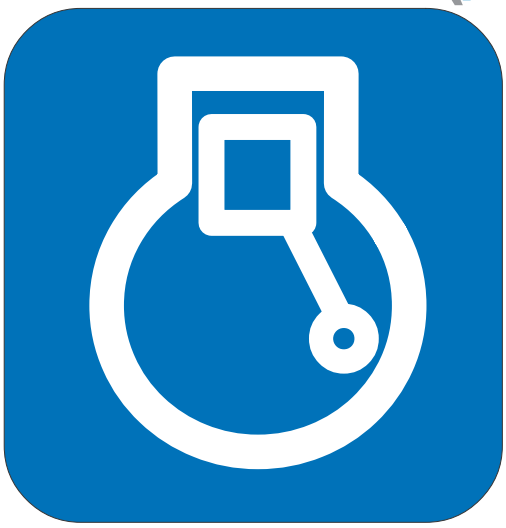


Design Change Overview(EC700B)

-D16E Engine, EMS2(Tier 3)
-IECU(Programmable)
-New alternator

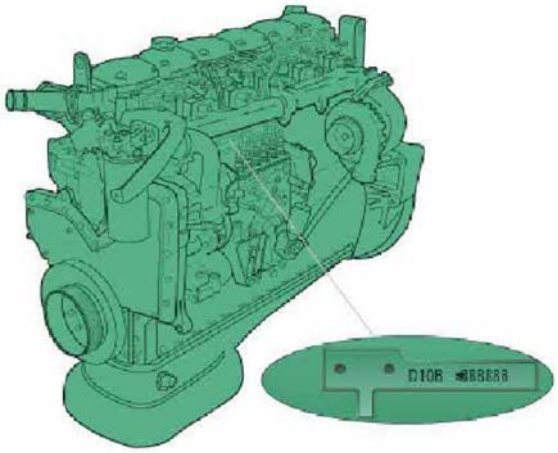
Picture text:

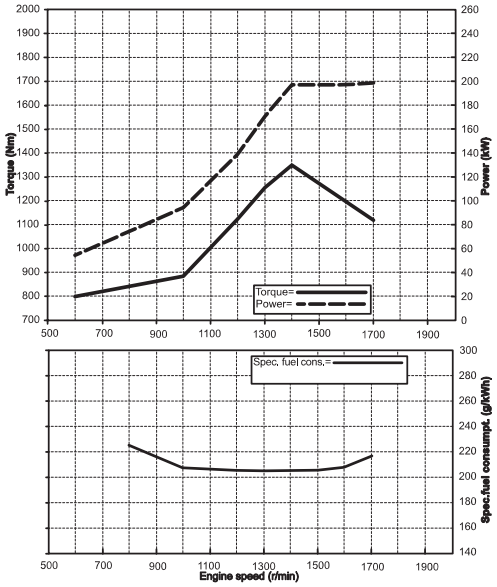
EC330B-EC360B(D10B)



Engine(D10B)

Picture text:

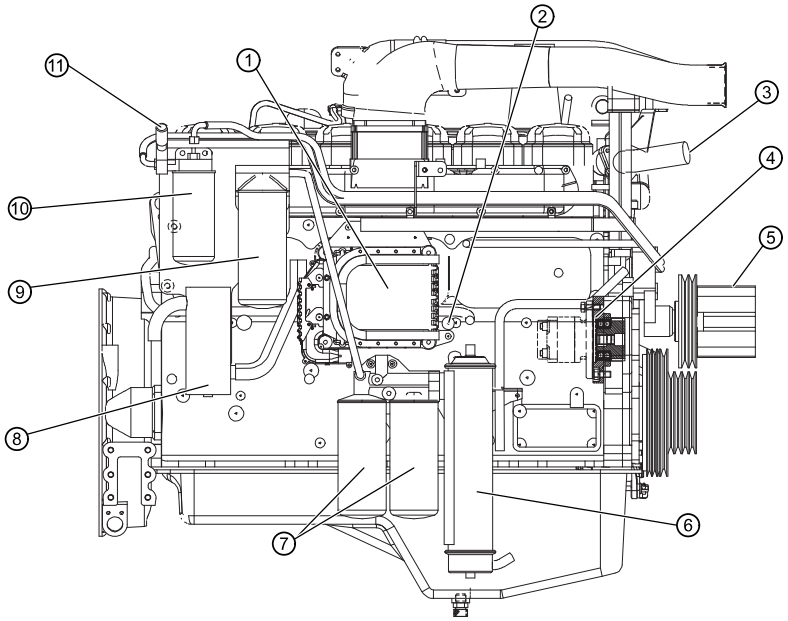




Engine specification

Model: D10B EAE2
Power(kW): 198 at 1700 rpm
Power(hp): 269 hp at 1700 rpm
Torque: 1345 Nm at 1400 rpm
Bore x Stroke: 120.65mm x 140mm
DISPLACEMENT: 9600 cc
Type: 4 cycle-diesel-turbo & charge air cooled

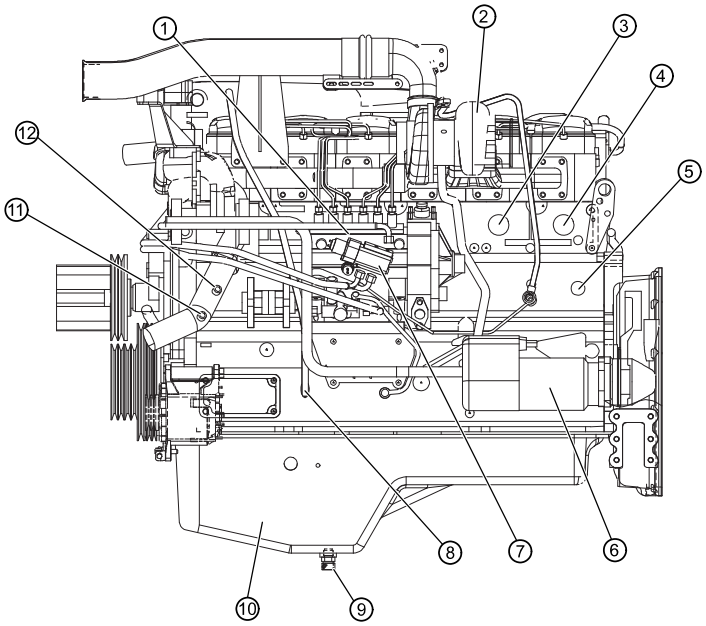
Picture text:



External view(1)

1. EMS(E-ECU)
2. Fuel inlet
3. Water outlet
4. Engine PTO
5. Fan drive & Pulley
6. Engine oil cooler
7. Engine oil filter(full)
8. Breather
9. Engine oil filter(bypass)
10. Fuel filter
11. Fuel feed pump

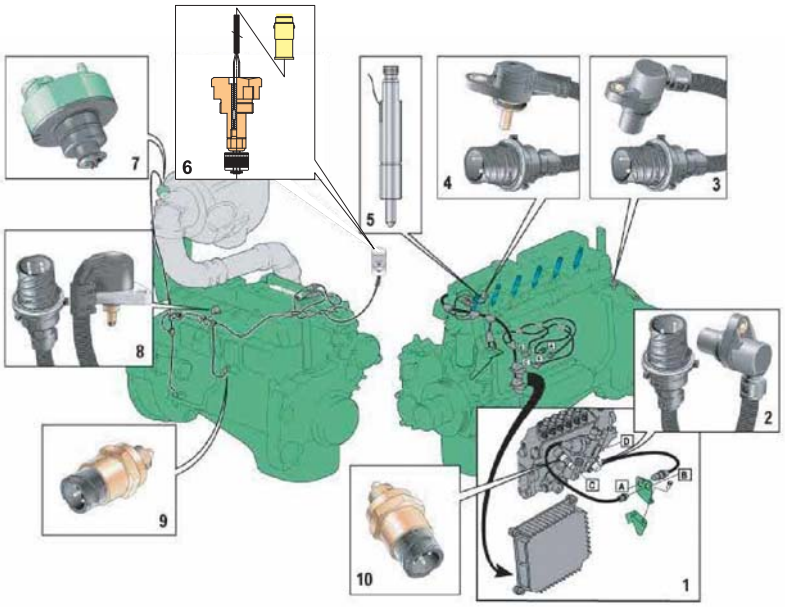
Picture text:



External view(2)

1. Fuel pump
2. Turbochargher
3. Cooler block heater
4. Cab heater supply
5. Coolant filter heater
6. Starter
7. Fuel shut-off solenoid
8. Dipstick
9. Oil drain valve
10. Oil pan
11. Coolant filter return
12. Cab heater return

Picture text:

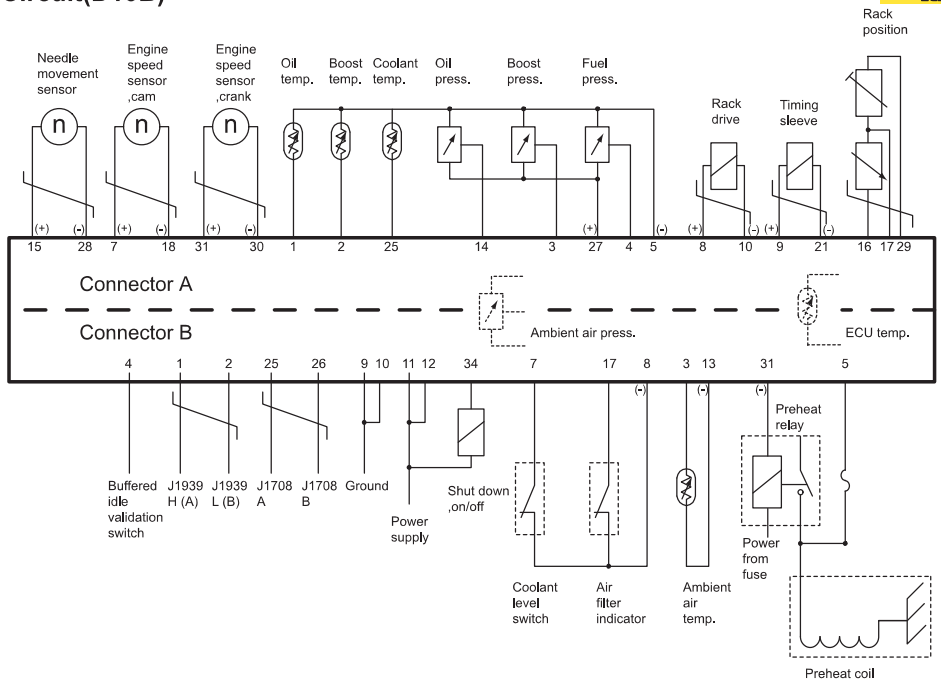


E-ECU Sensors

1. E-ECU
2,3. Speed sensor
4. Coolant temp.
5. Needle movement
6. Coolant level
7. Inlet air press. & temp.
8. Boost air press. & temp.
9. Oil press. & temp.
10. Fuel press. & temp.

Picture text:

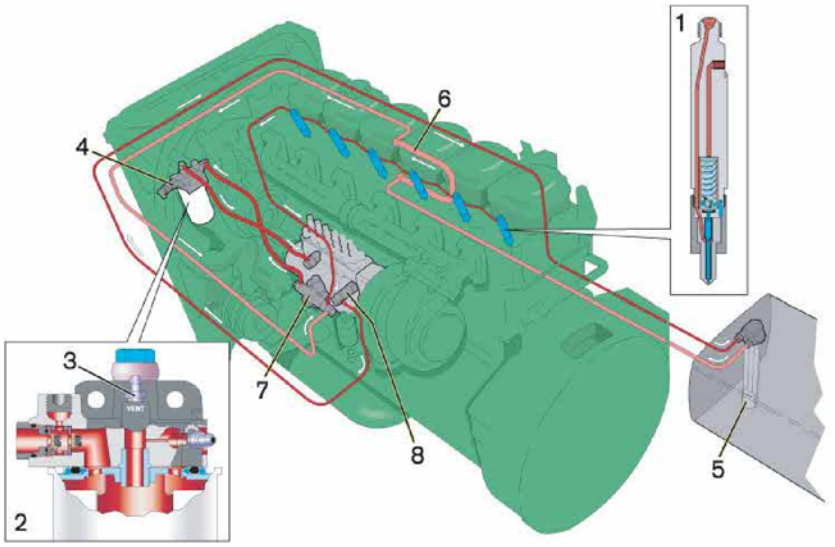
E-ECU Circuit(D10B)



E-ECU circuit

Communication line is at the Red color connector!(Connector B)

Picture text:



Fuel system

The injection pump is bolted onto a separate bracket on the left side of the engine.The injectors (1) used are made by Bosch. Their opening pressure is adjusted by means of washers of varying thickness inserted above the spring.
The fuel filter (2) is attached to a filter bracket. A bleeder nipple is also placed on the bracket (3).
From the feeder pump fuel is forced through the filter and into the injection pump feed side via the fuel shut-off valve. Return fuel from the injection pump goes via the fuel shut-off valve and overflow valve (8) to the tank. The leak-off line from the injectors is connected to the injection pump via the suction line connection.

1. Injector

2. Fuel filter

3. Bleeder nipple

4. Sensor fuel temp/pressure

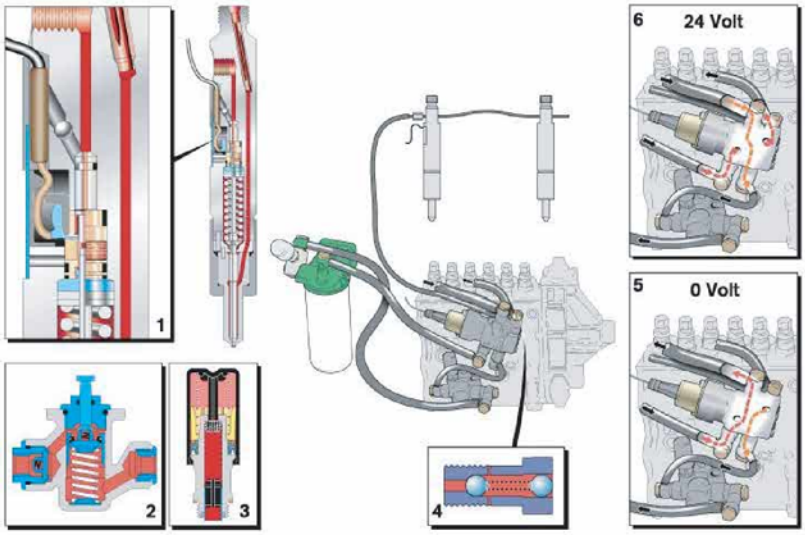
5. Tank strainer

6. Cooling loop, ECU

7. Feeder pump

8. Overflow valve

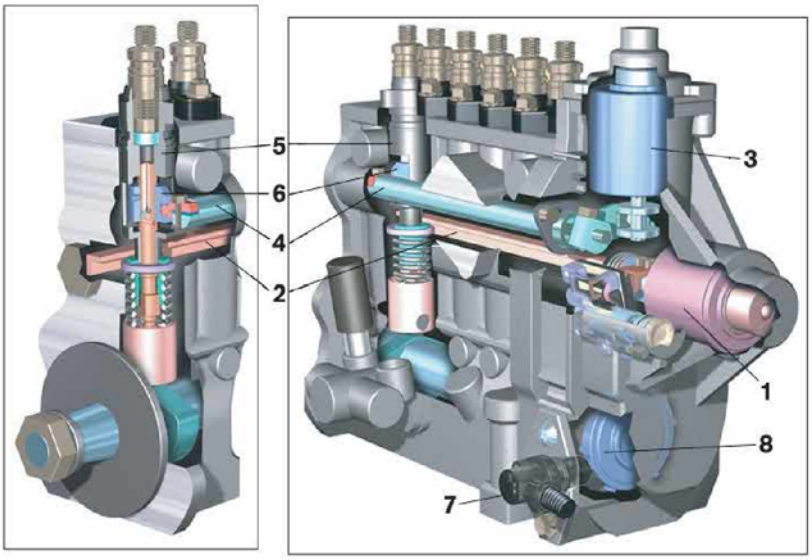
Picture text:



Fuel system-Injector

1 Needle movement sensor
2 Feed pump
3 Manual feed pump
4 Overflow valve
5 Fuel cut-off valve(Off condition)
6 Fuel cut-off valve(On condition)

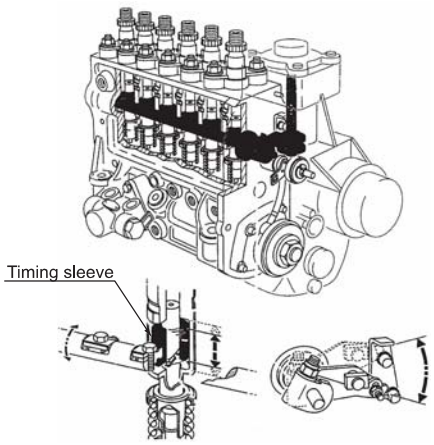
Picture text:



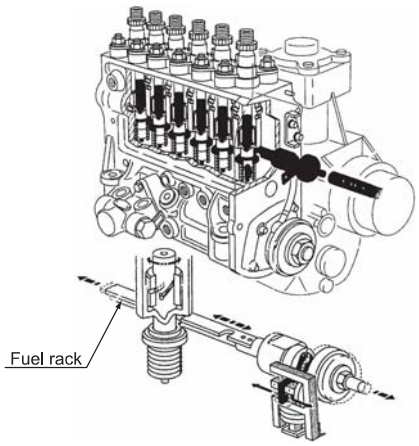
Fuel system-Injection pump

1 Fuel rack control solenoid
2 Fuel rack(injection quantity control)
3 Injection timing control solenoid
4 Lever
5 Delivery valve
6 Timing sleeve
7 Speed sensor
8 Toothed wheel

Picture text:



Injection timing



Injection quantity

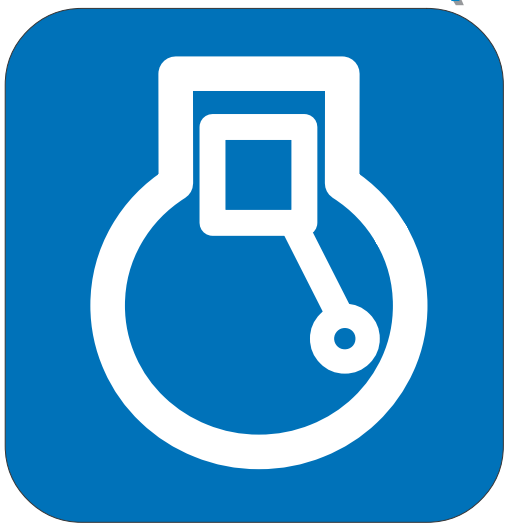
Fuel system-Injection control

Injection timing is adjusted by timing sleeve location.

Injection quantity is adjusted by fuel rack operation.

Picture text:

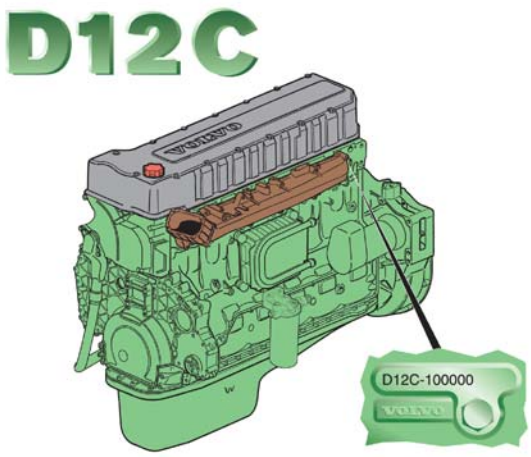
EC330B-EC460B(D12C)

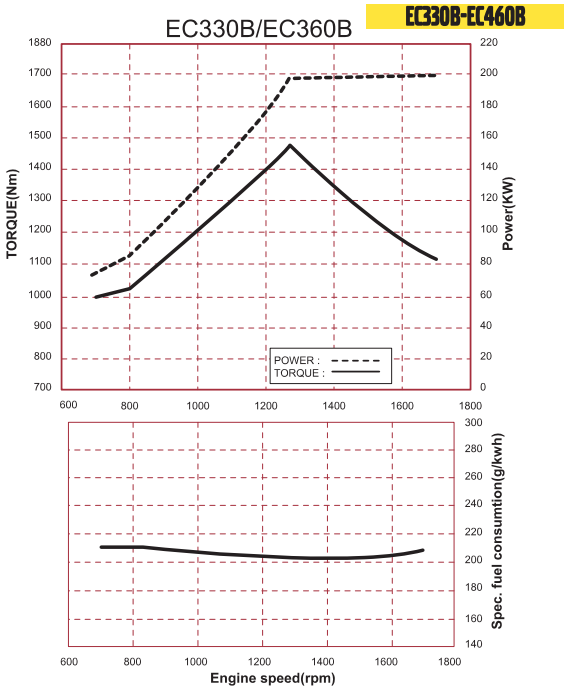


Engine(D12C)

Picture text:

Engine specification





EC460B

Volvo Construction Equipment
Customer Support

02-02-02

VOLVO

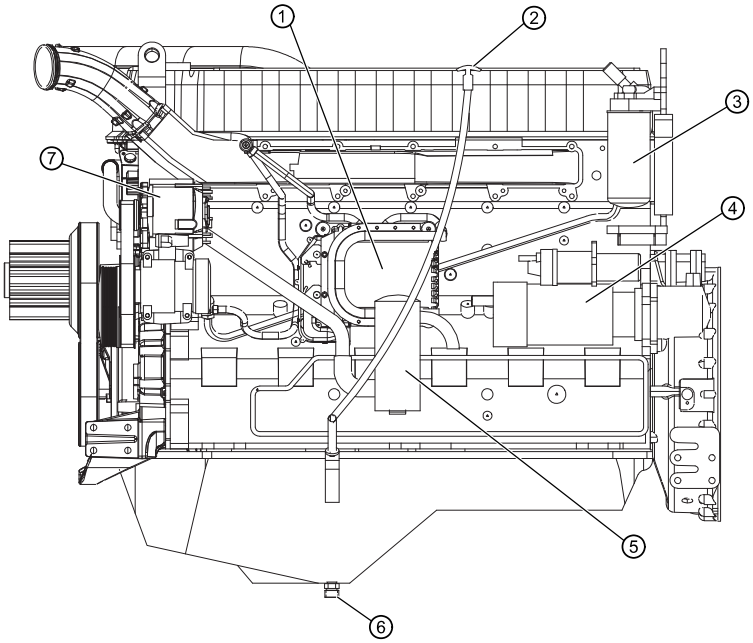
Engine specification

D=Diesel engine
12=Cylinder volume in litres
C=Generation
E=Excavator application
C=Version
E2= Valid to Tier-2 & Euro-2

1. EC330B-EC360B
D12CECE2(For NA), D12CEDE2(For EU), D12CEEE2(For other region)
Power: 198Kw at 1700rpm
MAX Torque: 1345Nm at 1400rpm

2. EC460B
D12CEAE2(For NA), D12CEBE2(For EU), D12CEFE2(For other region)
Power: 239Kw at 1900rpm
MAX Torque: 1600Nm at 1400rpm

D12 is the model number of the volvo 12 liter engine.
The engine is a 6-cylinder, 4-stroke, direct injection diesel with a 12 liter cylinder volume, turbocharger, charged air cooler and electronic controlled fuel injection, EMS (Engine Management System).
The serial number of the engine is to be found stamped in the cylinder block on the rear left side.
The cylinder head is of cast iron and manufactured in one piece which is necessary in order to provide stable bearings for the overhead camshaft.
The cylinder liner is sealed against the coolant casing with rubber rings.
The D12C has a four-valve system and overhead camshaft.
The engine timing gear transmission is located at the front of the engine on a 10 mm thick steel plate bolted to the cylinder block.
The crankshaft is drop forged and has induction hardened bearing surfaces and fillets.
The engine is force fed lubricated by an oil pump which is gear driven from the engine crankshaft via an intermediate gear
The fuel system for D12C has electronic control with unit injectors one for each cylinder and which operate at a very high pressure.

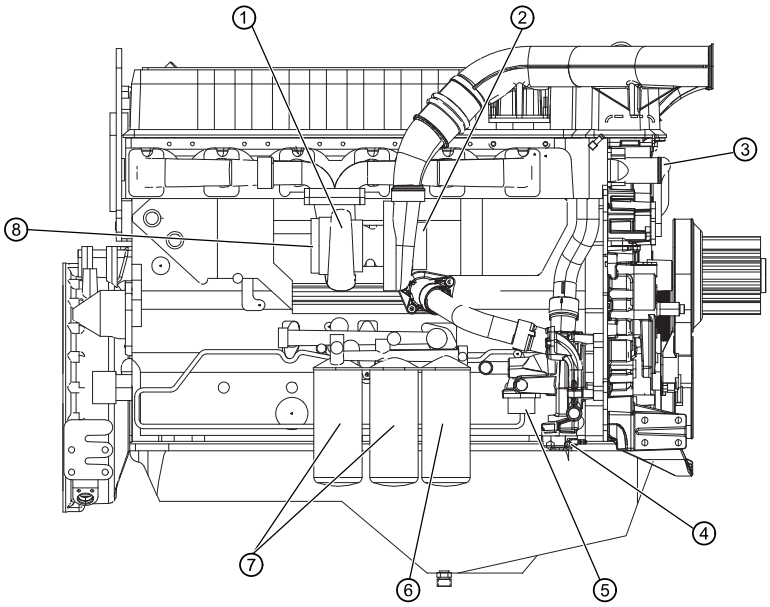


External view(1)

External view & component location

1. E-ECU
2. Dip stick
3. Fuel filter
4. Start motor
5. Breather
6. Oil drain valve
7. Alternator

Picture text:



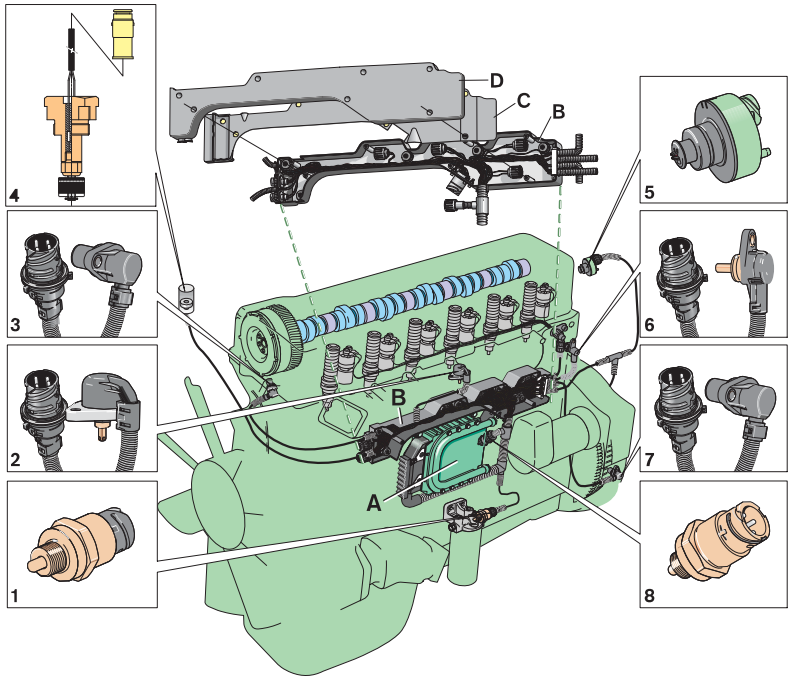
External view(2)

External view & component location

1. Turbocharger
2. Air inlet
3. Water outlet
4. Coolant filter connection
5. Water inlet
6. Oil filter(by-pass)
7. Oil filter(full flow)
8. Exhaust outlet

Picture text:

Sensor Location



1 : Fuel pressure
2 : Boost pressure & temperature
3 : Engine speed,cam
4 : Coolant level
5 : Inlet pressure & temperature
6 : Coolant temperature
7 : Engine speed,crank
8 : Oil pressure & temperature
A : E-ECU
B : Cable box
C : Dividing wall
D : Outer cover

E-ECU Sensors

The D12C has a total of eight sensors. Three of these have dual functions. This gives a total of 11 functions.

The dual function sensors are:
2 Turbo boost pressure/air temperature in inlet manifold.
5 Air temperature before intercooler and pressure drop indicator. Located in the union pipe between the air filter housing and the turbocharger inlet.
8 Oil pressure/temperature.

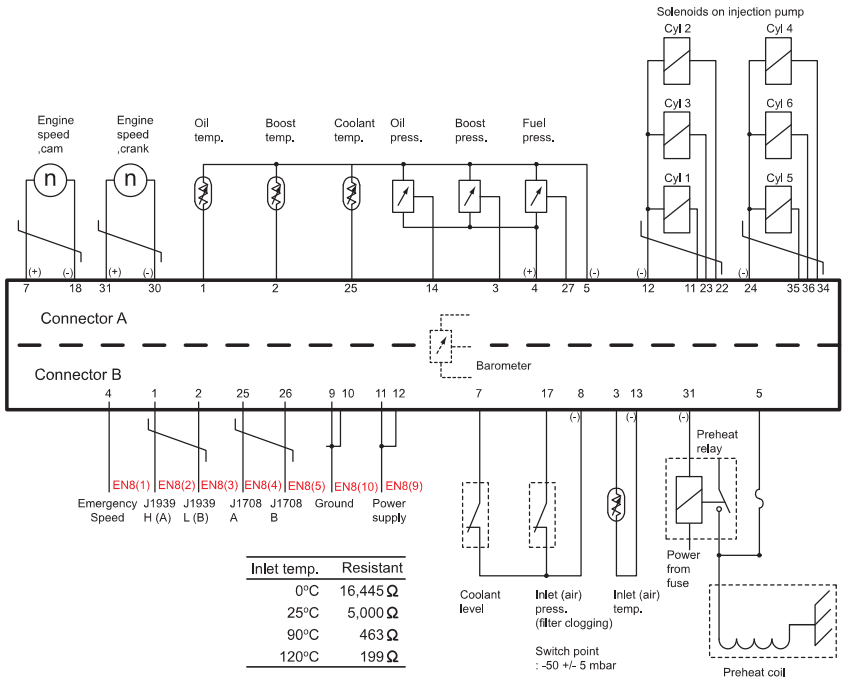
The other sensors are:
1 Fuel pressure sensor. Senses the pressure after the fuel filter.
3 Camshaft position sensor. Located in the upper timing mechanism cover.
4 Engine coolant level. Located in the expansion tank.
6 Engine coolant temperature. Located in the rear end of the cylinder head.
7 Engine speed sensor. Located in the fly wheel cover.

Apart from the sensors above, the system includes a sensor for Atmospheric Pressure, located inside the EECU.

Picture text:

E-ECU Electric circuit-Old(D12C)

EC330B-EC460B



Inlet temp.	Resistant
0ºC	16,445 Ω
25ºC	5,000 Ω
90ºC	463 Ω
120ºC	199 Ω

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EECU electric circuit(Old)

Communication between the control units go via two data buses.
The two data buses have different functions. One is used for the control signals of system and is designated SAE J1939.

The other databus, SAE J1708, is used for information and diagnostics. The link also functions as a back up for the other databus if this for any reason does not function.

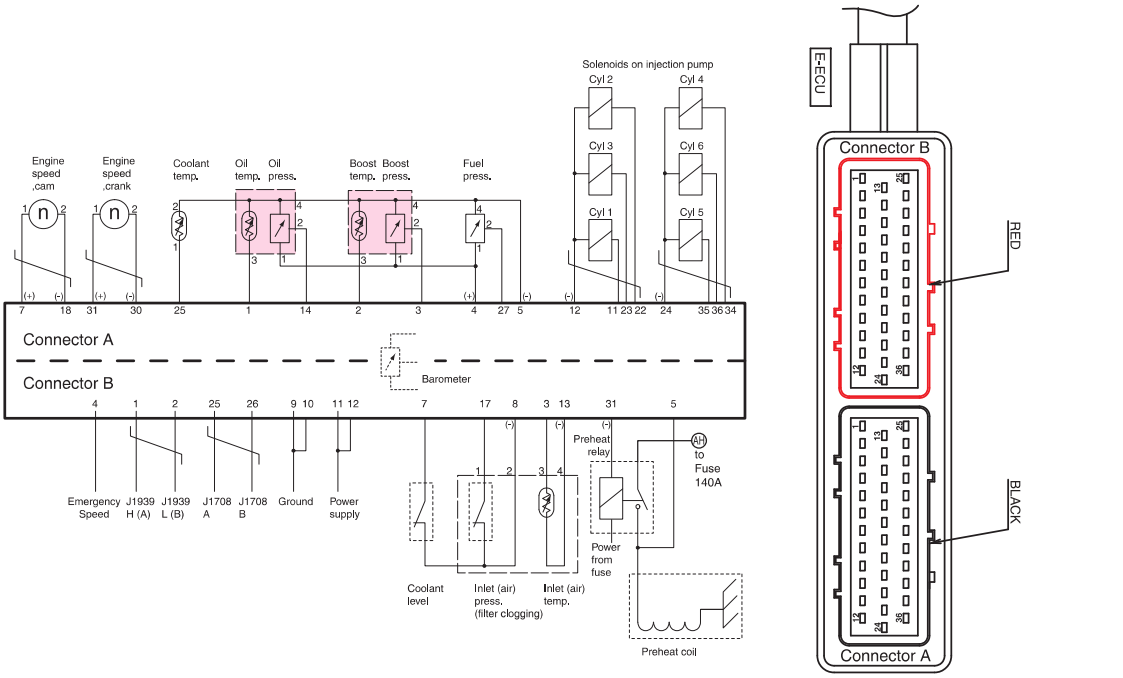
The Engine Management System (EMS) consists of a control unit (EECU) mounted to the engine, sensors and a wiring harness. The EECU, Engine Electronic Control Unit, is connects to both the data bus SAE J1939 and SAE J1708.

The unit receives signals from the Vehicle Control Unit, VECU.
It sends signals to control various functions on the engine and communicates with other control units via the databuses.

Picture text:

E-ECU Electric circuit-New(D12C)

EC330B-EC460B



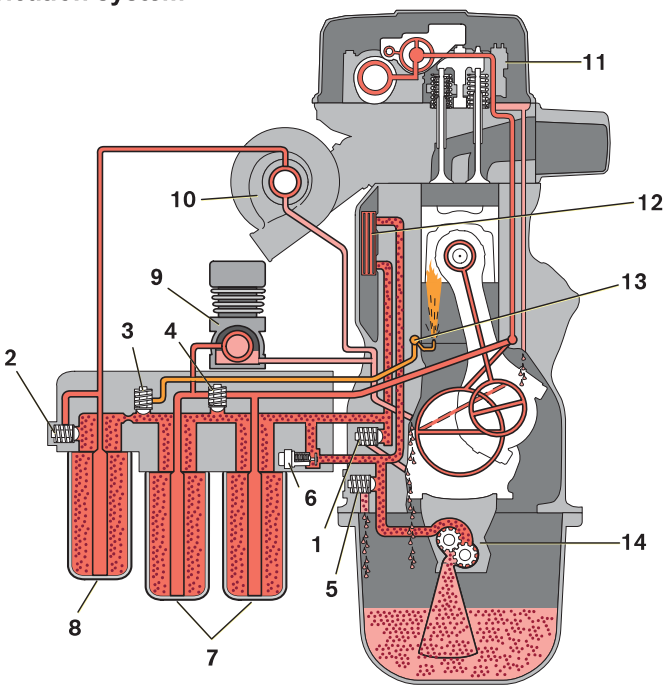
E-ECU Electric circuit(New)

New sensor
1. Oil temp. & oil pressure sensor
2. Boost temp. & boost pressure sensor

Picture text:

Lubrication system

EC330B-EC460B



1 : Regulator valve
2 : Overflow valve
3 : Piston cooling valve
4 : Overflow valve
5 : Overpressure valve
6 : Bypass valve
7 : Full flow filter
8 : Bypass filter
9 : Compressor
10 : Turbo charger
11 : Regulating valve
12 : Oil cooler
13 : Spray nozzle
14 : Oil pump

Lubrication system schematic

This is a schematic description of the lubricating system.

When the engine starts the gear driven pump forces the lubricating oil in to the filter housing. At low oil temperature, for example when cold starting in the winter the bypass valve for the oil cooler will open so the oil will reach the engine faster. From the full flow filters the oil is distributed to the bypass filter and the engine block gallery then to all the engine lubricating points.

The turbo charger is lubricated with oil directly from the bypass filter.

The air compressor is lubricated via an external hose from the filter housing.

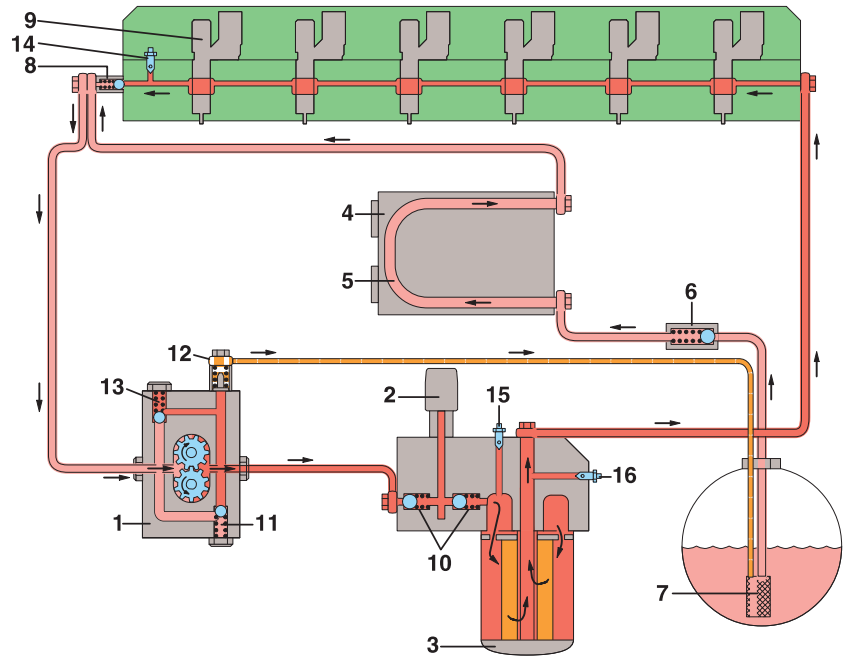
Oil return from the cylinder head
There are three oil return holes drilled through the cylinder head and block.

Oil pressure reducing
The regulator valve regulates the engine oil pressure and excess oil is led back to the sump.

Piston cooling
The valve for piston cooling is pressure sensitive and opens just above the normal idling pressure. The oil is led in to the lengthways channel in the block and sprayed via nozzle, one for each piston, onto the inside of the piston.

By-pass filter Overflow
The overflow valve for the bypass filter opens if the filter becomes blocked to ensure turbo lubrication.

Full flow filter Overflow
The overflow valve for the full flow filter opens if the filter becomes blocked to ensure engine lubrication.♀Oil cooler bypass
When the engine starts and the oil temperature is low (low viscosity), the oil cooling bypass valve opens. This is to lubricate the engine faster during cold start. When the oil temperature is stabilized (viscosity) the valve closes and the oil passes through the oil cooler.



Fuel system principle

The fuel flow and valve function is schematically described. Light red means suction and dark red means feed pressure.
The fuel is sucked up by the feeder pump (1) through the strainer (7) in the tank fitting, past the non-return valve (6).The non-return valve opens and the fuel flows to the control unit and goes through the cooling loop (5) (if the control unit (4) has cooling) up to the overflow valve (8) and from there, together with the return fuel which passes through the overflow valve to the feeder pump suction side.

The feeder pump (1) forces the fuel to the filter housing, past both of the non-return valves (10) for the hand pump (2) and at the same time valve (12) opens for the return fuel to the tank. If there is some air in the system it will automatically be bleeded.

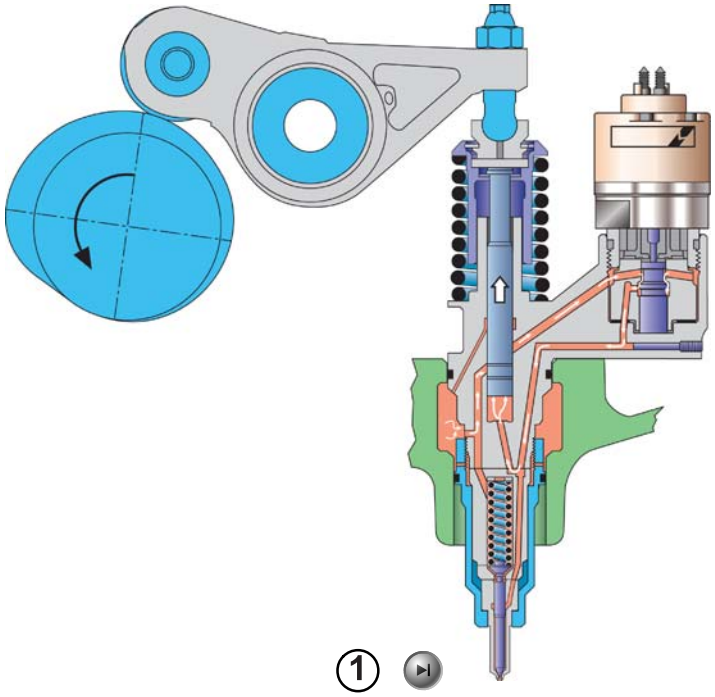
After through the filter (3), to the cylinder head lengthways channel to feed the injectors (9).

The overflow valve (8) maintains a constant pressure for the fuel feed to the injectors (9) and opens at the pressure of 3,5 to 4,5 bar.

The pressure regulating valve (11) in the pump opens to reduce the pressure in the pump for example during engine braking when the fuel injection is cut off.

Picture text:

Unit injector (Filling phase)



Unit injector

The unit injector
The unit injector is driven by the engine camshaft via a rocker arm. Simply put, a unit injector is a combination of an injection pump and a conventional injector and it consists of three main sections:
the pump section(1)
the valve section with the solenoid(2)
the injection section(3)

The pump piston pumps a constant quantity of fuel back and forth through the injector and there is no injection as long as the injector solenoid keeps the valve open.

1. Filling phase
This occurs the entire time that the pump piston is on the way up. The fuel valve is open since there is no voltage applied to the solenoid valve. Fuel can therefore be sucked from the feeder channel, past the open valve and into the pump cylinder.

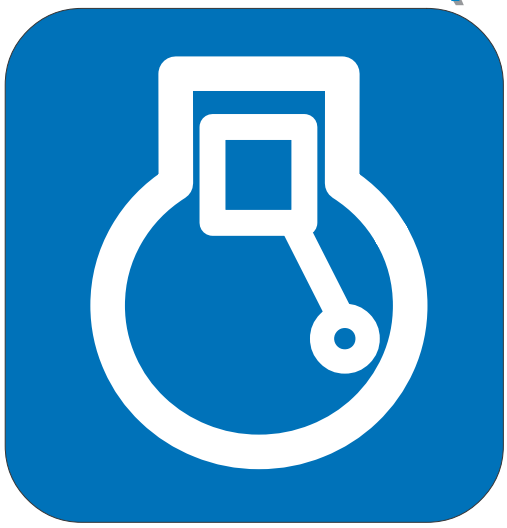
2. Spilling phase
The pump piston is on the way down. As long as there is no voltage to the solenoid valve, the fuel valve is open and the fuel flows back in return to the feeder channel.

3. Injection phase
The pump piston is still on the way down. Now the solenoid valve has received voltage from the control unit. The valve cone is lifted and the valve closes. Since fuel cannot pass through the valve, a pressure is quickly built up which lifts the nozzle needle and injection occurs.

Injection continues as long as the valve is closed and the pump piston is on the way down.
The injection timing and fuel quantity is determined by the length of the electrical pulse. It is the control unit which determines the pulse size via the information it receives from the control system.

4. Pressure reducing phase
The pump piston is still on the way down. The control unit ends the electrical pulse when the engine has received the amount of fuel needed at that instant. The fuel valve opens and the fuel can once again flow past in return to the feed channel. The pressure then drops quickly and the nozzle needle closes.

EC330B-EC460B(D12D)



Engine(D12D)

Picture text:

Engine Specification(D12D)

EC330B-EC460B

EC330B-EC360B

Specifications	Units	EC360B/330B NEW		EC360B/330B OLD
		TIER-3	Tier3 based Tier2	
Machine serial no.		EC330V 80001~ EC360V 80001~	EC330V 10713~ EC360V 12152~	EC330V 10001~ EC360V 10001~
EECU	-	EMS2	EMS1	EMS1
Model		D12DEBE3 (tier-3)	D12DEBE2 (tier-3 based tier-2)	D12CECE2 (tier-2)
No. of cylinders	-	6	6	6
Bore & stroke..	mm	131 x 150	131 x 150	131 x 150
Displacement.	cc	12,130	12,130	12,130
Liner Type	-	Wet	Wet	Wet
Compression ratio	-	18.5 : 1	18.5 : 1	18.5 : 1
Aspiration	-	T/Charged, A/Cooled, CAC	T/Charged, A/Cooled, CAC (different T/C with Tier3)	T/Charged, A/Cooled, CAC
Engine weight (delivered condition (dry))	kg	1200	1200	1200
Engine physical dimensions (L x W x H)	mm	1525x937x1185	1525x937x1185	1525x937x1185
Rotation direction(view from cooling fan)	-	CW	CW	CW
Performance				
Gross Power according to SAE J1349	kW+/-5 %@rpm	198@1700	198@1700	198@1700
Maximum Torque	Nm@rpm	1475@1275	1475@1275	1345@1400

EC460B

Engine specification (D12D)

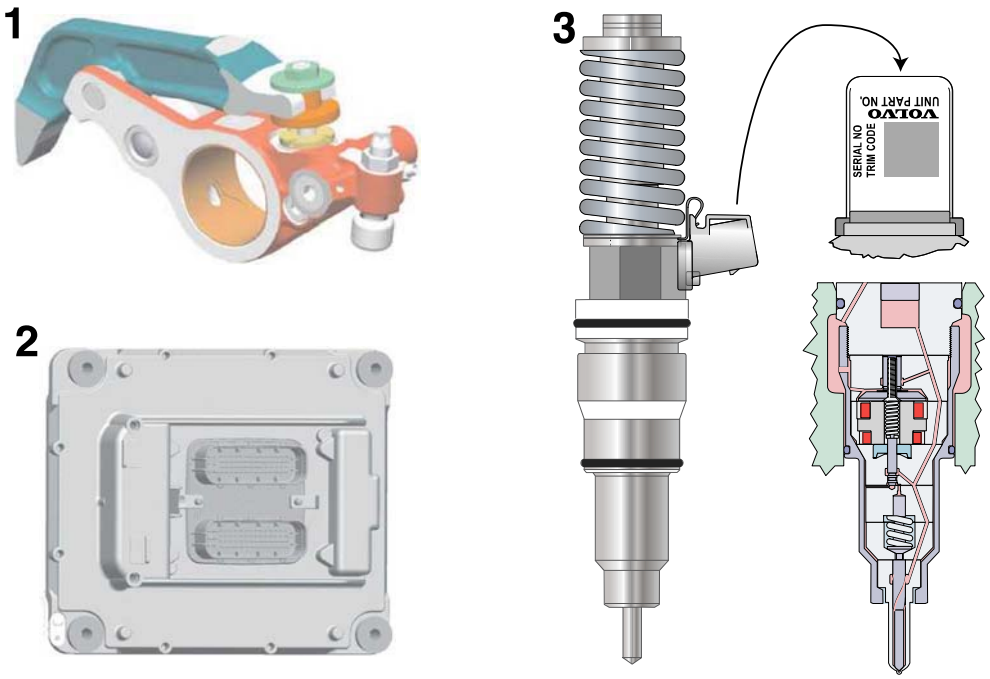
EC330B-EC360B
Excavator uses the D12DEBE3 & D12DEBE2.
For those 2 engines, external layout (fuel line, cooling, inlet & exhaust, mounting) is almost same but internal components (ECU, Unit injector, Piston etc.) are totally different.

Machine with D12DEBE3 has new serial number started with 80001 and will cover EU & NA region.

EC460B
Excavator uses the D12DEAE3 & D12DEAE2.
For those 2 engines, external layout (fuel line, cooling, inlet & exhaust, mounting) is almost same but internal components (ECU, Unit injector, Piston etc.) are totally different.

Machine with D12DEAE3 has new serial number started with 80001 and will cover EU & NA region.

Picture text:



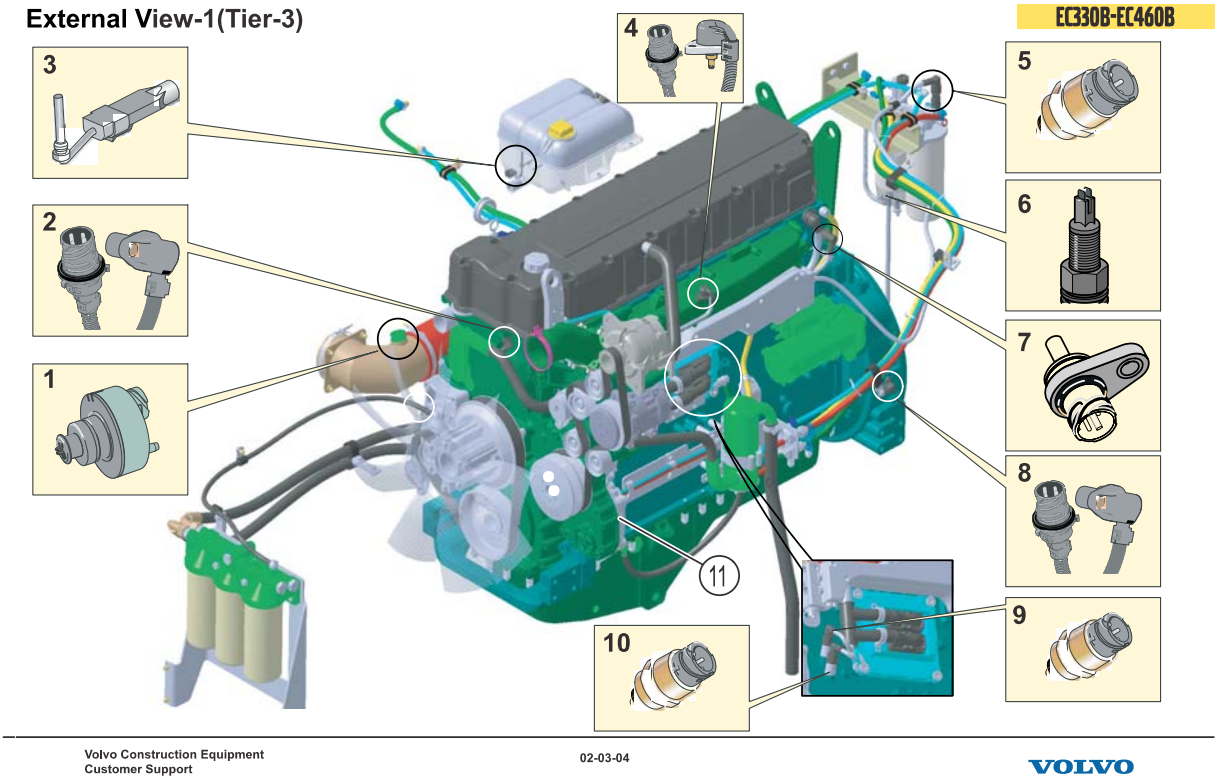
Main components

1.The IEGR double rocker has an extra arm, the follower arm, which creates a small second exhaust valve lift. This extra lift feeds exhaust gases back into the cylinder during the inlet stroke.

2.The most advanced Volvo engine controller, EMS2, will be utilized to provide the highest level of electronic features and to enhance reliability.

3.The proven new high-pressure dual solenoid diesel fuel injector, Delphi E3, introduced with the Volvo U.S. EPA 2002 highway engine, is an integral part of the V-ACT (Volvo Advanced Combustion Technology) system.
**When replacing the injector, we need parameter programing for trim code with VCADS Pro.

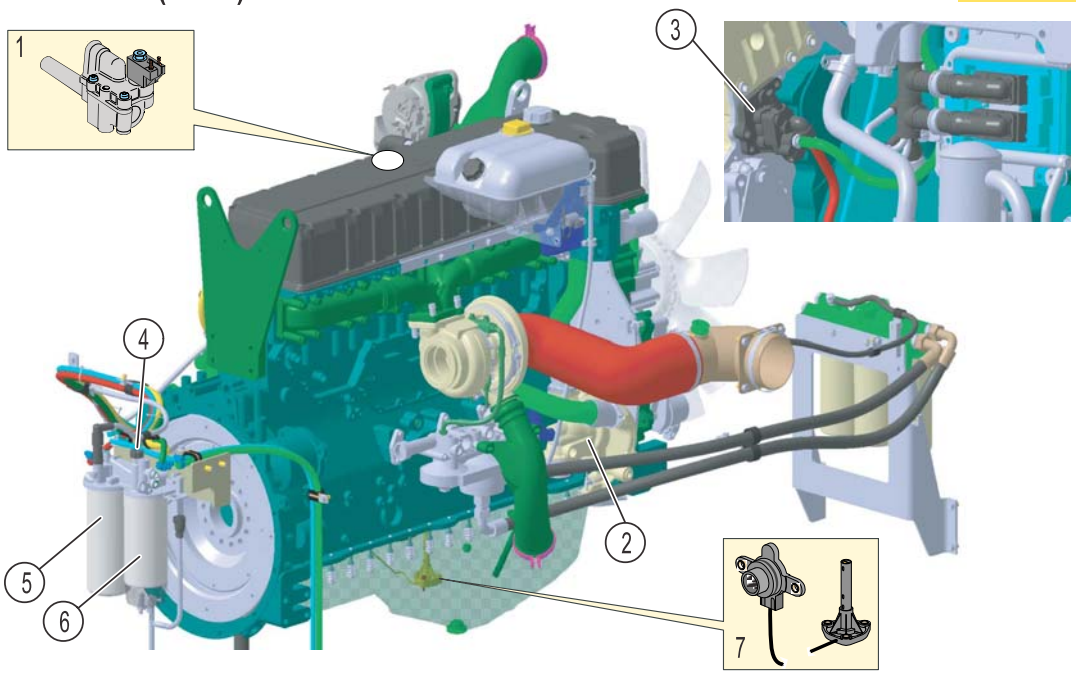
Picture text:
1. Switch Able Internal EGR Double Rocker
2. Engine Management System Controller EMS2
3. High-pressure dual solenoid fuel injector Delphi E3



External view-1(Tier-3)

1. Inlet air temp. & pressure sensor
2. Cam speed sensor
3. Coolant level sensor
4. Boost press. & temp. sensor
5. Fuel feed pressure sensor
6. Water in fuel sensor
7. Coolant temp. sensor
8. Crank speed sensor
9. Engine oil press. sensor
10. Crankcase pressure sensor
11. PTO

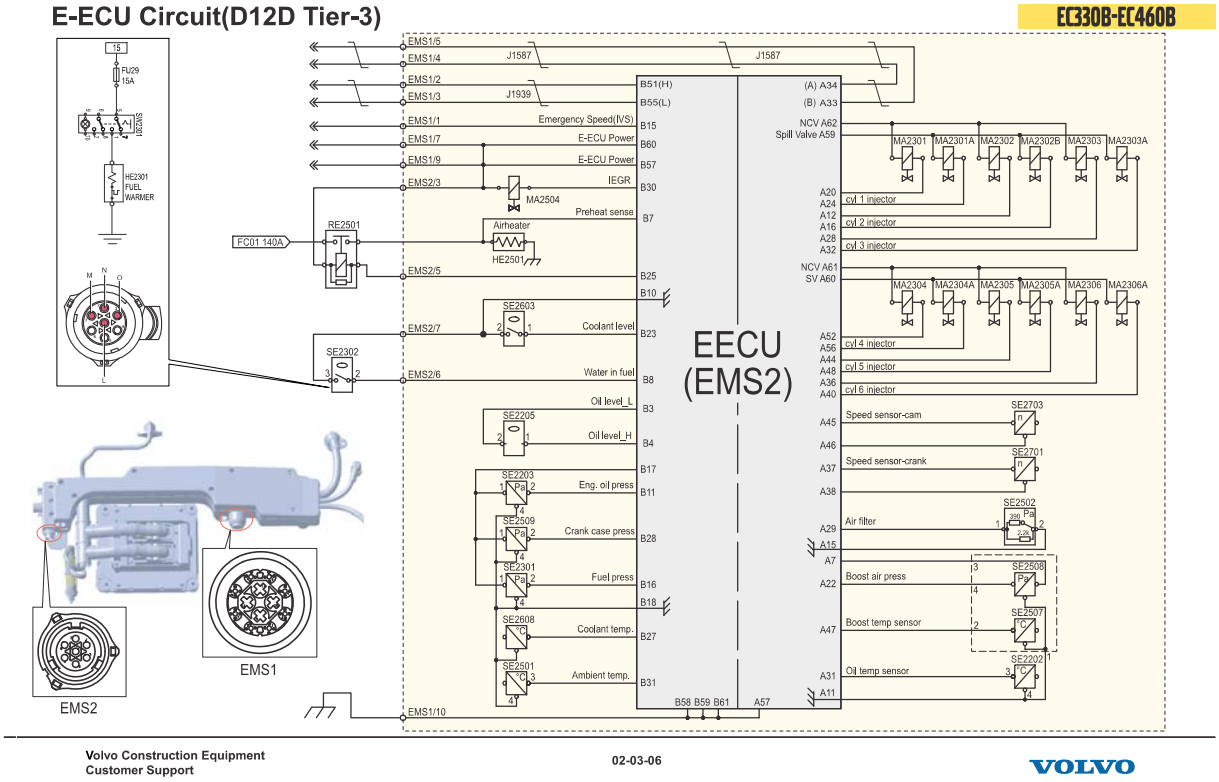
Picture text:



External view-2(Tier-3)

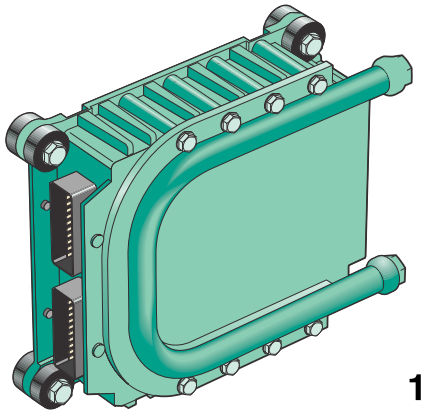
1. IEGR solenoid
2. Coolant pump
3. Fuel feed pump
4. Fuel lift pump
5. Fuel filter
6. Water seperator
7. Engine oil level & temp. sensor

Picture text:

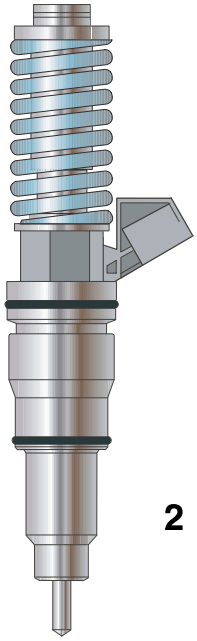


E-ECU circuit (D12D, Tier-3)

Picture text:



1



2

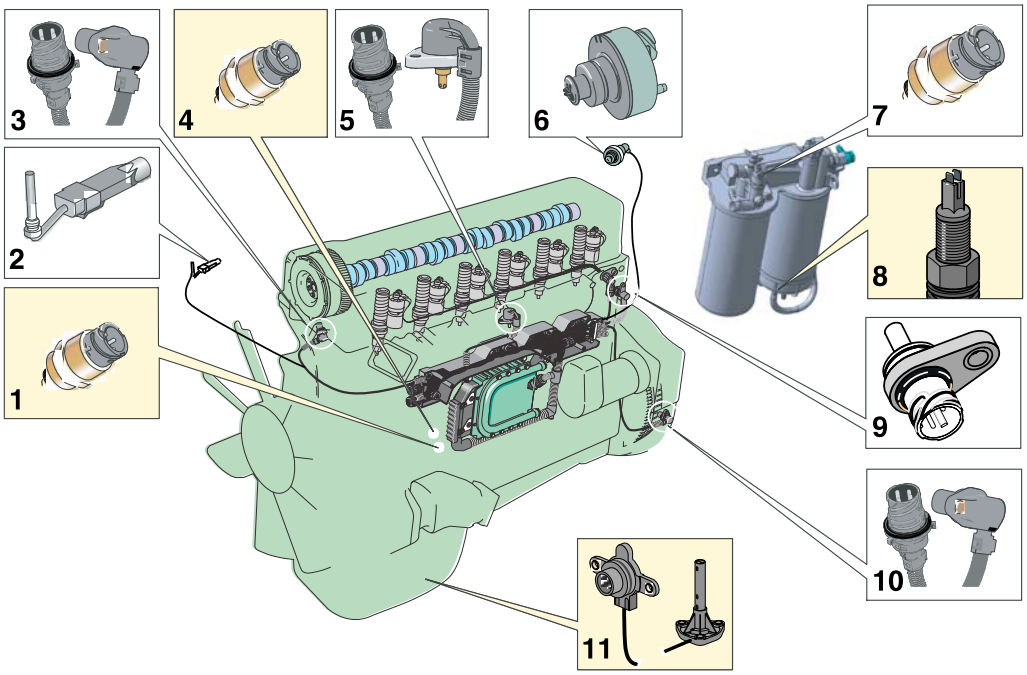
Main components (D12D, Tier-3 based Tier-2)

EMS1 & Delphi E1 injector

Picture text:

External View(D12D, Tier-3 based Tier-2)

EC330B-EC460B



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Sensors location (D12D Tier 3 based Tier2)

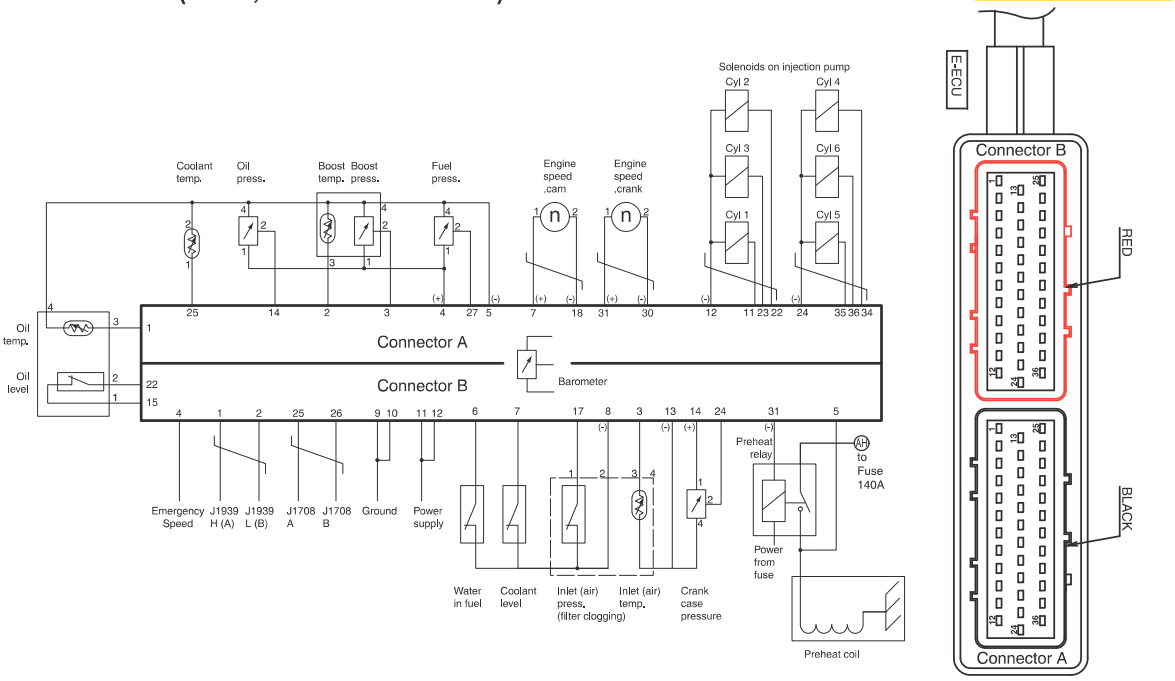
The picture shows all D12D engine sensors. Inside the EECU there are also sensors for ambient air pressure and the EECU temperature.

The sensors differing, compared with the D12C engine, are the crankcase pressure sensor (new), oil pressure sensor (before a combined pressure and temperature sensor), water in fuel sensor (new) and oil level and temperature sensor (before only a level sensor).

Picture text:
1. Crankcase pressure sensor
2. Coolant level sensor
3. Camshaft speed sensor
4. Oil pressure sensor
5. Charge air pressure and temperature sensor
6. Air pressure and temperature sensor
7. Fuel pressure sensor
8. Water in fuel sensor
9. Coolant temperature sensor
10. Crank shaft speed sensor
11. Oil level and temperature sensor

E-ECU Circuit(D12D, Tier-3 based Tier-2)

EC330B-EC360B



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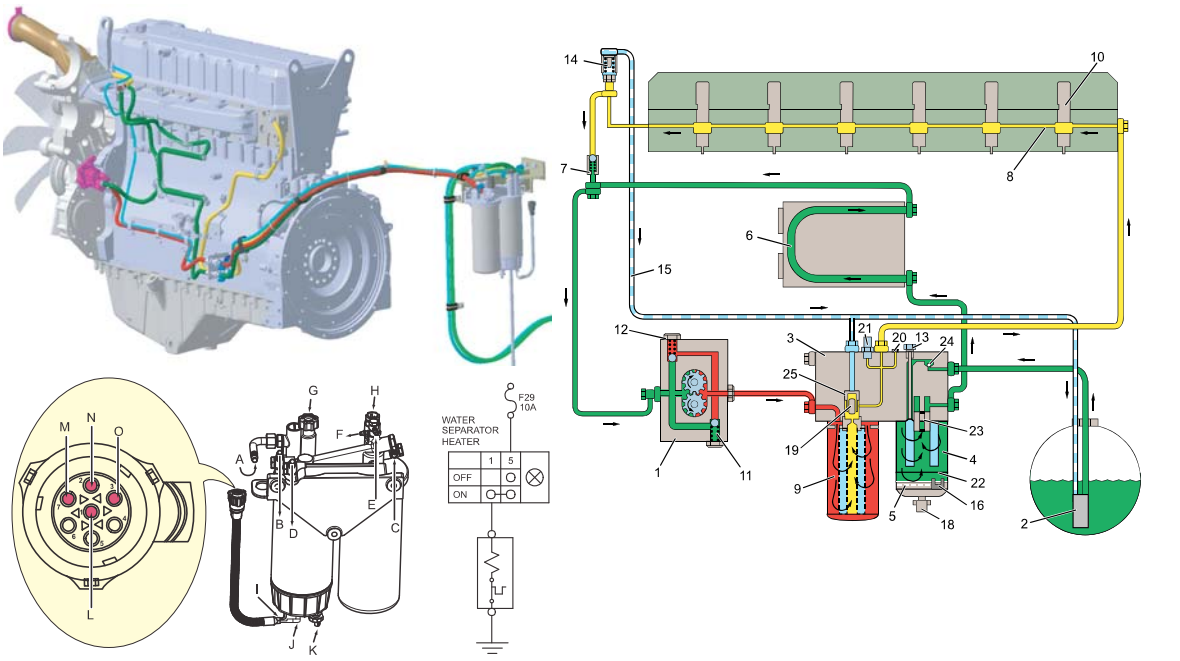
E-ECU circuit(D12D, Tier 3 based Tier 2)

Picture text:



Fuel system

The fuel is drawn with help of the fuel feed pump (1) through the tank unit (2), via fuel pre- filter (4) and water separator (5) into the fuel filter housing (3).
The fuel is then routed through the engine ECU□s cooling loop (6) to the overflow valve (7), where the fuel from the tank is mixed with the fuel returned from the fuel channel (8) in the cylinder head, and then forward to the suction side of the fuel feed pump (1). The fuel feed pump (1) press fuel to the fuel filter housing (3), through the main filter (9) to the cylinder head fuel channel (8). This channel provides every unit injector (10) with fuel via a ring formed passage around every unit injector in the cylinder head. The overflow valve (7) regulates the fuel feed pressure to the unit injectors.

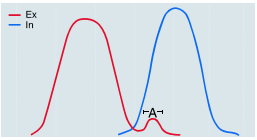
Fuel feed pump valves
The fuel feed pump has two valves: Safety valve (11), which allows fuel to flow back to suction side when the fuel pressure become too high e.g. when the fuel filter is clogged. Check valve (12) opens when the hand pump in the filter housing (13) is used.

Automatic deaeration
If air has entered the system, automatic deaeration occurs when the engine is started. The air is pushed through the deaeration valve (14) down to the tank via the fuel return hose (15) from cylinder head. Deaeration of fuel filters when changing filters is controlled by the valves (19), (25) and (14) in the filter housing.

Manual hand pump
The manual hand pump (13) in the filter housing is used to pump fuel (non-running engine), when the fuel system is empty. The check valve (24) for the hand pump is placed within the fuel filter housing.

Manual water drain
WIF (water in fuel) □sensor (16) will via the ECU give an indication on the instrument panel. This indicates that it is necessary to manually drain the water-separator (5) using the drain valve (18).

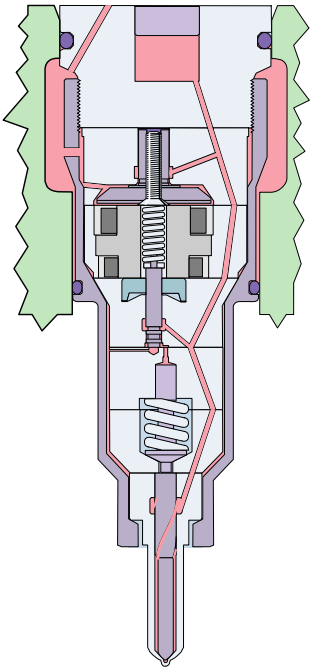
Miscellaneous
(20) Fuel pressure measuring point used for fault localization
(21) Pressure indicator
(22) Optional bowl heater



IEGR(V-ACT)

NOx reduction solution is provided by Internal Exhaust Gas Recirculation (IEGR) which is altering engine valve lift.

Picture text:



Delphi E3 function(Tier-3)

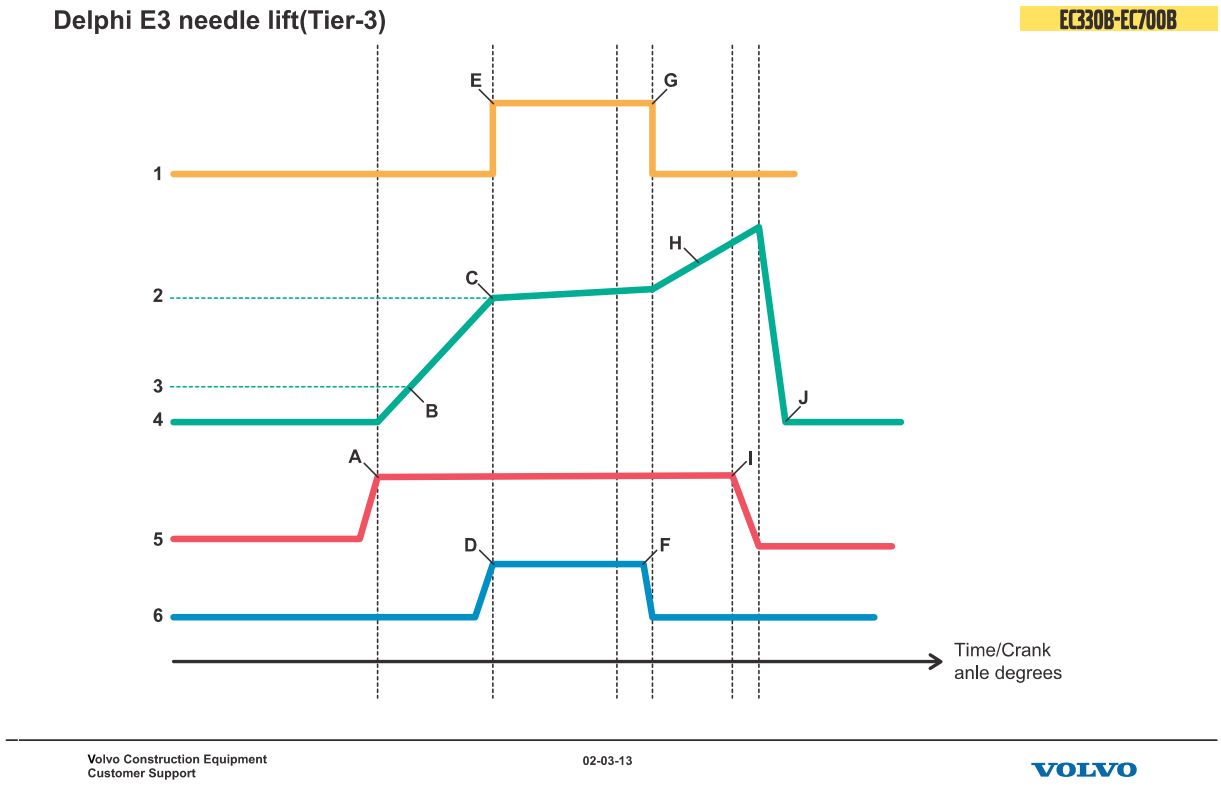
1. Neither the spill valve (SV) nor the needle control valve (NCV) solenoid is electrically activated. The return spring is forcing the SV to its upper position and the NCV to its lower position. In this position the SV is open and the fuel are routed from the pump chamber back into the low pressure fuel feed line and no internal pressure build-up occurs in the high pressure fuel line. In this position the NCV is closed connecting the needle backing chamber with the high pressure fuel line, but as the SV is open there is no pressure build behind the needle.

2. The SV solenoid is electrically activated and the SV is pulled downwards closing the connection to the low pressure feed line. In this position the SV is closed and all fuel is forced from the pump chamber via the high pressure fuel line. The fuel pressure increases acting on the injection needle lift area. The NCV is still not activated (still closed) connecting the needle backing chamber with the high pressure fuel line, why the needle can not be lifted.

3. The SV is still closed and the fuel pressure is still increasing. When the desired pressure is achieved, the NCV is activated (opened), closing the high-pressure line connection to the backing chamber of the needle and at the same time connecting the chamber to the low pressure line. The pressure on the lift side, now higher than required to overcome the closing force from the needle closing spring, opens the needle and injection occurs until the NCV is closed or until the SV is opened.

In this way the needle opening pressure can be varied between the preset NOP of the spring and the maximum pumping pressure. Practically the levels used are between 250 to 1800 bars, to be compared with a common nozzle, using 250 to 350 bar opening pressure.

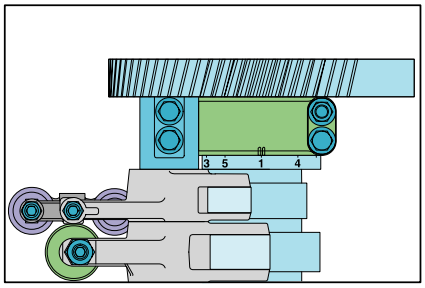
Picture text:

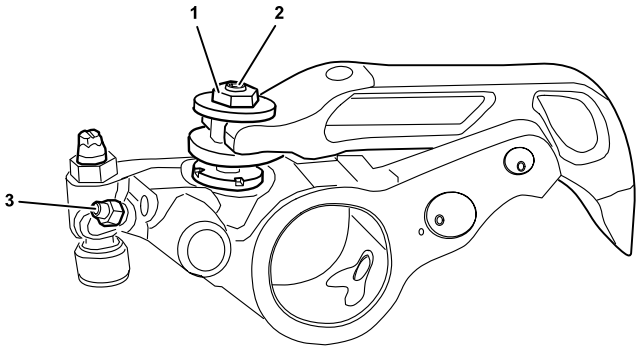


Delphi E3 needle lift

A. The spill valve is electrically activated and closes; fuel is forced from the pump chamber via the high pressure fuel line acting on the injection needle lift area.
B. The fuel pressure increases and reaches the pressure required to overcome the closing force from the needle closing spring, but as the NCV is still open the needle can not lift.
C. The fuel pressure reaches the desired needle opening pressure.
D. The NCV is electrically activated and opens; the fuel pressure in the needle backing chamber is evacuated allowing the needle to lift.
E. The injection needle is lifted.
F. The fuel amount required is now injected and the NCV is deactivated, closed. The needle backing chamber is now again connected to the high pressure fuel line and the needle is forced to close.
G. The needle closes and injection ends.
H. As the SV is still closed the pressure continues to increase as long as the pump piston is moving downwards.
I. The spill valve is deactivated, opened. The fuel is routed into the low pressure feed line.
J. The fuel pressure is evacuated to the low pressure feed line via the open SV.

Picture text:
1. Needle lift
2. Needle opening pressure, desired
3. Needle opening pressure, spring
4. Fuel pressure
5. Spill valve (SV)
6. Needle control valve (NCV)





Valve lash adjustment(1)

The below lashes is to be set when the engine is cold, approx. 20-25 °C.

Engine	IEGR valve lash	Exhaust valve lash (mm)
D12D	Gauge 88820003	0.7

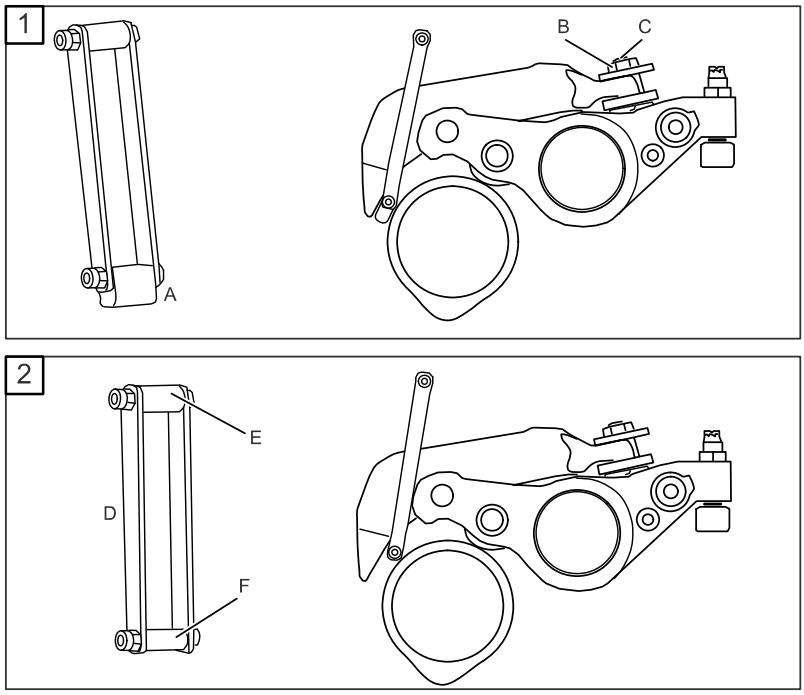
Rotate the camshaft and position it according to the marking for the cylinder being adjusted. The marking on the camshaft shall be placed between the two marks on the front camshaft bearing cap

Before checking the double rocker arm clearance, adjust the exhaust valve lash (also inlet valve lash and preload the injector) according to normal procedure

Loosen the oil drain nipple (3).

Loosen the lock nut (1) and counter hold the piston (2) with an internal 4 mm Allen head key.

Picture text:
1. Nut (lock)
2. Piston
3. Oil drain nipple



Valve lash adjustment(2)

1. Adjustment
Insert a special adjustment gauge (A) tool (P/N: 88820003-1) between the follower arm contact surface and the cam base circle.

Turn the hex key until the gauge is squeezed tight between the cam lobe and the follower arm contact surface.

Tighten the nut (B), while piston (C) is kept in position.

Tighten the oil drain nipple.

2. Inspection
Insert a special go/no go gauge tool (D) (P/N: 88820003-2) between the follower arm contact surface and the cam base circle. The go gauge side (F) must pass through between the follower arm surface and the cam base circle; if not the IEGR lift will be too big.

Insert the opposite, no-go, side (E) between the follower arm contact surface and the cam base circle. The no-go gauge side must not pass through; if it does the IEGR lift will be too small.

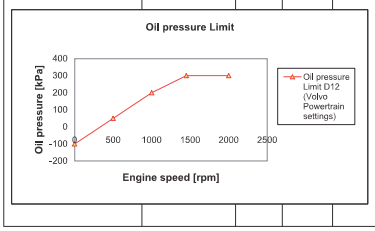
If the IEGR valve lash does not pass the inspection, the lash has to be readjusted.

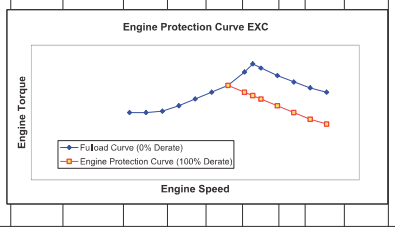
Picture text:
1. Nut (lock)
2. Piston

Engine protection function(EMS2)

EC330B-EC700B

Parameter	Level of Engine Protection	"Yellow lamp"	"Red lamp"	Derate 0 %	Derate 100%	Derate for EGR [Nm]	Max Torque []	Torque rate []	Max engine speed [rpm]	Max vehicle speed [km/h]	Idle delay [s]	Engine Shutdow delay [s]	Engine Shuldown Vehicle speed [km/h]	Remarks
Coolant level (PID111)	**Basic**		Yes											
	No protection		Yes											
	Extended protection		Yes								10	5	2	
Coolant temperature (PID110)	**Basic**		103 °C	100 °C	105 °C									
	No protection		103 °C											
	Extended protection		103 °C	100 °C	105 °C						10	5	2	
Oil temperature (PID175)	**Basic**	127 °C	130 °C	127 °C	135 °C									
	No protection	127 °C	130 °C											
	Extended protection	127 °C	130 °C	127 °C	135 °C						10	5	2	
High boost temp (PID105)	**Basic**	81 °C	83 °C	81 °C	91 °C									
	No protection	81 °C	83 °C											
	Extended protection	81 °C	83 °C	81 °C	91 °C						10	5	2	
High crankcase pressure (PID153)	**Basic**		5 kPa		5 kPa				750	5	10	5	2	
	No protection		5 kPa											
	Extended protection		5 kPa		5 kPa				750	5	10	5	2	
Low oil pressure (PID100)	**Basic**		Limit		Limit									
	No protection		Limit											
	Extended protection		Limit		Limit						10	5	2	
EGR	**Basic**	Yes				D12 max 7% D16 max 12%								
(PPID19)	No protection	Yes				D12 max 7% D16 max 12%								
	Extended protection	Yes				D12 max 7% D16 max 12%								
Crank sensor failure (SID22)	**Basic**	Yes					90%	2% / s						
	No protection	Yes					90%	2% / s						
	Extended protection	Yes					90%	2% / s						





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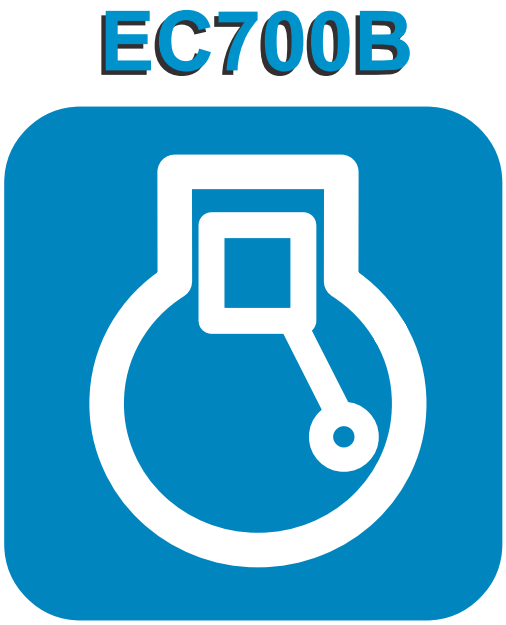
Engine protection function

Excavator are using only basic protection function.

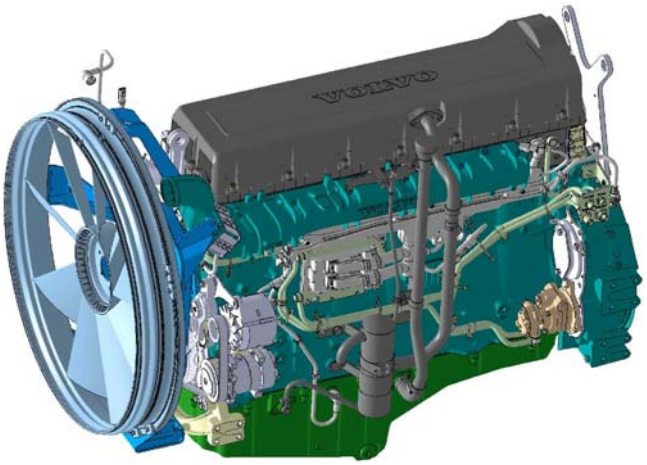
Picture text:

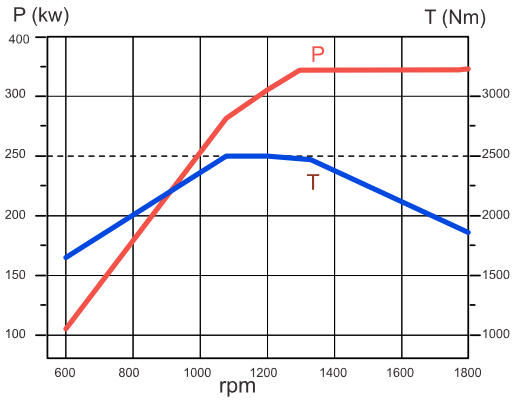


Engine(D16E)

Model: D16EEAE3
Rated output: 346kW @ 1800rpm

Picture text:





Engine specification

Unit Injector type

EC700B : D16E EAE3

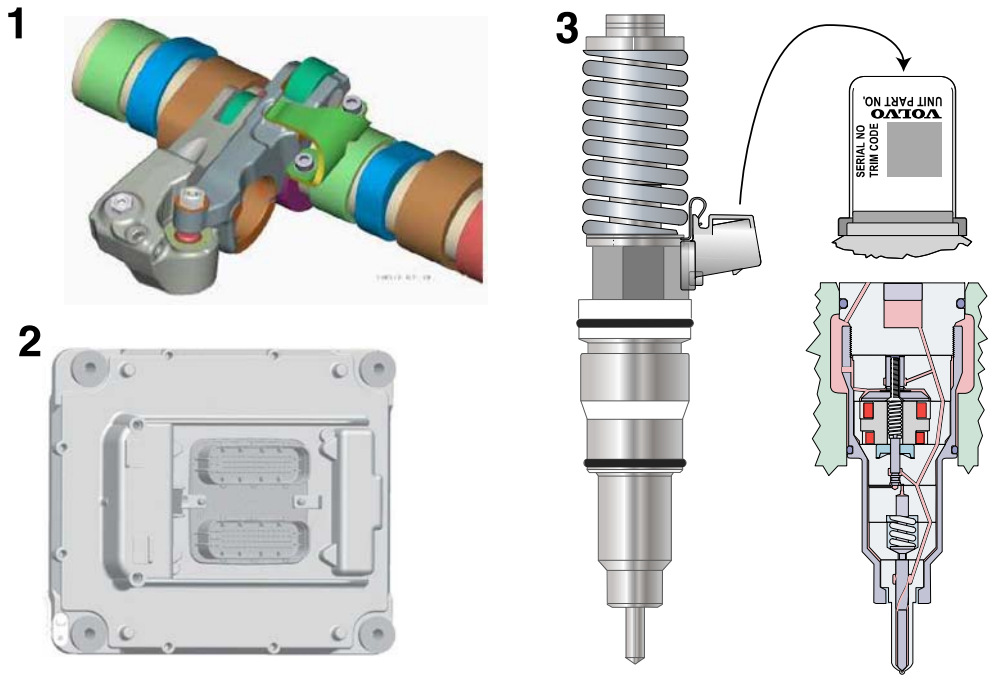
Type: 4 cycle, Diesel, Turbo charged, Air to Air After cooled
No.of cylinder : 6 vertical in line type
Bore X Stroke: 144mm X 165mm

Max. Power(fan not in operation)
346kW@1800rpm

Max. Torque(fan not in operation)
2500Nm@1080rpm

Governor type: EMS2
Displacement: 16100cc
Emission : Tier3

Picture text:



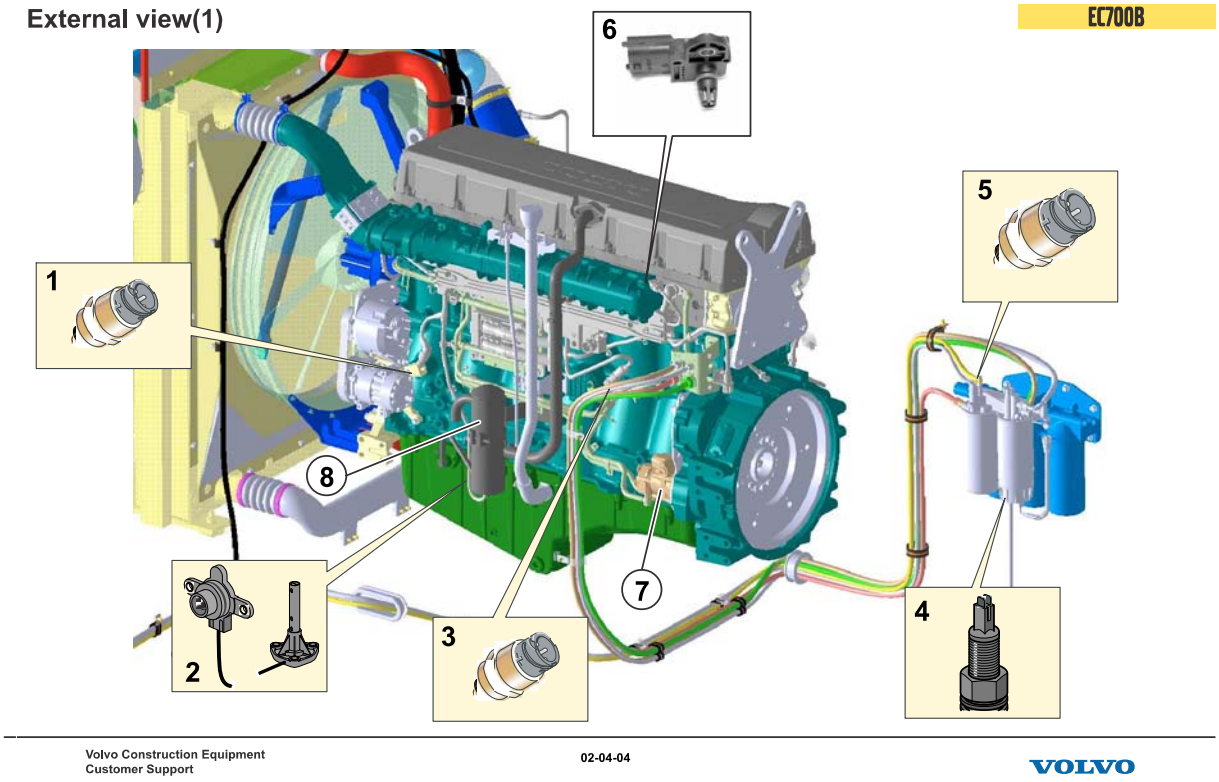
Main components

1.The IEGR double rocker has an extra arm, the follower arm, which creates a small second exhaust valve lift. This extra lift feeds exhaust gases back into the cylinder during the inlet stroke.

2.The most advanced Volvo engine controller, EMS2, will be utilized to provide the highest level of electronic features and to enhance reliability.

3.The proven new high-pressure dual solenoid diesel fuel injector, Delphi E3, introduced with the Volvo U.S. EPA 2002 highway engine, is an integral part of the V-ACT (Volvo Advanced Combustion Technology) system.
**When replacing the injector, we need parameter programing for trim code with VCADS Pro.

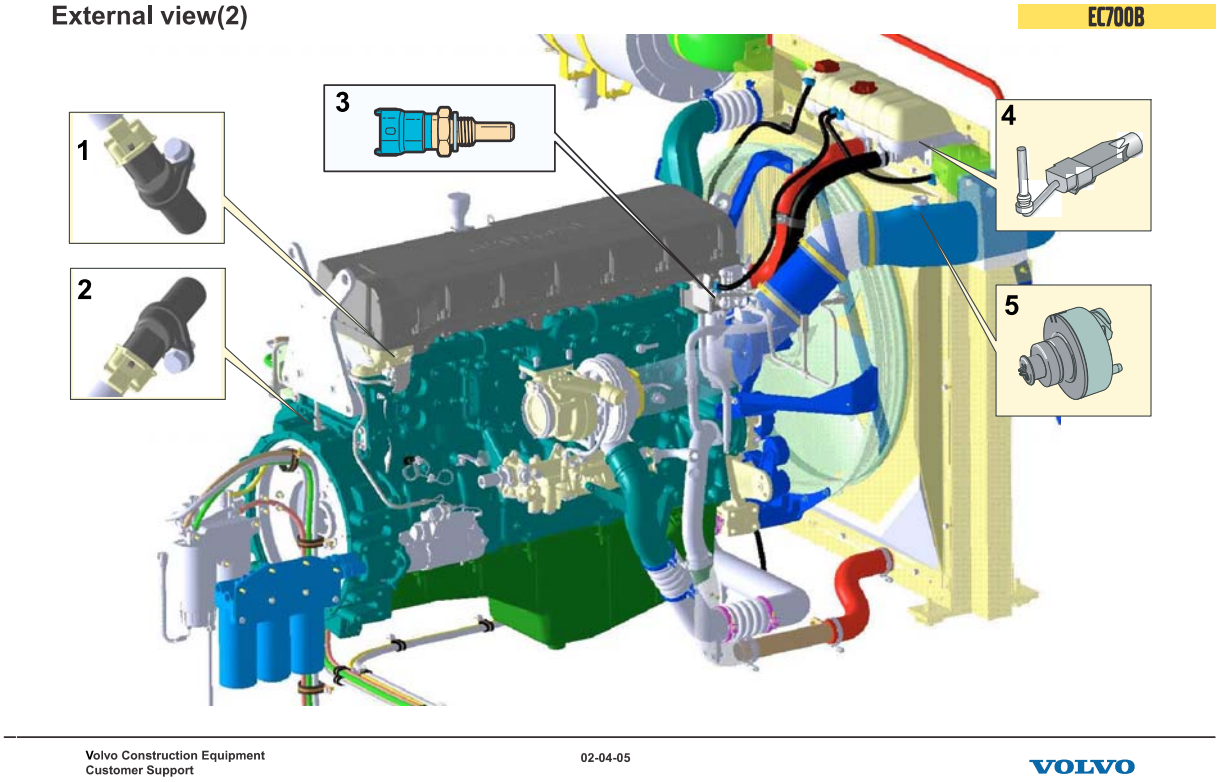
Picture text:
1. Switch Able Internal EGR Double Rocker
2. Engine Management System Controller EMS2
3. High-pressure dual solenoid fuel injector Delphi E3



External view(1)

1. Crankcase pressure sensor
2. Engine oil temp. & Level
3. Engine oil press. sensor
4. Water in fuel sensor
5. Fuel feed pressure sensor
6. Boost press. & temp. sensor
7. Fuel feed pump
8. Breather

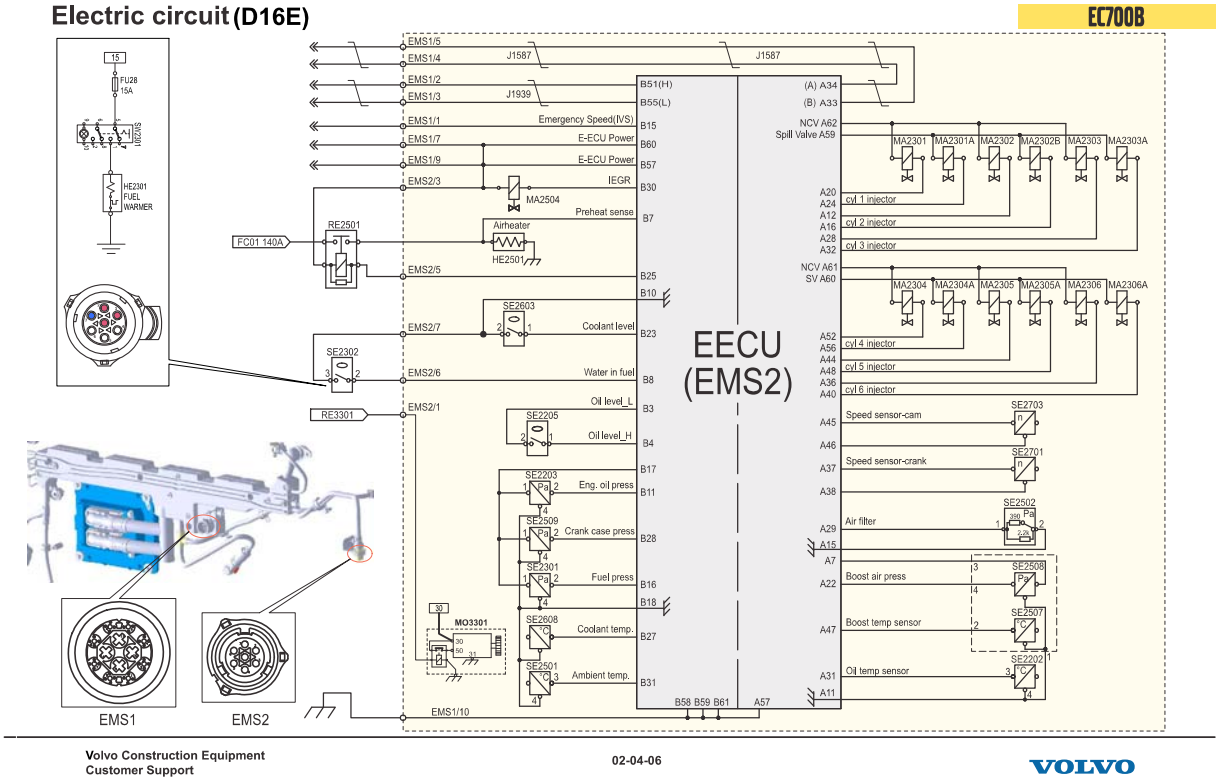
Picture text:



External view(2)

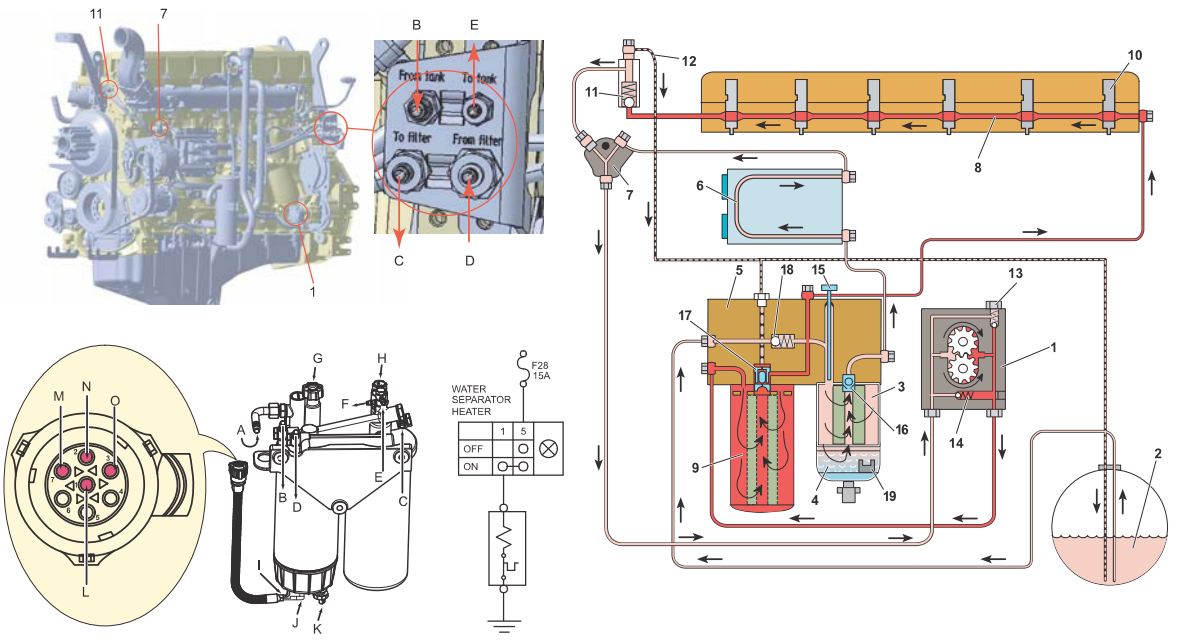
1. Crank speed sensor
2. Cam speed sensor
3. Coolant temp. sensor
4. Coolant level sensor
5. Inlet air temp. & Pressure

Picture text:



Electric circuit (D16E)

Picture text:



Fuel system

The fuel is drawn with help of the fuel feed pump (1) through the tank unit (2), via fuel pre- filter (3) and water separator (4) into the fuel filter housing (5).
The fuel is then routed through the engine ECU cooling loop (6) to the distribution housing (7), where the fuel from the tank is mixed with the fuel returned from the fuel channel (8) in the cylinder head, and then forward to the suction side of the fuel feed pump (1). The fuel feed pump (1) press fuel to the fuel filter housing (5), through the main filter (9) to the cylinder head fuel channel (8). This channel provides every unit injector (10) with fuel via a ring formed passage around every unit injector in the cylinder head. The overflow valve (11) regulates the fuel feed pressure to the unit injectors.

Fuel feed pump valves
The fuel feed pump has two valves: Safety valve (13), which allows fuel to flow back to suction side when the fuel pressure become too high e.g. when the fuel filter is clogged. Check valve (14) opens when the hand pump in the filter housing (15) is used.

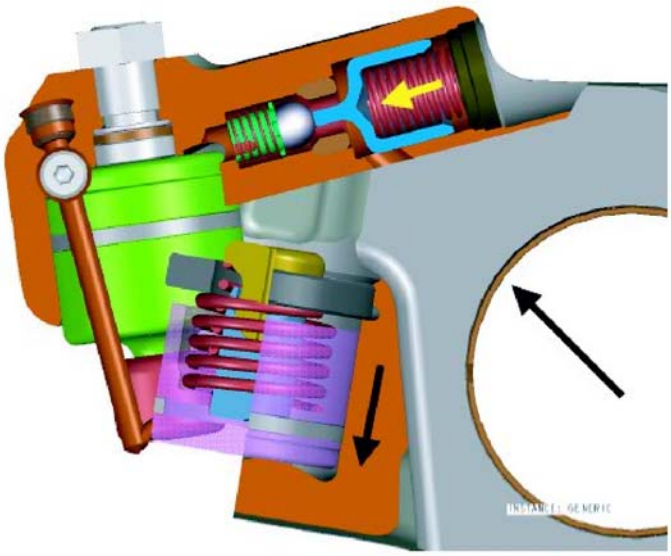
Automatic deaeration
If air has entered the system, automatic deaeration occurs when the engine is started. The air is pushed through the air bleed valve (11) down to the tank via the fuel return hose from cylinder head. Deaeration of fuel filters when changing filters is controlled by the valves (16) and (17) in the filter housing.

Manual hand pump
The manual hand pump (15) in the filter housing is used to pump fuel (non-running engine), when the fuel system is empty. The check valve (18) for the hand pump is placed within the fuel filter housing.

Manual water drain
WIF (water in fuel) sensor (19) will via the ECU give an indication on the instrument panel. This indicates that it is necessary to manually drain the water-separator (4) using the drain valve.

Picture text: A: from fuel tank
B: to ECU cooling
C: from fuel pump

Function hydralic system

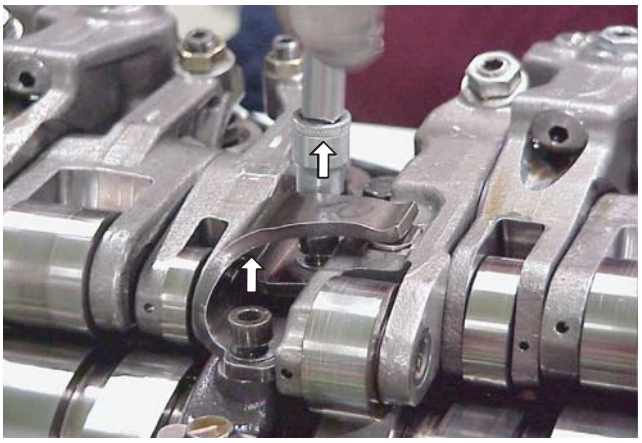


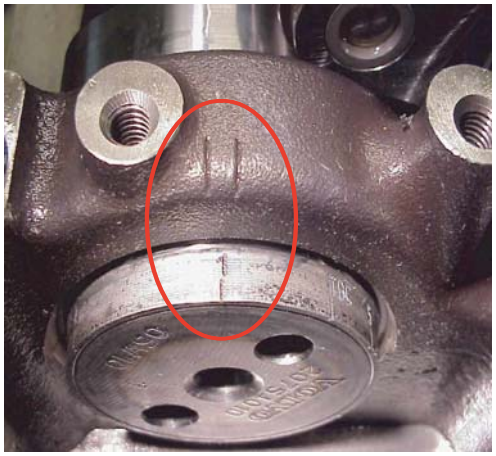
Engine running mode

- ✓Pressure rocker arm shaft approx 1 bar.
- ✓Back-valve open.
- ✓Oil canals filled up.

I-EGR Valve operation

Picture text:





Valve adjustment

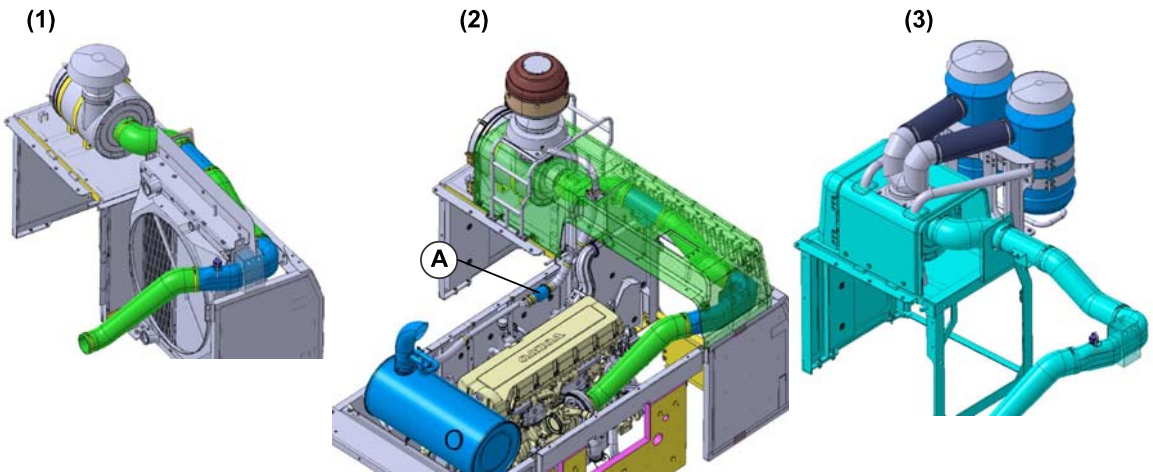
1)
- Loosen the hexagon screws that hold the leaf springs.
The screws are to be loosened on all six cylinders.
- Rotate the cam shaft to adjust the rocker arms.
- The dash marking on the cam shaft must be positioned between the two dash marks on the bearing housing.
- Adjust all rockers(in,ex,injector) for that cylinder per number! Cylinder 1 shown.

2)Adjust the inlet rocker arm clearance.
- Set the clearance between the rocker arm ball socket and the valve caliper to 0.3 mm using the adjusting screw on the rocker arm and a feeler gauge.
(Torque to tighten the nut : 38 Nm)
A : Inlet
B : Injector
C : Exhaust

3)
- Eliminate the clearance between the adjusting screw and the injector by turning the adjusting screw.
- Turn the adjusting screw another 240º (4 hexagons : 180 + 60).
- Torque to tighten the nut : 52 Nm

4)
- The valve caliper must be balanced before adjusting the exhaust rocker arm clearance.
- Adjust the clearance between the exhaust rocker arm ball socket and the valve caliper to 0.60mm, using the adjusting screw on the rocker arm and a feeler gauge.
- Torque to tighten the nut : 38 Nm

5)
- Loosen the nut on the brake rocker arm.
- Place a dial indicator on the feeler gauge, close to the ball socket, and set the dial indicator to zero.
- Tighten the adjusting screw with a hexagon key until the dial indicator shows that the valve yoke has



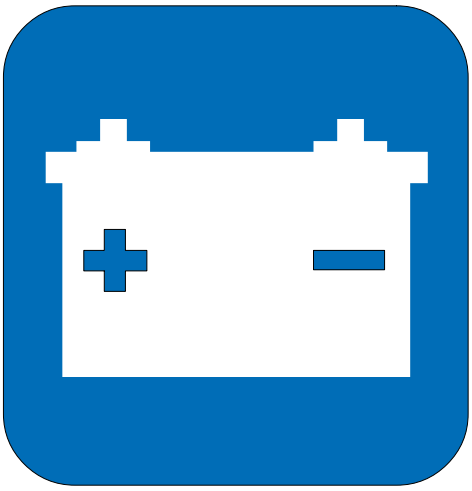
Air intake system

(1) Rain cover + Filter
(2) Pre-cleaner with scavanger + Filter
(3) Oil bath type pre-cleaner + Filter

A: check valve

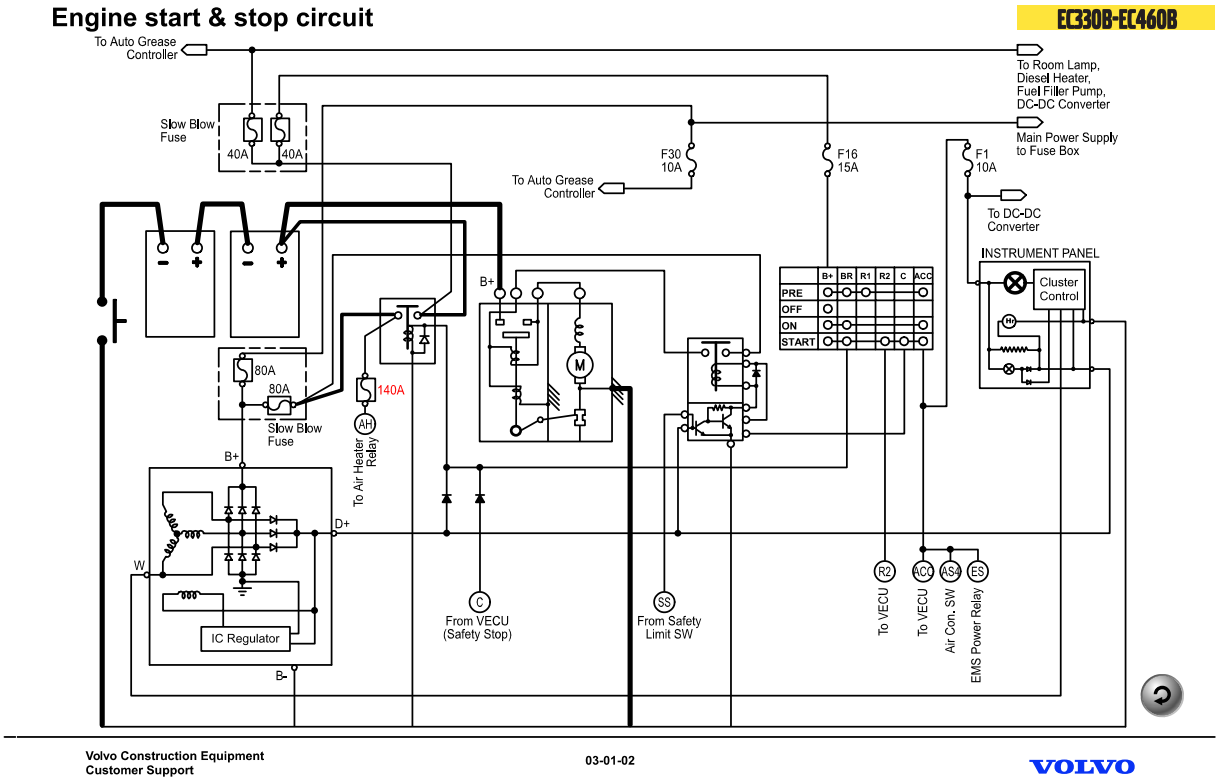
Picture text:

EC330B-EC460B(Before IECU)



Electric system(Before I-ECU)
EC330B-EC460B

Picture text:



Engine start and stop circuit

If battery disconnection switch is off position, we cannot use the whole of electric system.

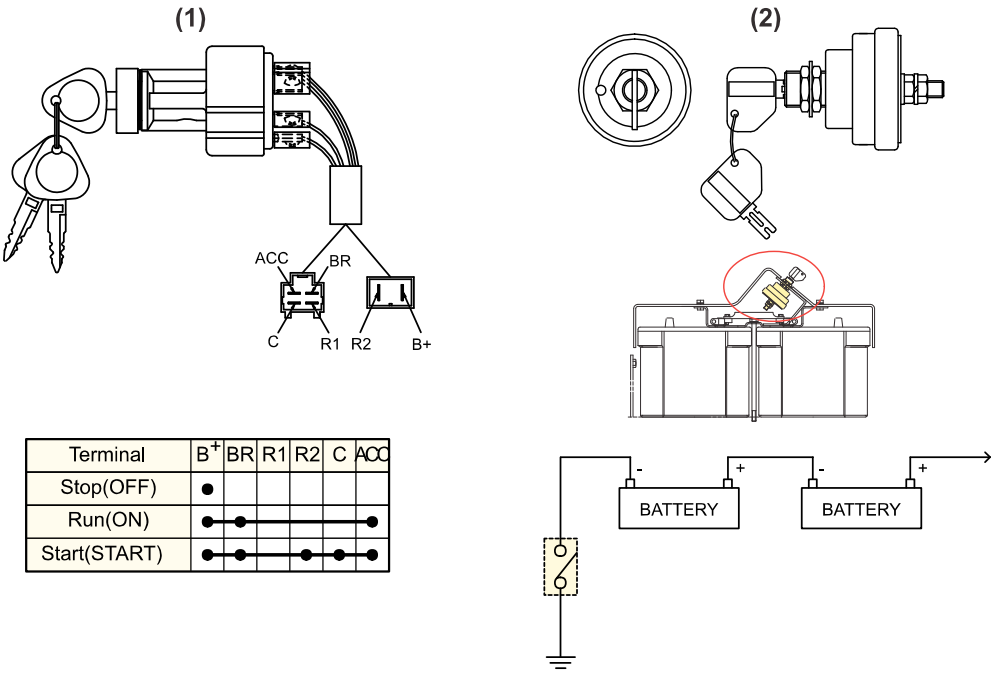
When master switch (Battery disconnection switch) is ON, we can use Room lamp, diesel heater, fuel filler pump, DC-DC converter, Auto greasing system without the key.

When the start switch is ON position,
BR signal turn on the battery relay. From now, we can supply the power to the whole of electric system. ACC signal send ON signal to VECU, air-conditioner and energize EMS power relay. And Power supplied to instrument panel pass through the charge- warning lamp and goes to alternator terminal D and magnetizes the field coil.

When the start switch is START position,
R2 signal goes to V-ECU to inform the key position and C signal activate safety start relay so power from battery can drive the starter. From this, alternator can produce electric power. W signal from alternator indicates engine status to the instrument panel IC.
Start inter-Lock function
If safety start relay has some level of signal from alternator or safety lever, it cannot have ground connection to activate this relay.

There are two diodes that are related with battery relay.
One is used for time delay function of VECU during the stop condition.
The other is used to protect electric system from electrical surge.

Picture text:

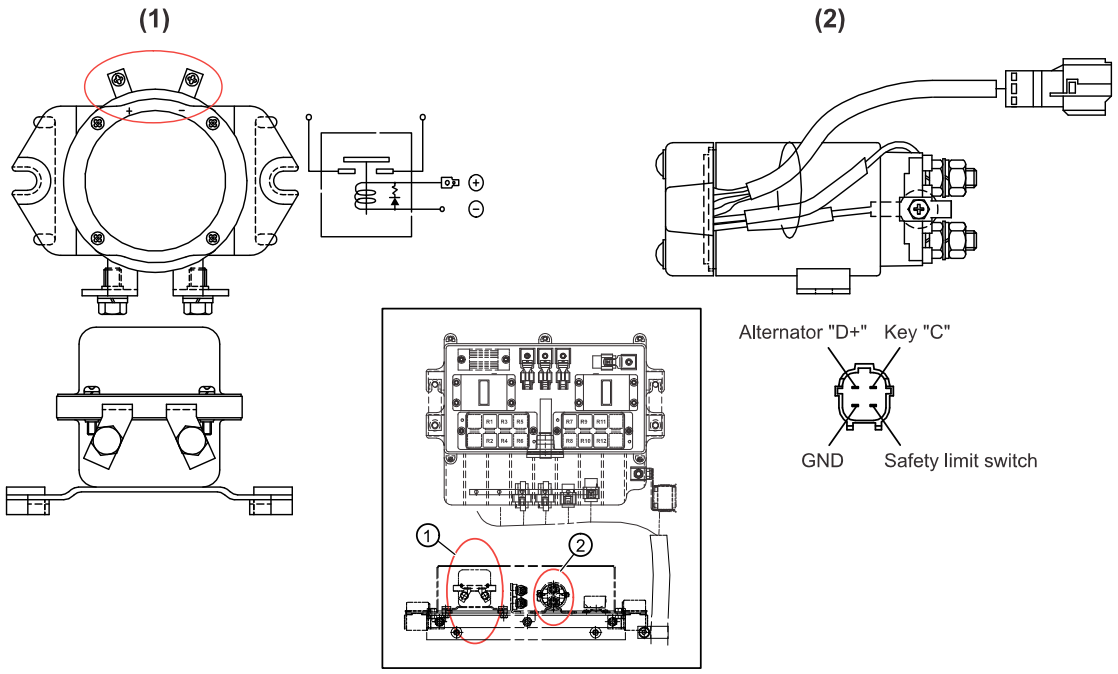


Key switch & Master switch

(1) Key switch
In key switch, there are three positions.
Off, On, Start.

(2) Master switch
To disconnect the electrical system from the batteries for protection of electrical components when welding, servicing of circuits and as a safety precaution when parking the machine.
Mounted on the battery cover.
If battery disconnect switch is turned to the ON position, the automatic greasing (option), fuel filler pump and room lamp are available even when the start switch is in the OFF position.

Picture text:

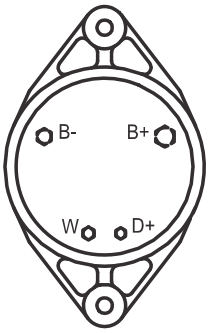


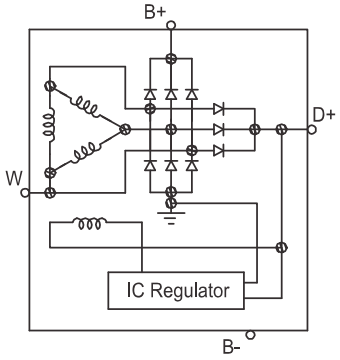
Battery relay & Safety start relay

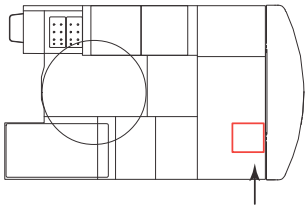
1. Battery relay
This is main relay for electric system.
The relay turns the battery current ON or OFF, according to low power signals received from the start switch. Use of the relay permits the start switch to control the power of the batteries with a small capacity wire.
When you replace this component, pay attention to the +/- signs on the relay.
Wrong connection can cause early failure of relay.

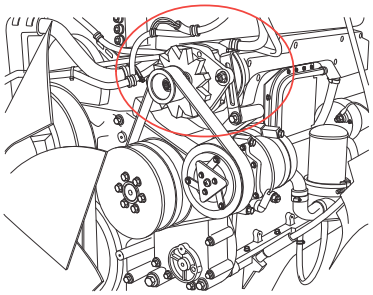
2. Safety start relay
When trying to restart the engine while the engine is running, or if the start switch is in the START position after the engine is activated, the relay cuts off the current to the starter motor to protect it.

Picture text:









Alternator

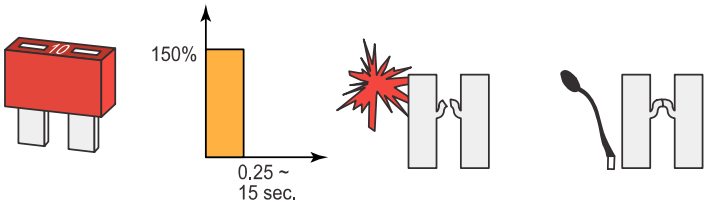
The alternator generates current to activate all the electrical systems, and the extra current charges the battery.
The current from D+ flows to the safety start relay to cut off the operation of starter motor and prevent accidentally re-engaging the starter.
After the engine starting, the battery charge warning lamp is turned off because the signal from "D+" remove voltage difference at lamp.

Picture text:

Fuse Box

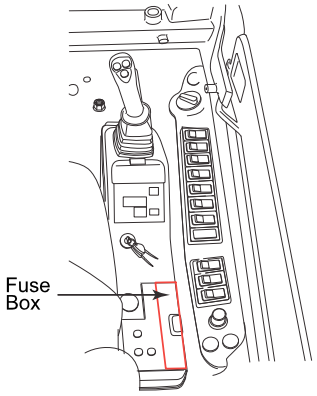
EC330B-EC460B

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
10A	10A	20A	10A		10A	10A	20A	25A	25A	10A	15A	10A	5A	20A
												VECU	MDU	EECU
F16	F17	F18	F19	F20	F21	F22	F23	F24	F25	F26	F27	F28	F29	F30
15A	5A	10A	20A	10A	15A		5A	5A		10A	20A	10A	10A	10A



Color Codes

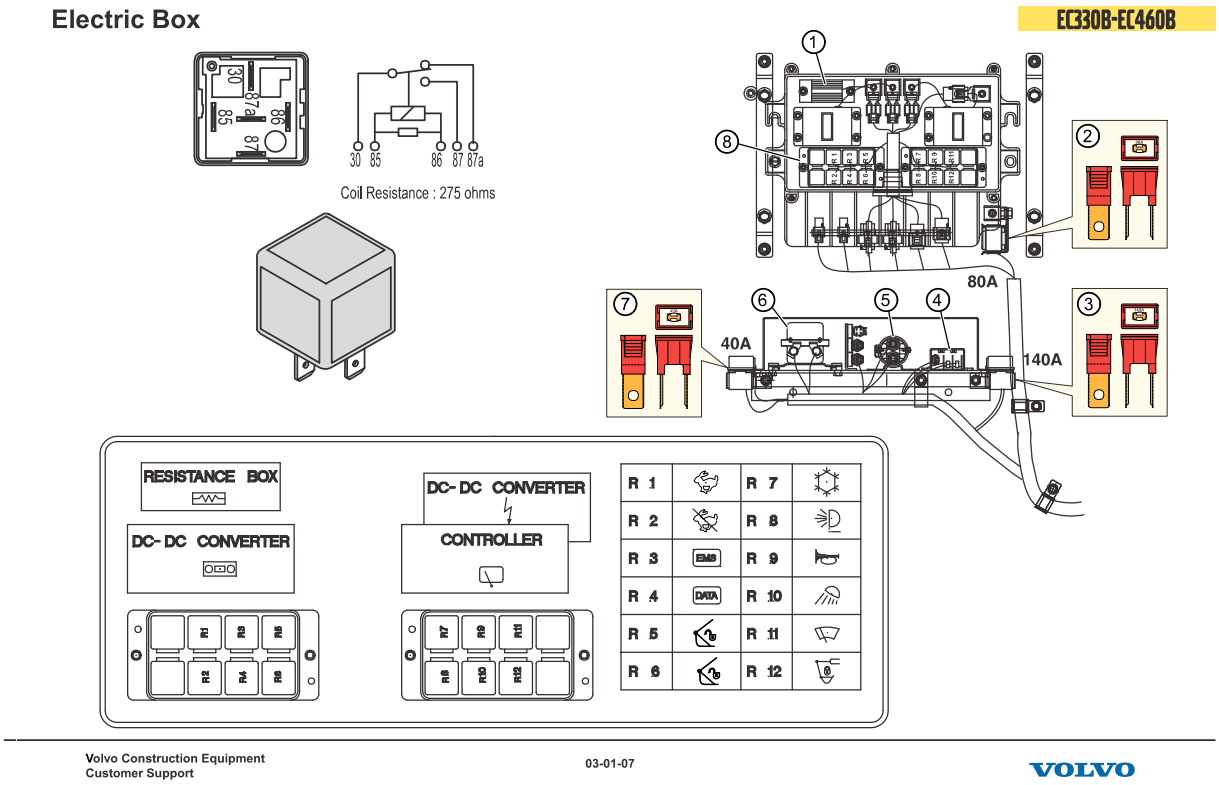
Amperage rating	Color	Amperage rating	Color
1 A	Black	10 A	Red
3 A	Violet	15 A	Light blue
4 A	Pink	20 A	Yellow
5 A	Tan	25 A	Natural(White)
7,5 A	Brown	30 A	Light green



Fuse box

Fuse failure is often caused by a fine crack in the fuse, and this kind of crack is very hard to detect by visual inspection. Checking fuse continuity with a tester is far superior to eye inspection.

Picture text:



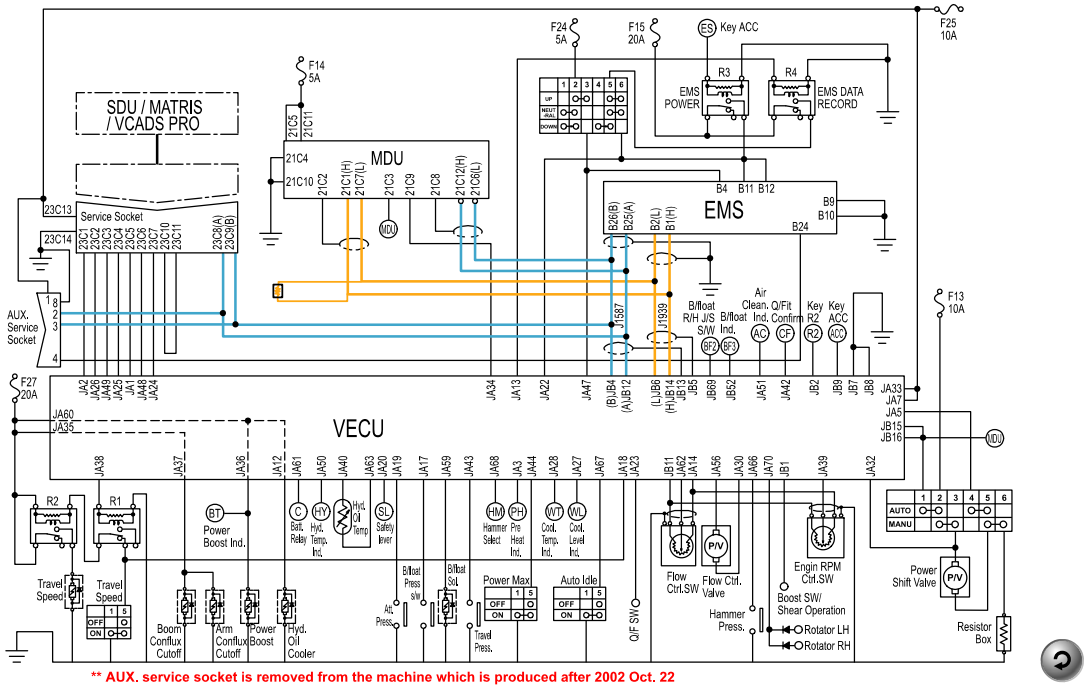
Electric Box

1. Resistance box for emergency pump control.
2. Slow blow fuse(80A)
3. Slow blow fuse(140A)
4. Preheater relay
5. Safety start relay
6. Battery relay
7. Slow blow fuse(40A)
8. Relay: R1~R12

Picture text:

Control system circuit

EC330B-EC460B

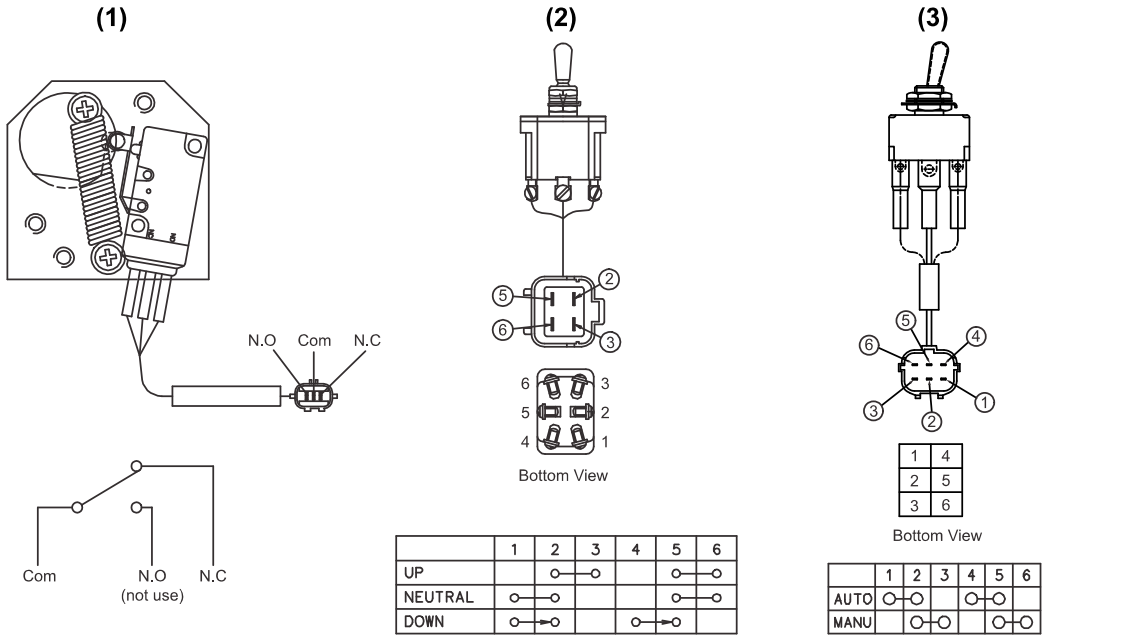


Control system circuit(Animation)

This is brief circuit diagram to explain the electronic control system.
First of all, think about operating power and ground of each ECU.
Then move on to each function. After understanding each function and input-output of VECU, Compare those functions with this circuit diagram.

When you pushed line in the circuit, the color of line will be changed.

Picture text:



Switch

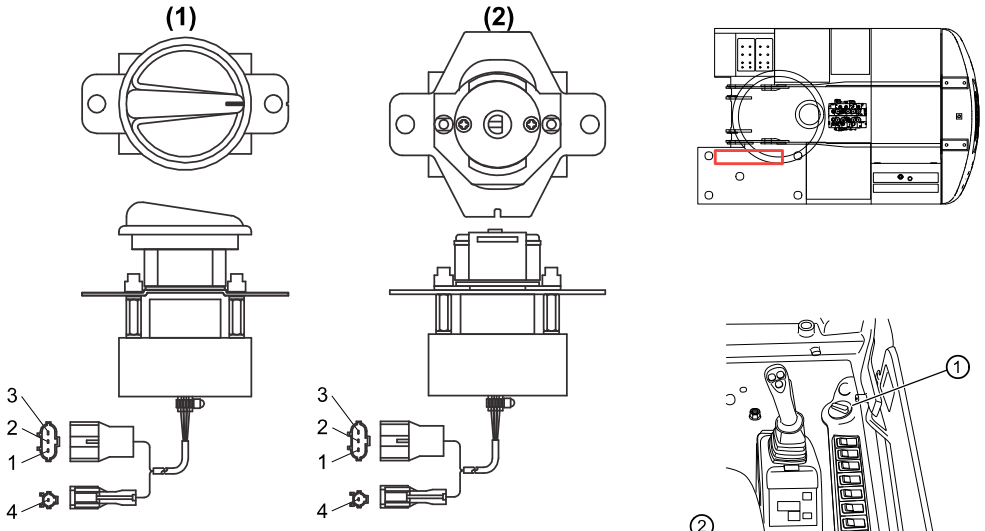
1. Safety limit switch
When the safety lever is in the up position, the hydraulic system will work.
When the safety lever is in the down position, the servo pressure is cut off to functions, which are operated with control levers and pedals.

2. Emergency switch

3. Auto/Manual switch

Picture text:

Speed Control SW and Flow Control SW



Pin	Signal
1	Power(B+)
2	Output(Signal)
3	Ground(GND)
4	Shield GND

step	Signal(V)	step	Signal(V)	step	Signal(V)
1	0.5	4	2.0	7	3.5
2	1.0	5	2.5	8	4.0
3	1.5	6	3.0	9	4.5

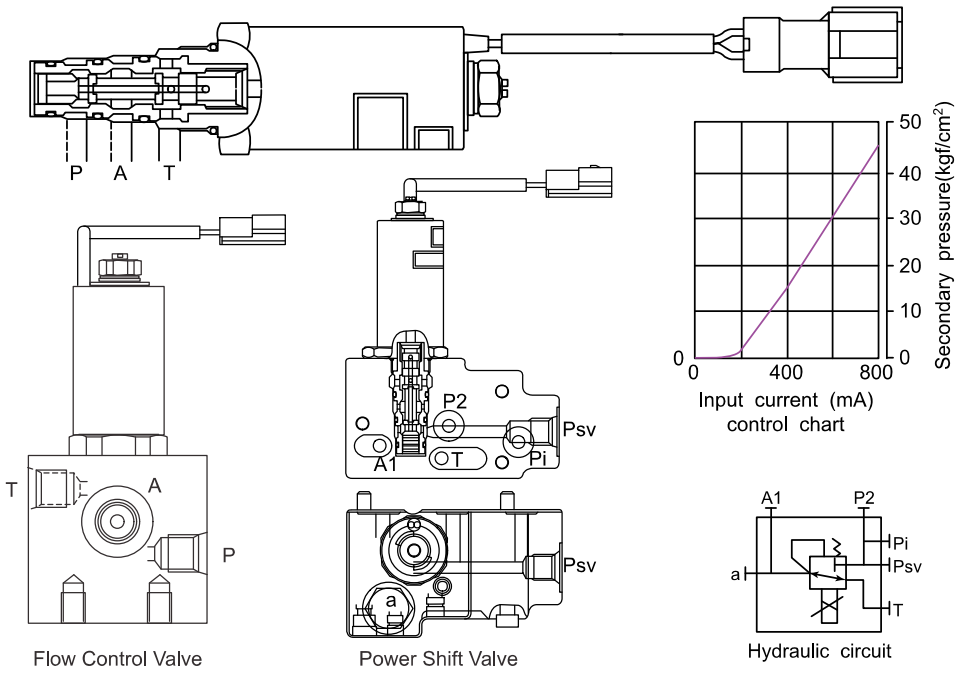
Speed control switch and Flow control switch

1. Speed control switch
2. Flow control switch

Two switches are almost same components.
Only different thing is that the flow control switch needs screw driver to adjust the step.
Input voltage is 24v and output voltage is 0.5~4.5V.
They have a shield ground to prevent noise at signal line.

Picture text:

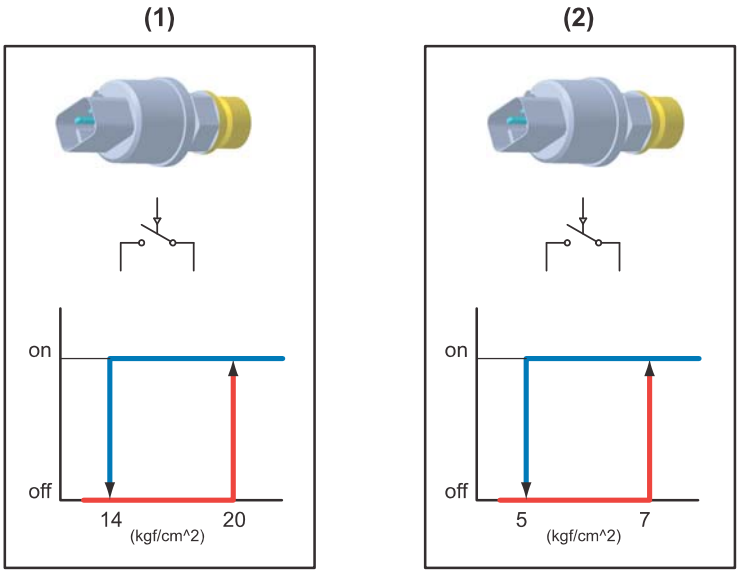
Power Shift Valve & Flow Control Valve



Power shift valve

The valve regulates the secondary servo hydraulic pressure to the hydraulic pump regulators to control the swash plate angle and allowable pump output.
The secondary servo hydraulic pressure varies in proportion to the current value at the proportional solenoid valve.
The proportional solenoid valve spool vibrates continuously to maintain the secondary servo hydraulic pressure, and is very sensitive to contamination due to the close tolerances of the spool/valve body. In the event of a malfunction, always inspect the valve for contamination before replacing it.

Picture text:

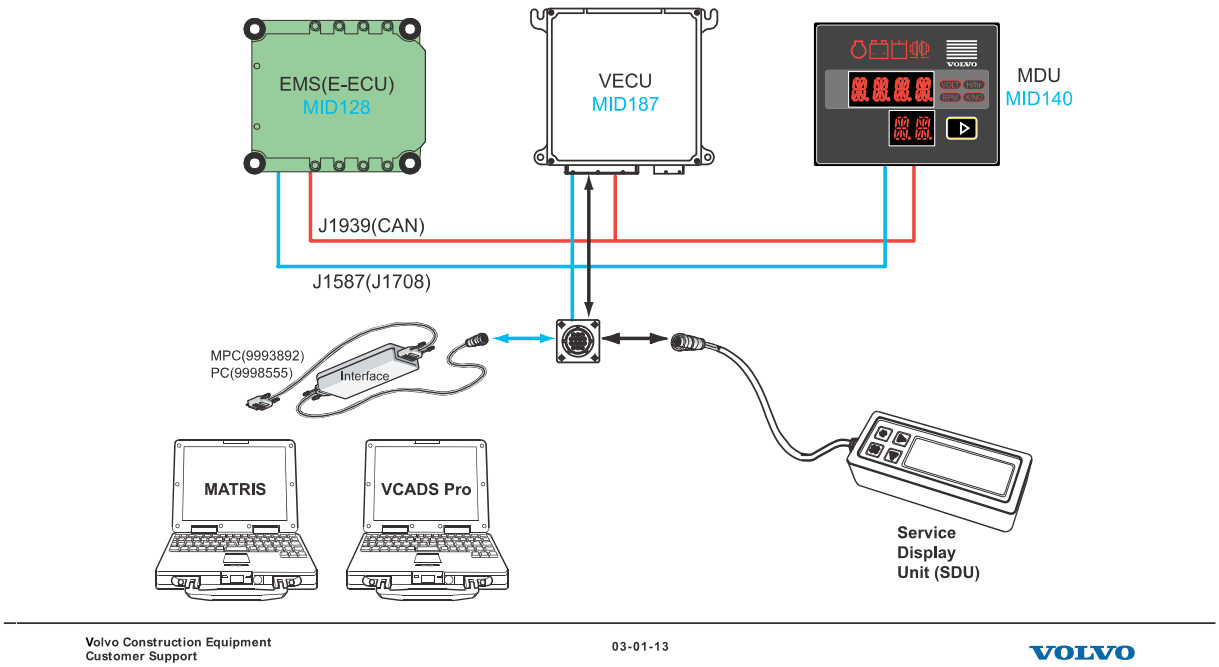


Pressure Switch

1. Attachment Pilot pressure switch/Travel Pilot pressure switch/Travel alarm(Option)
-On: 20 Kgf/cm^2
-Off: 14 Kgf/cm^2

2. Hammer Pilot pressure switch/Boom float Pilot pressure switch
-On: 7 Kgf/cm^2
-Off: 5 Kgf/cm^2

Picture text:



Electronic control system overview

Electronic control system is composed of various computers and its communication line. In our system, 2 computer (EECU, VECU) is programmable and 1 computer (MDU) is not.
Communication is important thing to control the machine properly.
We use two communication lines that is international protocol.
The line is twisted to protect the bus from electrical interference.

CAN bus (SAE J1939)
CAN stands for Control Area Network. Actually this signal control machine and is very fast.

Information bus (SAE J1708)
This bus is connected to all control units and the service socket and have back-up function for the control bus of E-ECU. The system status is continuously updated. By using this bus, we can use MATRIS and VCADS Pro and can program the ECU.

MID (Message Identification Description):
Unique number for each control unit

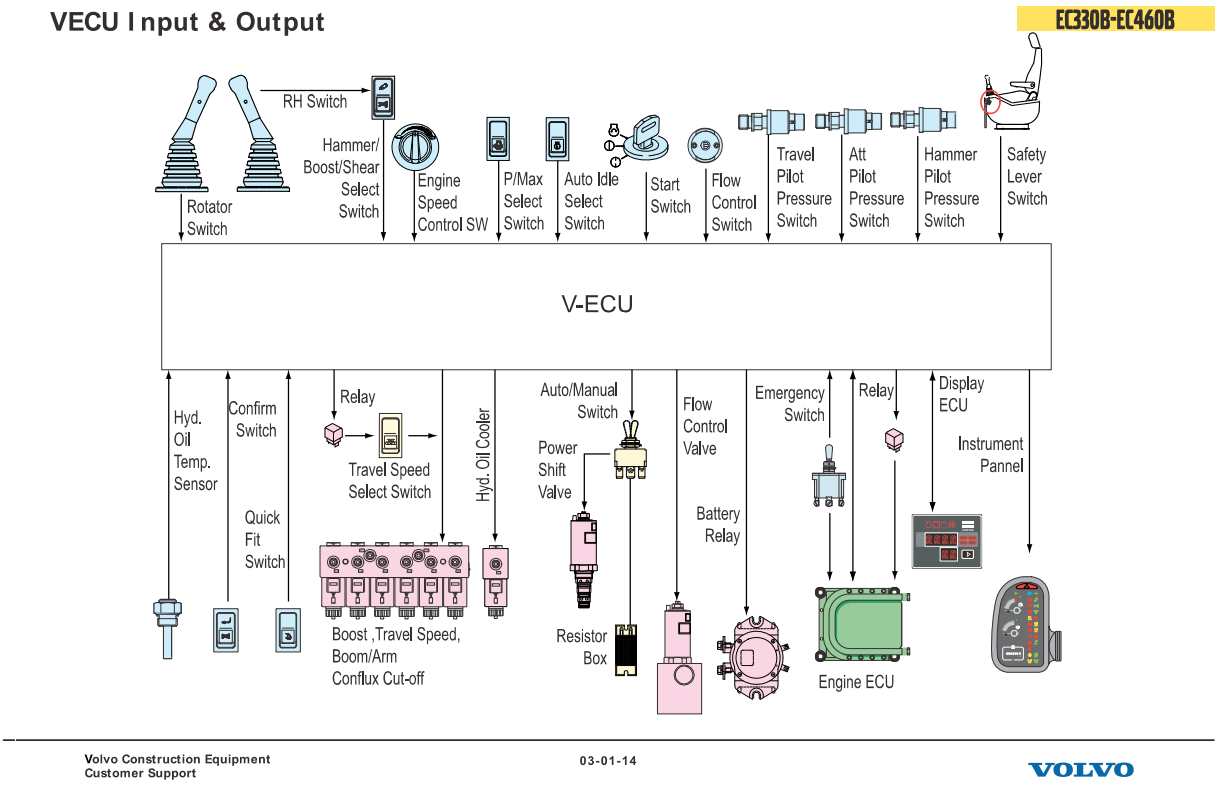
PID (Parameter Identification Description):
Unique number for each parameter

PPID (Proprietary Parameter Identification Description):
Volvo-Unique number for each parameter

SID (Subsystem Identification Description)
Unique number for component

PSID (Proprietary Subsystem Identification Description)
Volvo-Unique number for component

Picture text:

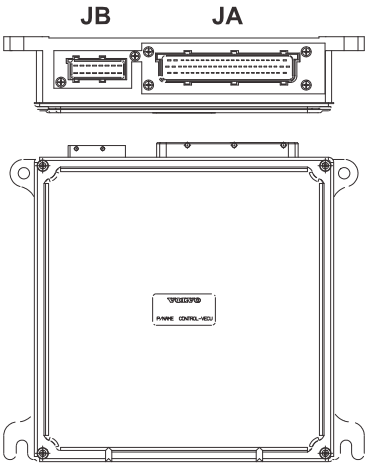


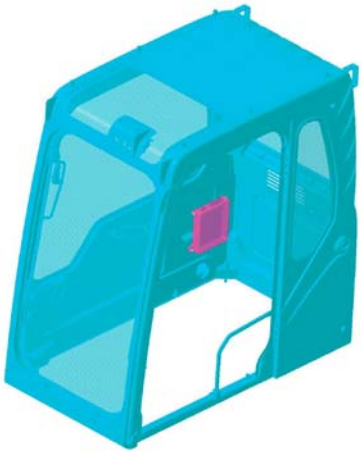
VECU Input and Output

The vehicle control unit is mounted at right wall of cabin. This controls all of functions related with vehicle according to the input signal. There is various input and output signal. The service people have to know about the function first and input-output signal to diagnose and fix the problem.

Function of VECU
- Self diagnose
- Machine status indication
- Mode selection
- Engine Speed Sensing Power Control(ESSPC)
- Automatic return to idle
- Automatic and one-touch power boost
- Safe start and stop
- Automatic travel speed control
- Emergency control (Limp home mode)
- Pump flow control for optional equipment(X1)

Picture text:



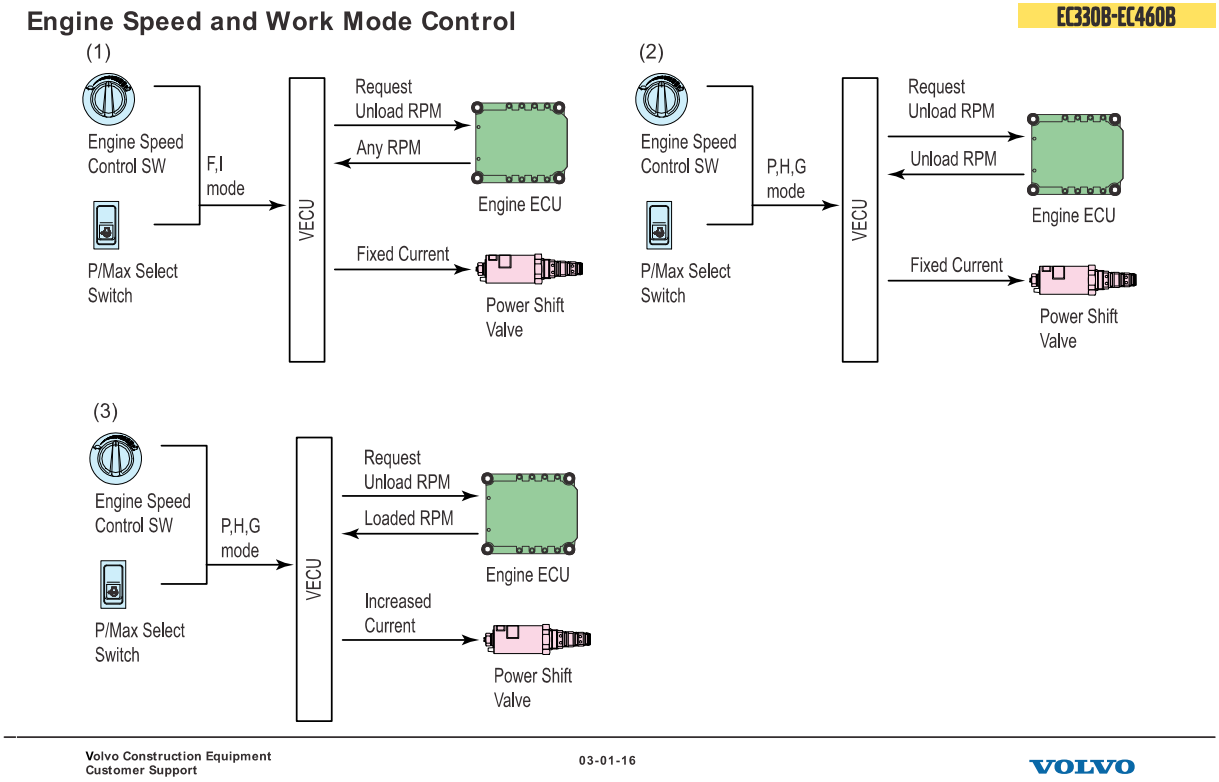


V-ECU

There are two connectors for VECU.
JA connector has 70 pins and JB has 16 pins.

When you replace the VECU, you have to check the part number of VECU because you need to run the conversion kit of VCADS Pro if failed VECU is old one.

Picture text:



Engine speed and work mode control

In control system, we can have 10-step engine speed and 5 work-modes.
By rotating engine speed control switch, Engine rpm and work-mode is set at the same time. You can see the specification at the next page.

This function allows the operator to select the engine speed and work mode according to working condition and to optimise the machine performance and fuel efficiency.

Principle is simple. Excavator converts the mechanical power from engine to hydraulic power using hydraulic pump. So engine power should be bigger than pump consuming power. If not, engine could be stall or stop.

The V-ECU always receives the current engine speed from the E-ECU . It balances engine horsepower and pump consuming power by changing output current to power-shift valve. Power-shift valve is kind of proportional valve using PWM signal. By controlling power-shift valve, we can change the swash plate angle and finally change pump flow rate. So system can keep pump torque maintain lower than engine torque at the selected engine speed.

(1) In I (Idle)& F (Fine) mode, current is fixed at specified value regardless of engine load condition. That means engine output is bigger enough compared to pump input power.

In P (Power max.), H (Heavy duty), G (General) mode,

(2) If engine is not loaded, it uses the specified current value at each engine speed.

(3) When engine is loaded, VECU increase the current of power-shift valve to decrease the consuming power of pump.

Picture text:

Engine & Pump Control Specification

EC330B-EC460B

1. for NA

Switch steps	Engine rpm (±40)	Mode	P/V current (±10mA)	P/V Output pressure kgf/cm²(psi)
9	1800 / 1700	H	210 / VAR	3.5(49.8)
8	1700 / 1600	G1	250 / VAR	5.8(82.5)
7	1600 / 1500	G2	300 / VAR	8.7(123.7)
6	1500 / 1400	G3		
5	1400	F1	530	26.4(375.5)
4	1300	F2		
3	1200	F3		
2	1000	I1	665	37.6(534.8)
1	800	I2		
-	Manual control	-	340	

2. Other area except NA

Switch steps	Engine rpm (±40)	Mode	P/V current (±10mA)	P/V Output pressure kgf/cm²(psi)
9	1800 / 1700	P	210 / VAR	3.5(49.8)
	1700 / 1600	H	250 / VAR	5.8(82.5)
8	1600 / 1500	G1	300 / VAR	8.7(123.7)
7	1500 / 1400	G2		
6		G3		
5	1400	F1	530	26.4(375.5)
4	1300	F2		
3	1200	F3		
2	1000	I1	665	37.6(534.8)
1	800	I2		
-	Manual control	-	340	

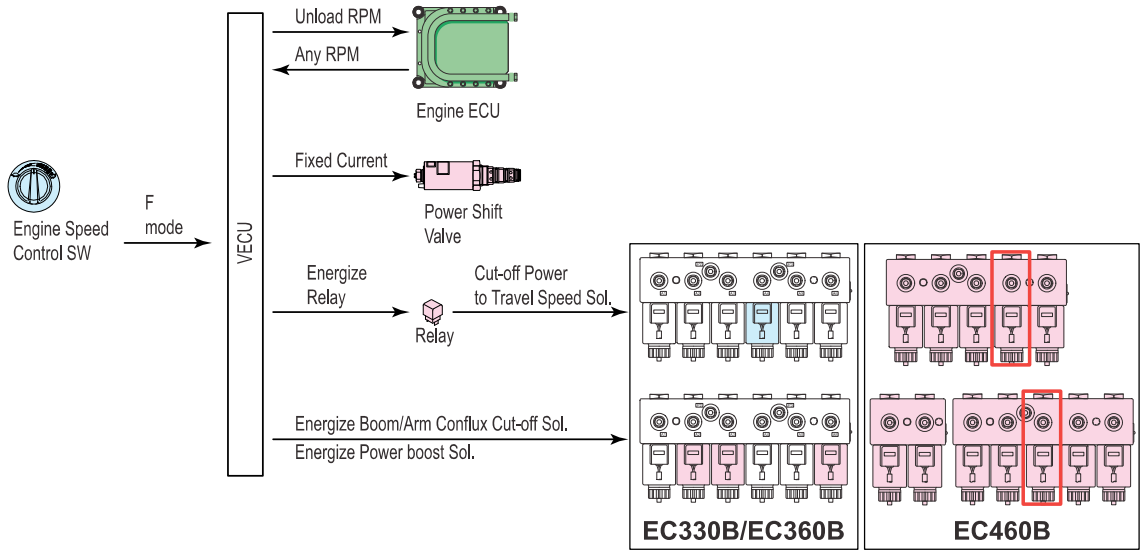
EC330B

EC360B EC460B

Engine and pump control specification

USA market do not have P mode.

Picture text:



F-mode operation

F-mode is used for lifting heavy material or finishing touch.
Machine needs slow speed and large lifting force to satisfy these conditions.

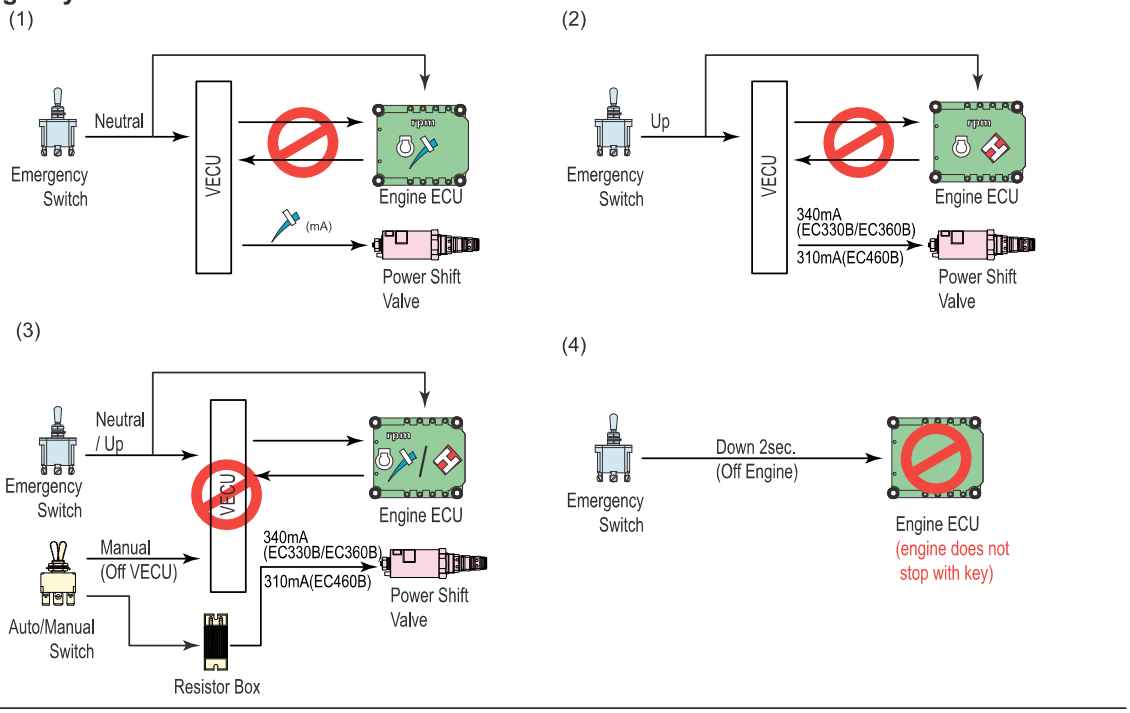
When control switch is in F mode,

- VECU turns off power to travel speed solenoid. That means travel speed is fixed to low speed regardless of travel speed select switch position.

- VECU energize power boost solenoid to increase main relief set pressure by 10%.

- VECU turns on power to boom-arm conflux cut-off solenoid. Then boom & arm use only 1 pump flow for slow speed.

Picture text:



Emergency control

This function is for emergency operation when malfunction of data bus or V-ECU has occurred.

1. When there is communication error, E-ECU realizes this condition and automatically goes to the emergency mode. If emergency switch is in neutral position, engine speed will be emergency low speed and maximum current will be supplied to power-shift valve from V-ECU.

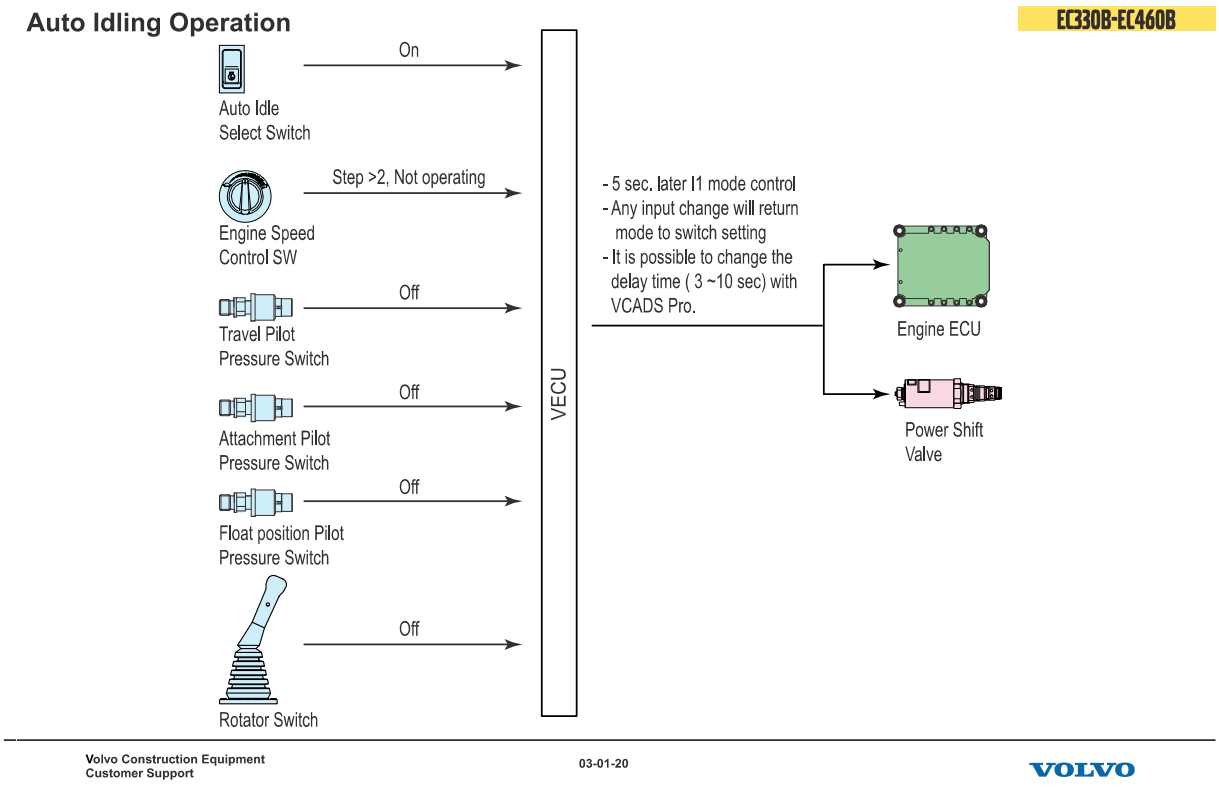
2. When there is communication error, E-ECU realizes this condition and automatically goes to the emergency mode. If emergency switch is up position, engine speed will be emergency high speed and power-shift valve current is set to the value that corresponds to 85% of the maximum pump input torque from V-ECU.

3. When malfunction of V-ECU, Emergency switch control the engine speed and Auto-Manual switch decide power shift current with resistor box. Machine can use 85% of the maximum pump input torque.

4. Emergency switch have emergency stop function when engine is still running after turning off the key-switch.

** Emergency low-high speed can be adjusted by VCADS Pro.

Picture text:



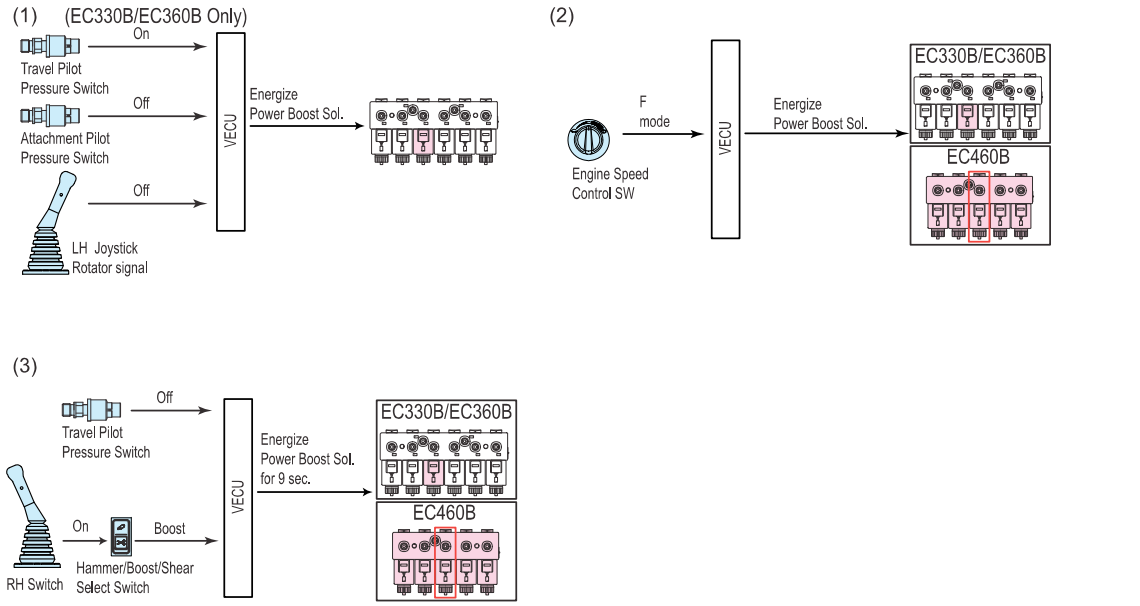
Auto-return to idle

Without any movement of machine, engine speed automatically goes down to I1 mode. This increase fuel economy and decrease noise. After engine has decelerated, if the operator changes one of input signals, then engine speed return to the previous speed.

Default time delay is 5 second. This can be adjusted form 3 to 10 seconds by VCADS Pro.

Picture text:

Power boost operation



Power boost operation

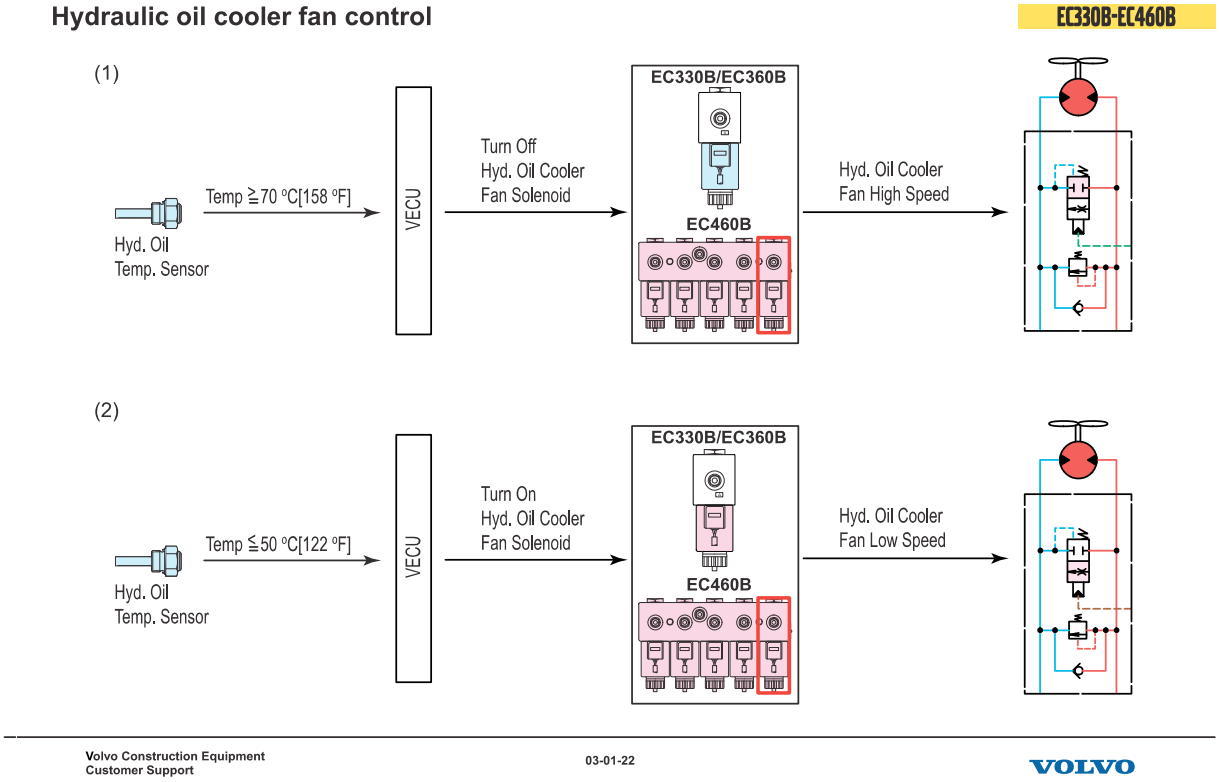
1. In travel-only mode, we have power boost function to increase travel performance(EC330B/EC360B only).

**Power boost is not needed for travel-only mode in EC460B.

2. In F-mode, machine has power boost function.

3. When selection switch is boost or shear position, by pushing RH joystick button we can use power boost function for 9 seconds. We call this one touch power boost. This is useful function when machine confront the heavy-load.

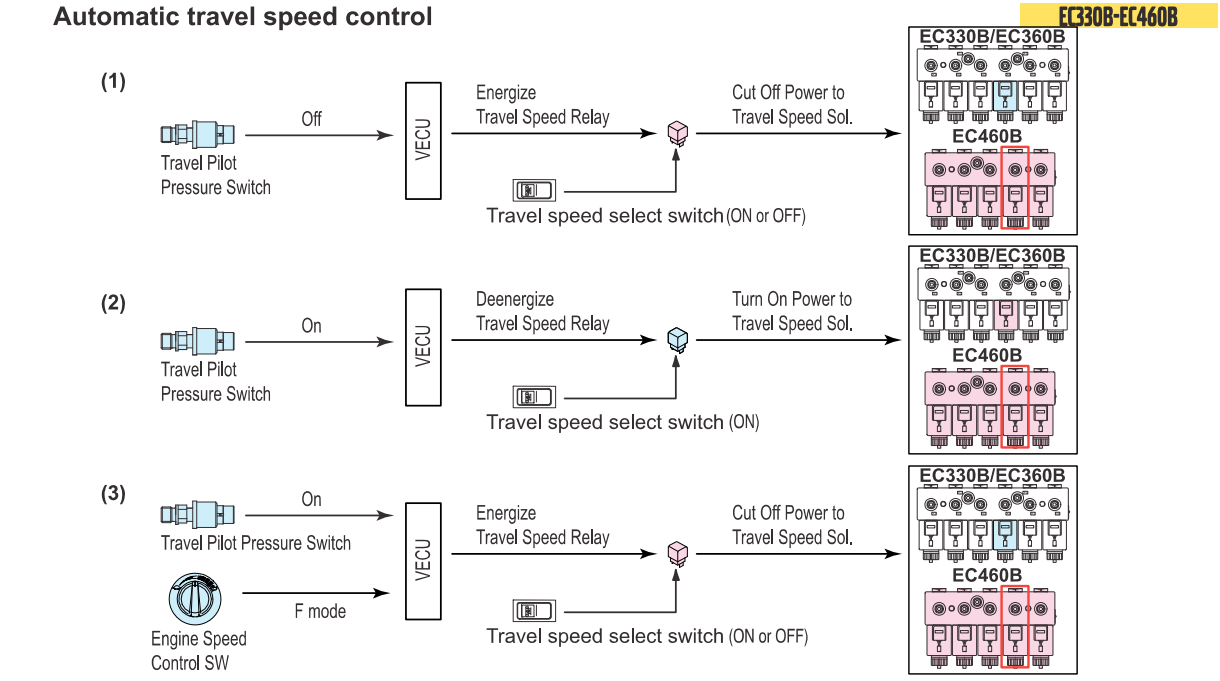
Picture text:



Hydraulic oil cooler fan control

Hydraulic oil cooler use independent pump and motor for fan driving.
Fan speed has two steps (low and high) according to the temperature of hydraulic oil. If temperature goes up to 70 degree, V-ECU turns on solenoid then fan motor speed become high. If temperature goes down to 50 degree, V-ECU turns off solenoid then fan motor speed become low.

Picture text:



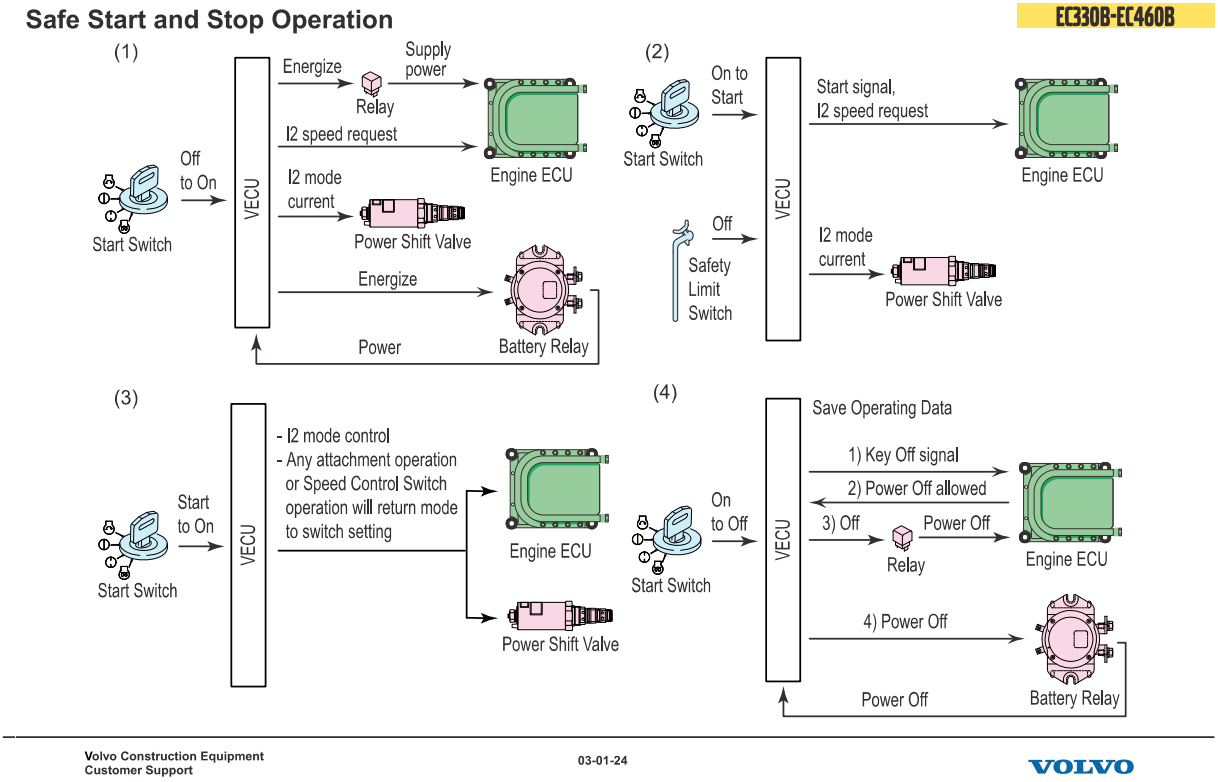
Automatic travel speed control

(1)When machine stands still, machine needs more brake torque during digging to prevent machine drifting toward because of reaction force from bucket. V-ECU realize the stop condition from travel pilot pressure switch, then V-ECU cut off the power to the travel speed solenoid regardless of the position of travel speed selection switch.

(2)High speed

(3)F-mode control

Picture text:



Safe start and stop control

The optimal condition of engine start and stop is automatically set by this function. The engine can be protected from damages that may occur at engine start and stop condition.

1. During starting engine, Engine rpm is fixed to low idle (I2) regardless of engine rpm control switch position to protect engine from sudden rpm increase in cold period or other situation.

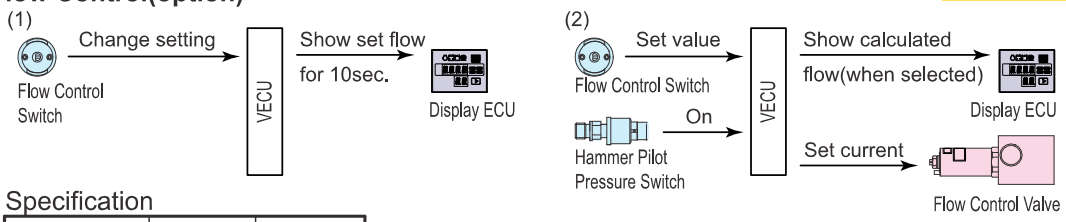
2. During starting, if safety lever is up, this signal disengage starter to prevent from sudden movement of hydraulic function.

3. After starting, any attachment operation or speed control switch operation makes engine return to the speed set by rpm control switch.

4. When start switch is turned off,
- Start switch signal is transferred to E-ECU.
- Important data are saved to ECUs.
- EMS power cut off relay is off.
- V-ECU cut-off power to battery relay.
- Whole system power will be off.

Picture text:

X1 Flow Control(option)



Specification

Model		Pump flow (Lpm / Gpm)	PV current (mA)
EC160B	Max.	143/38	270
	Min.	30/8	610
EC180B	Max.	143/38	270
	Min.	30/8	610
EC210B	Max.	200/53	260
	Min.	40/11	600
EC240B	Max.	230/61	280
	Min.	40/11	610
EC290B	Max.	250/66	280
	Min.	40/11	610
EC360B	Max.	280/74	300
	Min.	40/11	600
EC460B	Max.	345/91	300
	Min.	40/11	630

* Set pump flow is a specification at rated engine rpm, one pump flow condition.

** (calculated flow) = $\frac{\text{(set pump flow) x (current rpm)}}{\text{(rated rpm)}}$

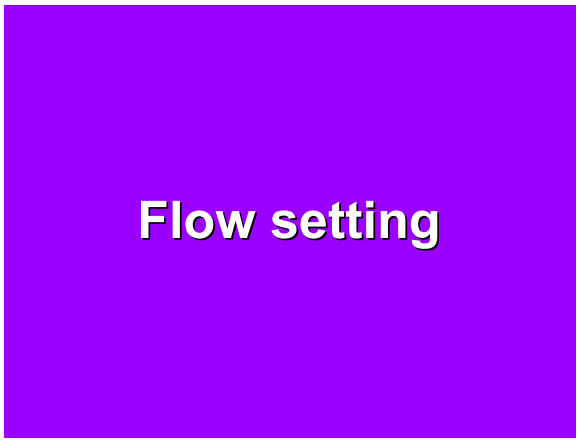
Pump flow control

At job site, customer uses various kind of optional attachment like hammer, shear etc. Every attachment has their unique operating specification especially in flow. Our machine can satisfy this request by using flow control switch and flow control proportional valve.

1. When operator adjust flow control switch, display automatically shows the flow value at the present engine rpm.

2. When operator uses the option attachment, the pilot pressure switch will be activated. V-ECU receives this signal and then start to controls the flow control valve according to flow control switch position. If the pilot switch is off position, there is no output current from V-ECU. That means flow control function is engaged only during the working of optional attachment.

Picture text:

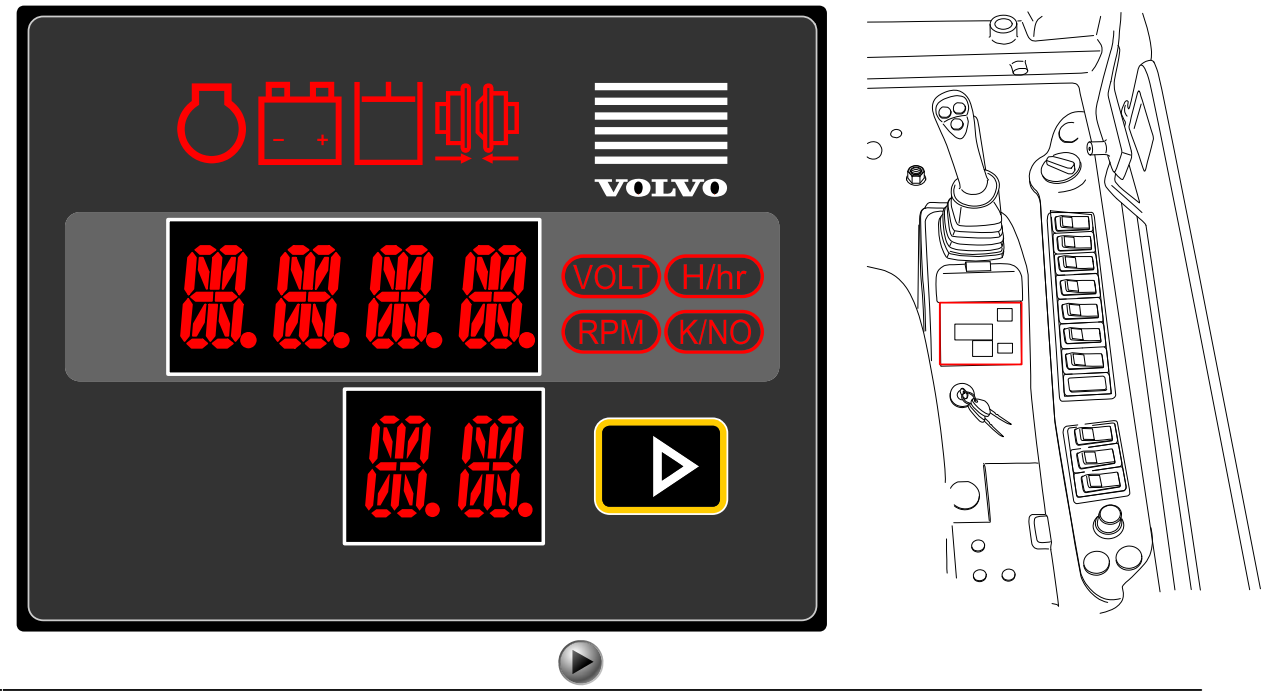


Flow setting video

Picture text:

Display ECU (MDU)

EC330B-EC460B



MDU(Machine Display Unit)

This animation is to show you how to operate display unit.
Push the arrow button step by step.

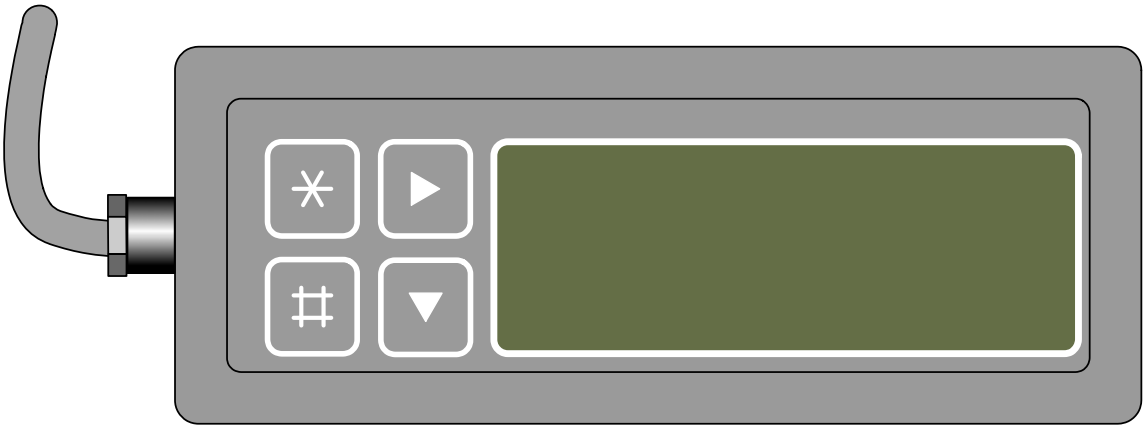
If the key is ON position, all lamps are ON for one second and then engine speed and work-mode are displayed. By pushing arrow button, display contents are changed from engine speed to battery voltage, hammer operating hour, key number, pump flow rate and error code.

When pump flow rate is selected, if you push the arrow button for 5 second, the unit of flow will be changed between lpm and gpm.

When error code is selected, active error codes are displayed consecutively.

If pump flow rate (option) is changed, set value is displayed on main display window for 10 seconds.

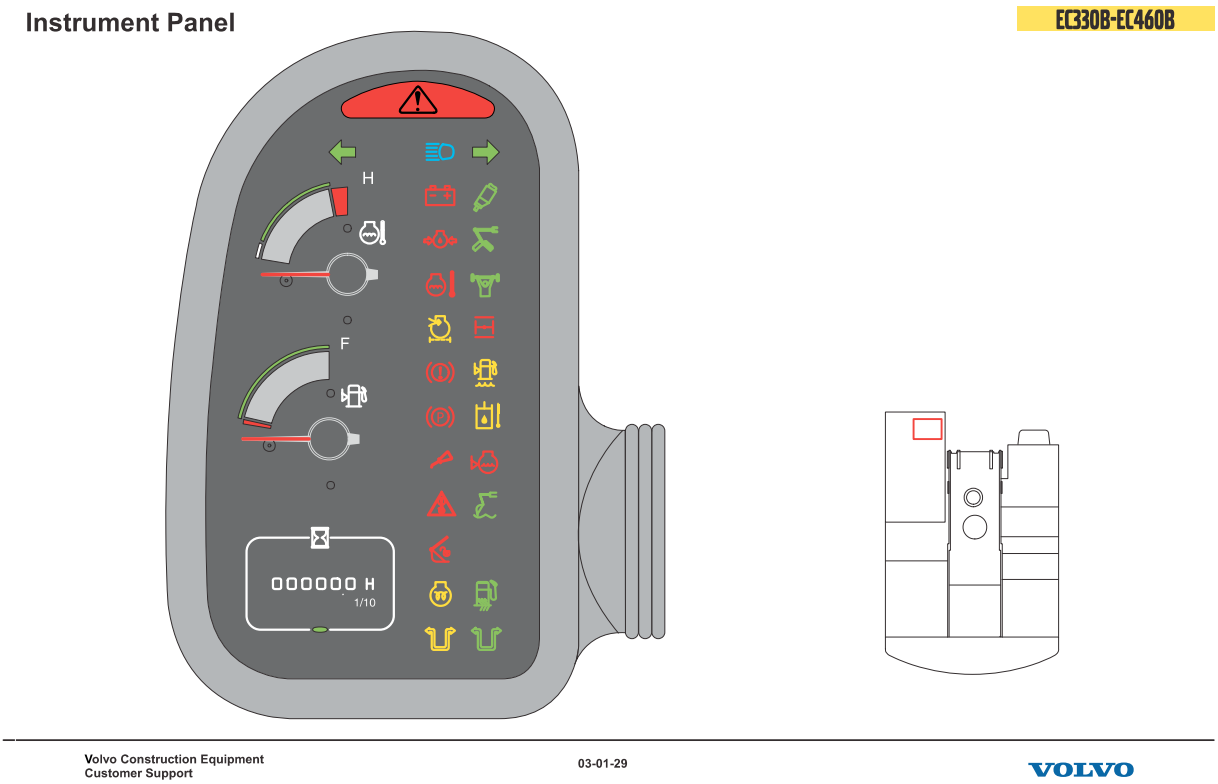
Picture text:



SDU(Service Display Unit)

The service display unit can be connected to service socket above the radio. The display unit is used for the service & troubleshooting. This can give additional information, which cannot be seen on the MDU.

Picture text:

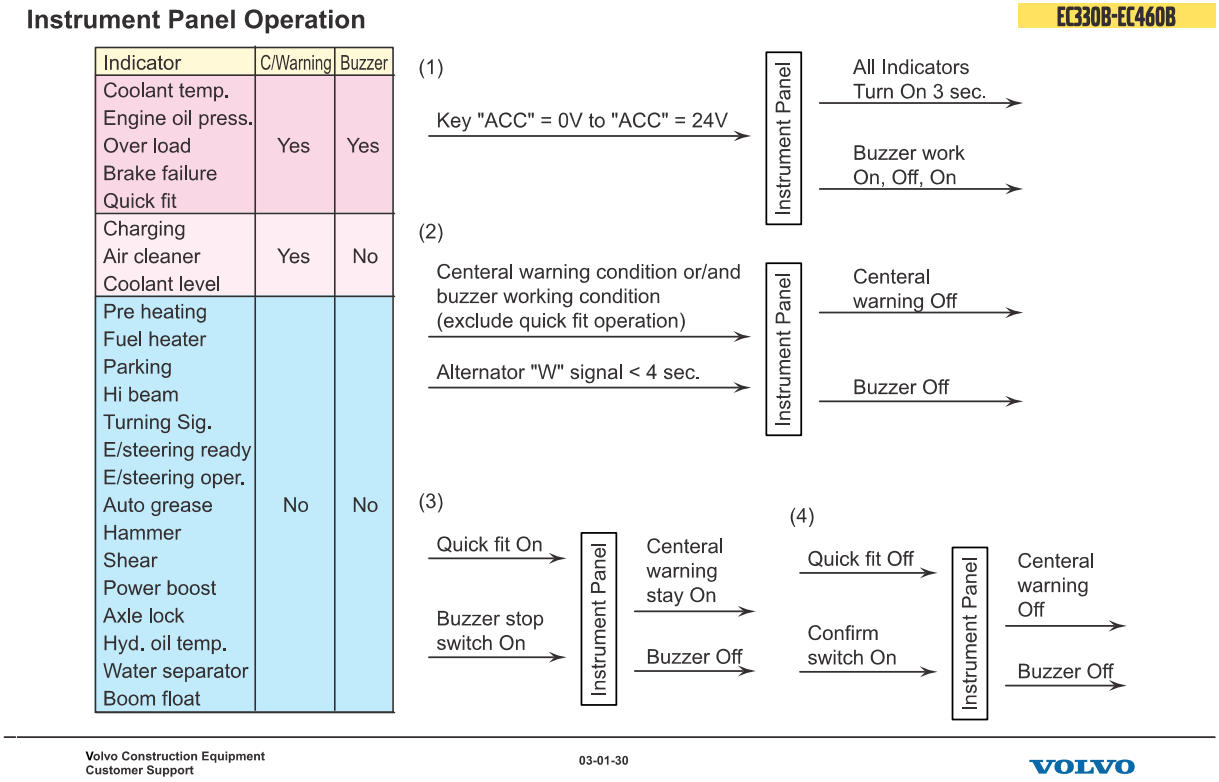


Instrument panel

The instrument panel shows the information received from the sensors and switches of the machine to alert the operator of any abnormality.
The instrument is adjustable for operator viewing angle and is illuminated for night work.
All light bulbs should be checked daily and replaced if burnt-out because the indicators alert the operator of a failure in the machine.
The panel contains a coolant temperature gauge, fuel gauge, hour meter and alert indicators to show machine conditions.
The instrument panel utilizes a plug-in printed circuit board (PCB) to facilitate replacement and troubleshooting. If a failure is suspected always check the plug-in connection.

This is common parts with wheel excavator.

Picture text:



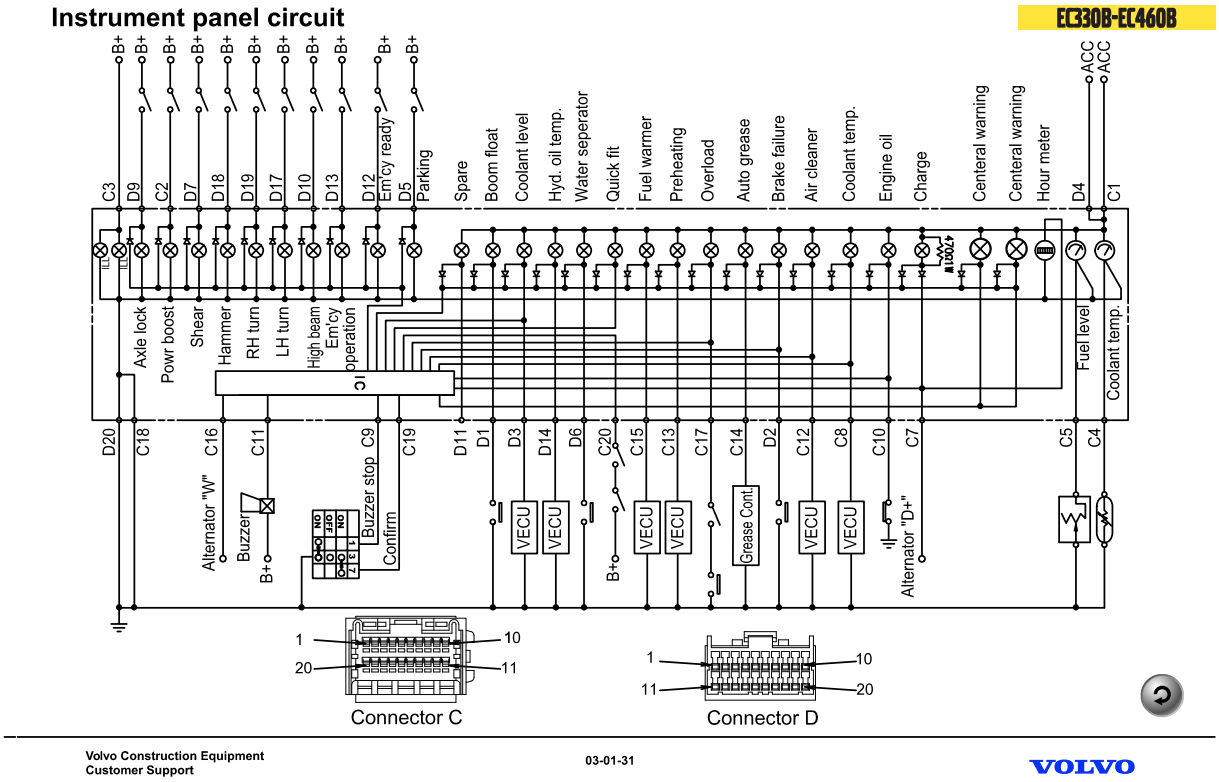
Instrument panel operation

1. Lamp and buzzer check procedure
Before starting the engine, if you turn the start switch to the ON position all lamps are turned ON for 3 seconds. At the same time the buzzer is operated 2 times with the cycle of 1.0 second ON and 1.0 second OFF.
Check if all indicator lights come on, and if not, check for burnt-out light bulbs, and the plug□in connectors (connector A, B) of the printed circuit board.

2. Central warning and buzzer sound
W signal indicates engine status whether engine is running or not.
IC in the instrument panel receives warning signal and this W signal and then decides that this situation is warning case or not.
For example, when we turn the key switch from OFF to ON, we can see only charge warning lamp and engine oil low pressure without central warning and buzzer sound because there is no signal from alternator W terminal.

3. Quick fit release operation
4. Quick fit re-engage operation

Picture text:

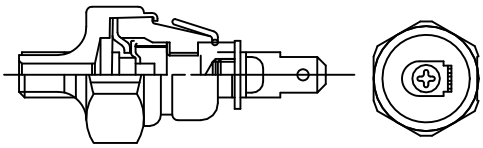


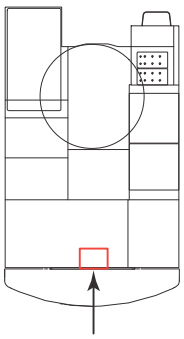
Instrument panel circuit

Inside of instrument panel, there is an IC chip to control the lamp and warning case.
In this page, think about how to operate this circuit to make the function of previous page.

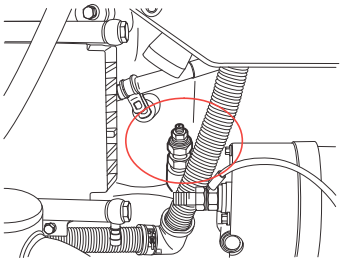
Picture text:

Engine oil pressure switch(Instrument Panel)





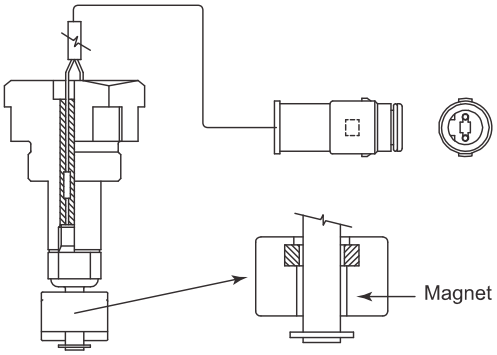
Item	Specification
Rated load	24V, 5W
Working pressure	0.7±0.2kgf/cm^2 [10±3psi]
Contact point type	Normally closed type(NC) (Below the working pressure : ON, Above the working pressure : OFF)

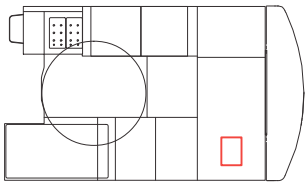


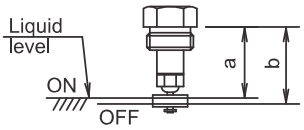
Engine oil pressure switch

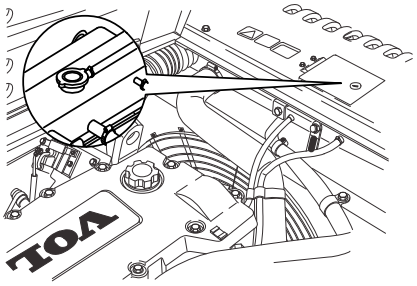
Check the location of this sensor.

Picture text:







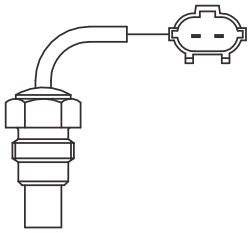


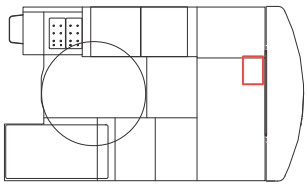
Liquid	Density	a(mm[in])	b(mm[in])
Water	1.00	60.9±3[2.40±0.12]	61.9±3[2.44±0.12]
Oil	0.88	58.9±3[2.32±0.12]	59.5±3[2.34±0.12]

Coolant level sensor

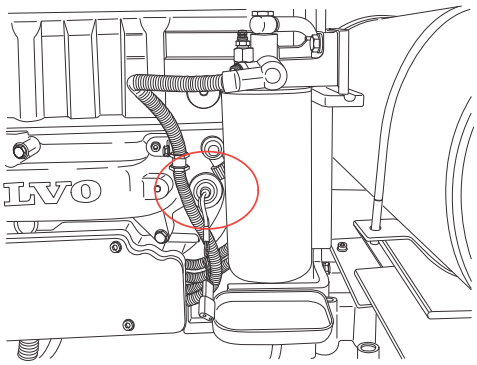
Tolerance of this sensor is very small between ON & OFF.
This can cause frequent on & off of warning lamp. To prevent this we have some special program at ECU.
To turn on the lamp, coolant switch should maintain off position for some period.

Picture text:





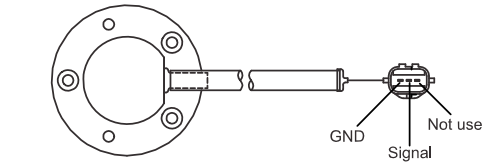
Temp.	Resistant
(50°C[122°F])	153.9 Ω
80°C[176°F]	51.9 Ω
100°C[212°F]	27.4 Ω
(120°C[248°F])	16.1 Ω



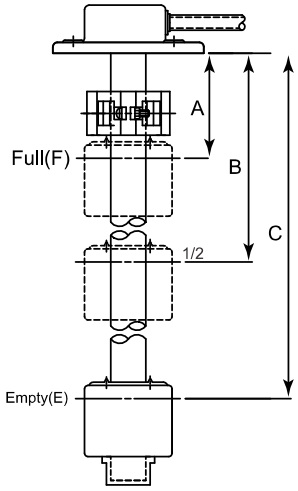
Coolant temperature sensor

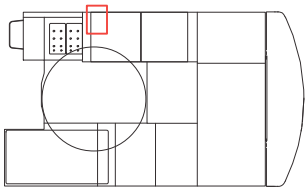
This sensor is used for needle gage of instrument panel.

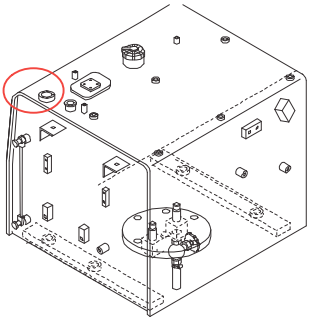
Picture text:



	A	B	C
Distance(mm[in])	87[3.43]	360[14.17]	680[26.77]
Resistance(Ω)	3	32.5	110





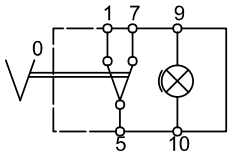


Fuel level sensor

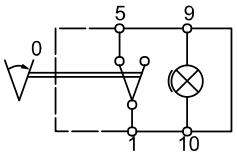
This unit sends variable resistance value according to the level of the fuel in the fuel tank to the fuel level gauge on the instrument panel.

Picture text:

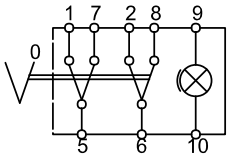
Switch Circuit



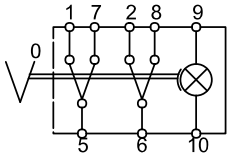
Switch 3, 4, 11, 13, 14, 16, 17



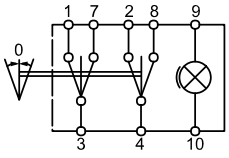
Switch 2, 10



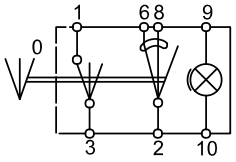
Switch 12, 18



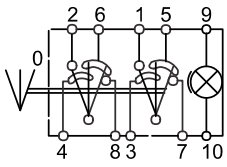
Switch 19



Switch 6, 7, 15



Switch 1



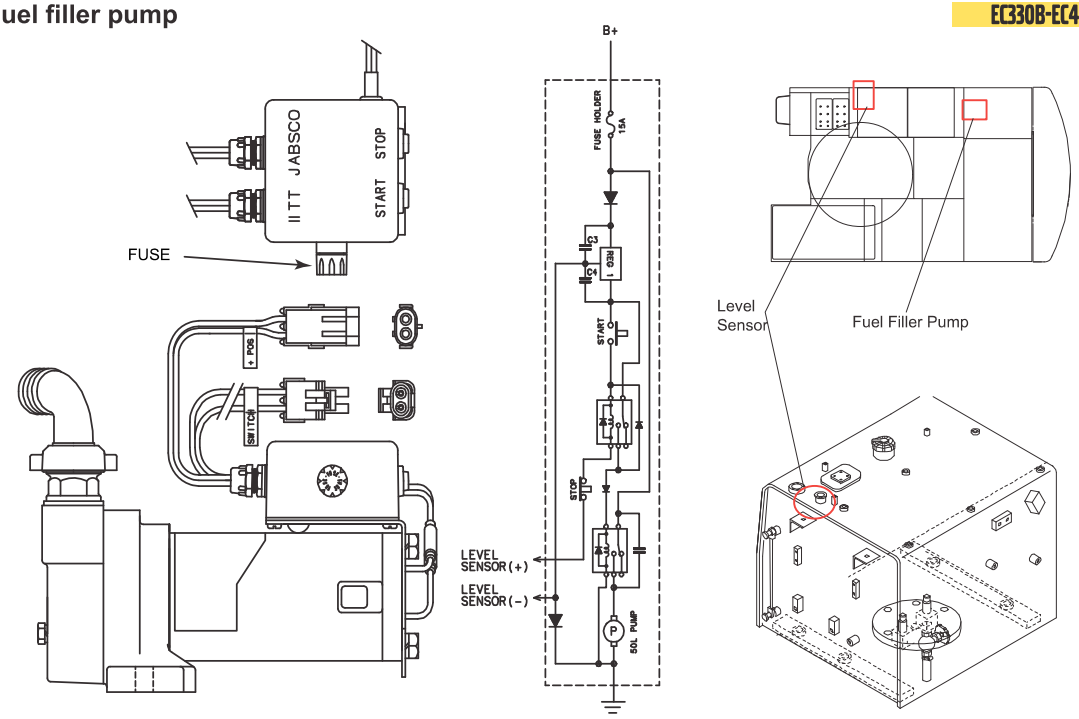
Switch 5, 9

1. Work lamp
2. Power max. select
3. Auto idle select
4. Travel speed select
5. Shear/power boost /hammer select
6. Quick fit
7. Buzzer stop / confirm
9. Upper wiper
10. Washer
11. Lower wiper
12. Seat heater
13. Overload warning
14. Travel alam stop
15. Quick fit
16. Room lamp
17. Beacon lamp
18. Extra lamp
19. Cassette mute

Switch circuit

By using this circuit, you can do continuity test for switches.

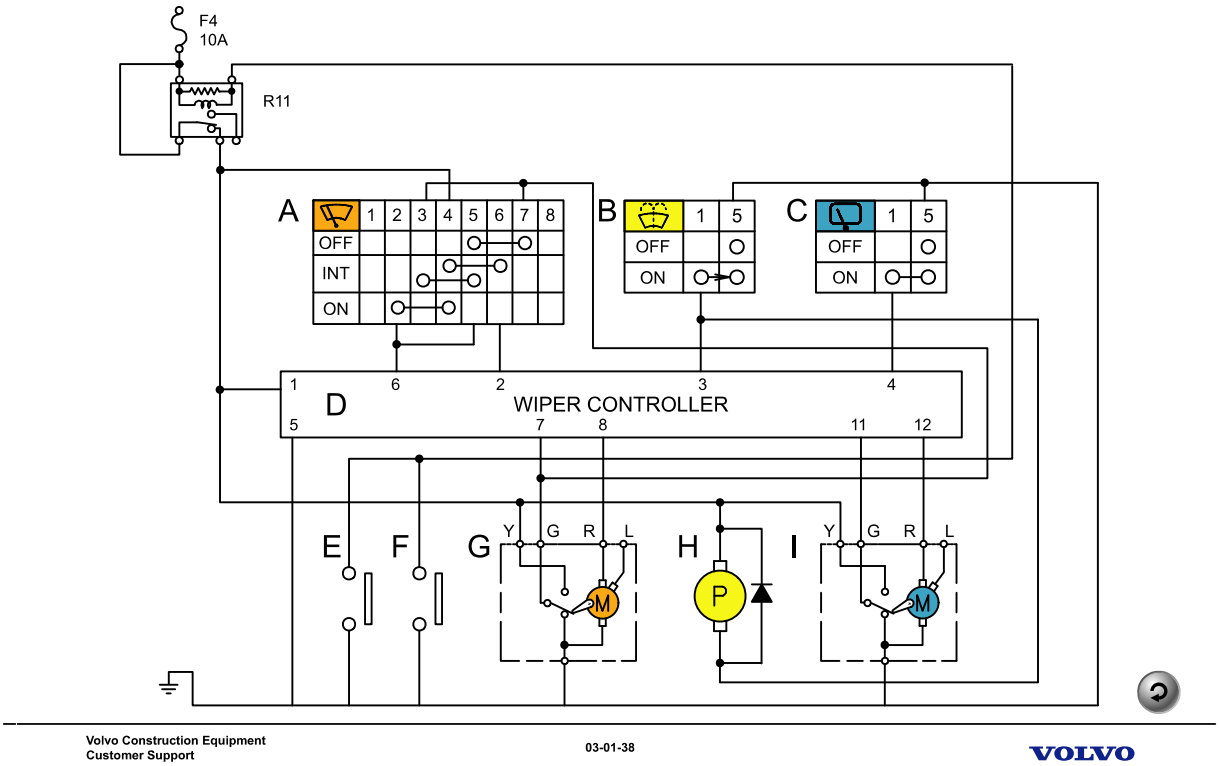
Picture text:



Fuel filler pump

This shows the 50LPM pump with level sensor.
This has automatic stop function when fuel level reach to maximum.

Picture text:

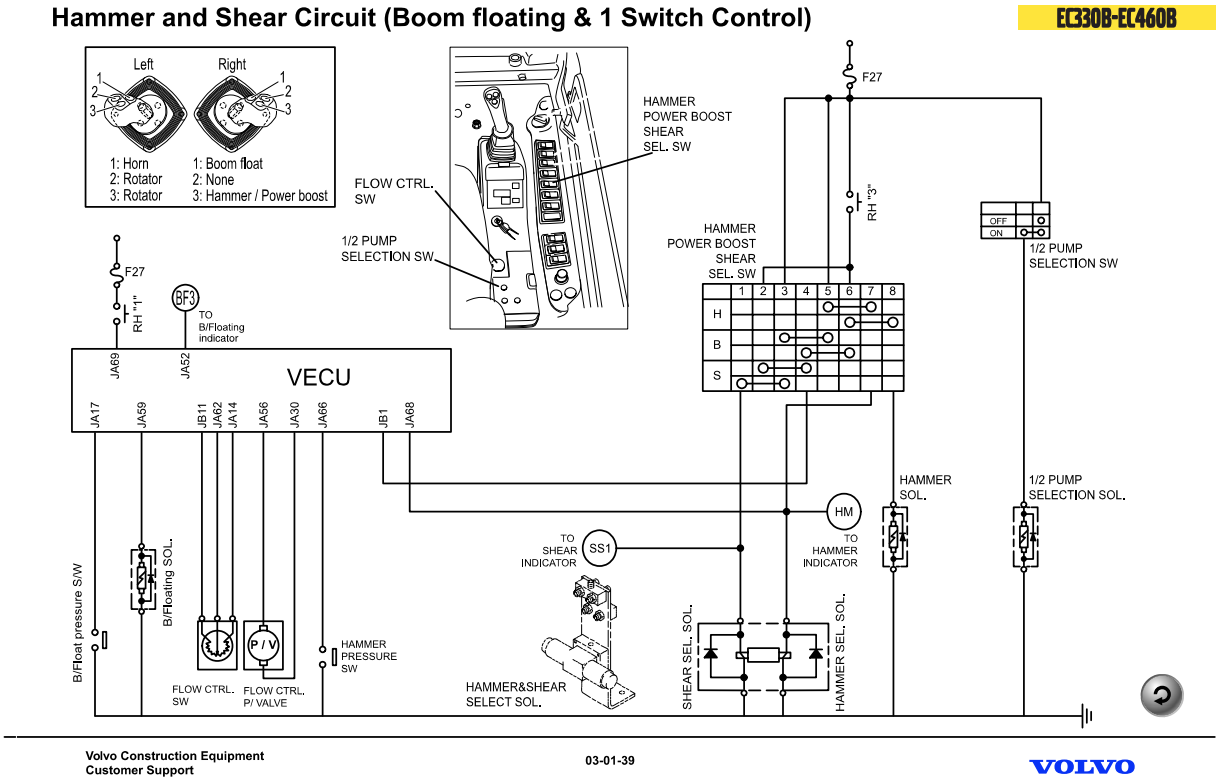


Wiper Control Circuit

A : Upper wiper switch
B : Washer switch
C : Lower wiper switch
D : Wiper controller
E,F:Upper and lower limit switch
G : Upper motor
H : Washer pump

During wiping,Y and G are connected. So,even though switch(A or C) is OFF, motor(G or I) will work to its stroke end.

Picture text:



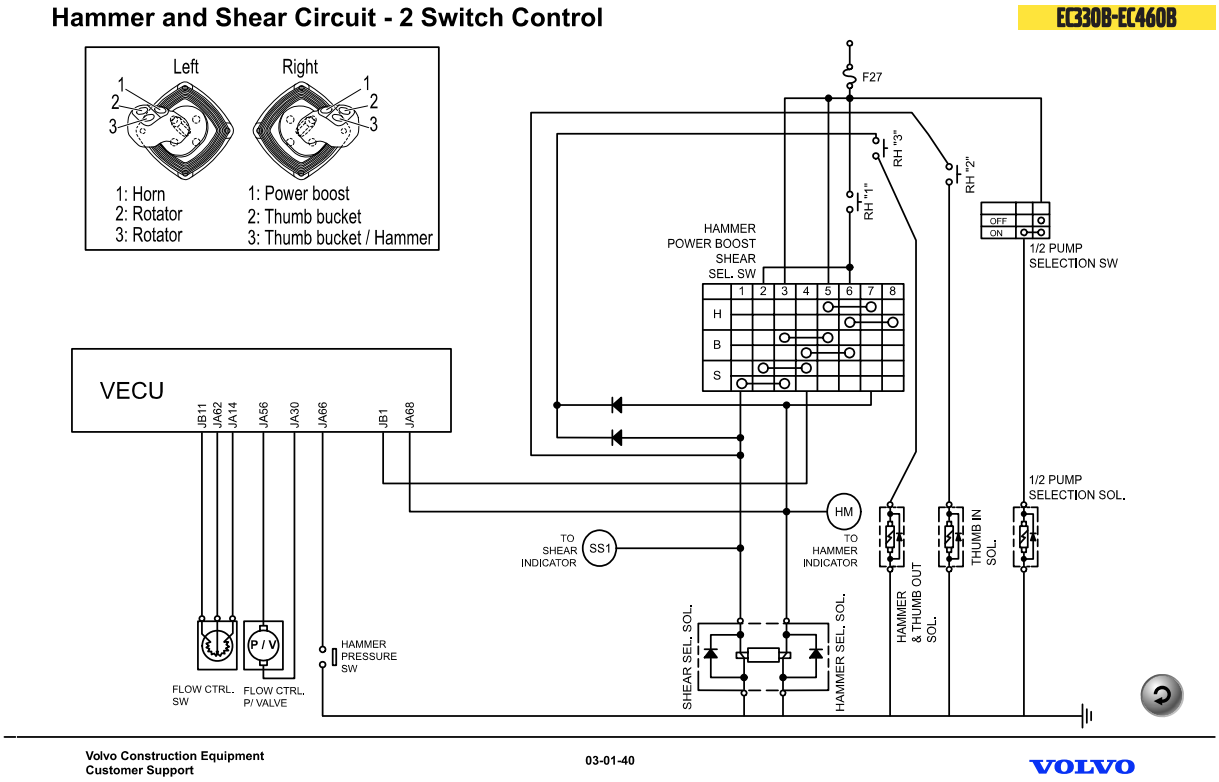
Hammer and Shear circuit(Boom floating & 1-switch control)

This option is brought with pedal in the X1 cirucit.

Single acting(hammer) is operated by joystick button and pedal. In this case, RH joystick 3 can be used for hammer or power boost according to the position of hammer&shear select switch.
But double acting(shear) is operated by only the pedal.

And RH joystick 1 can be used for boom floating function. Boom floating is to make both chamber of cylinder connected to tank.

Picture text:



Hammer and Shear circuit(2-switch control)

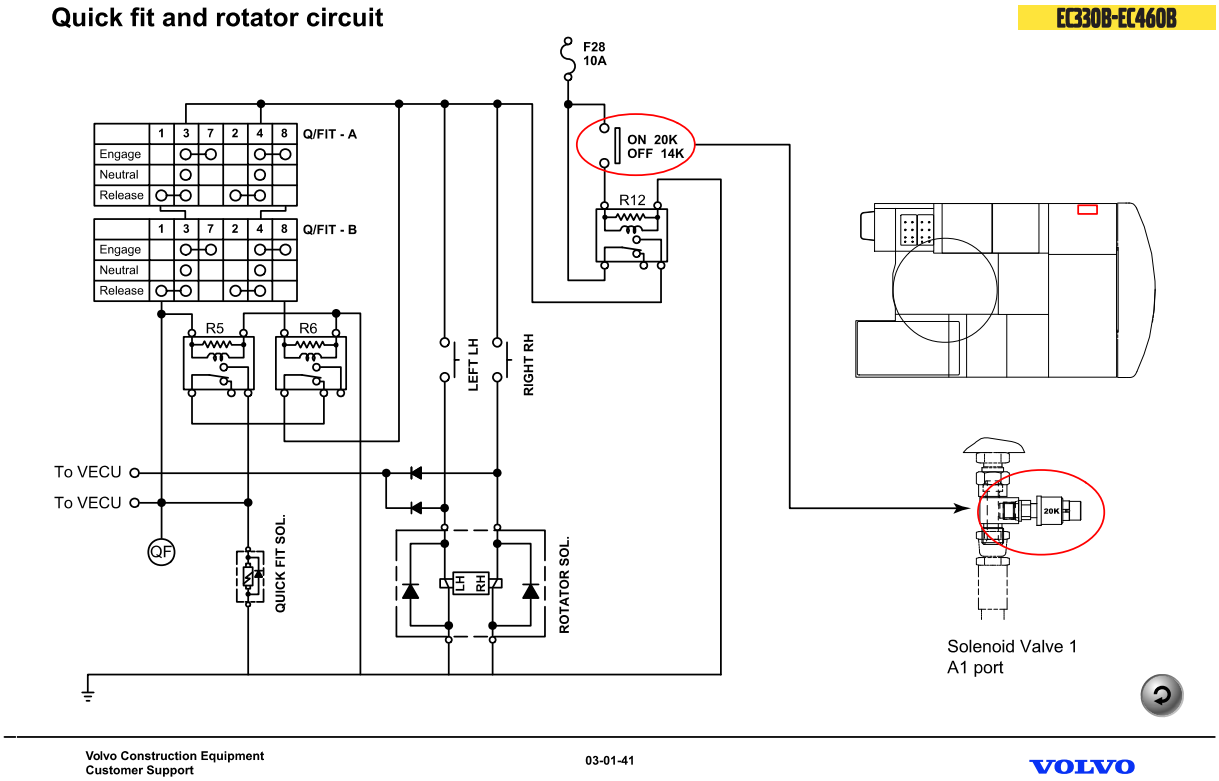
This option is brought with one more solenoid valve for double acting without the pedal.

Single acting(hammer) is operated by joystick button. In this case, RH joystick 3 can be used for hammer.

But double acting(shear) is operated by RH joystick 3 & 2.

And RH joystick 1 can be used for one-touch power boost.

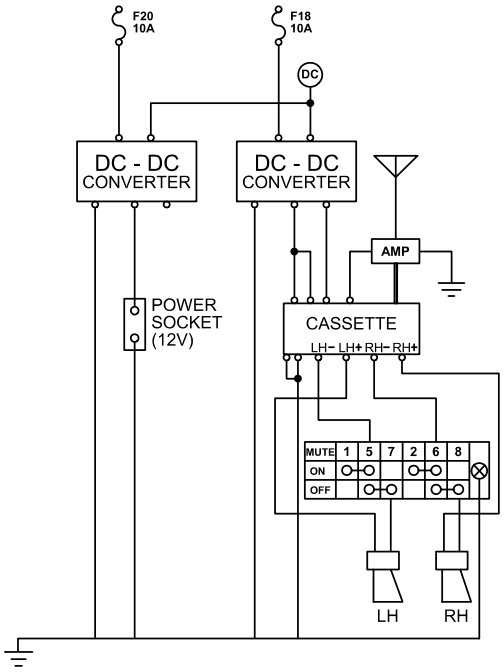
Picture text:



Quick fit and rotator circuit

These two systems can be activated after lifting up the safety lever. Lifting safety lever activate pressure switch then turn on the R12.
This is safety function for this option hydraulic.

Picture text:



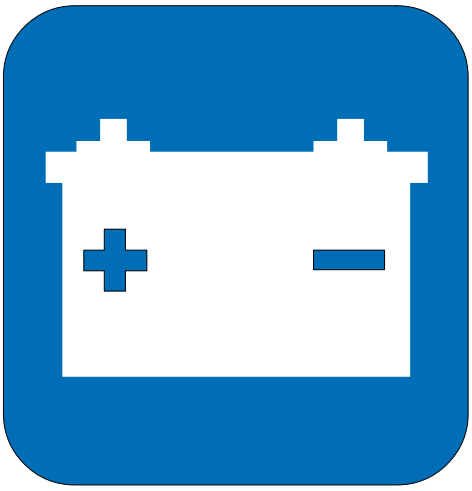
Radio circuit

Radio system uses 12V power. So we need DC-DC converter.
From DC-DC converter, 2 lines are used for operating power and 1 line is used for frequency memory function.

If the cassette mute switch is installed and turned to ON, the speaker is cut off even when the cassette power is ON.

Picture text:

EC330B-EC460B(I-ECU)

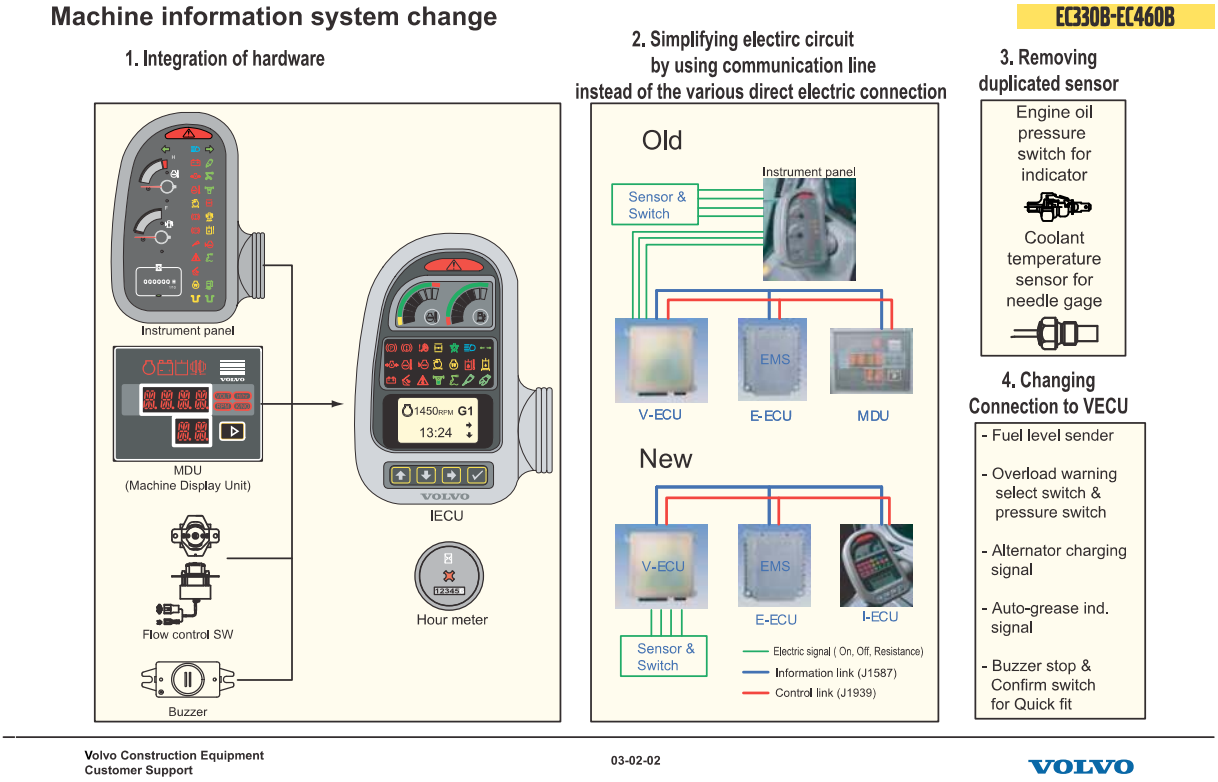


Electric system(I-ECU application)

New I-ECU is introduced for commonality.
With the New I-ECU changes, electric circuit changes took place at the same time.

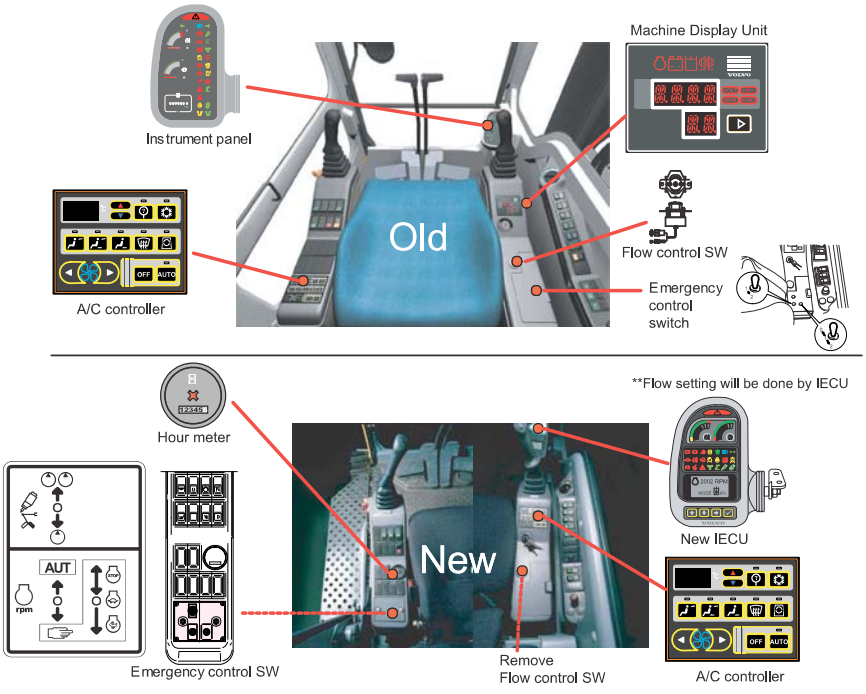
Applied Serial no.
EC330B: 10417~
EC360B: 11226~
EC460B: 10922~

Picture text:



Machine information system change

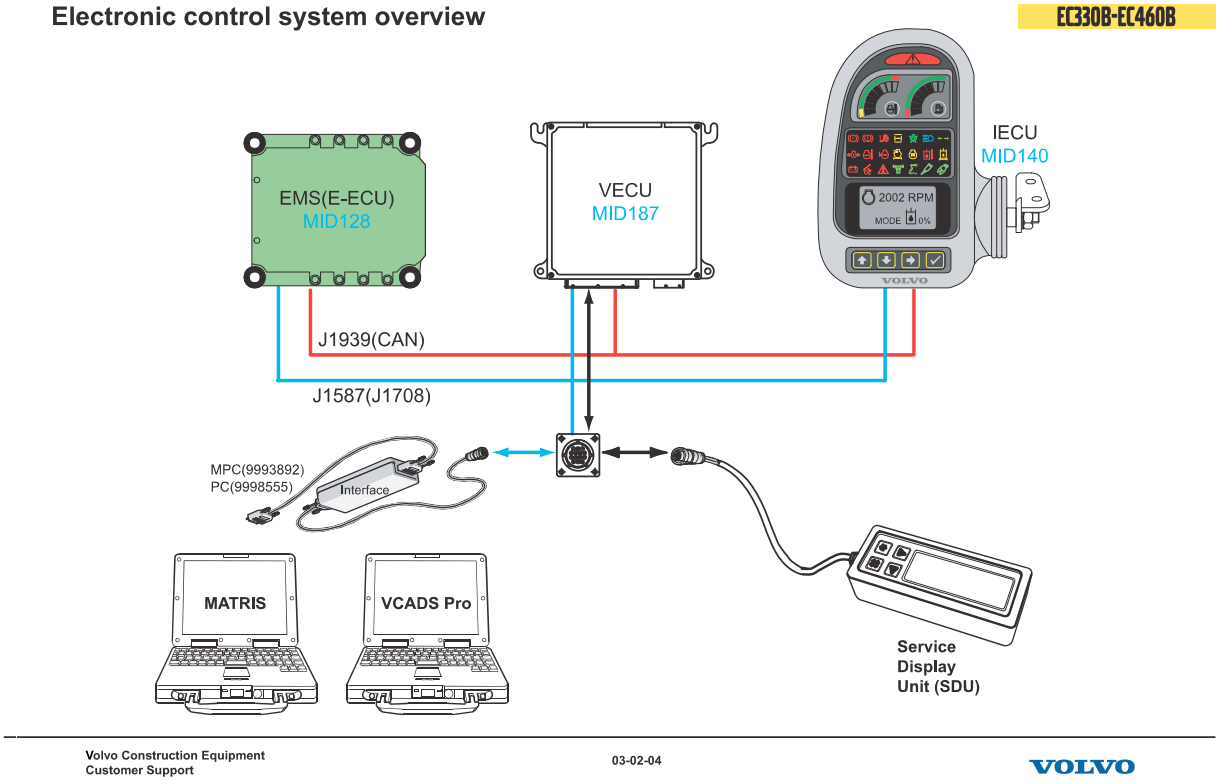
Picture text:



System layout change

1. A/C switch moves to RH control box.
2. Emergency, Auto/Manual and 1-2 pump select switch move to LH control box.
3. Hour-meter is located at LH control box.
4. No flow control switch. Flow setting will be done at I-ECU.

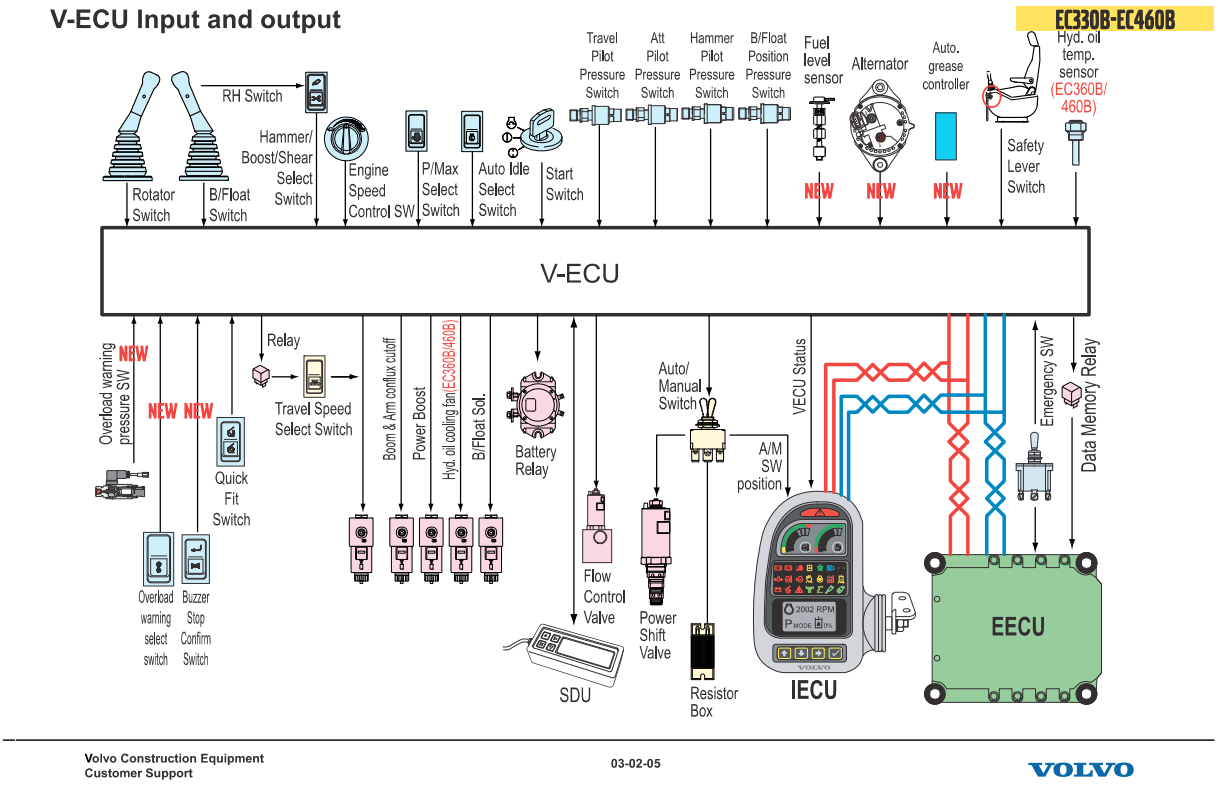
Picture text:



Electronic control system overview

Programmable I-ECU added.

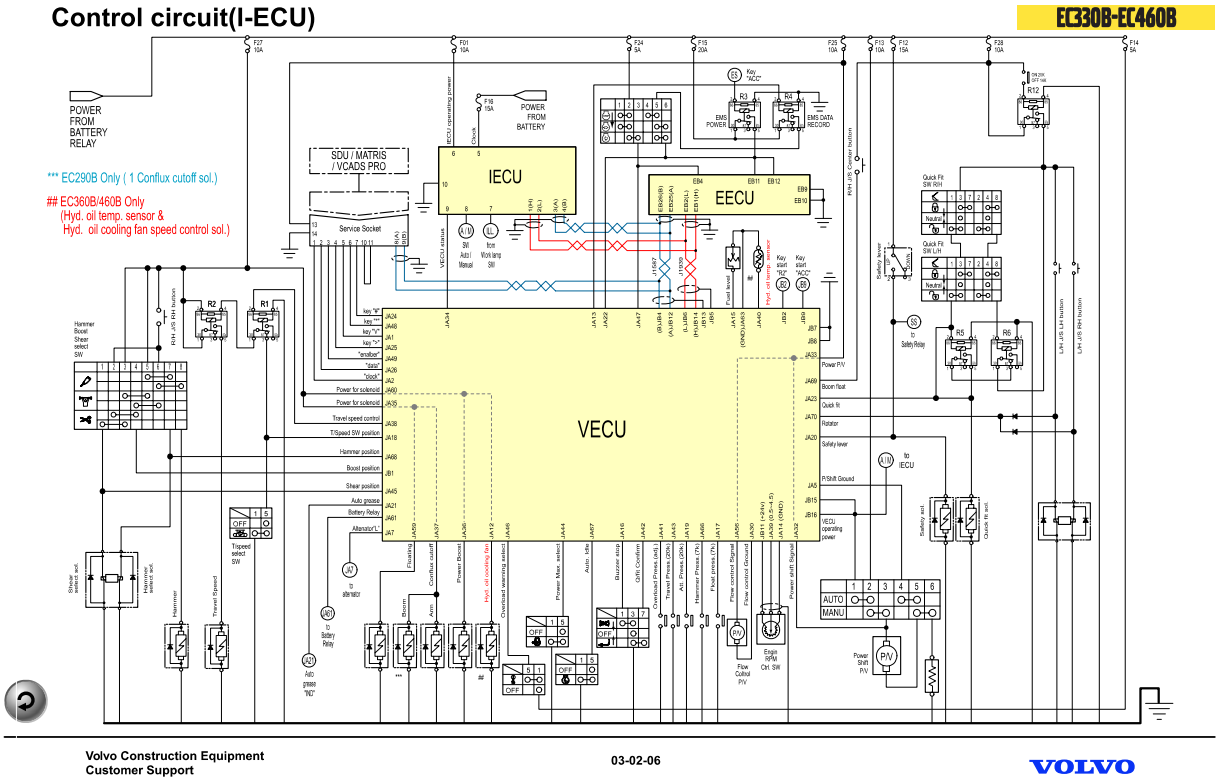
Picture text:



V-ECU input and output

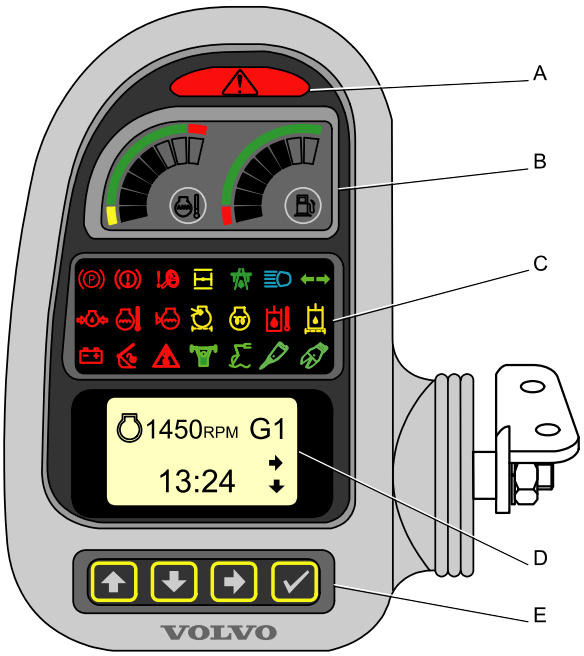
Many input signal was directly connected to instrument panel for old system.
Now those signals go to V-ECU, which sends information to I-ECU.

Picture text:



Control circuit

Picture text:



I ECU

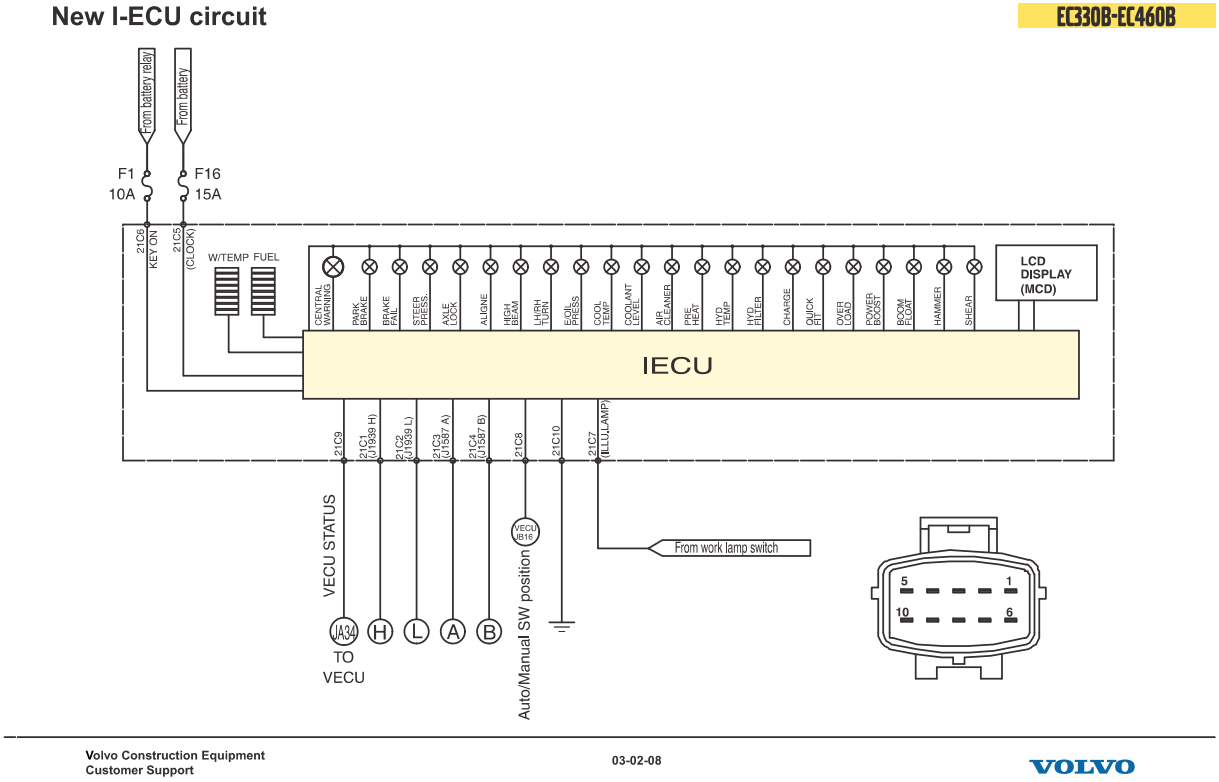
1) Layout
A : Central warning lamp
B : Coolant temp. & fuel Gauge
C : Warning indicator
D : MCD(Message Center Display)
E : Key button

2) Key OFF condition

3) Key ON (Booting operation)
Central warning lamp(2 times), gauge(all segment ON),all indicator lamp ON

4) Key OFF (Shutdown operation)

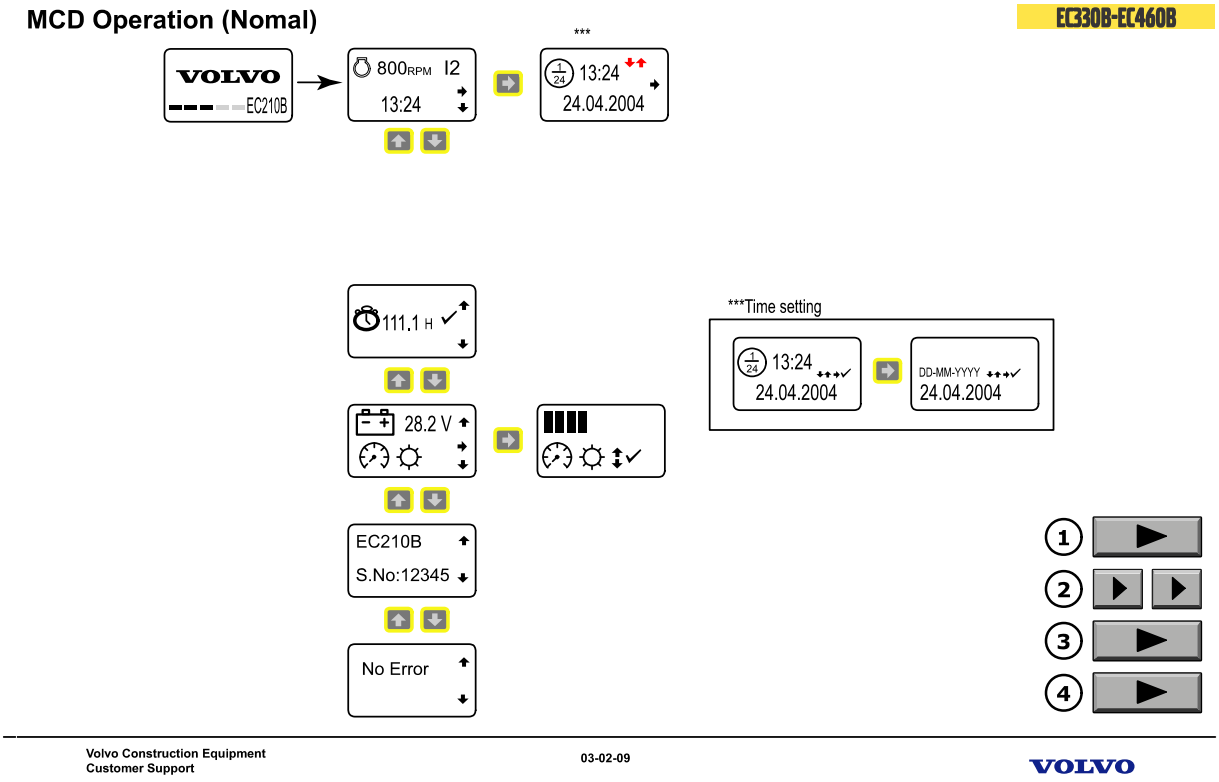
Picture text:



New I-ECU circuit

New I-ECU uses only 10 pin connector because I-ECU use the communication line for various signal.

Picture text:

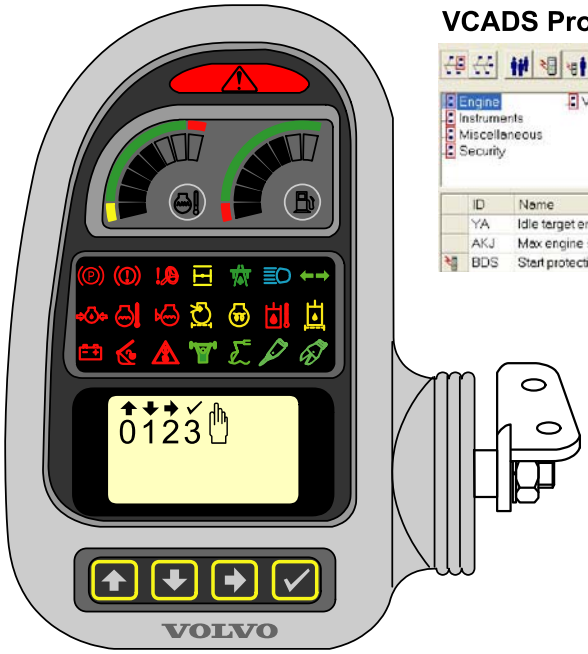


MCD Operation

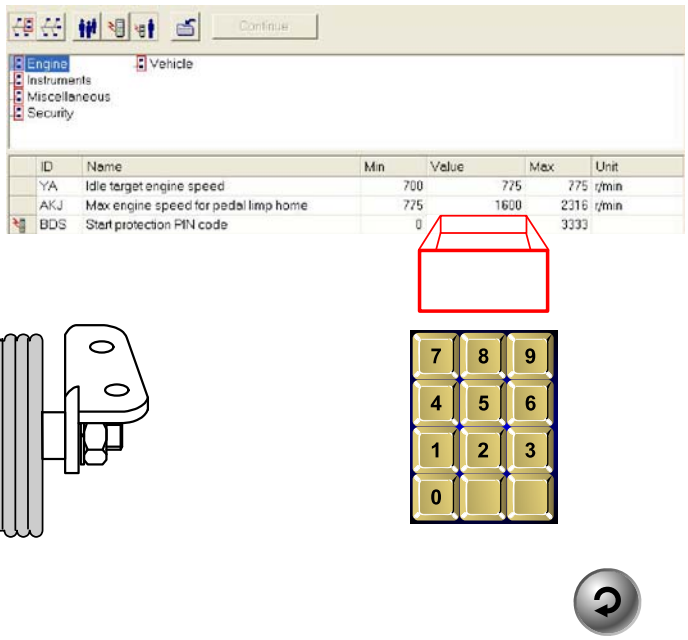
(1) : Normal condition
(2) : Anti-theft(Code-lock) condition
(3) : X1 menu
(4) : Error display

Picture text:

IECU Operation (Code Lock)



VCADS Pro Start protection PIN code change



IECU Operation(Code Lock)

(a) : Put 4-digit number!(This PIN code will be saved in the IECU)
(b) : Enter the PIN code through IECU(arrow & confirm buttons).
(c) : Push the confirm button more than 2 sec.

(d) : If the correct code is entered,Indicator Operation menu is displayed.

(e) : Alarm sound can be off by pushing confirm button.

Picture text:

Overload selection
(not warning)

Auto grease

** If two pop-up indicators are activated at the same time, The indicator of highest priority is shown on MCD.
Priority (1 : Overload selection, 2 : Auto grease)

Pop-up indicator

This is not a warning but just indication of activation.

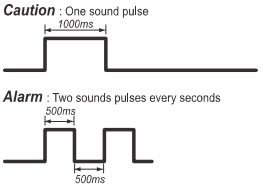
Picture text:

Indicator operation

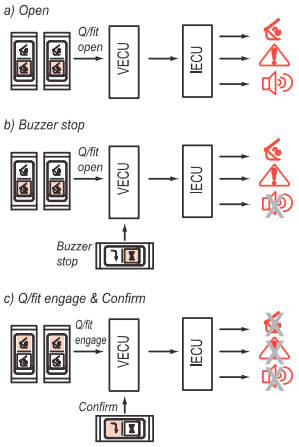
Category	Symptom	Operation		
		Indicator	Central warning	Buzzer Sound
Alarm	Engine coolant temperature high	On	Blink	Alarm
	Engine oil pressure low	On	Blink	Alarm
	Overload warn	On	Blink	Alarm
	Brake oil pressure low	On	Blink	Alarm
	Quickfit open	On	Blink	Alarm
	Steering pressure low	On	Blink	Alarm
Caution	Battery no-charge	On	Blink	Caution
	Air cleaner clogging	On	Blink	Caution
	Coolant level low	On	Blink	Caution
	Hydraulic oil temperature high	On	Blink	Caution
	Hydraulic oil filter cloggi ng	On	Blink	Caution
Telltale	Air preheating	On	X	X
	Alignment	On	X	X
	Parking brake	On	X	X
	High Beam (Working lamp)	On	X	X
	Left/right turn signal	On	X	Alarm
	Hammer selecting	On	X	X
	Shear selecting	On	X	X
	Power boost operating	On	X	X
	Oscillation lock	On	X	X
	Float operation	On	X	X

Buzzer Alarm sound will last until operator pushes confirm button of IECU

(1) Buzzer Sound spec.



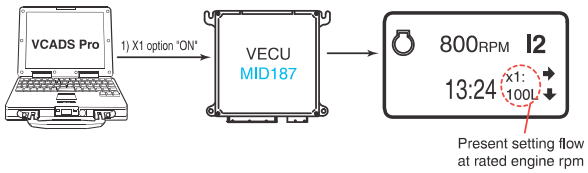
(2) Quick fit buzzer stop & Confirm



Indicator operation

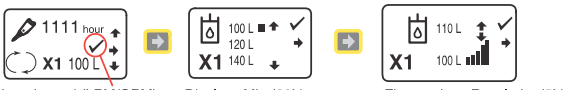
Picture text:

(1) Parameter programming : X1 option(ON)



Present setting flow
at rated engine rpm

(2) Flow setting



Changing unit(LPM/GPM)
by pressing this button

Display : Min.(20L),
Max(480L)

Fine setting : Resolution(5L)

(3) Max. & Min. flow at rated engine rpm

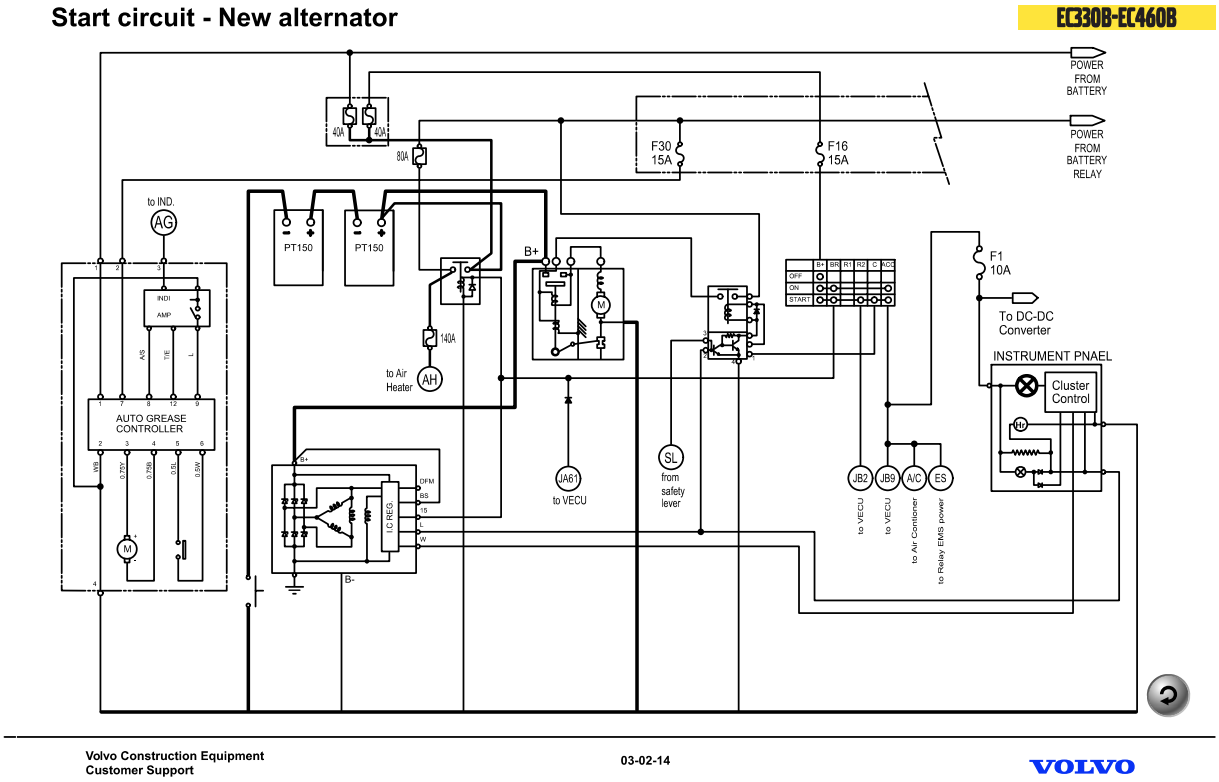
Model		Pump flow (Lpm / Gpm)	PV current (mA)
EC160B	Max.	143/38	270
	Min.	30/8	610
EC180B	Max.	143/38	270
	Min.	30/8	610
EC210B	Max.	200/53	260
	Min.	40/11	600
EC240B	Max.	230/61	280
	Min.	40/11	610
EC290B	Max.	250/66	280
	Min.	40/11	610
EC360B	Max.	280/74	300
	Min.	40/11	600
EC460B	Max.	345/91	300
	Min.	40/11	630

X1 flow setting

You can select any number from 30 to 500 at flow setting screen.
But if you select number that is larger than actual maximum flow, the set value will not be changed as you select.

For example, if you select 240 at EC210B, the set value will be changed to 200.

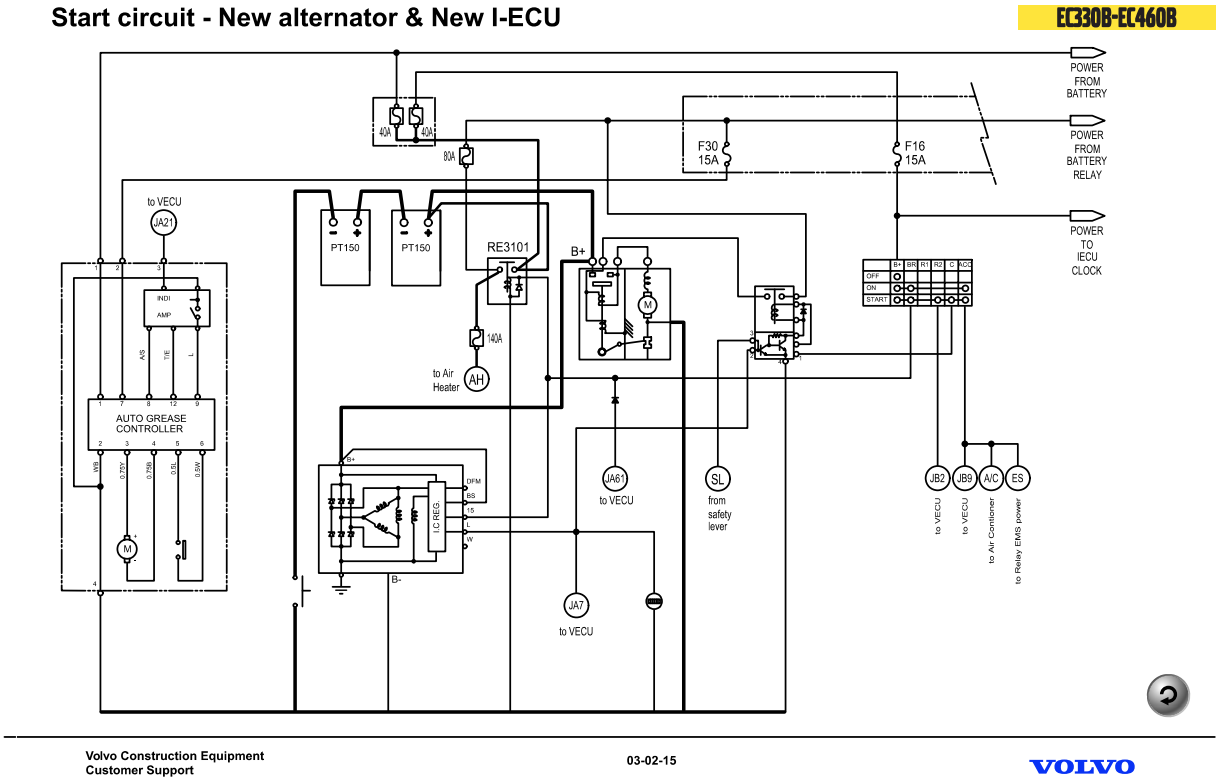
Picture text:



Start circuit-New alternator

New alternator and old instrument panel.

Picture text:



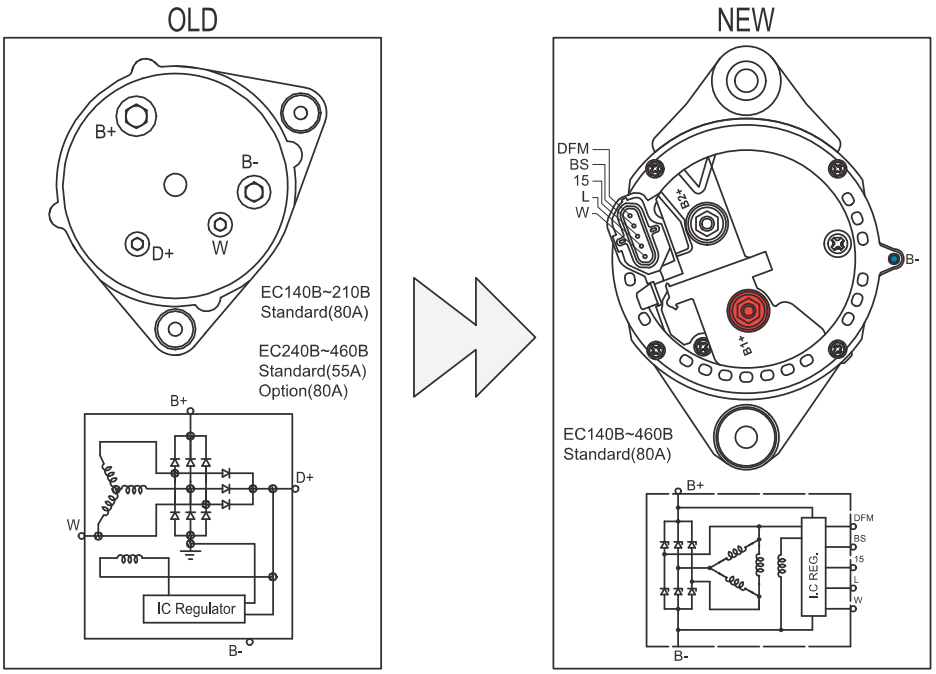
Start circuit-New alternator and New I-ECU

New alternator with new I-ECU

Picture text:

Alternator change

EC330B-EC460B

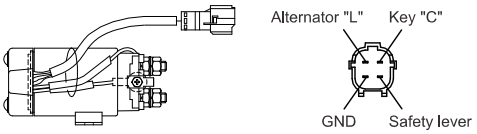


Alternator change

Picture text:

Safety start relay change

EC330B-EC460B



(1) Old(14526226)

	Normal operation	Hold key switch on ST position after engine started.	Turn the key switch to ST and ON while engine is running	Start the engine again after the failure
KEY SWITCH	V, ST, ON, t	ST, ON	V, ST, ON, t	ST, ON
SAFETY RELAY	V, t	V, t	V, OFF, t	ON, OFF, 2-4 sec.
STARTER	V, t		r/min, OFF, t	
ENG	t		r/min, OFF, t	
ALT	t		r/min, OFF, t	B, A
SAFETY RELAY		Prevent overrunning	Prevent restart	Prevent overrunning while motor is cranking

(1) New(14531201)

***td = 30 +/- 5sec

	Normal operation	Hold key switch on ST position after engine started.	Turn the key switch to ST and ON while engine is running	Start the engine again after the failure
KEY SWITCH	V, ST, ON, t	ST, ON	V, ST, ON, t	ST, ON
SAFETY RELAY	V, t	V, ***td, t	V, OFF, t	ON, OFF, 2-4 sec.
STARTER	V, t		r/min, OFF, t	
ENG	t		r/min, OFF, t	
ALT	t		r/min, OFF, t	B, A
SAFETY RELAY		Prevent overrunning	Prevent restart	Prevent overrunning while motor is cranking

Volvo Construction Equipment
Customer Support

03-02-17

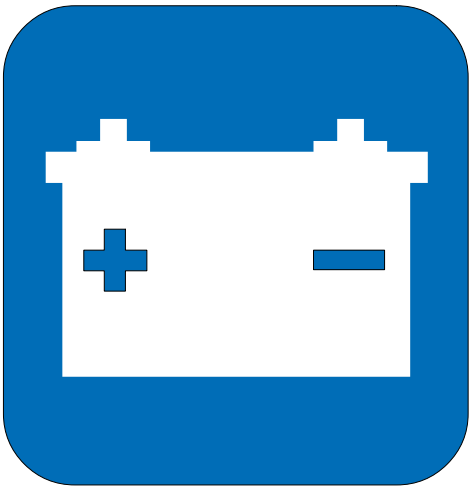
VOLVO

Safety start relay change

During the air bleeding procedure from fuel line, we need more cranking time to start engine. But new alternator produces a little bit higher voltage at the terminal L. This deactivate safety relay and interrupt start motor. To prevent this, we add the time delay function at the safety relay.

Picture text:

EC330B-EC460B(D12D)

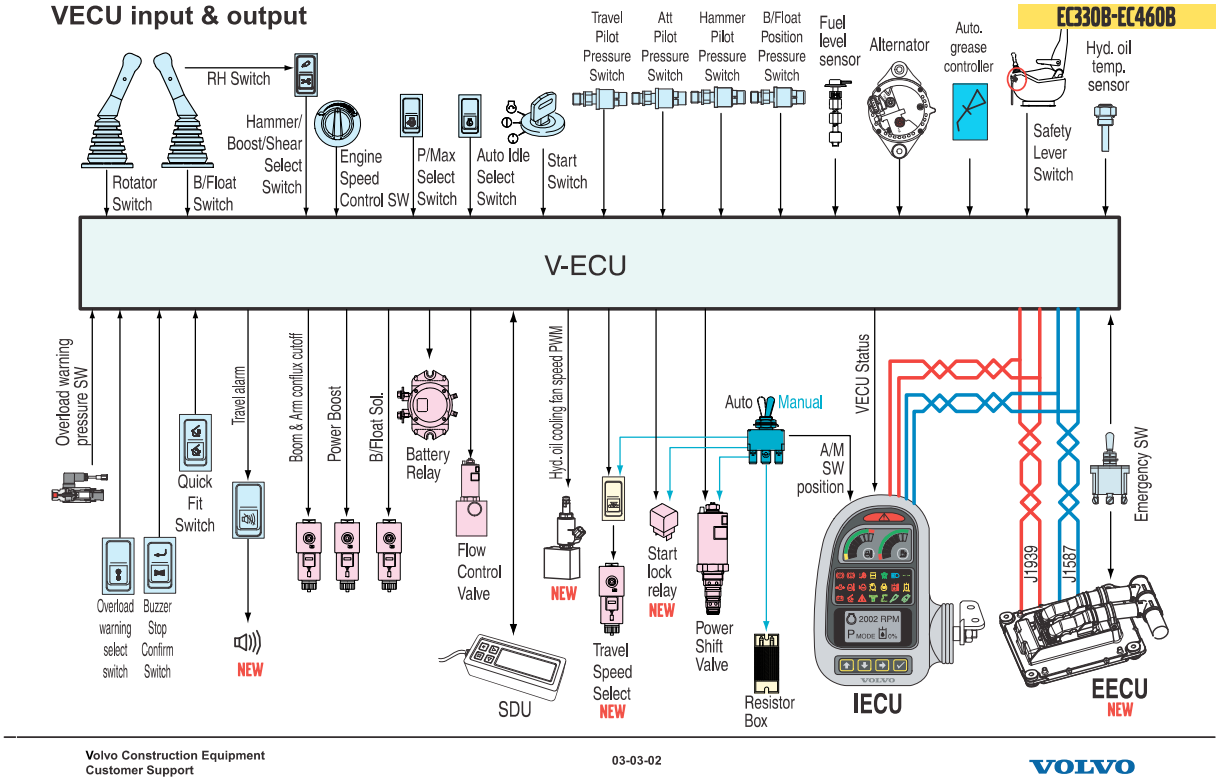


D12D Engine Applicatin(EC330B-EC460B)

Applied Serial no.(Tier-3)
EC330B: 80001~
EC360B: 80001~
EC460B: 80001~

Applied Serial no.(Tier-3 based Tier-2)
EC330B: 10713~
EC360B: 12152~
EC460B: 11515~

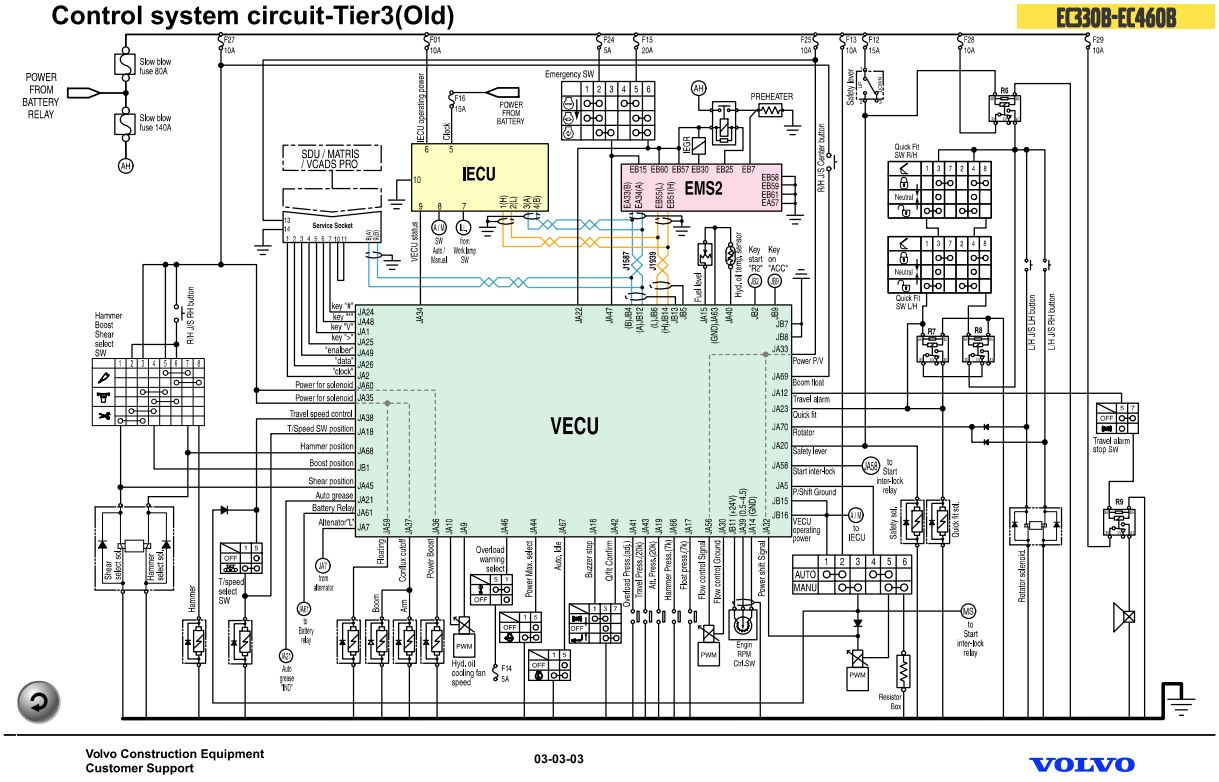
Picture text:



VECU input & output

1. Fan speed select solenoid (2 speed) ->
Fan speed select PWM (Variable speed)
2. Start lock function
3. Travel speed circuit
4. Travel alarm controlled by V-ECU

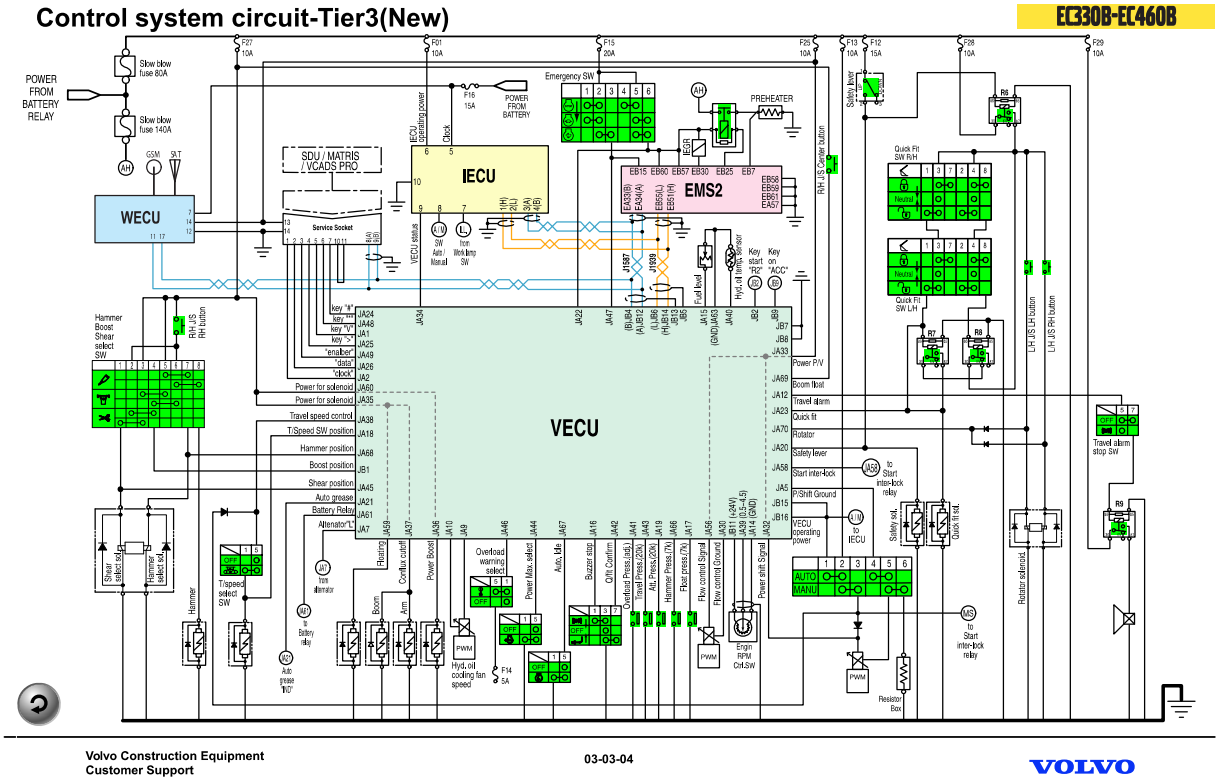
Picture text:



Control system circuit-Tier3(Old)

Serial No.: 80001~
E-ECU: EMS2

Picture text:

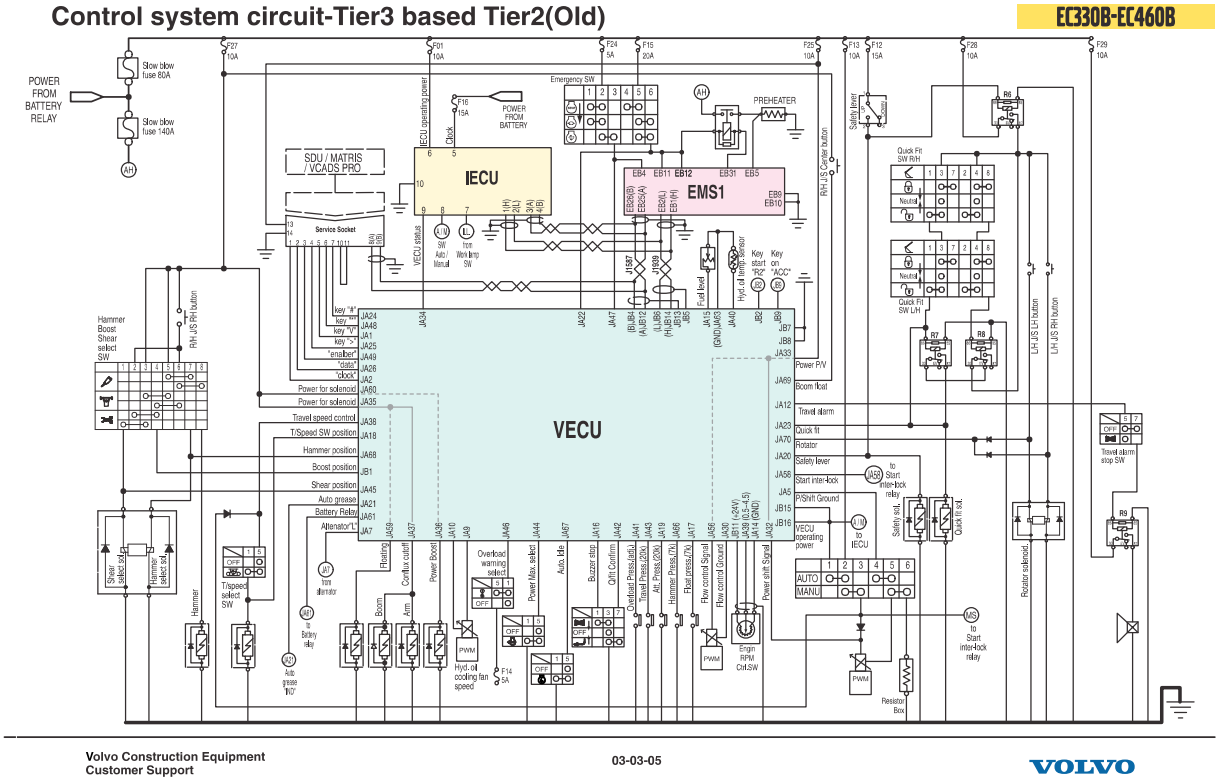


Control system circuit-Tier 3(New)

Changed items
1. Power supply to Emergency sw
-Old: F24, F15
-New: F15

2. WECU: New option

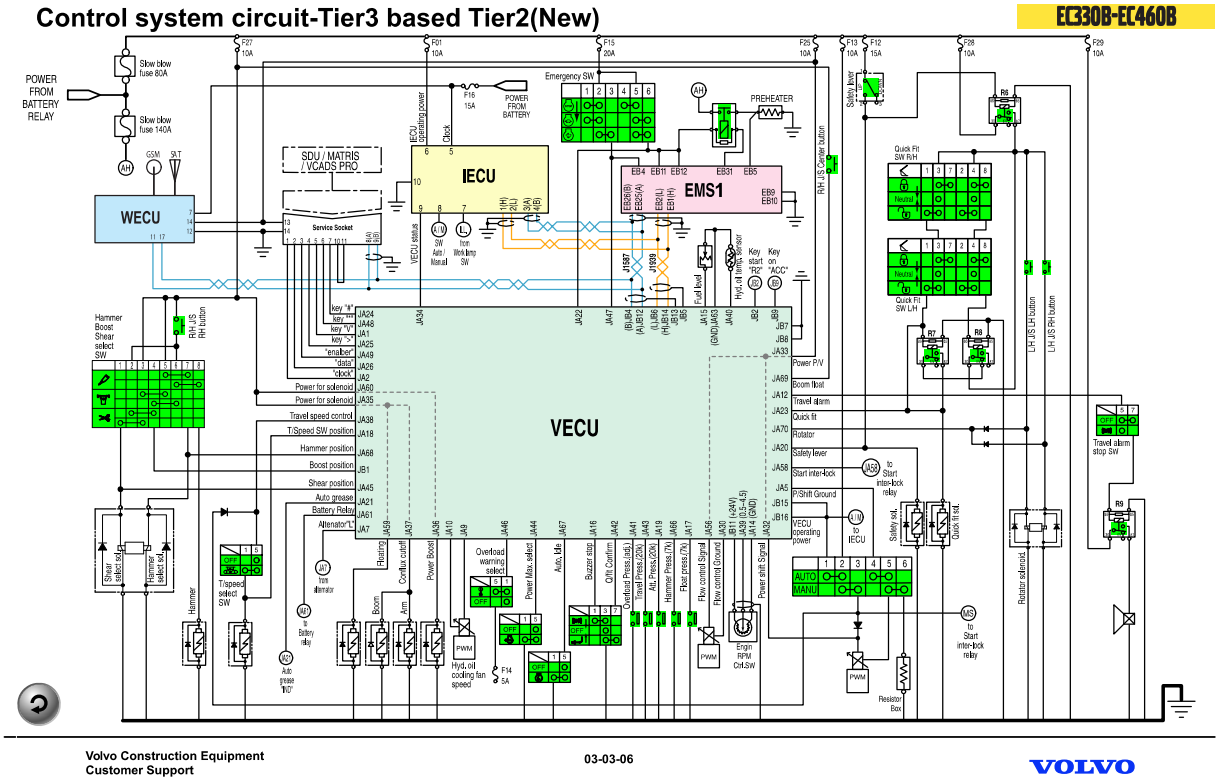
Picture text:



Control system circuit-Tier3 based Tier2(Old)

EC330B 10713~
EC360B 12152~
EC460B 11515~

Picture text:

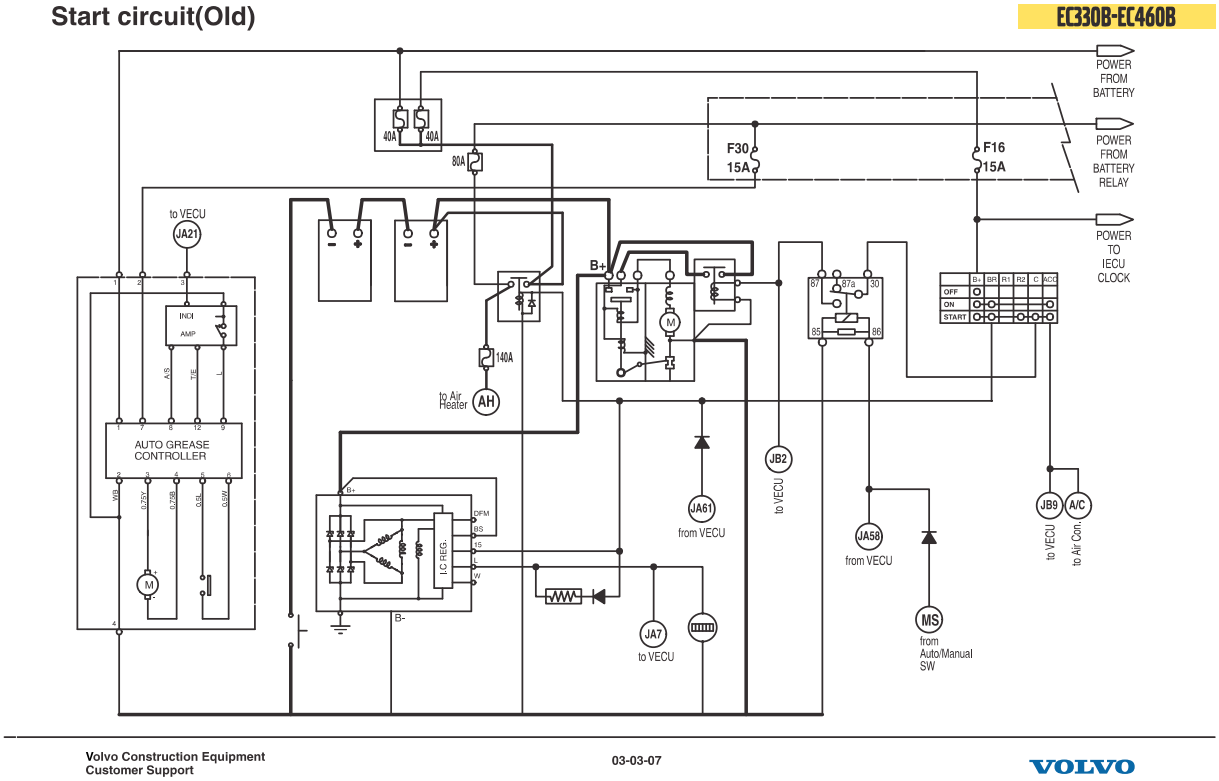


Control system circuit-Tier3 based Tier2(New)

Changed items
1. Power supply to Emergency sw
-Old: F24, F15
-New: F15

2. WECU: New option

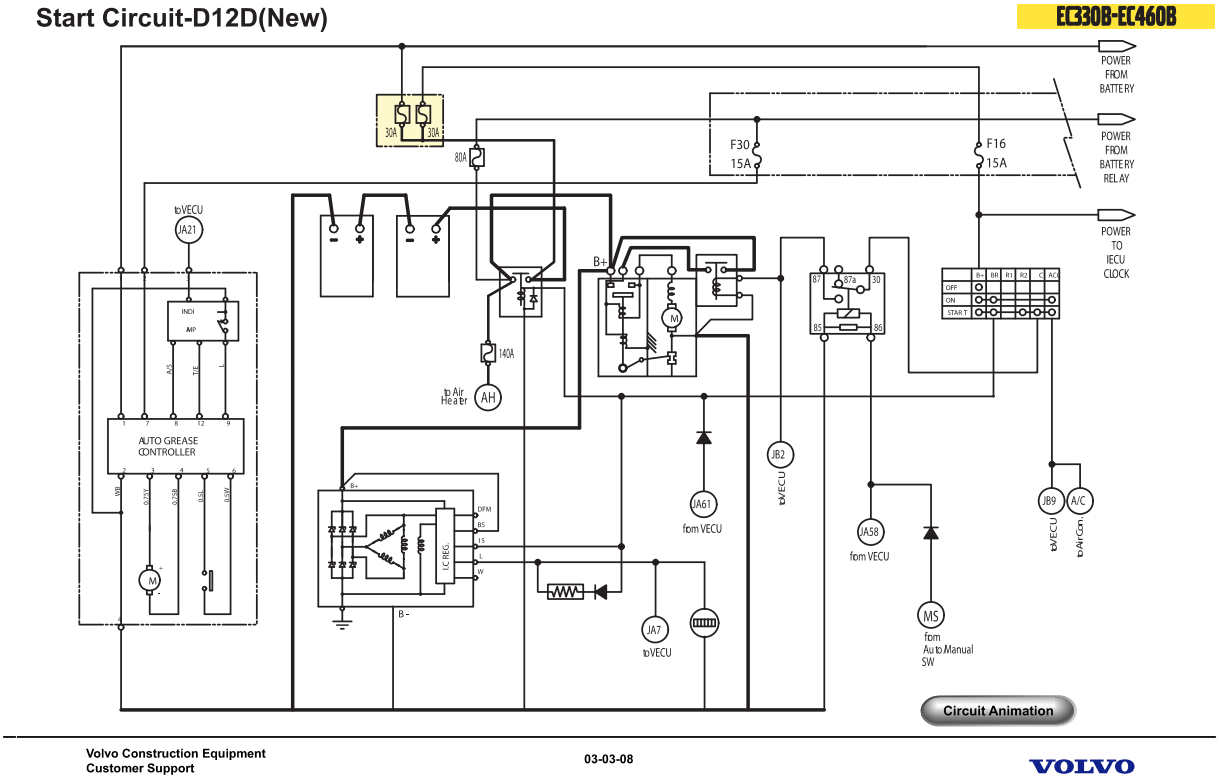
Picture text:



Start circuit

Start lock system change

Picture text:



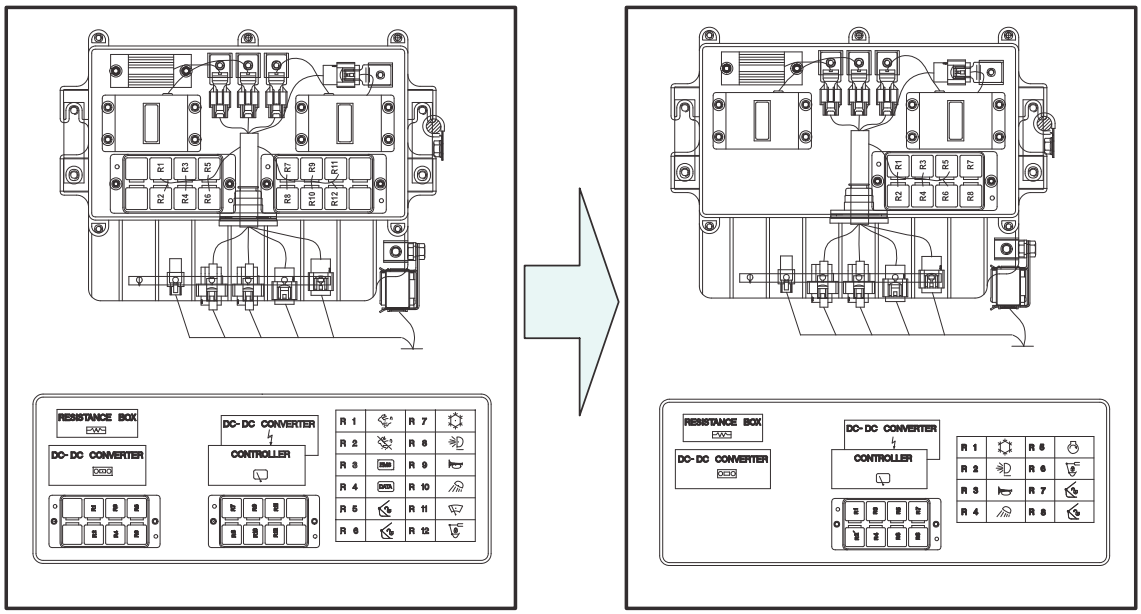
Start circuit(New)

1. Master switch removed
2. Slow blow fuse change: 40A->30A

Tier3
-EC330B: 80426~
-EC360B: 80993~
-EC460B: 80661~

Tier3 based Tier2
-EC330B: 10780~
-EC360B: 13096~
-EC460B: 12543~

Picture text:



Electric box

The number of relay is reduced.
Only 1 relay box.

Picture text:

For NA

Switch steps	Engine rpm (±40)	Mode	EC360B		EC330B	
			P/V current (±10mA)	P/V Output pressure kgf/cm²(psi)	P/V current (±10mA)	P/V Output pressure kgf/cm²(psi)
9	1800 / 1700	H	200 / VAR	3.0(42.7)	210 / VAR	3.5(49.8)
8	1700 / 1600	G1	240 / VAR	5.2(73.9)	250 / VAR	5.8(82.5)
7	1600 / 1500	G2	290 / VAR	8.1(115.2)	300 / VAR	8.7(123.7)
6	1500 / 1400	G3				
5	1400	F1	520	25.6(364.1)	530	26.4(375.5)
4	1300	F2				
3	1200	F3				
2	1000	I1	665	37.6(534.8)	665	37.6(534.8)
1	800	I2				
-	Manual control	-	340		340	

For other area

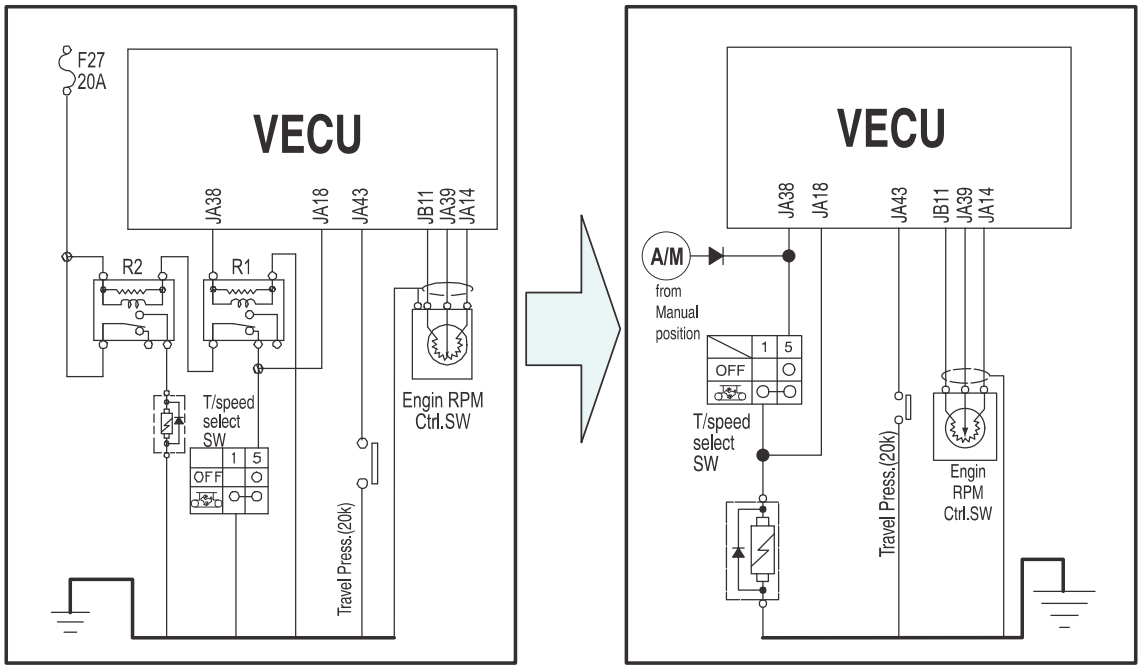
Switch steps	Engine rpm (±40)	Mode	EC360B		EC330B	
			P/V current (±10mA)	P/V Output pressure kgf/cm²(psi)	P/V current (±10mA)	P/V Output pressure kgf/cm²(psi)
9	1800 / 1700	P	200 / VAR	3.0(42.7)	210 / VAR	3.5(49.8)
	1700 / 1600	H	240 / VAR	5.2(73.9)	250 / VAR	5.8(82.5)
8	1600 / 1500	G1	290 / VAR	8.1(115.2)	300 / VAR	8.7(123.7)
7	1500 / 1400	G2				
6		G3				
5	1400	F1	520	25.6(364.1)	530	26.4(375.5)
4	1300	F2				
3	1200	F3				
2	1000	I1	665	37.6(534.8)	665	37.6(534.8)
1	800	I2				
-	Manual control	-	340		340	

Engine & Pump control spec.

1. EC330B/EC360B
Engine control spec. is same with D12C engine

2. EC460B
Because of pump change, power shift current value is changed.

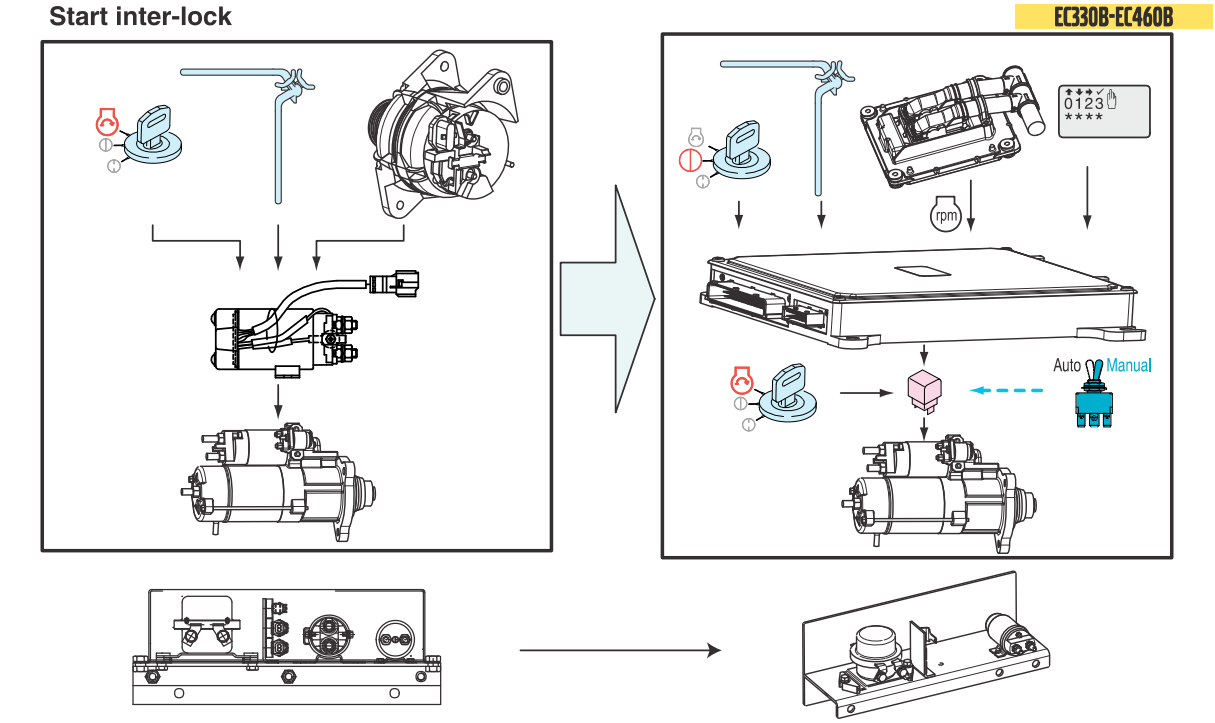
Picture text:



Travel speed control

Electric circuit change.

Picture text:



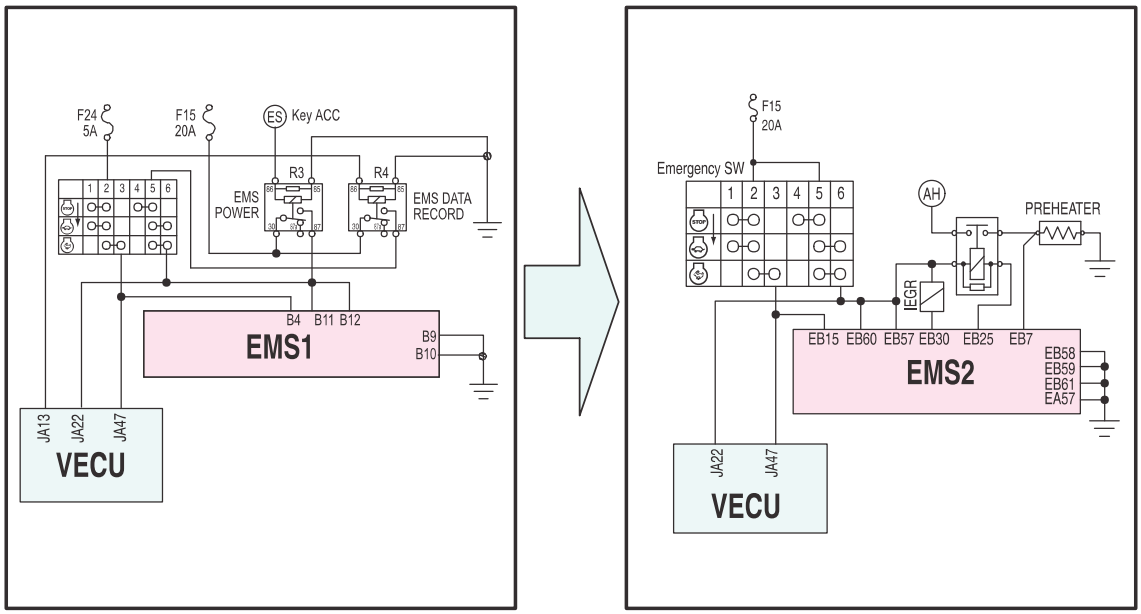
Start lock system

Safety start relay is removed.

Start lock relay will be off when:
- wrong password
- Safety lever up
- engine running
- for 6 second after engine start
- for 2 second after engine off

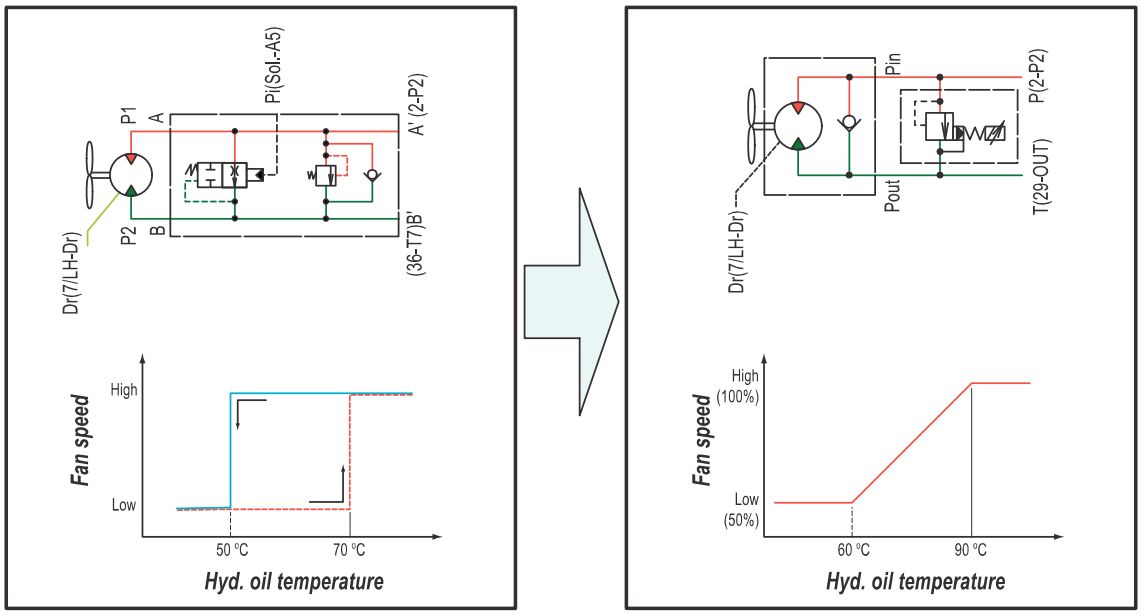
If Auto/Maunal switch is at Manual, the power for start lock relay will be supplied by Auto/Manual switch.

Picture text:



Power supply to E-ECU

Picture text:

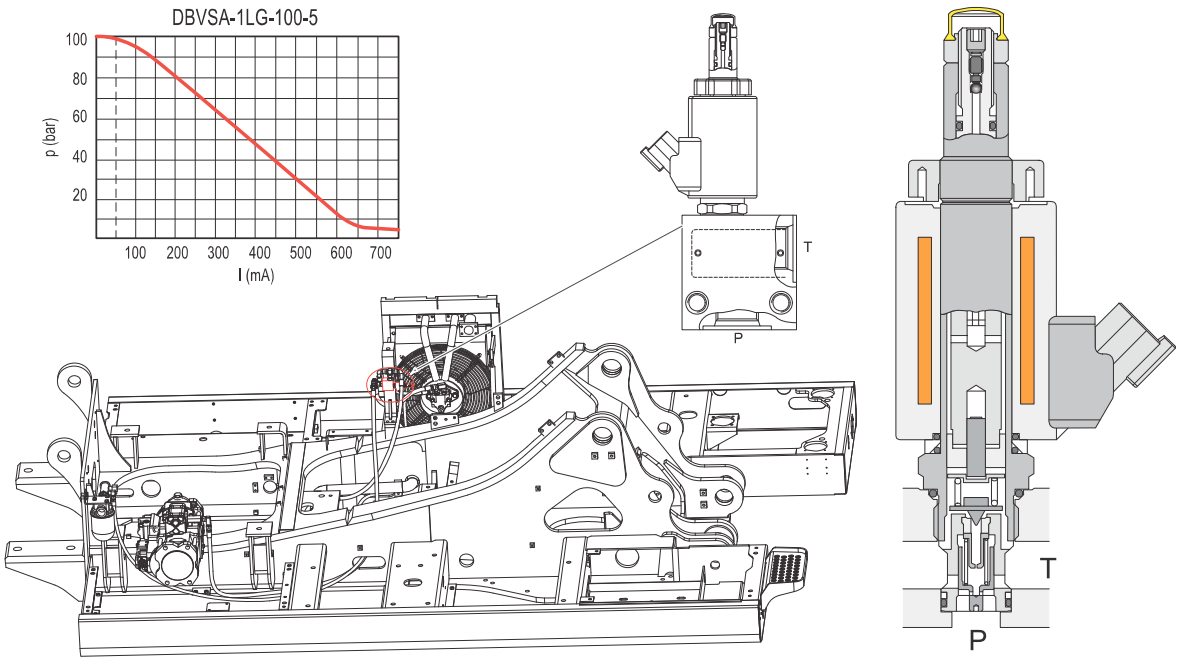


Hydraulic oil cooling system

V-ECU controls fan speed according to the input from hydraulic oil temperature sensor. In previous machine, there was only 2-speed step but now is variable speed.

	EC360B	EC330B
60oC	rpm	1000	1000
	mA	575	520
90oC	rpm	2000	2000
	mA	130	100

Picture text:



Proportional relief valve

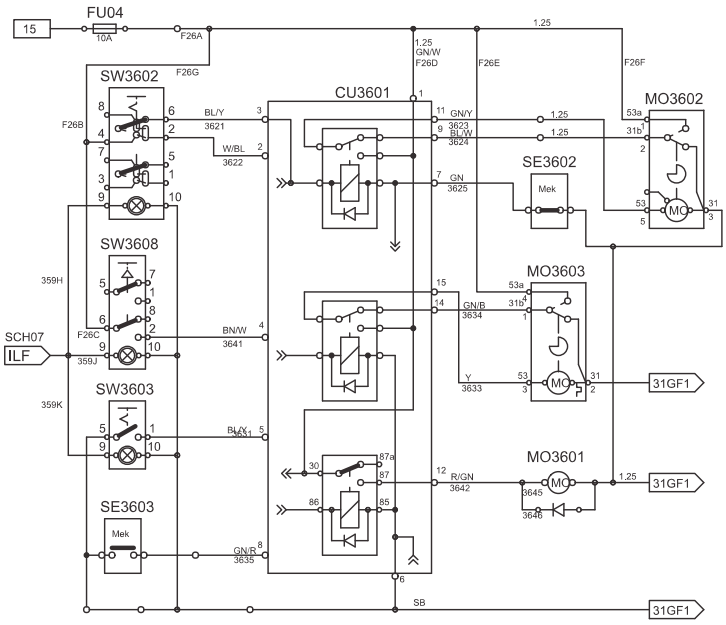
This valve is inverse proportional valve. As the current goes up, 2ndary pressure drops down.

Picture text:

Wiper circuit

EC330B-EC460B

SCH11

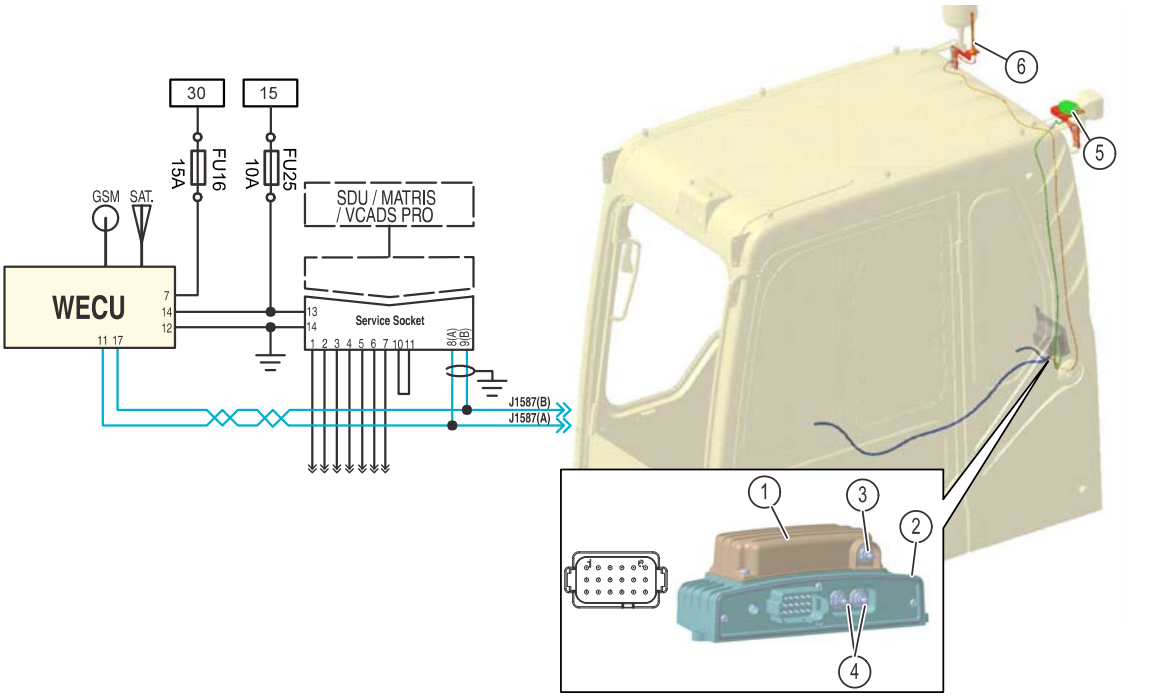


SW3602 WIper switch, upper
SW3603 Wiper switch, lower
SW3608 Washer switch
CU3601 Wiper motor controller
SE3602 Limit switch, upper
SE3603 Limit switch, lower
MO3601 Washer pump
MO3602 Wiper mptor, upper
MO3603 Wiper motor, lower

Wiper circuit

New wiper controller

Picture text:

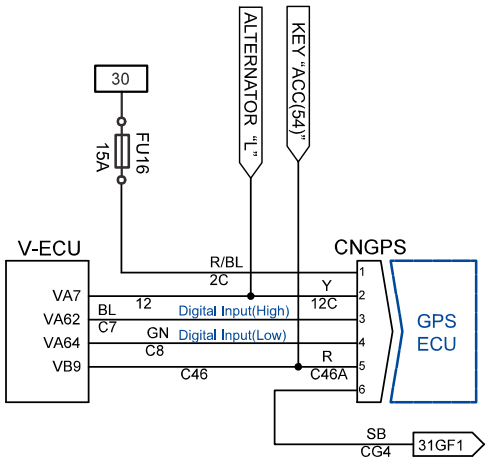


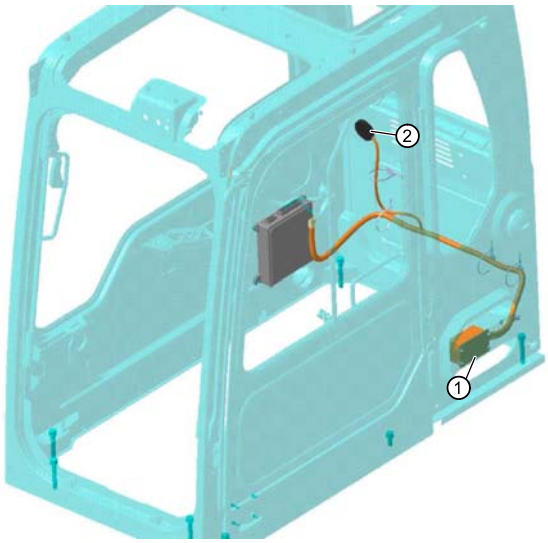
Care Track(Telematics)

The VCE telematics solution will contain three main services; Mapping and Tracking, Operational Management, and Service Management. Within Mapping and Tracking services such as mapping of machines, geo fence and location report will be included. Operational Management will contain performance and utilization reports. Under Service Management service for the different machines can be planned and followed up. Different alarms and error codes will be handled under service management.

Service
- Machine position
- Instantaneous Machine data
- Geographical fence
- Location report
- Sanil Trail
- Machine Utilization Report
- Event Report
- Performance/Productivity Report
- Immobilizer
- Alarms & Warnings
- Error Codes
- Service Report
- Logged Machine Data, Complete Download
- Logged Machine Data, Partial Download
- Sleep Mode
- Work Shift
- Over the Air Programming

Picture text: 1. ECU_Wireless for GSM/GPS
2. Satellite modem
3. Antenna connection point for satellite modem
4. Antenna connection point for GSM/GPS





China GPS

This option is only used in China.

Function
- Machine position on real time through GPS based signals
- Anti tempering system (Machine will stop if GPS is removed)
- Machine immobilization (Next engine starting is impossible)
- Machine immobilization (If there is no GSM or GPS signal)
- Machine hour meter information.
- MATRIS information is not available through the China GPS.

Installation
- GPS-ECU unit, Antenna and cable installation by Dealer.
- Base machine production by Volvo.
- China GPS Parameter(MXD) must be turned on by VCAD-pro.
- Anti-thieft protection(ABP) must be turned off by VCAD-pro.

Shut down request from V-ECU
-Power line cut: 60 (Duty ratio output by GPS-ECU)
-GSM cable cut or GPS cable cut: 70
-Open ECU cover: 80
-Stop request from web: 90
-GPS ECU failure: 100
-GPS ECU thift: 0

Engine running condition
-Normal condition: 40 (Duty ratio output by GPS-ECU)
-ECU normal but no GPS signal: 20 (Machine can move tunnel)
-ECU normal but no GSM signal: 30 (Machine can move tunnel)
-Reserved: 50

Picture text: 1. GPS ECU

Connector naming method change

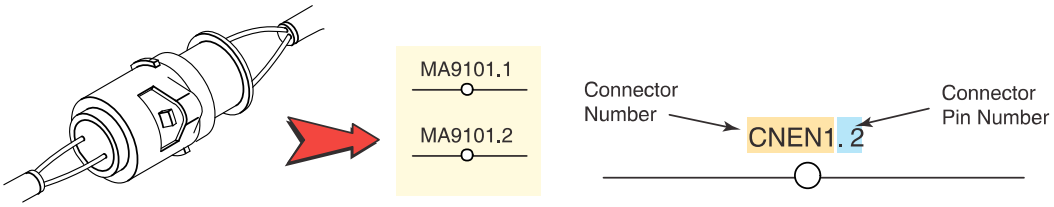


Abb.	Description
MA	Solenoid valve
MO	Motor
LC	Control lamp
LA	Lamp
FU	Fuse
Di	Diode
SW	Switch
CU	Control unit
AL	Alternator
RE	Relay
R	Resistance

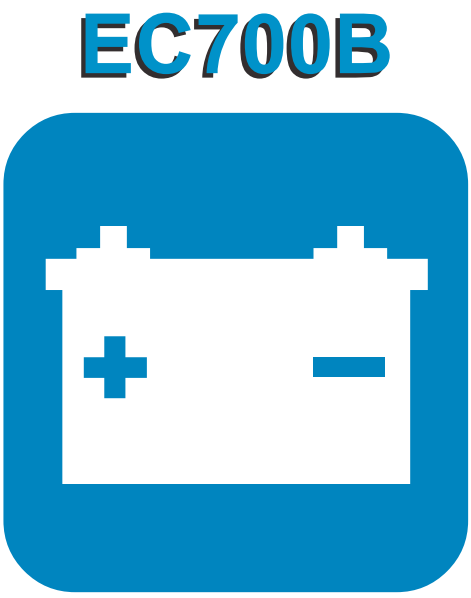
Abb.	Description
CNEN	Main WH to Engine WH connection
CNRH	Main WH to RH WH connection
CNLH	Main WH to LH WH connection
CNCA	Main WH to Cab WH connection
CNSW	Main WH to Switch WH connection
CNEL	Main WH to Elec-box WH connection
CNAC	Main WH to AC unit WH connection
CNIN	Main WH to Instrument WH connection
CNBO	Main WH to Boom WH connection
CNTF	Main WH to Thumb & Float WH connection
GF	Frame ground
GE	Engine wire harness ground

03-03-19

Connector naming method change

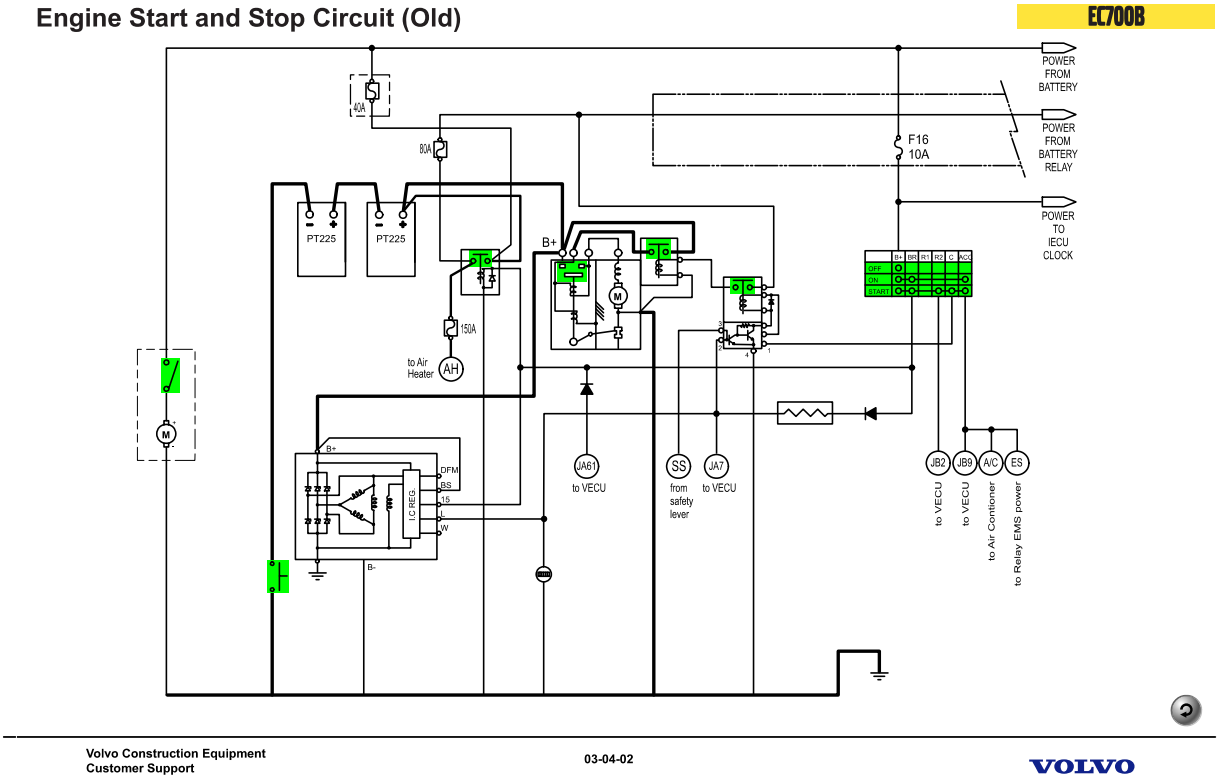
The way of naming connector is changed.

Picture text:



Electric system (EC700B)

Picture text:

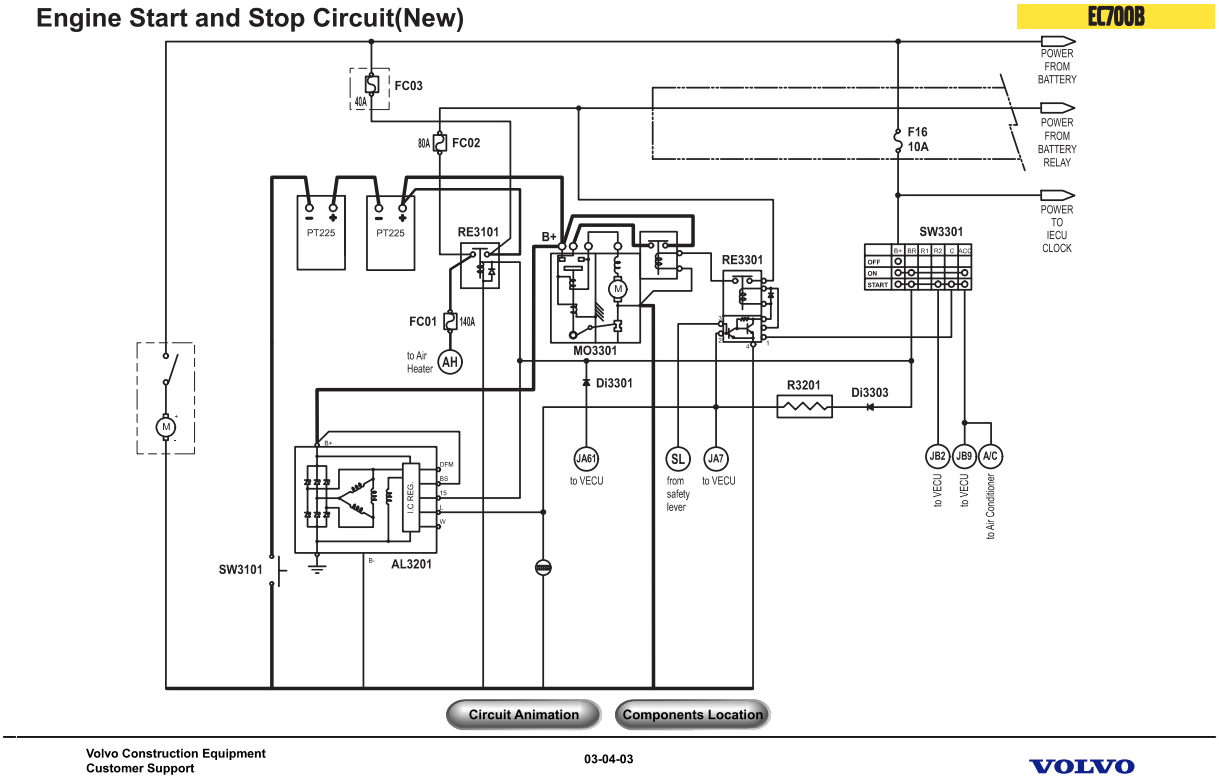


Engine Start and Stop Circuit(Old)

Power from battery => electric greasing system,start key,start motor,battery relay
Power from battery relay =>safety start relay

1) Key ON
   BR=> Battery relay,alternator(15,pre-magnetization)
   ACC=>VECU,Air conditioner,EMS power relay
2) Key Start
   R2=> VECU
   C=> safety start relay
3) Engine running
   Alternator(L)=>hour meter,safety start relay,VECU(charge lamp off)
   * Resistor between alternator and BR termainal for quick charge lamp off
   Alternator(B+)=>alternator(BS,voltage sensing for regulation)
   Alternator(15)=>battery relay
4) Key Off
   VECU(JA61)=>battery relay

Picture text:

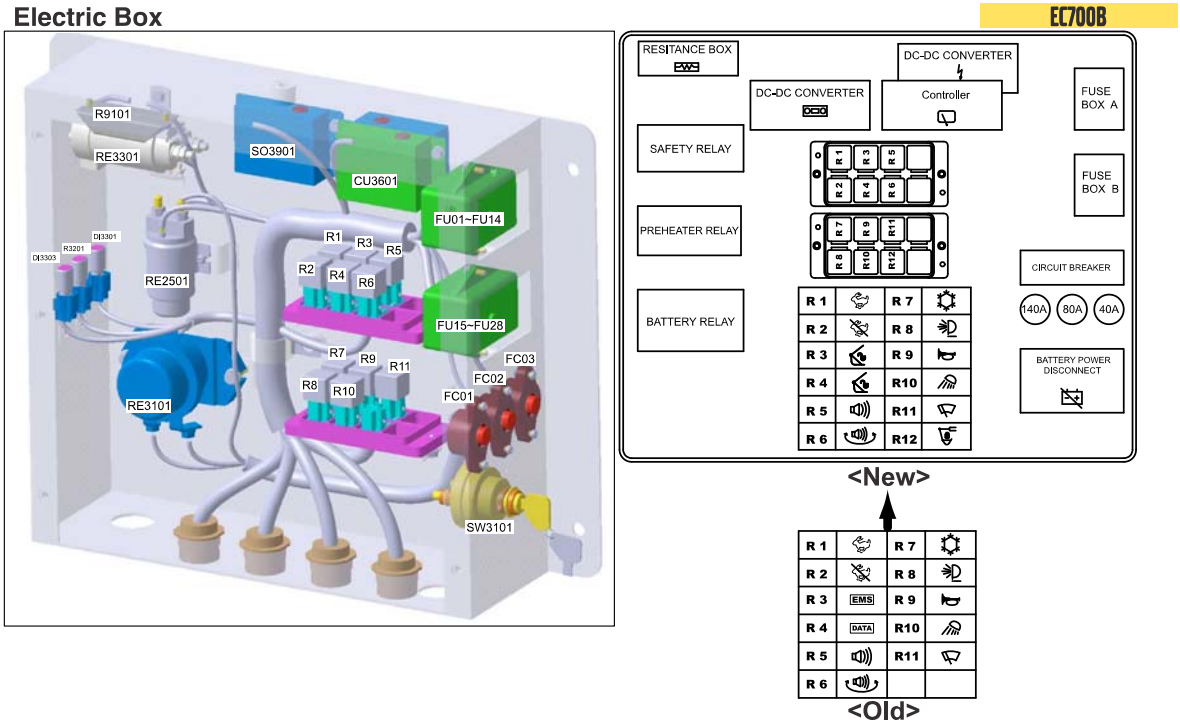


Engine Start and Stop Circuit(New)

-Relays for EMS power and EMS data(R3, R4 relay) were removed.

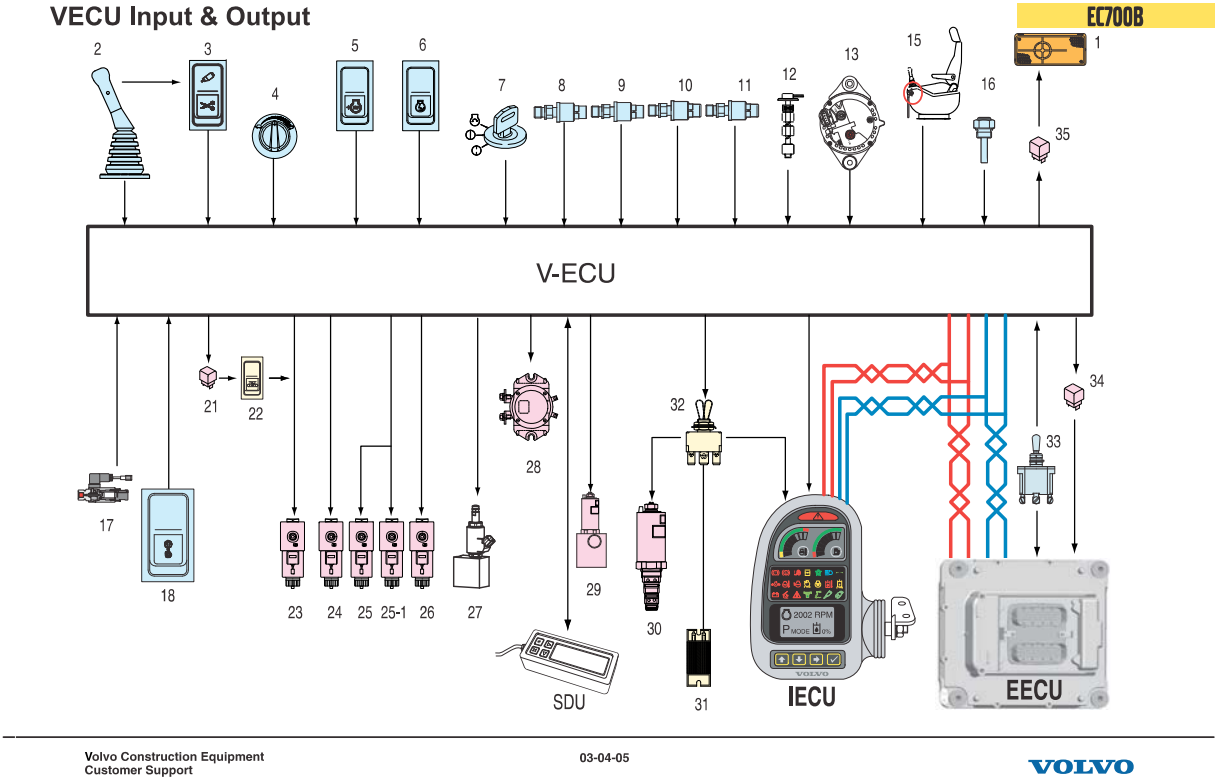
1. Circuit animation
- if you click the line, the color will be changed.
2. Component location
- if you clikc the symbol on the circuit, you can see the location of component.

Picture text:



Electric Box

Picture text:



VECU input & output

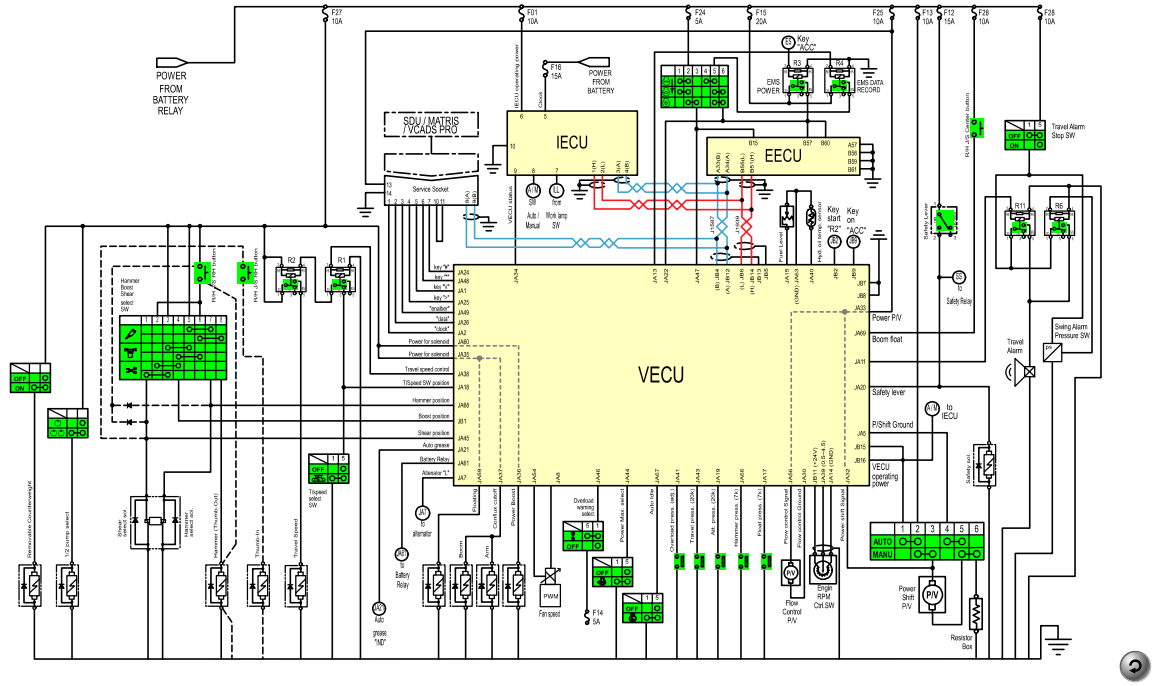
This diagram shows the primary input and outputs based on the connection found within the VCEU circuitry. Input factors (communications) can be divided into two broad categories. One category relates to selection switches which send a signal to the VECU initiated by the operator. The other, relates to combined parts that are composed of hydraulic and electric components such as solenoid valves or pressure limit switches.

The following are associated with the VECU:

1. Alarm(Travel or swing)
2. Boom float switch on the RH side of the RCV
3. Hammer and shear selection switch
4. Engine speed control switch
5. Power max selection switch
6. Auto idle selection switch
7. Start switch
8. Boom float position pressure switch
9. Travel pilot pressure switch
10. Attachment pilot pressure switch
11. Hammer pilot pressure switch
12. Fuel level sensor
13. Alternator 'L' signal (Lamp)
15. Safety lever
16. Hydraulic oil temperature sensor
17. Overload pressure switch
18. Overload switch
21. Travel speed relay
22. Travel speed selection switch
23. Travel speed solenoid
24. Boom floating solenoid
25. Boom/Arm conflux cut-off solenoid
26. Power boost solenoid
27. Hydraulic oil cooler fan control proportional relief valve

Control Circuit (Old)

EC700B



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03-04-06

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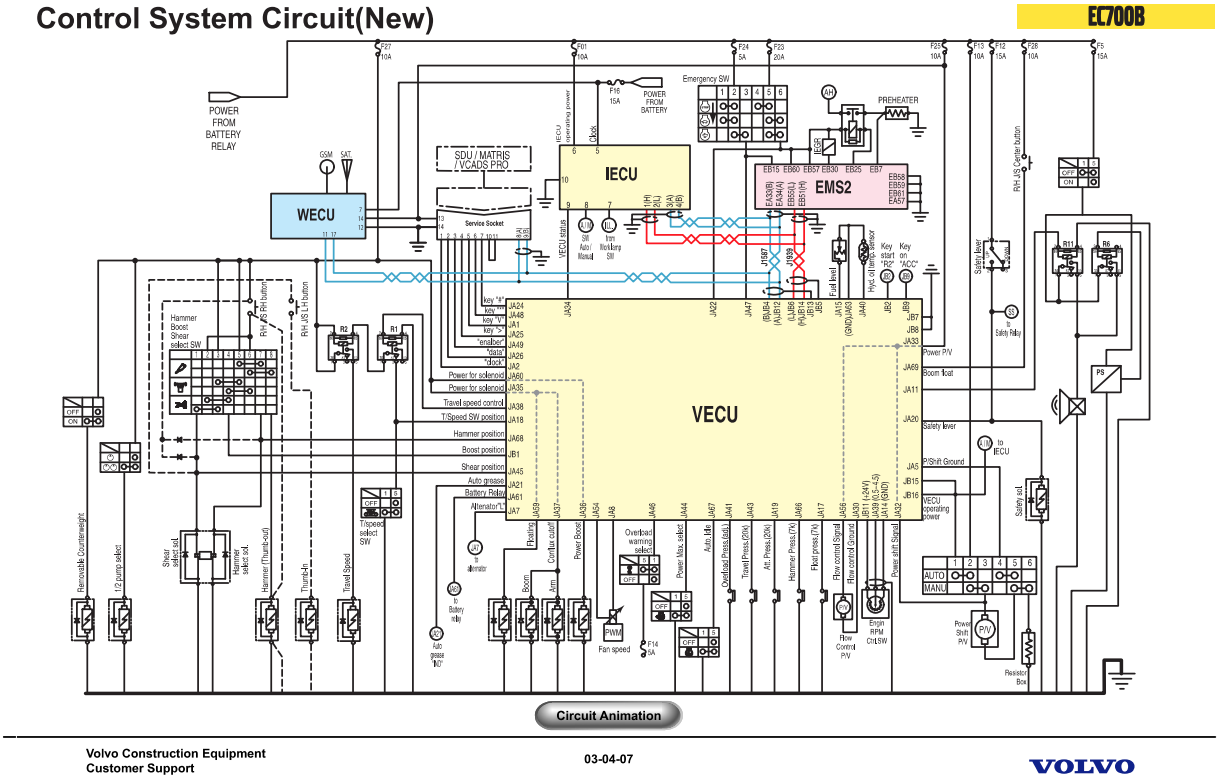
Control System Circuit(Old)

Checking points!

1 : Power supply to each ECUs,relays
2 : Auto/manual switch function
3 : Solenoid valve power line inside V-ECU
4 : V-ECU status line to IECU
5 : Boom floating button & solenoid function
6 : Travel speed switch & relay & solenoid function
7 : Hammer & shear selection switch and solenoid
8 : Fuse and its related components
9 : Hydraulic oil cooling valve(Proportional relief valve)
10 : Travel alarm relay connection

Picture text:



Control System Circuit(New)

1. R3 & R4 Relay removal
- Direct power supply from the emergency switch.
- Serial No. break : 10076~

2. WECU(Option)

Picture text:

Engine & Pump Control Specification

EC700B

For NA

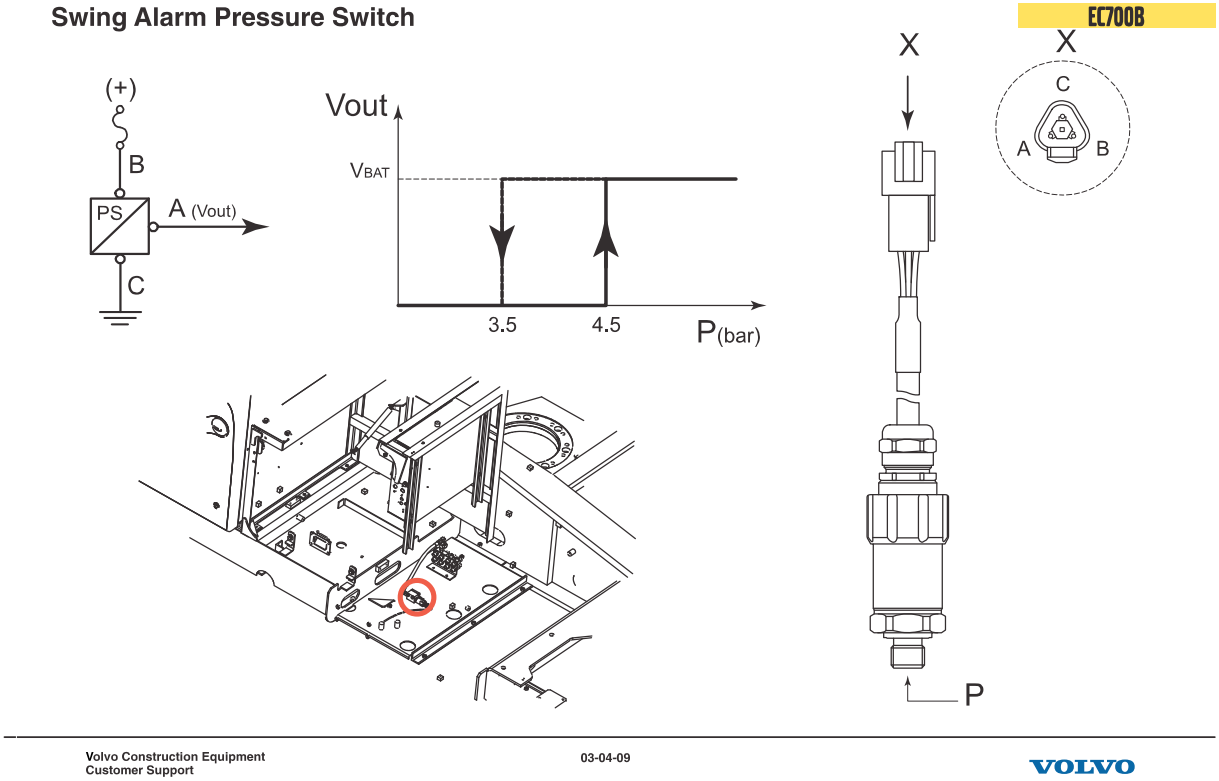
Switch step	Engin RPM Request/Loaded	Mode	Powershift Current (mA)	Powershift Pressure (kgf/cm²[psi])
9	1900/1800	H	200 / Var	3.0[43] / Var
8	1800/1700	G1	230 / Var	4.7[67] / Var
7	1700/1600	G2	270 / Var	6.9[98] / Var
6	1600/1500	G3		
5	1400	F1	450	19.8[282]
4	1300	F2		
3	1200	F3		
2	1000	I1	610	32.4[461]
1	800	I2		

Other Market

Switch step	Engin RPM Request/Loaded	Mode	Powershift Current (mA)	Powershift Pressure (kfg/cm²[psi])
9	1900/1800	P	200 / Var	3.0[43] / Var
	1800/1700	H	230 / Var	4.7[67] / Var
8	1700/1600	G1	270 / Var	6.9[98] / Var
7	1600/1500	G2		
6	1500/1400	G3		
5	1400	F1	450	19.8[282]
4	1300	F2		
3	1200	F3		
2	1000	I1	610	32.4[461]
1	800	I2		

Engine and Pump Control specification

Picture text:



Swing alarm pressure switch

Pin map
A : Voltage output (Max. 1.2 A)
B : Power supply
C : Ground

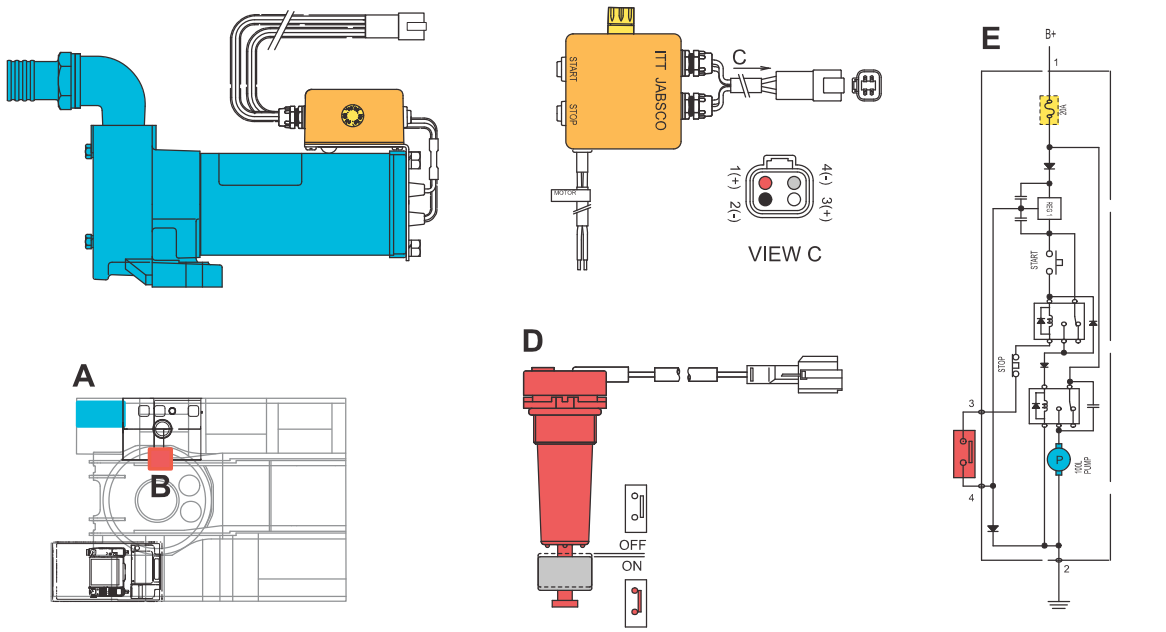
X : connector view
P : Pressurized port(Max. 100 bar)
VBAT : Battery Voltage

Hydraulic pressure sensor : strain gauge sensor
Electric switch : Transistor type and Normally open

Switching hystereses are On (4.5 bar) and Off (3.5 bar).

The location of this is behind CAB and below electric box.

Picture text:

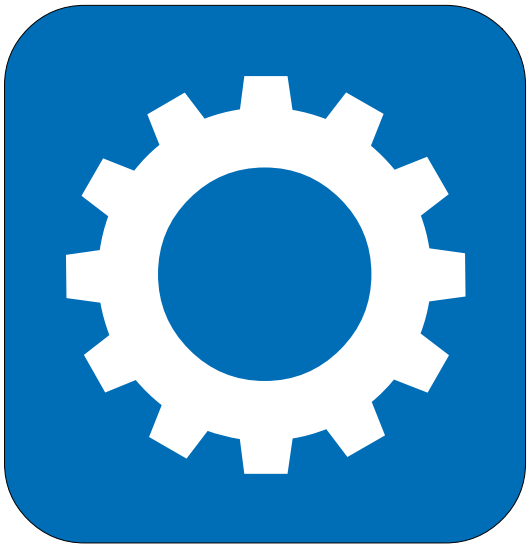


Fuel Filler Pump

A : Pump(100 lpm) location
B : Location of fuel level sensor for auto stop
D : Fuel level sensor for auto stop
E : Circuit

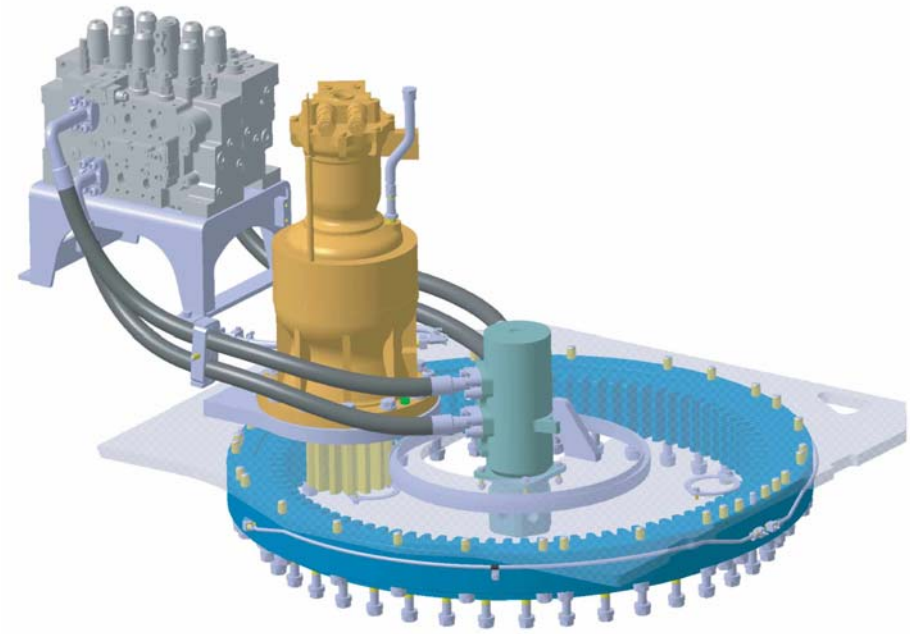
Picture text:

EC330B-EC700B



Power transmission

Picture text:



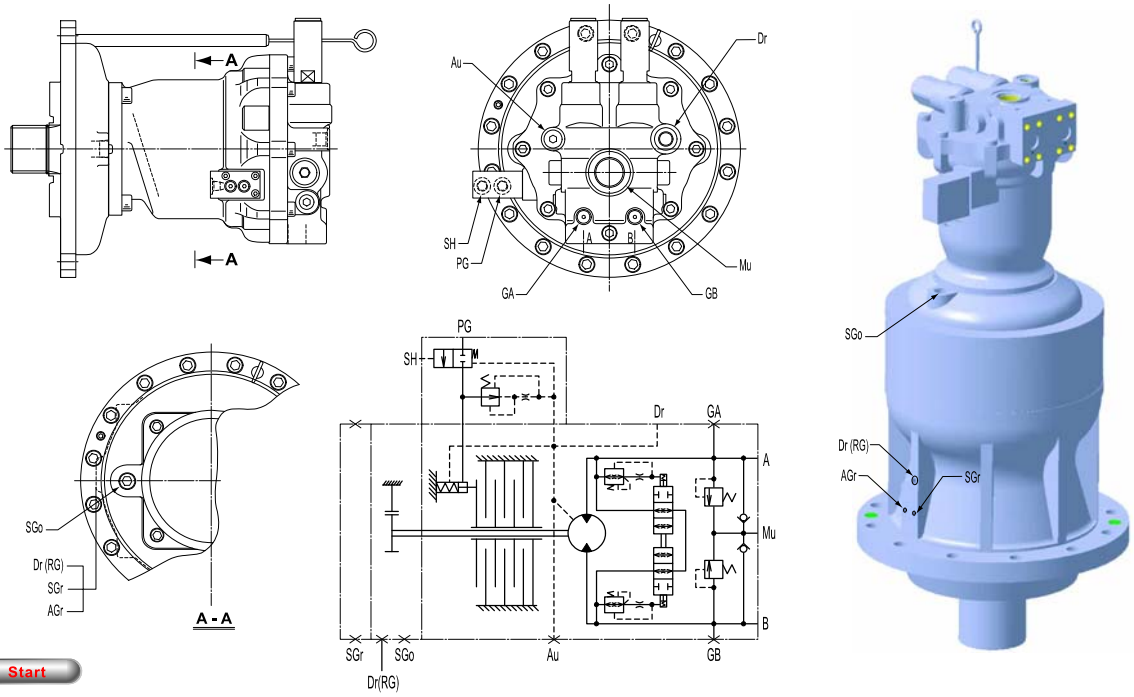
Swing System (EC330B-EC360B)

- Swing motor
- Gear box
- Pinion
- Turning joint
- Swing Ring gear

Picture text:

Swing Motor External View

EC330B/EC360B



External view

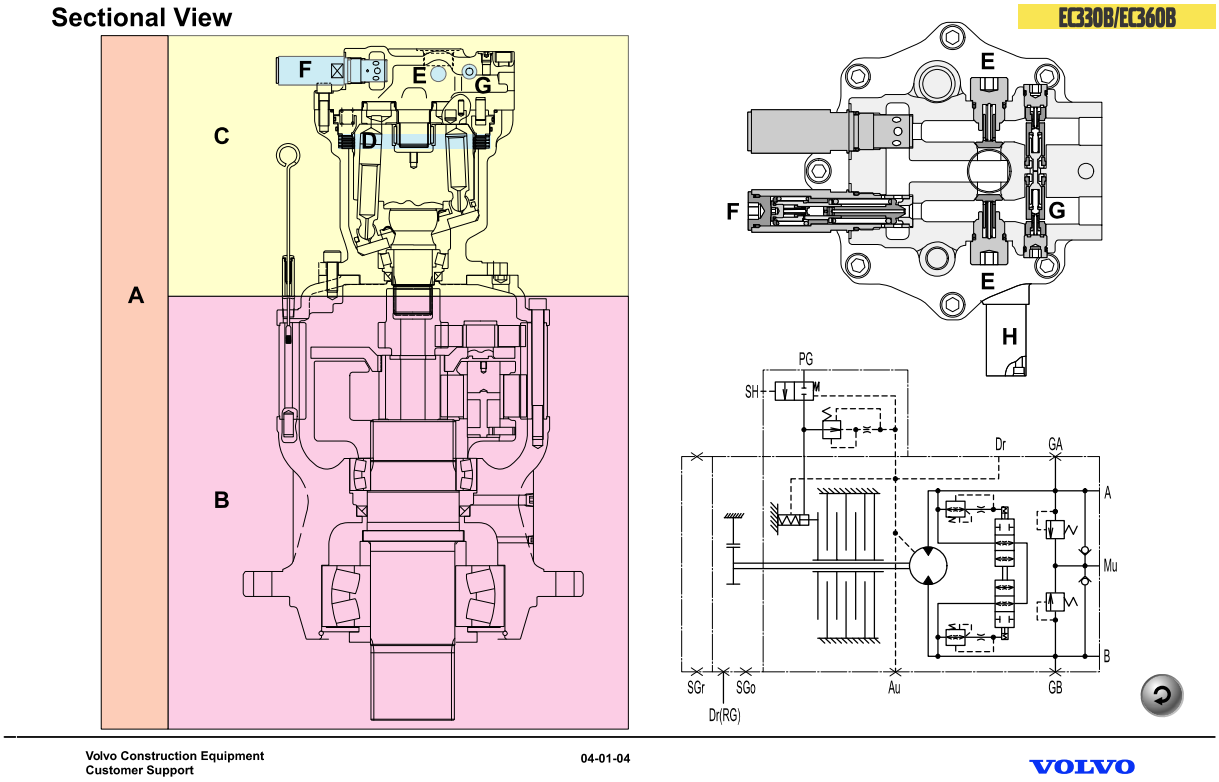
Motor
- Displacement : 250cc/rev
- Relief pressure : 260 kgf/cm^2(25.5 MPa)
- Time delay : 6.5 (+/- 1.5) sec.

Gearbox
- Gear ratio : 24.37
- Oil : SAE NO. 90 (6 liter)

*Compare the circuit & port on the motor.

A,B : Main
Mu : Anti-cavitation
Dr : Case drain
PG : Brake releasing
SH : Brake pilot
GA,GB: Pressure checking
SGo : Oil filling
Au : Air vent port for oil filling
Dr(RG): Gear oil drain
SGr : Grease filling port
AGr : Air vent port for grease filling

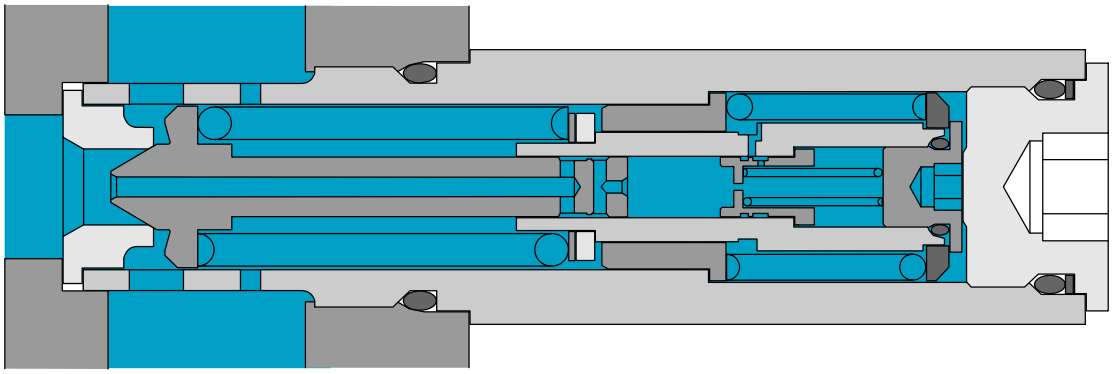
Picture text:

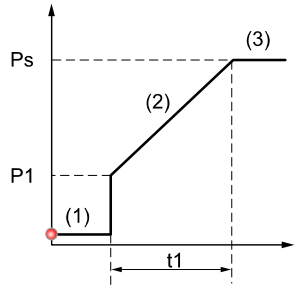


Sectional view

A: swing drive unit
B: reduction gear box
C: swing motor
D: Mechanical brake
E: Anti-cavitation check valve
F: Relief valve
G: Rebound damping valve
H: Time delay valve

Picture text:



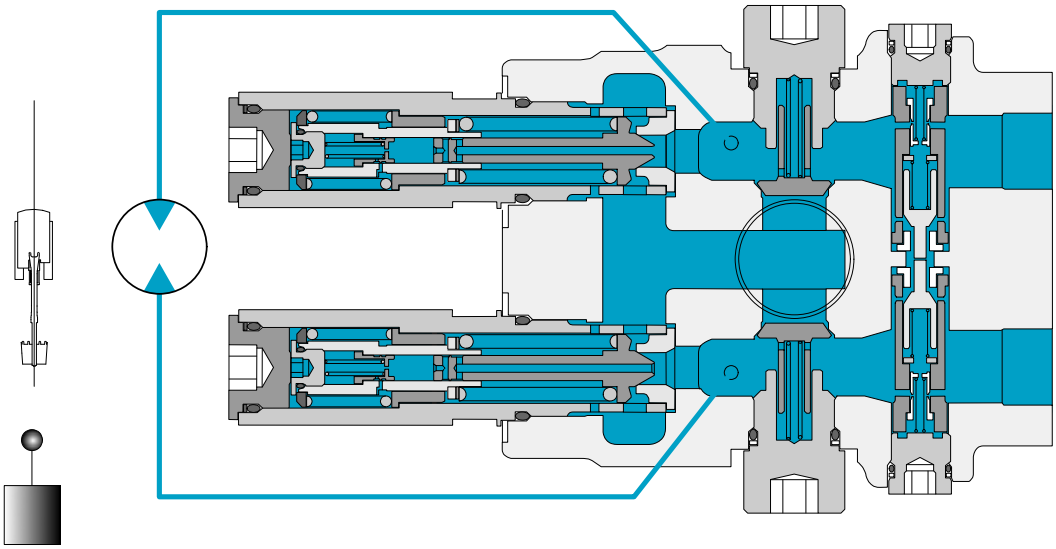


Relief valve operation

Most of brake force comes from this relief valve when we stop slewing.
Therefore we need smooth build-up of pressure for smooth braking.

(1) Low pressure relief
(2) Pressure increasing with time
(3) Final stage of relief

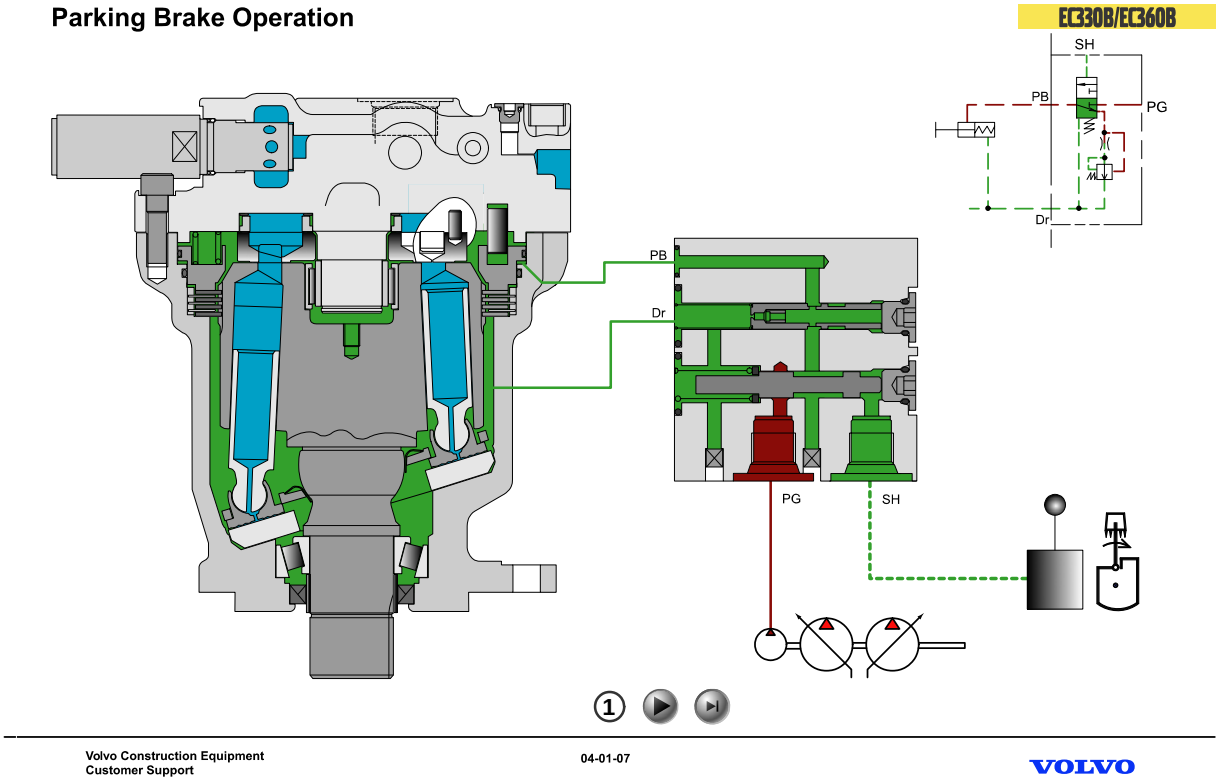
Picture text:



Rebound damping valve operation

(1) Neutral position : A & B port is connected through the valve
(2) Swing : B port (in), A port (out) , valve is pushed to A port and closed.
(3) Hydraulic braking & rebound begin : A port is pressurized by discharged oil. But valve is moving slowly. A & B ports are connected.
(4) Rebound damping : high press (A) is gone to B port through the valve

Picture text:



Parking brake operation

The slew brake is spring applied and hydraulically released. Friction plates are splined to cylinder block and rotate with cylinder block. Mating plates are splined to motor casing.

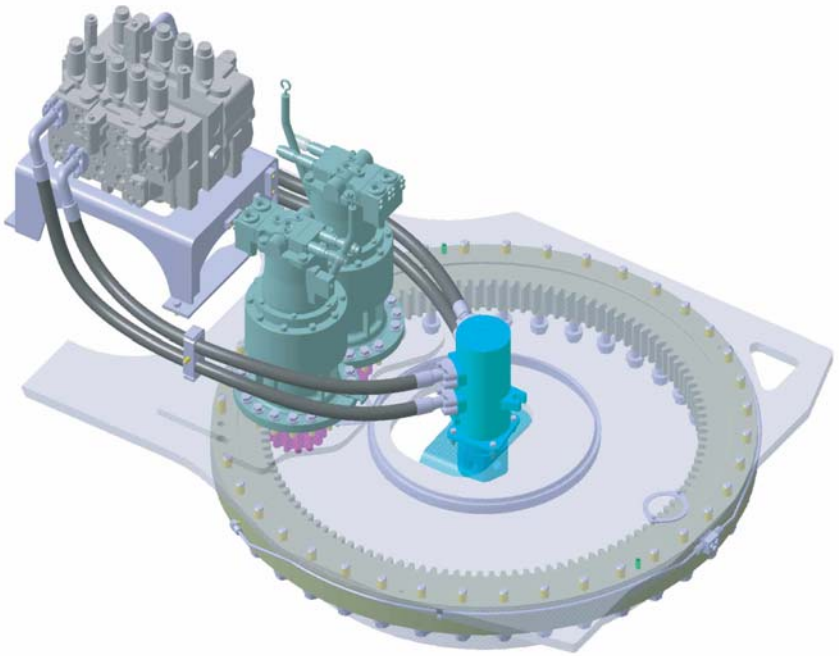
1. When there is no SH signal, parking brake will be engaged by spring force.

2. When there is SH signal, primary pilot pressure(40bar) goes to brake piston through PG and push the brake piston against spring.

3. When there is no SH signal, Pilot pressure can not go to the brake chamber and oil in side of that chamber shoud be drained. But there is only small hole for drain near to time delay valve. In the beginning, oil pass through the orifice and go to tank, but pressure will be built up in front of the orifice and push the valve. Now the valve blocks tank line. There is no flow to tank. That means there is no pressure difference between front and rear side of valve. But the valve has return-spring at the rear side. So the valve can return to initial position and open tank passage again. The oil from brake chamber can go to tank again.

Open-close-open movement can delay the parking brake engaging time for 6.5 seconds.

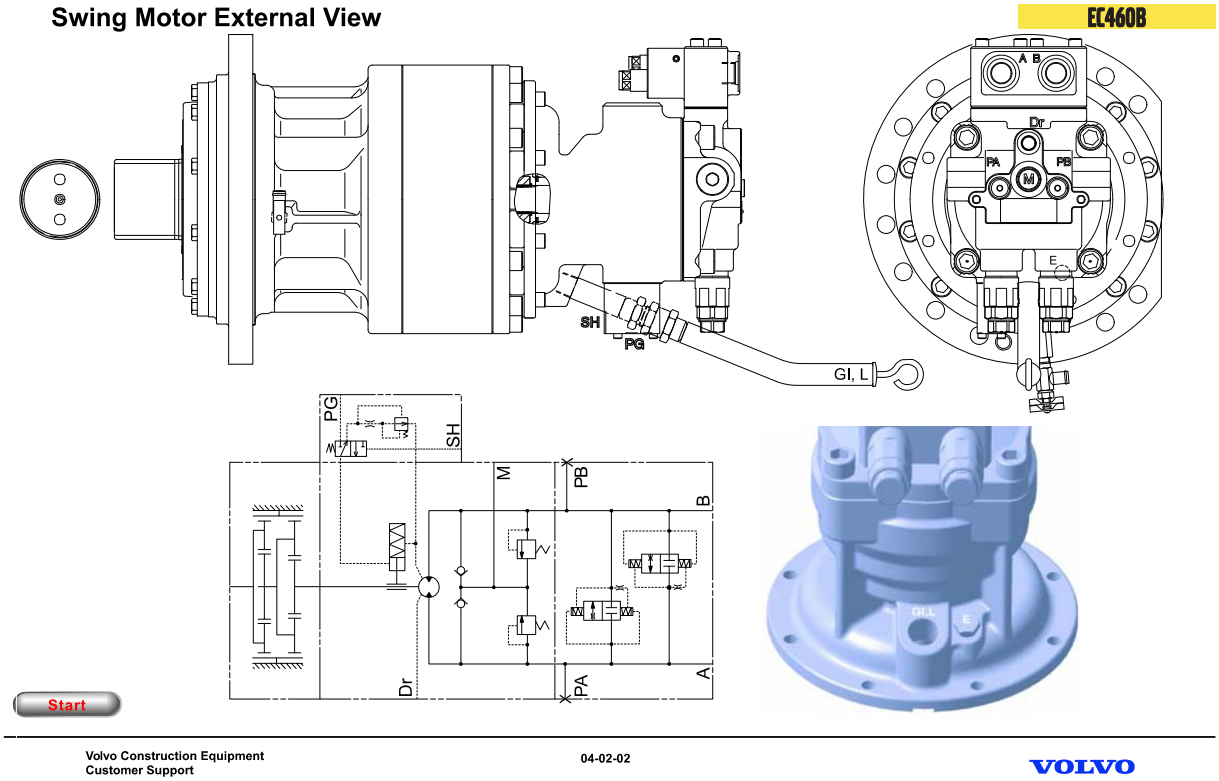
Picture text:



Swing System(EC460B)

- Swing motor(2EA)
- Gear box
- Pinion
- Turning joint
- Swing Ring gear

Picture text:



External view

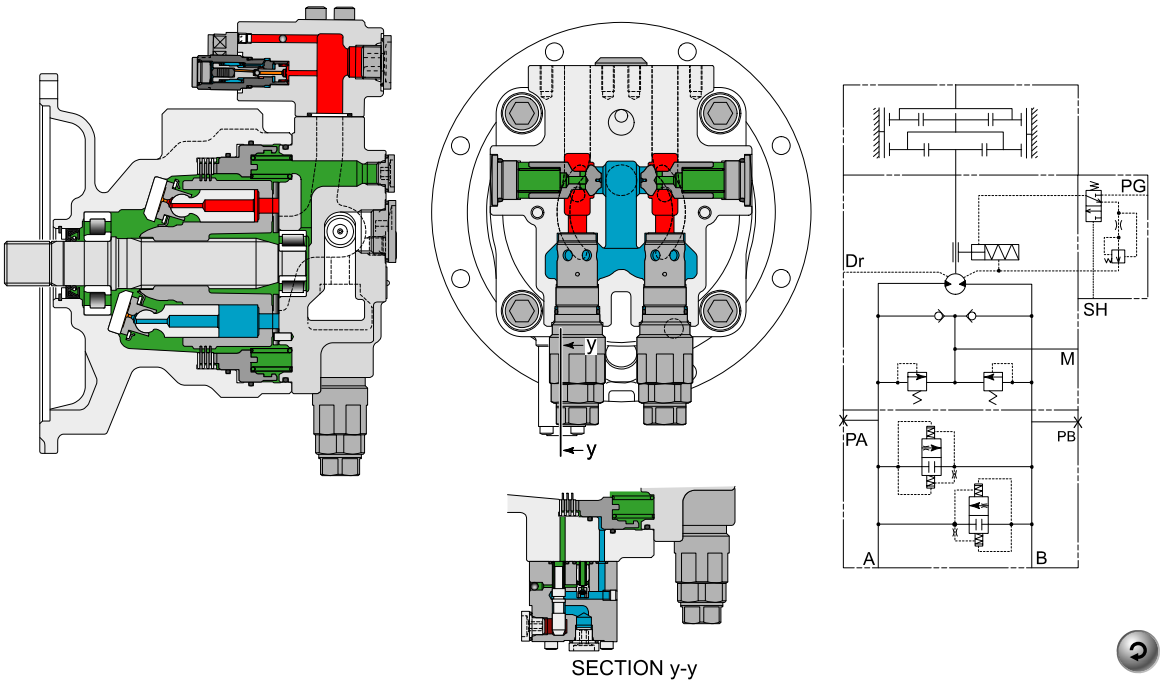
Motor
- Displacement : 121.5cc/rev
- Relief pressure : 250 kgf/cm^2
- Time delay : 5 sec.

Gearbox
- Gear ratio : 20.01
- Oil : SAE NO. 90 (6 liter)

*Compare the circuit & port on the motor.

A,B : Main
M : Anti-cavitation
Dr : Case drain
PG : Brake releasing
SH : Brake pilot
PA,PB: Pressure checking
GI,L : Gear oil filling & Oil level checking
GO : Gear oil outlet
E: Air vent port for gear oil filling

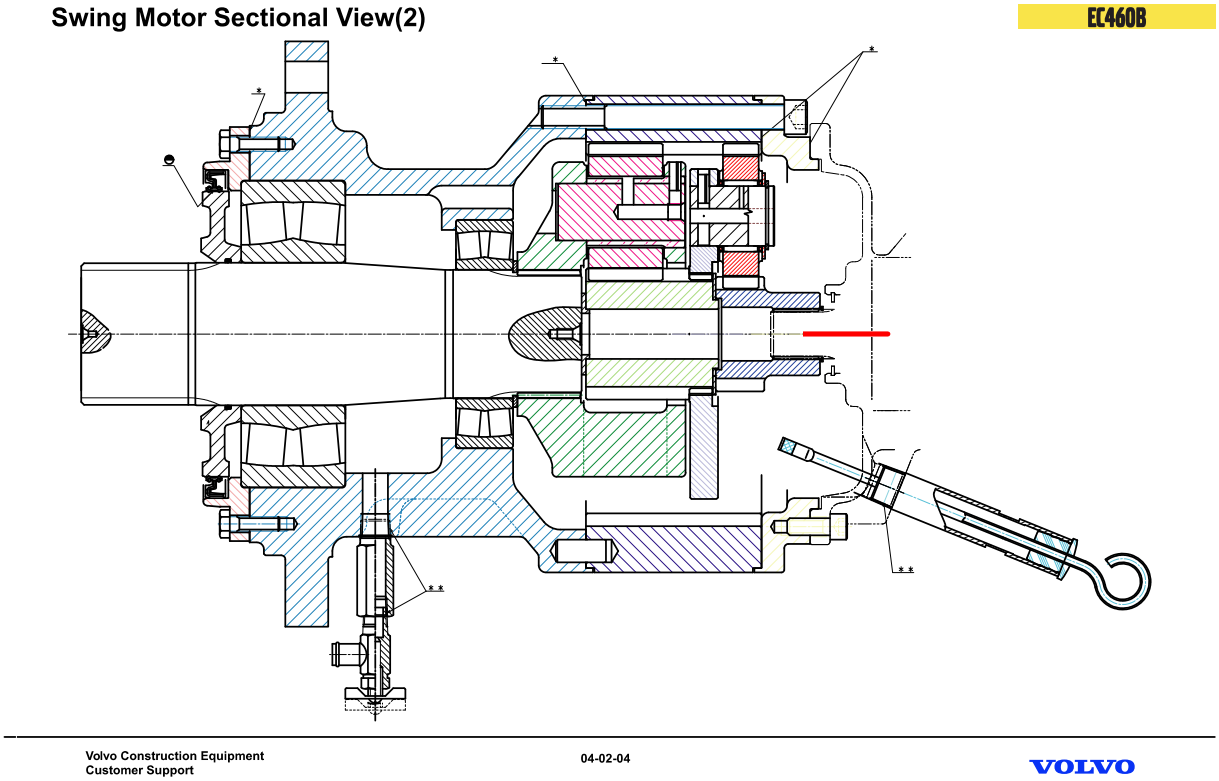
Picture text:



Sectional view(1)

Rotary group consists of cylinder block and 9 piston assemblies located in the cylinder. Both ends of cylinder block are supported by bearings. Piston assemblies are guided by return plate and spring so they slide smoothly on the swash plate. Valve plate is pressed against the cylinder block surface by the mechanical pressure of spring and hydraulic pressure working on the bushing.
Between the outer diameter of the cylinder block and housing a mechanical brake for parking is mounted. The cover section has a relief valve for cushioning and an anti-cavitation valve to prevent cavitation and rebound damping valve for smooth stoping.

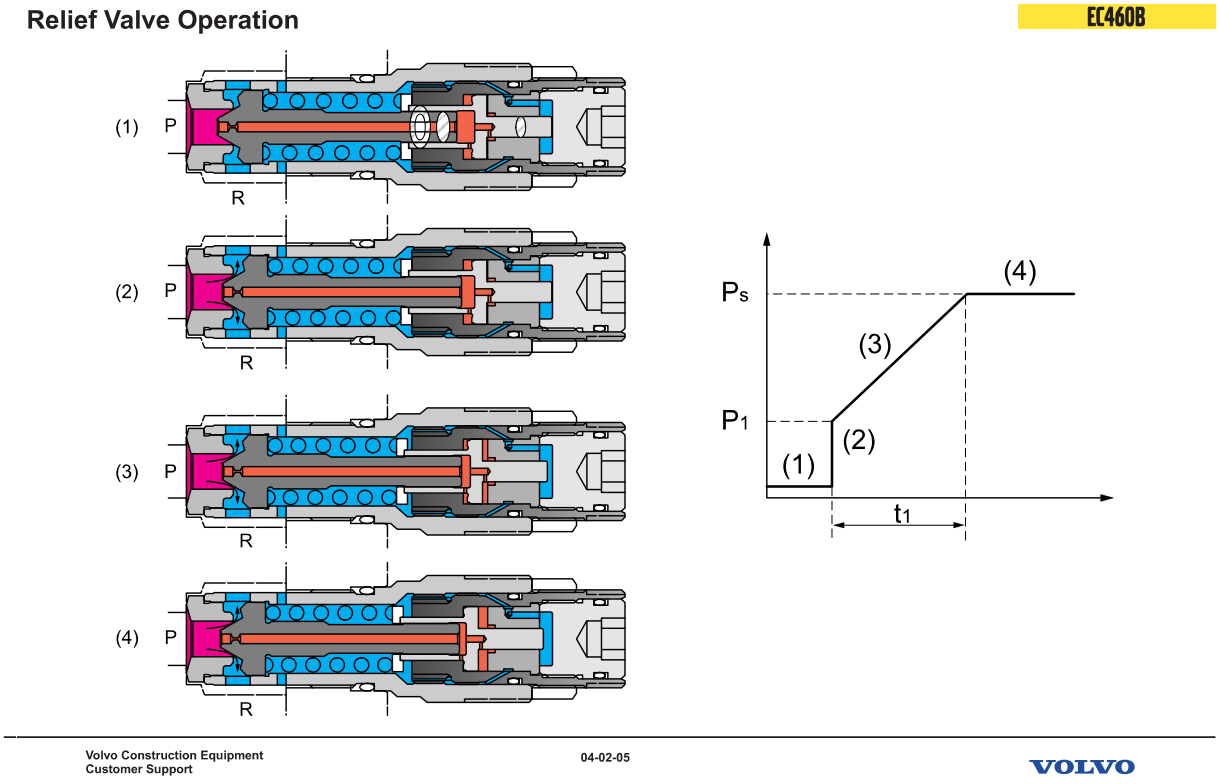
Picture text:



Sectional view(2)

Gear box reduce the speed and increase torque using planetary gear.

Picture text:

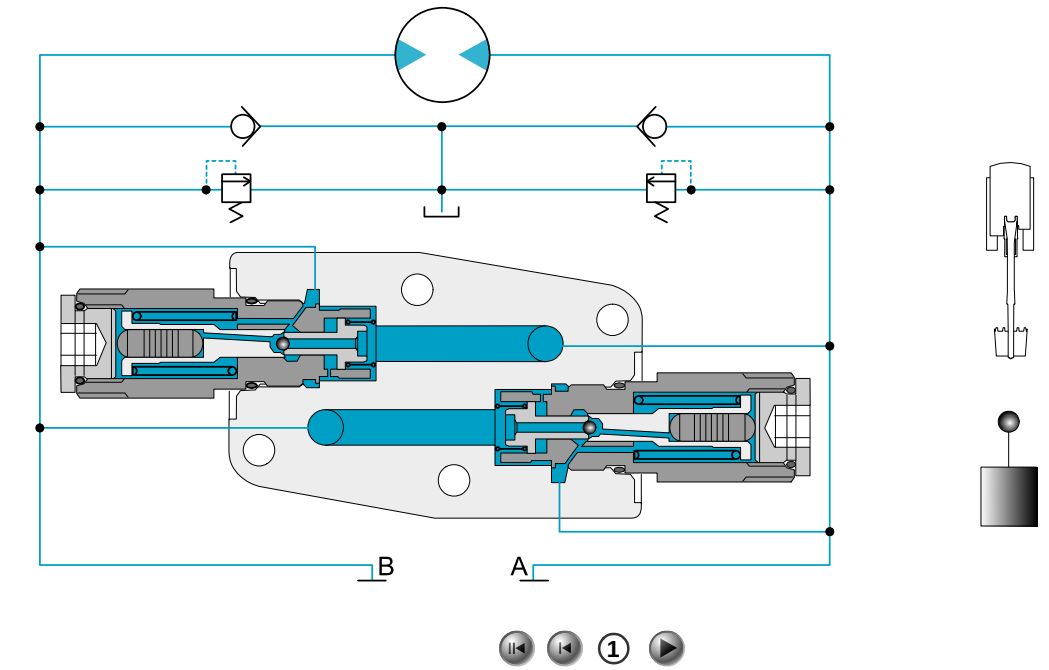


Relief valve operation

Most of brake force comes from this relief valve when we stop slewing.
Therefore we need smooth build-up of pressure for smooth braking.

(1) Closing position
(2) Low pressure relief
(3) Relief pressure increase by moving of piston
(4) Final stage of relief

Picture text:



Rebound damping valve operation

(1) Neutral position

(2) Start of swing

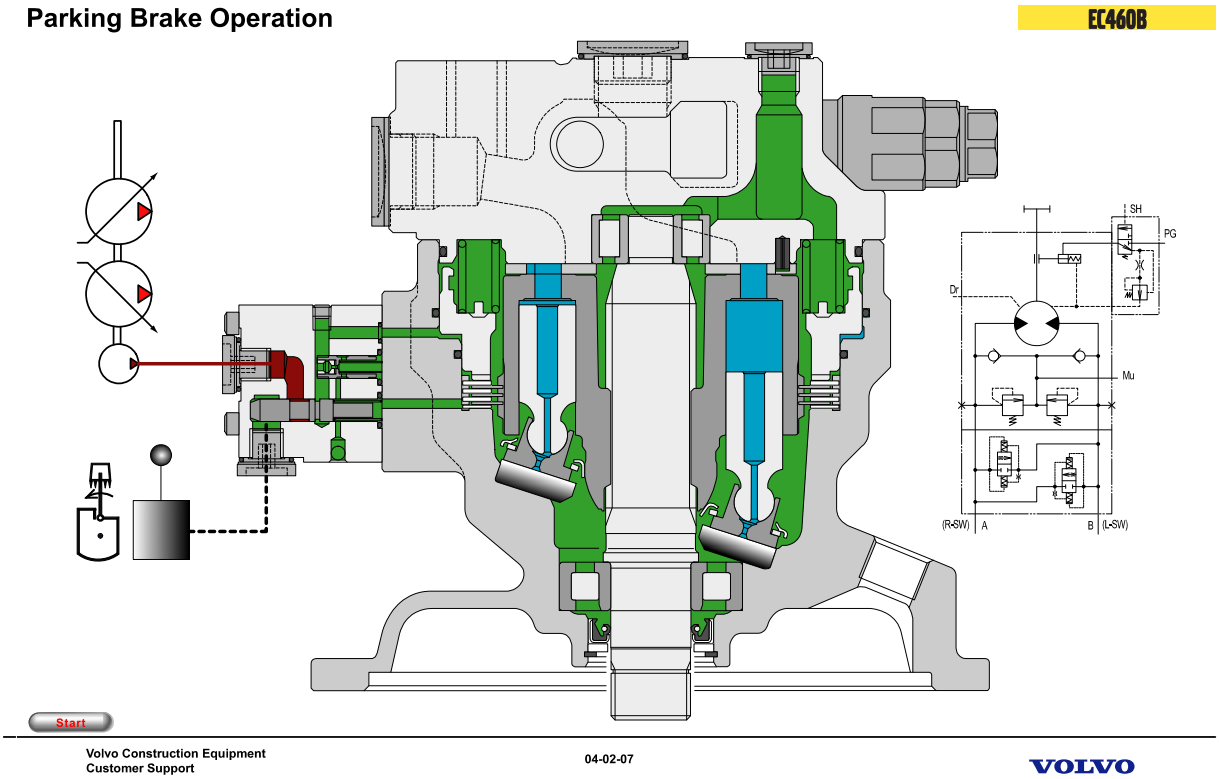
(3) full swing

(4) Joystick return to the neutral. PA pressure goes high.

(5) PA will reach to relief valve set pressure and machine will stop.
In this point, PA=Relief set pressure and PB=Tank pressure.
There is pressure difference between PA & PB. That means rebound of machine.

(6) When machine starts rebound, PA pressure drops down.
If PA is lower than the spring force of damping valve, those two valves starts to return to original position.
But return speed is different because of small hole of front valve. This speed difference make gap between two valves. This gap connects A & B ports. As result, PA & PB will be same for short time. That means there is no force to rotate motor again.
Finally, this valve can stop the machine at the early stage of first rebounding.
During normal slewing, the port A & B must be disconnected at any case.

Picture text:



Parking brake operation

The slew brake is spring applied and hydraulically released. Friction plates are splined to cylinder block and rotate with cylinder block. Mating plates are splined to motor casing.

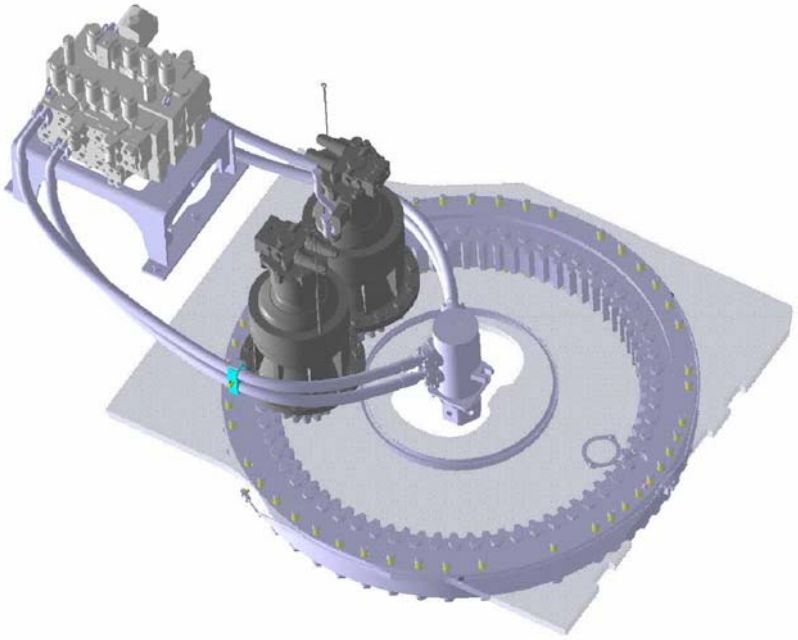
1. When there is no SH signal, parking brake will be engaged by spring force.

2. When there is SH signal, primary pilot pressure(40 bar / 580 psi) goes to brake piston through PG and push the brake piston against spring.

3. When there is no SH signal, Pilot pressure can not go to the brake chamber and oil in side of that chamber shoud be drained. But there is only small hole for drain near to time delay valve. In the beginning, oil pass through the orifice and go to tank, but pressure will be built up in front of the orifice and push the valve. Now the valve blocks tank line. There is no flow to tank. That means there is no pressure difference between front and rear side of valve. But the valve has return-spring at the rear side. So the valve can return to initial position and open tank passage again. The oil from brake chamber can go to tank again.

Open-close-open movement can delay the parking brake engaging time for 5 seconds.

Picture text:



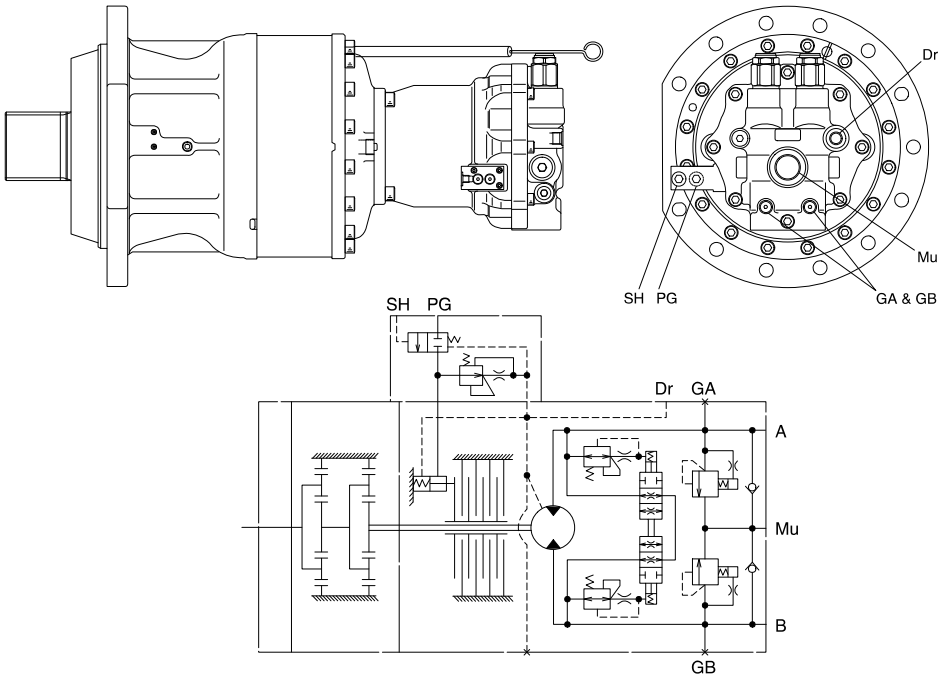
Swing System(EC700B)

- Swing motor(2EA)
- Gear box
- Pinion
- Turning joint
- Swing Ring gear

Picture text:

External View

EC700B



Start

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04-03-02

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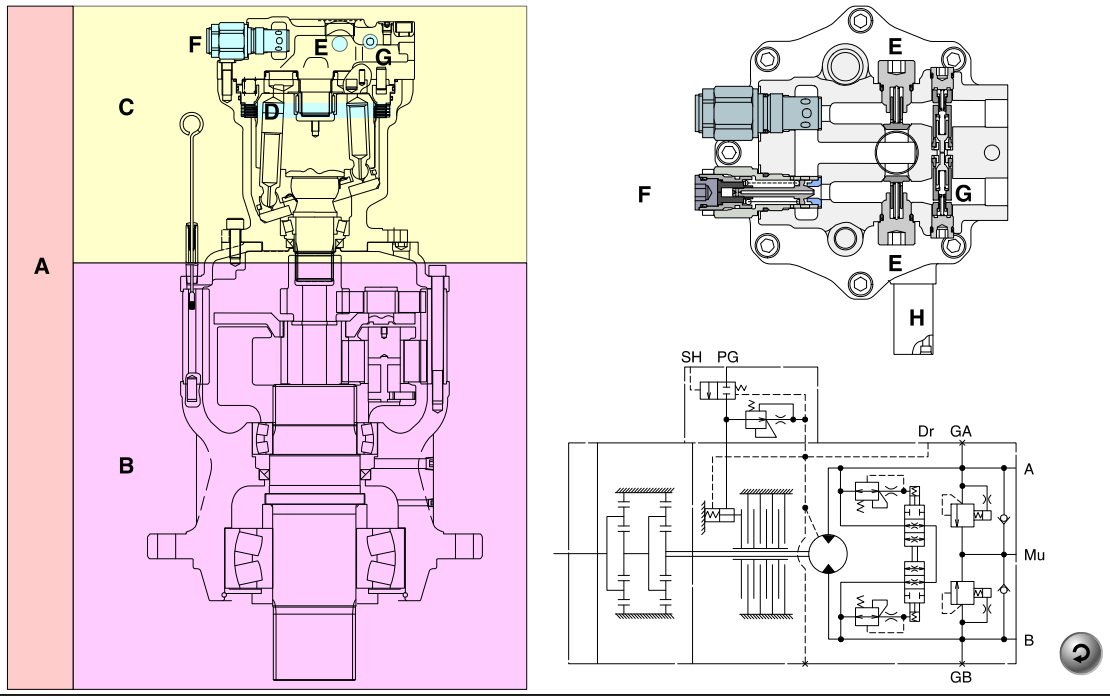
Spec & External View

Specification
Model :MFC250
Displacement :250 cc/rev
Type :Fixed swash plate,piston motor
Relief valve pressure :250 kgf/cm2
Max. drain pressure :3 kgf/cm2
Brake release pressure :Min. 33 ~ Max. 50 kgf/cm2
Brake delay time :5~8 sec

SH : Pilot signal for brake release
PG : Brake releasing pressure signal
Dr : Drain
GA,GB : Gauge port
Mu : Anti cavitation port
A,B : In & out port

Picture text:

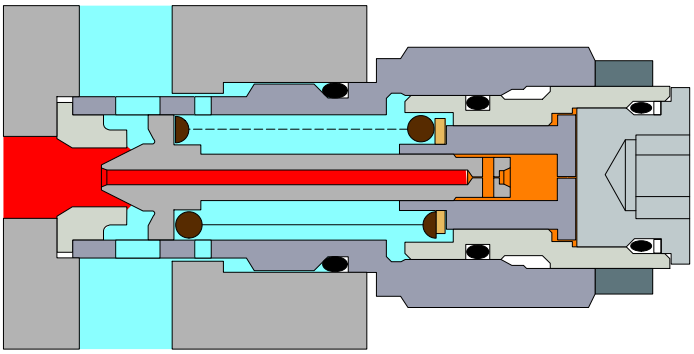
Sectional View

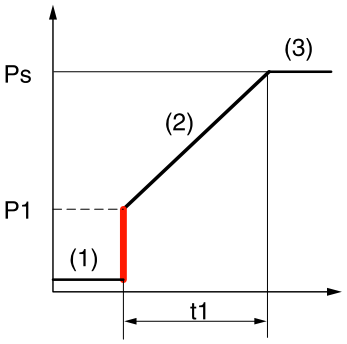


Sectional View

A : Swing drive unit
B : Swing reduction gear
C : Swing motor
D : Mechanical brake
E : Anti canvitation check valve
F : Relief valve
G : Rebounding damping valve
H : Time delay valve

Picture text:





Relief Valve

1 : Pressure increase

2 : Gradual pressure increase
The inner cylinder push the spring seat and during the movement,the pressure increases gradualy.

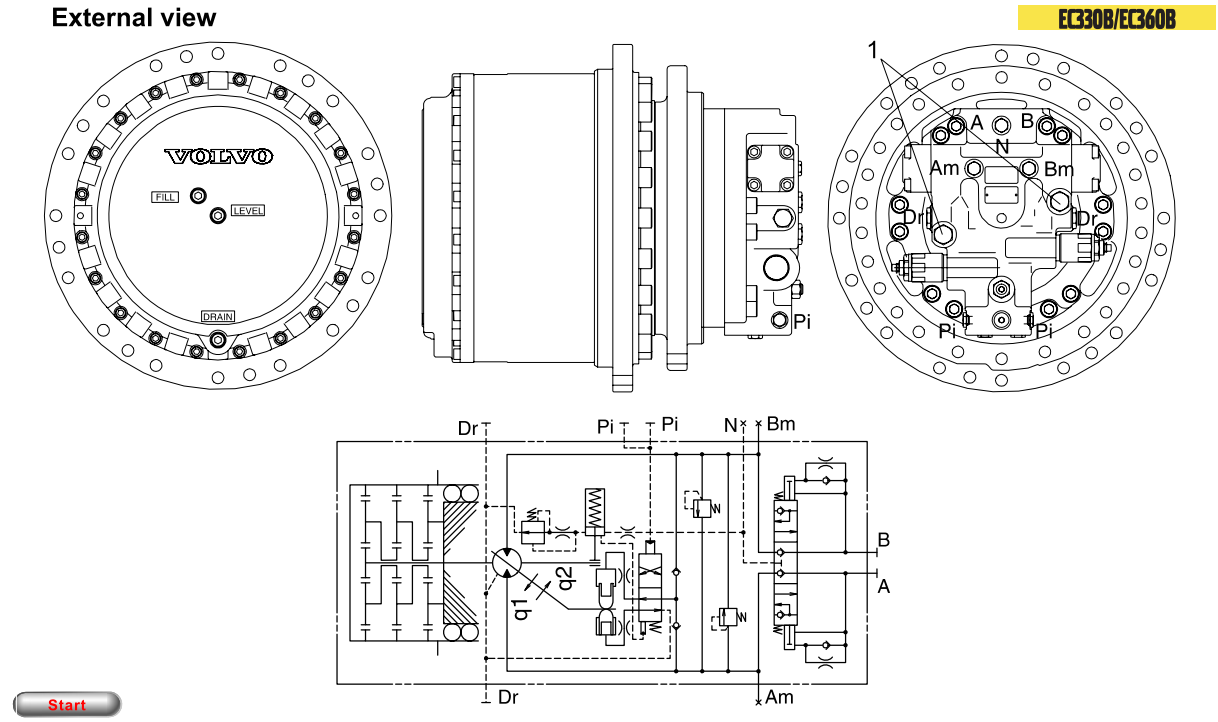
3 : Setting pressure

Picture text:

EC330B/EC360B(Old)

Travel motor(Old)

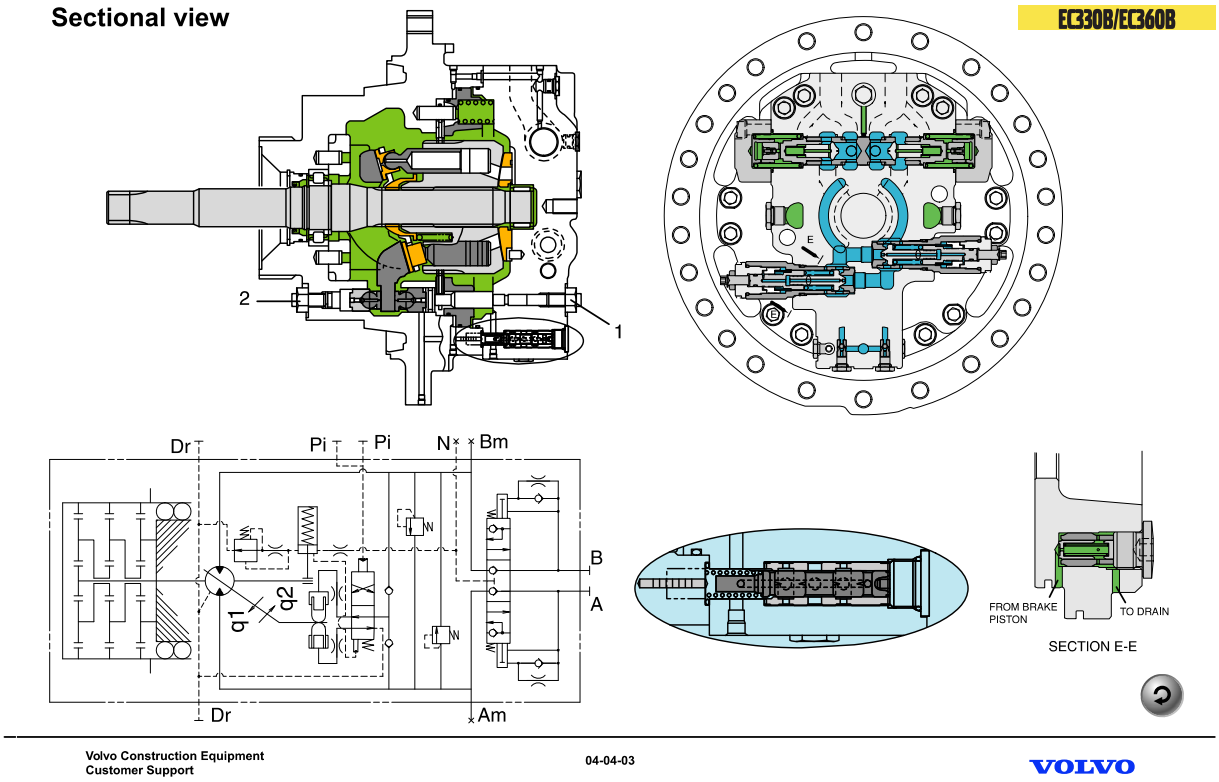
Picture text:



External view

Circuit animation for travel motor

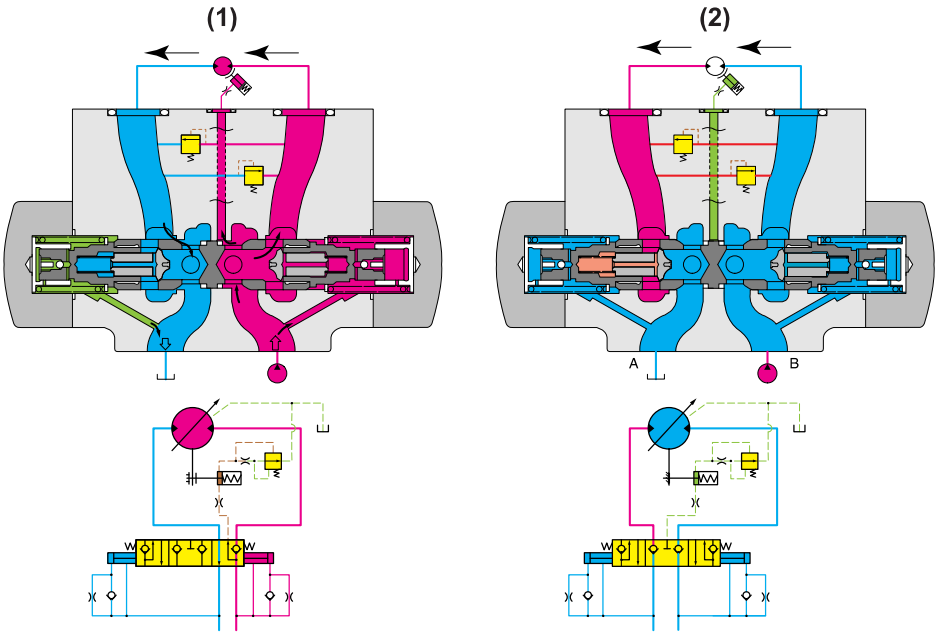
Picture text:



Sectional view

1. Set screw for large displacement
2. Set screw for small displacement

Picture text:



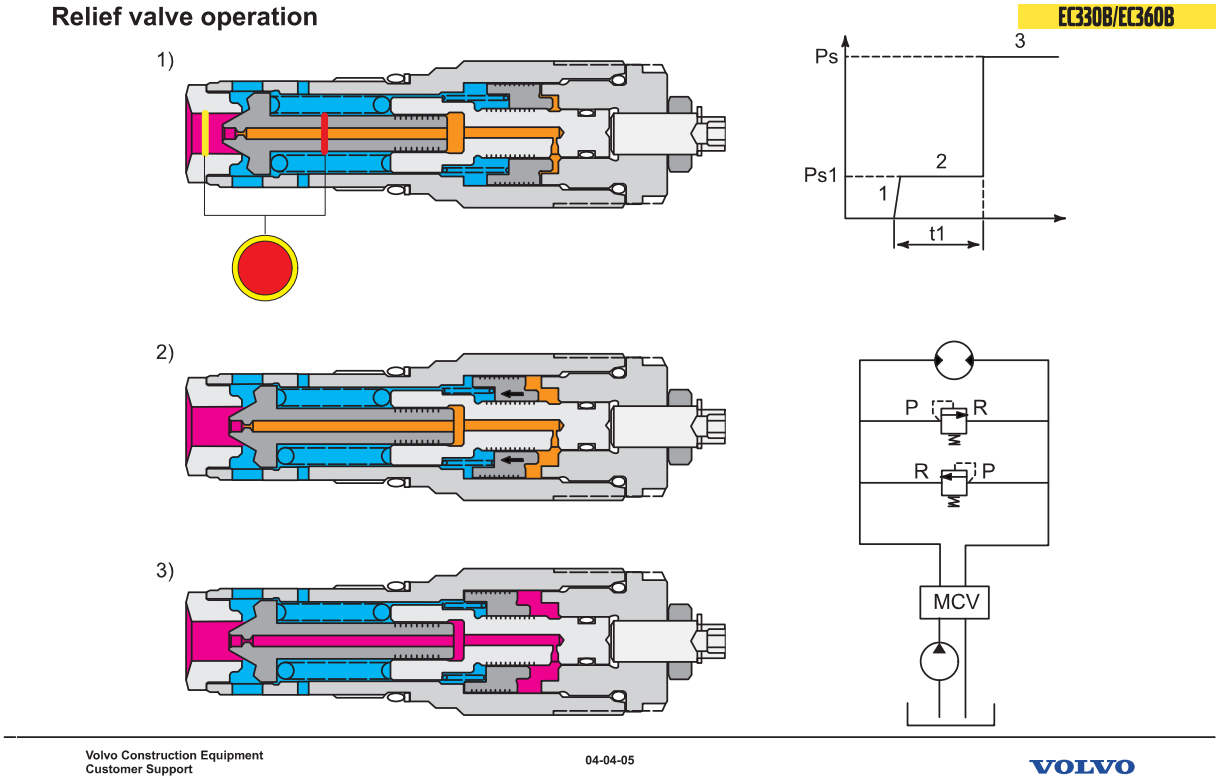
Brake valve operation

(1) Travel
The pressure of supply line goes high and this pressure applies to the backside of brake valve and then pushes the brake valve against spring. So return side oil can go to tank.

(2) Overrun
When machine travels at the down slope, this can cause overrun. That means the amount oil of supply line is less than expected. In this case we need brake function to control the machine from over-speed.

The pressure of supply line becomes low and the brake valve return to the neutral position. So we can block the return line and slow down the machine speed.

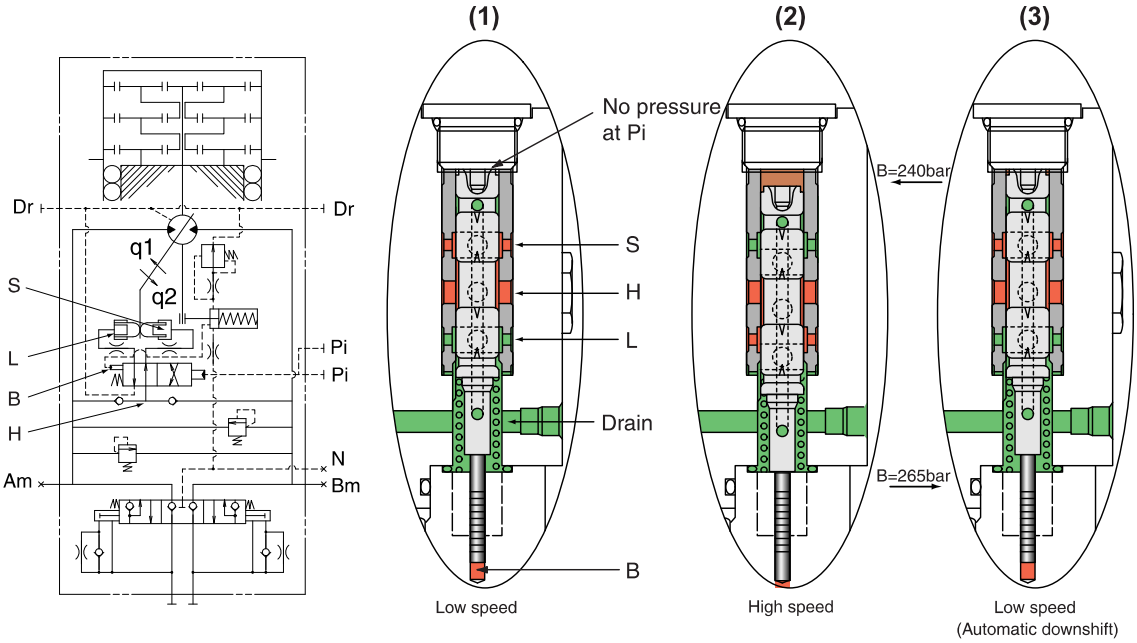
Picture text:



Relief valve operation-1

(1) The pressure is lower than the set value.
(2) The pressure is reached to the set value.

Picture text:



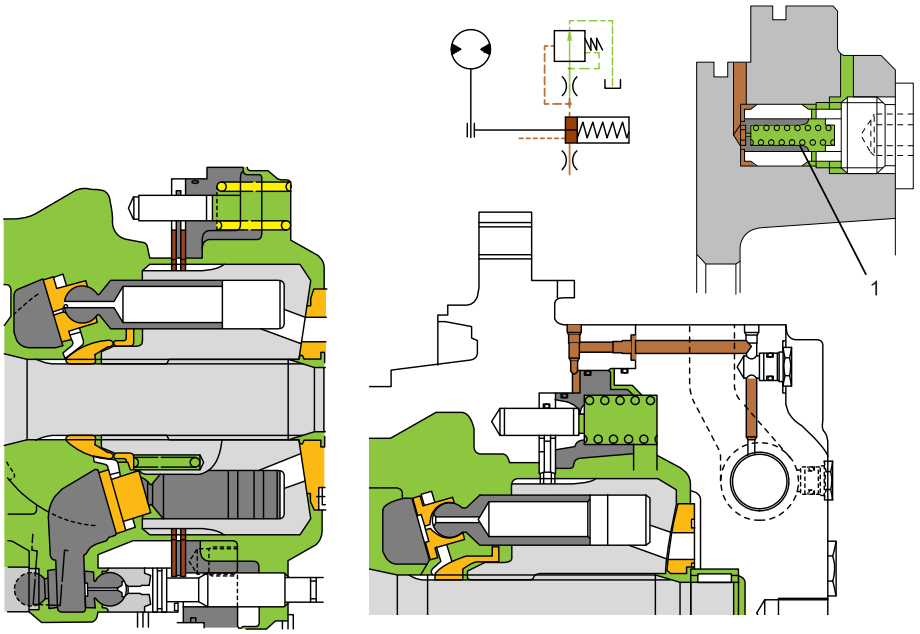
Speed change

(1) Low speed
-No pressure at pi port
-Supply pressure H is supplied to S

(2) High speed
-Pilot pressure at pi port
-Speed change spool is moved downward
-Supply pressure H is supplied to L port

(3) Automatic downshift
-Pilot pressure at pi port
-Supply pressure reaches to 265bar(B)
-Speed change spool is pushed upward against pi pressure, Supply pressure H is connected to S port.

Picture text:

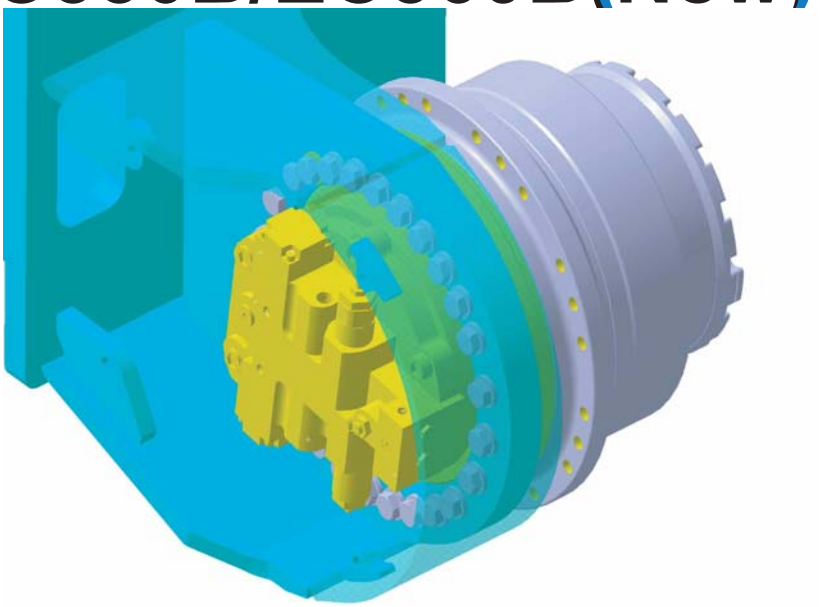


Parking brake

1. Time delay valve

Picture text:

EC330B/EC360B(New)



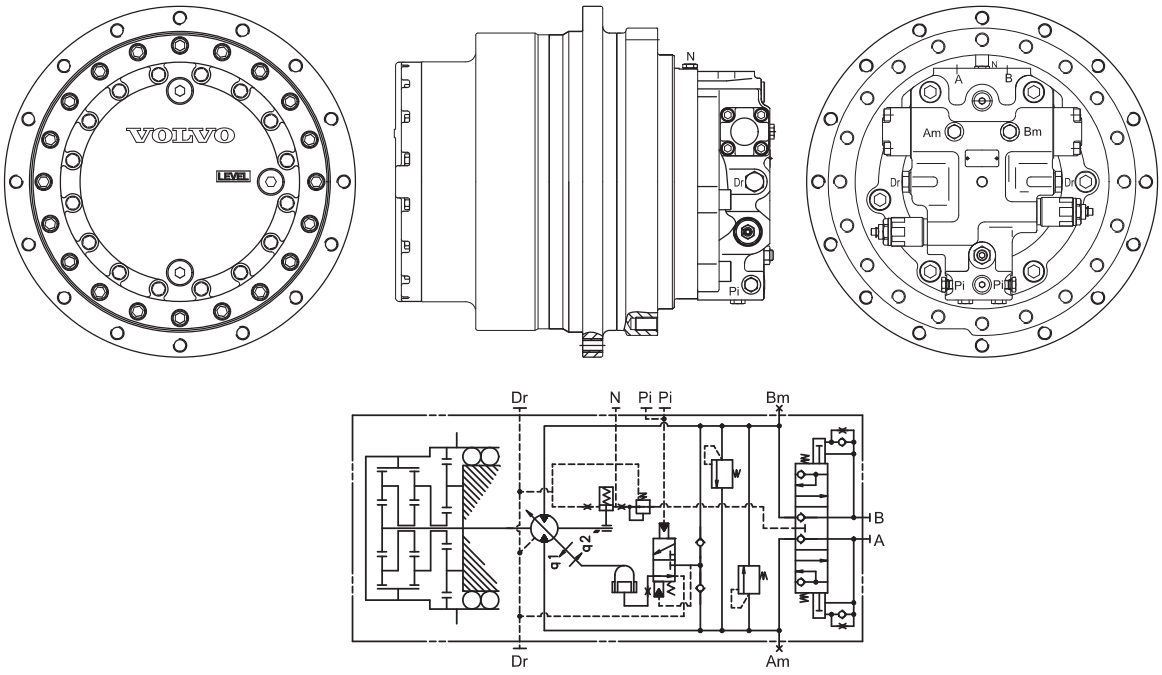
Travel system-New(EC330B-EC360B)

-Travel motor
-Gear box

Picture text:

External View

EC330B/EC360B



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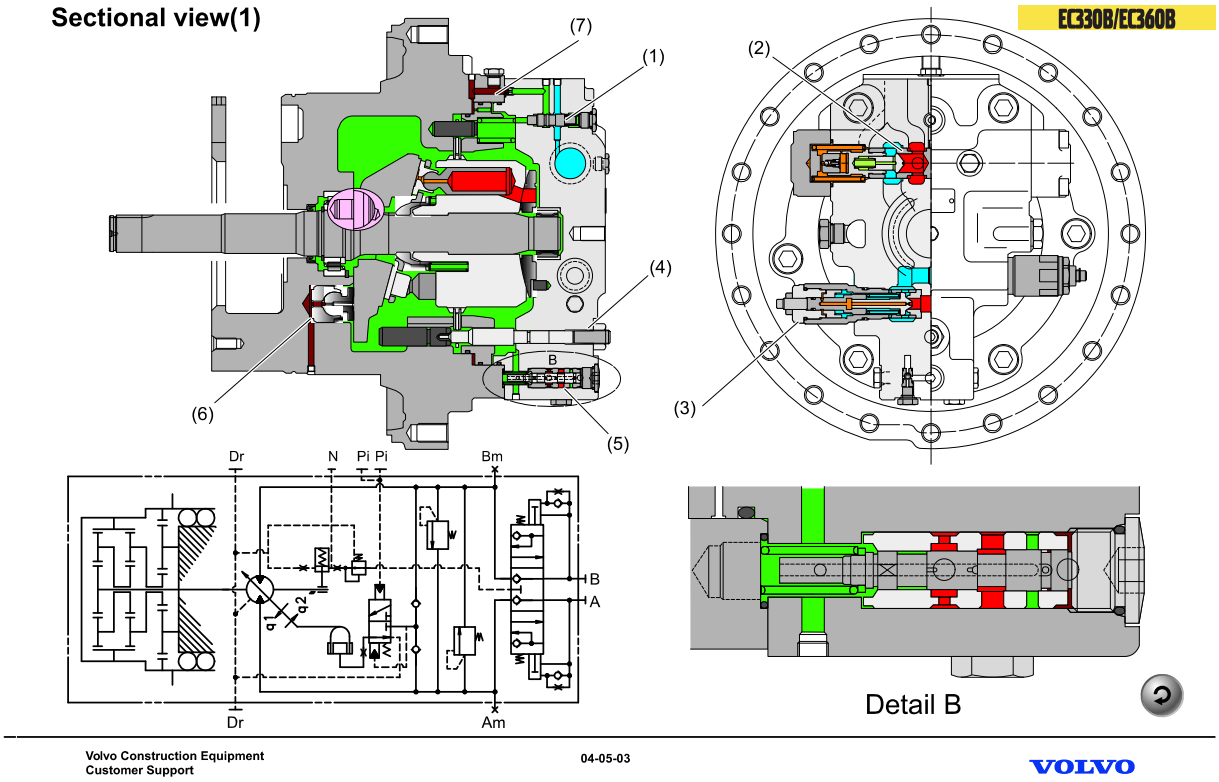
External view

Travel motors for EC330B/360B are almost same with EC290B except the displacement & gear ratio.

Travel motors
- Displacement: 129/178 cc/rev
- Relief pressure: 370 kgf/cm^2 (36.3 MPa)
- Speed changeover pressure: 265Kgf/cm^2(26.0 MPa)
- Brake release pressure: 8 kgf/cm^2(0.83MPa)

Gear box
- Gear ratio: 65.436
- Oil : SAE#90 Gear oil(6.2 liter)

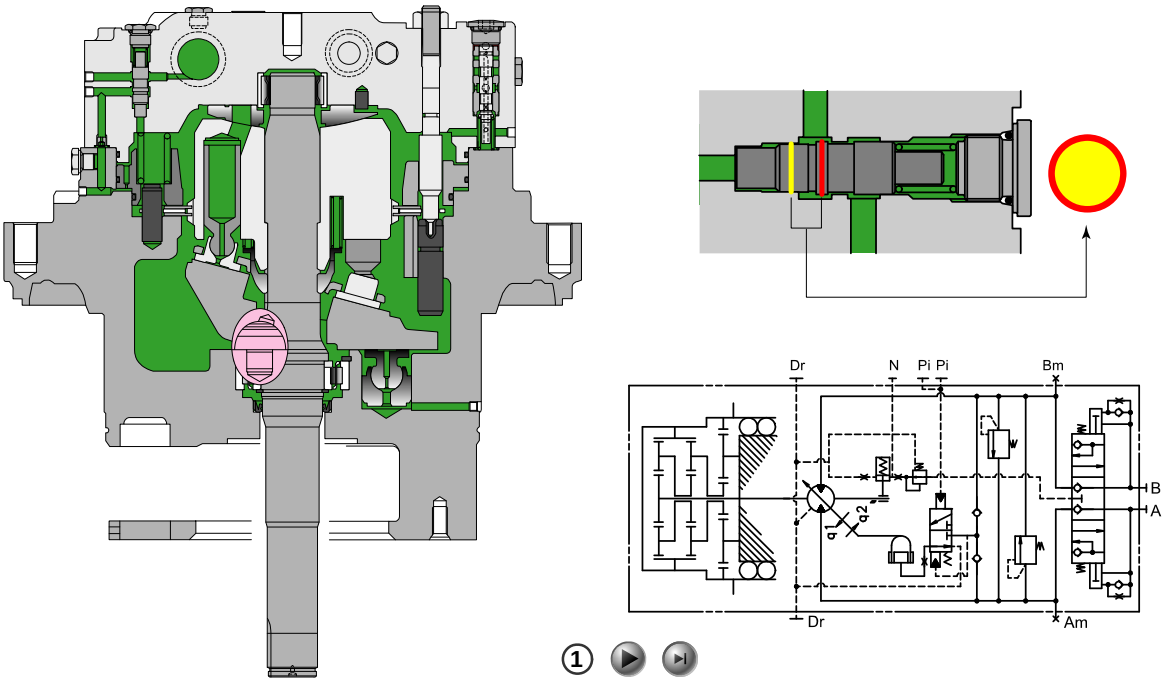
Picture text:



Sectional view(1)

1. Pressure reducing valve for parking brake
2. Counter-balance valve or Brake valve
3. Relief valve
4. High speed set screw
5. Speed changeover valve
6. Swash piston
7. Parking brake

Picture text:



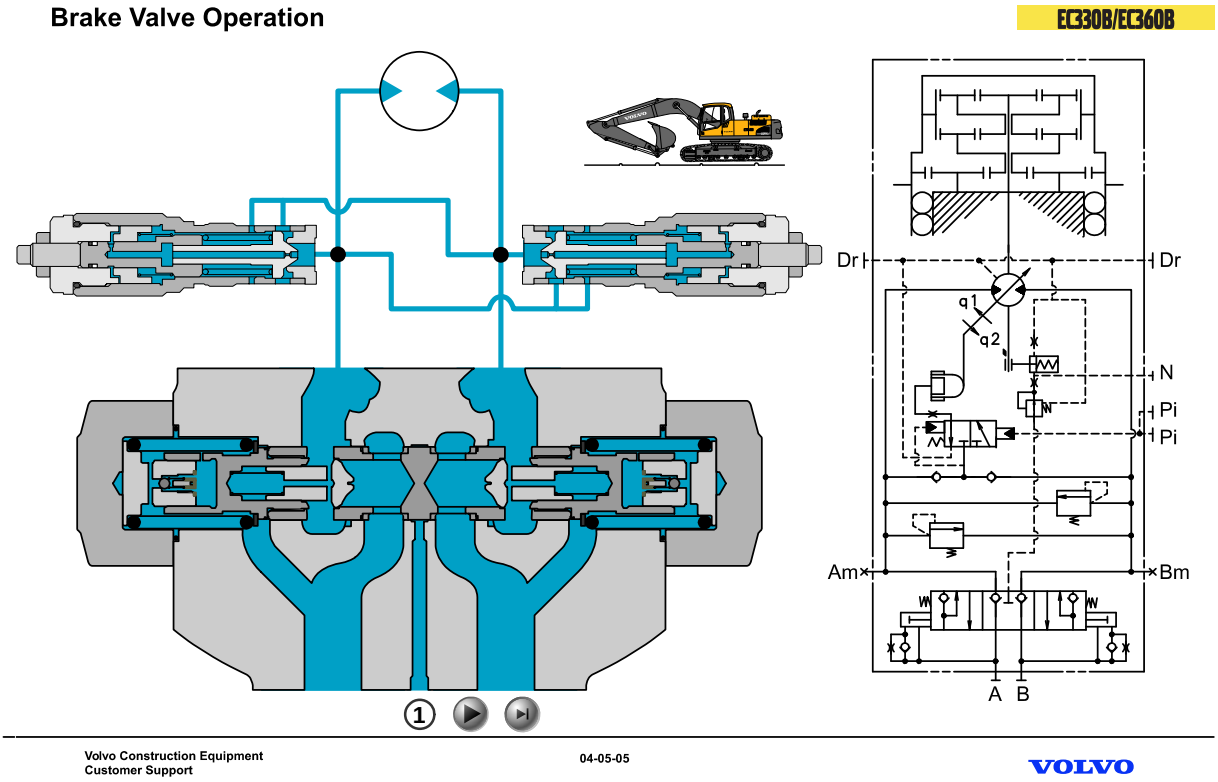
Reducing valve operation

In order to release parking brake, system uses the pressure from main pressure of supply line. So we need to decrease the pressure by using this valve.

(1) Supply pressure goes to brake chamber to release the brake.

(2) If the pressure of brake chamber exceed the specified value(spring tension), main pressure push the valve to the right becasue of area difference of valve and disconnect passage between main pressure and brake chamber. Therefore the parking pressure cannot exceed the setting pressure.

Picture text:



Brake valve operation

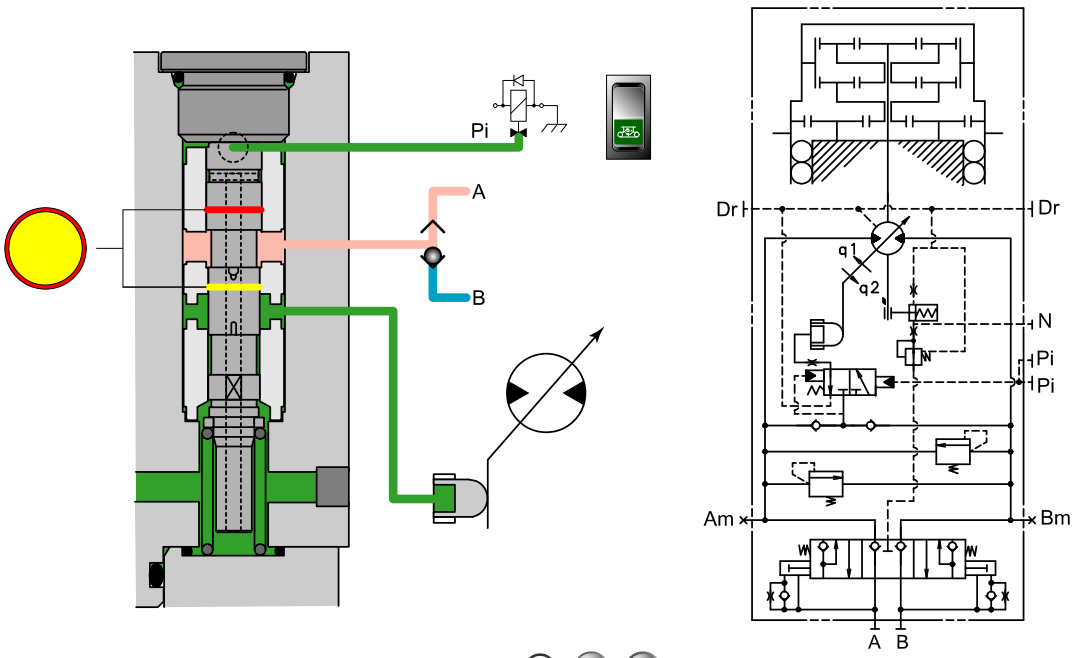
1. Brake valve is now at neutral position.

2. The pressure of supply line goes high and this pressure applies to the backside of brake valve and then pushes the brake valve against spring. So return side oil can go to tank.

3. When machine travels at the down slope, this can cause overrun. That means the amount oil of supply line is less than expected. In this case we need brake function to control the machine from over-speed.

The pressure of supply line becomes low and the brake valve return to the neutral position. So we can block the return line and slow down the machine speed. During this period, the orifice on the brake valve help machine to be driven smoothly.

Picture text:



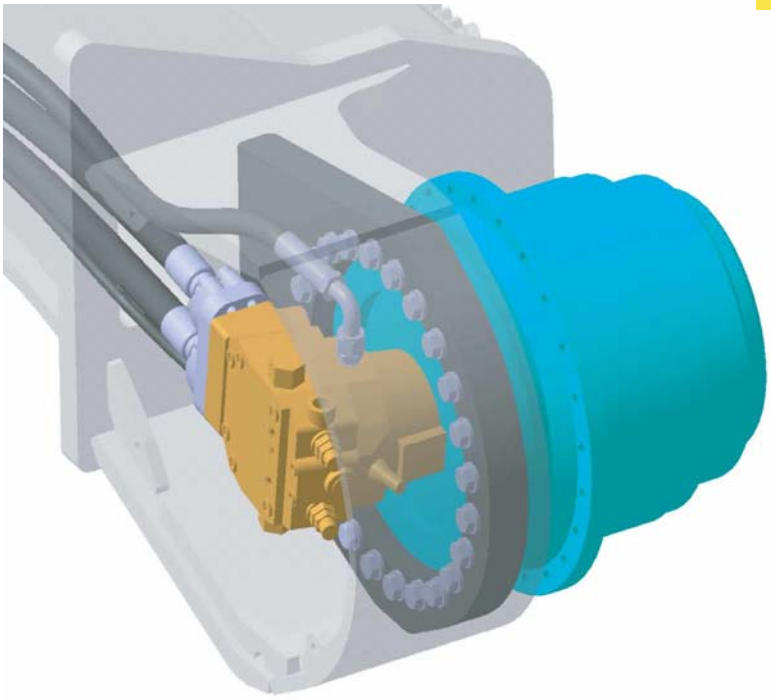
Speed changeover

1. When the pilot pressure at port Pi is disconnected, the spool moves upward by the spring force & hydraulic force which is applied to the differential area between red section and yellow section. The oil in chamber of swash piston flows to the drain line, and the swash plate moves to increase swash angle, so the motor rotates at low speed.

2. When the pilot pressure at port Pi is connected, spool moves downward by the pressure at Pi. The supply oil through check ball folws to the swash piston. Swash pisto pushs the swash plate and decrease swash angle, so the motor rotates at high speed.

3. In this picture, the force by Pi port pressure acts against the force by supply pressure which is applied on the differential area and spring. When the supply pressure reach to specified value, the force by supply pressure and spring overcomes the force by Pi pressure. So the spool moves upward.
The oil in chamber of swash piston flows to the drain line, and the swash plate moves to increase swash angle, so the motor rotates at low speed and high torque.

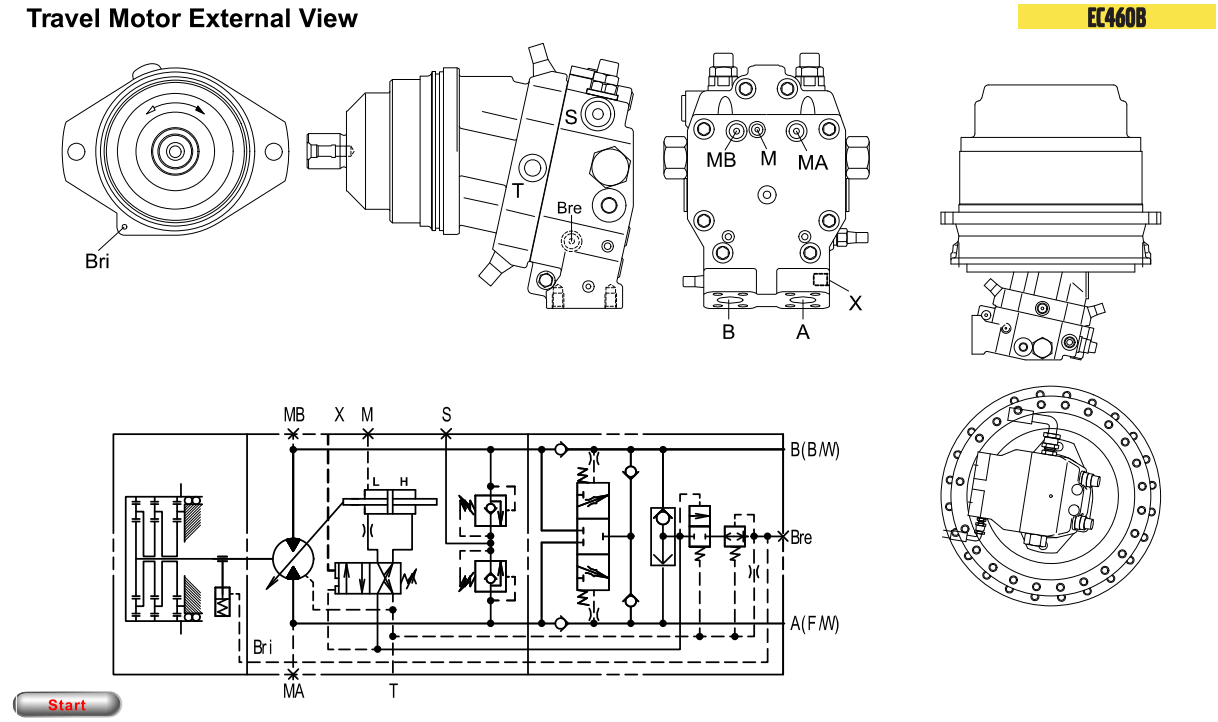
Picture text:



Travel System(EC460B)

- travel motor
- Gear box

Picture text:



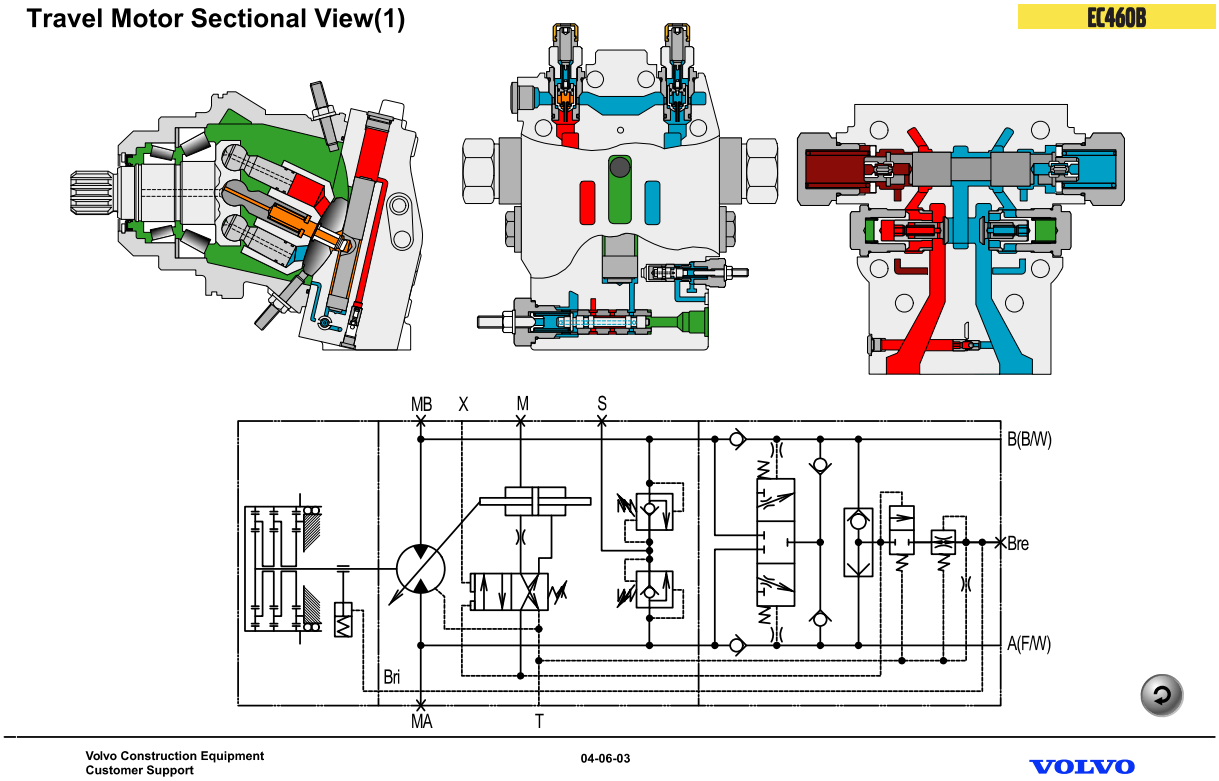
External view

*Circuit animation for travel motor

Travel motors(Bent axis type)
- Displacement: 99/160 cc/rev
- Relief pressure: 330bar (33 MPa)
- Speed changeover pressure: 240 bar(24.0 MPa)
- Brake release valve set pressure: 21+4bar

Gear box
- Gear ratio: 108.1
- Oil : SAE80W/90 (5 liter)

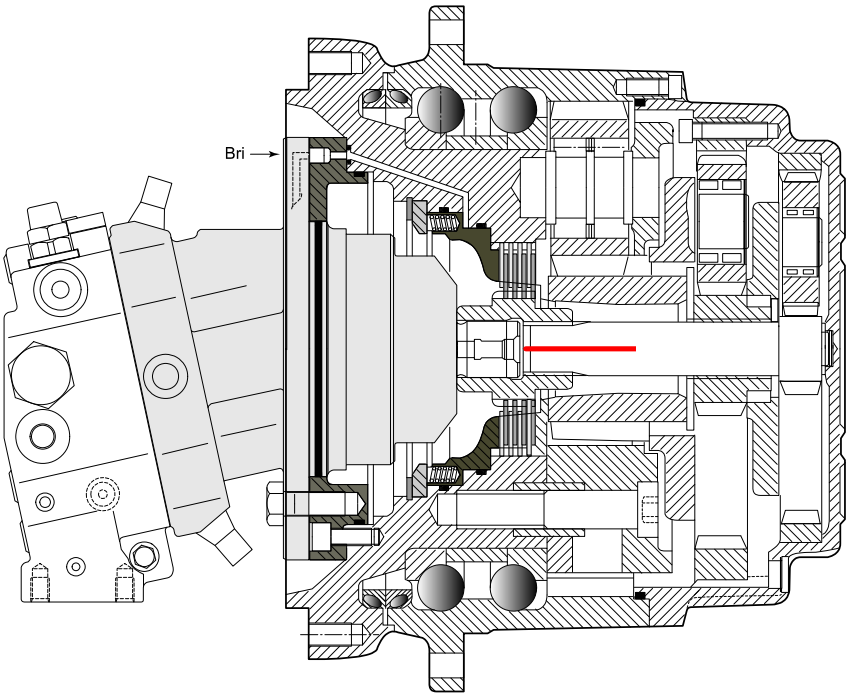
Picture text:



Sectional view(1)

When you click the component on the circuit diagram, you can see the location of correspondent component.

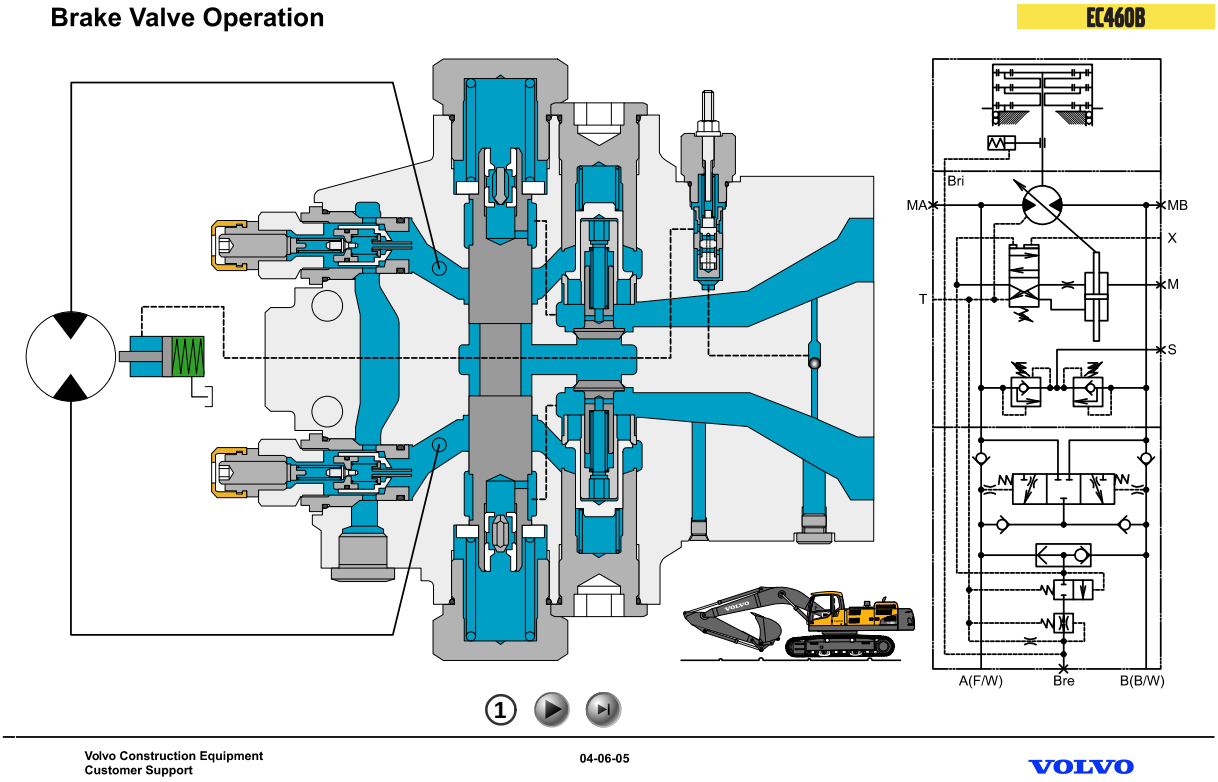
Picture text:



Sectional view(2)

Gear box

Picture text:



Brake valve operation

1.Brake valve is now at neutral position

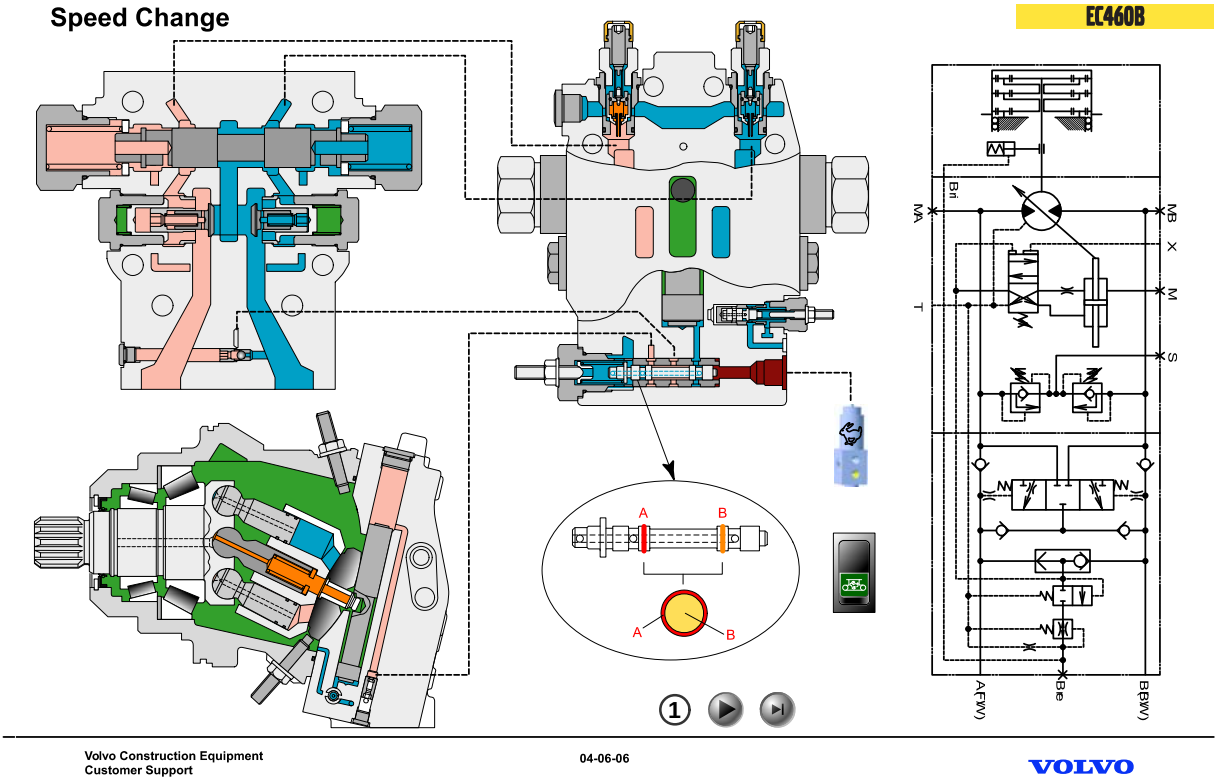
2.Oil supplied to motor but return line is blocked by the brake valve. The pressure of supply line goes high.

3.This high pressure release the parking brake through the reducing valve.

4.This high pressure applies to the backside of brake valve and then pushes the brake valve against spring. So return side oil can go to tank.
Machine starts to move.

5.When machine over running, supply side pressure will be low. This moves the brake valve to the neutral side.

Picture text:



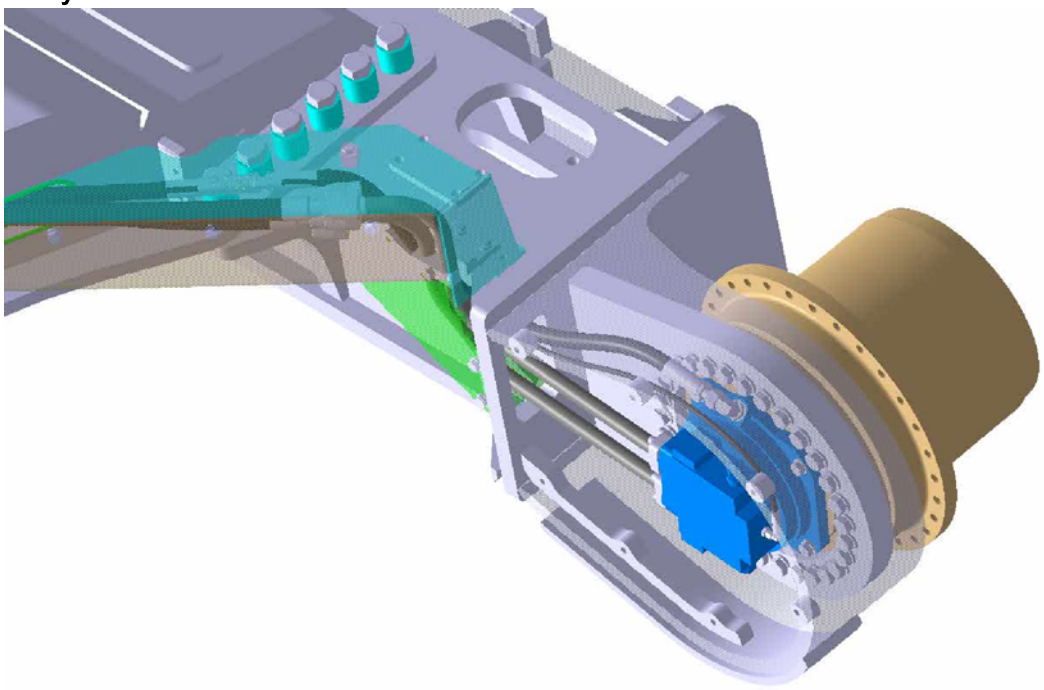
Speed change

1. Neutral condition

2.Hydraulic oil flow from supply line opens shuttle ball and flows to the speed change valve.
There is no pilot oil pressure from travel speed solenoid valve. The speed change valve move to the right because of spring force and make passage between the supply line and the bottom side of piston. And the top side of piston is connected to the drain line through internal hole of speed change valve.
So the axis angle decreases and machine travels at high speed condition.

3.While the machine travels at high speed condition, according to the travel load increment, pressure at the speed change valve is increased. Due to the sectional area A is larger than sectional area B, the suply pressure is applied to the ring area (A □ B). When the supply pressure reaches to the setting pressure of spring, the speed change valve moves to the left and and make passage between the supply line and the top side of piston. And the bottom side of piston is connected to the drain line through internal hole of speed change valve.
So the axis angle increases and machine travels at low speed condition.

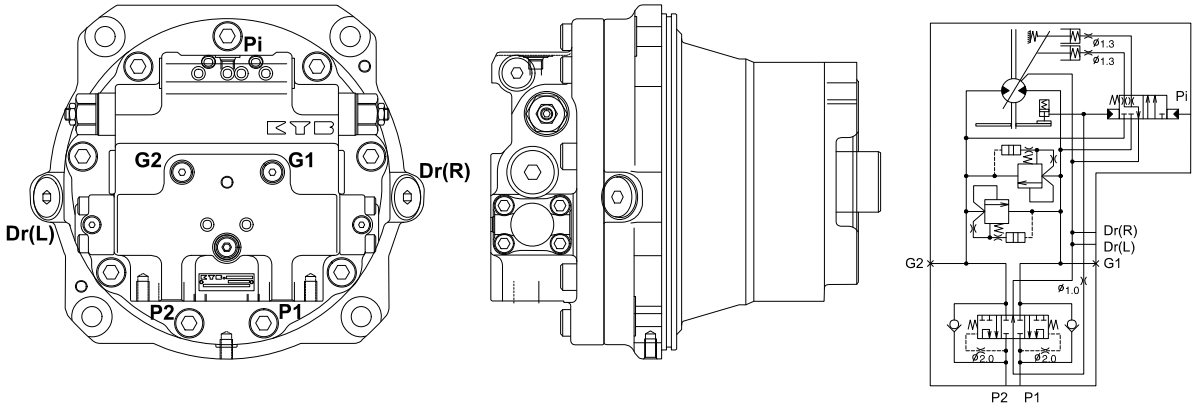
Picture text:



Travel System(EC700B)

- travel motor
- Gear box

Picture text:



Start

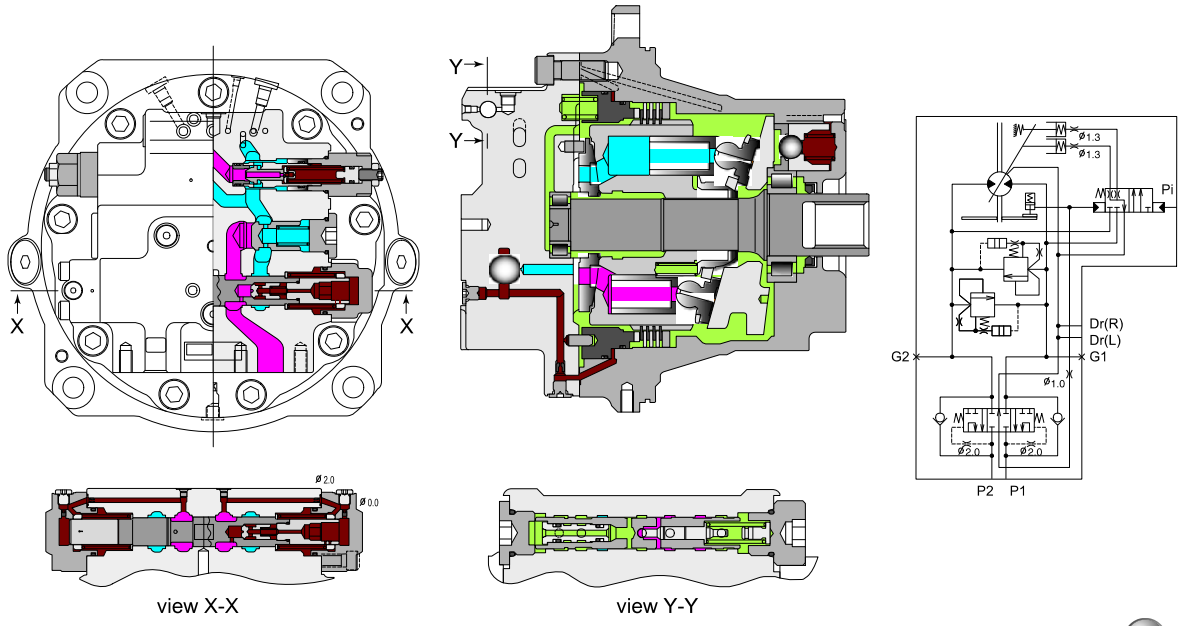
Spec & External View

Specification
Model : MSF-340VP
Type : variable swash plate,piston motor
Displacement : 304.1(Large) / 196.8(Small) cc/rev
Relief valve pressure : 350 kgf/cm2
Speed changeover
pressure (High -> low) : 263 kgf/cm2 at Pi=40 kgf/cm2
Brake release pressure : 18.4 kgf/cm2
Drain pressure
- Continuous : Lower than 2 kgf/cm2
- Intermittent : Lower than 5 kgf/cm2

G1,G2 : Gauge port
Dr(R),Dr(L) : Drain
Pi : Pilot signal for travel speed changeover
P1,P2 : In & Out port

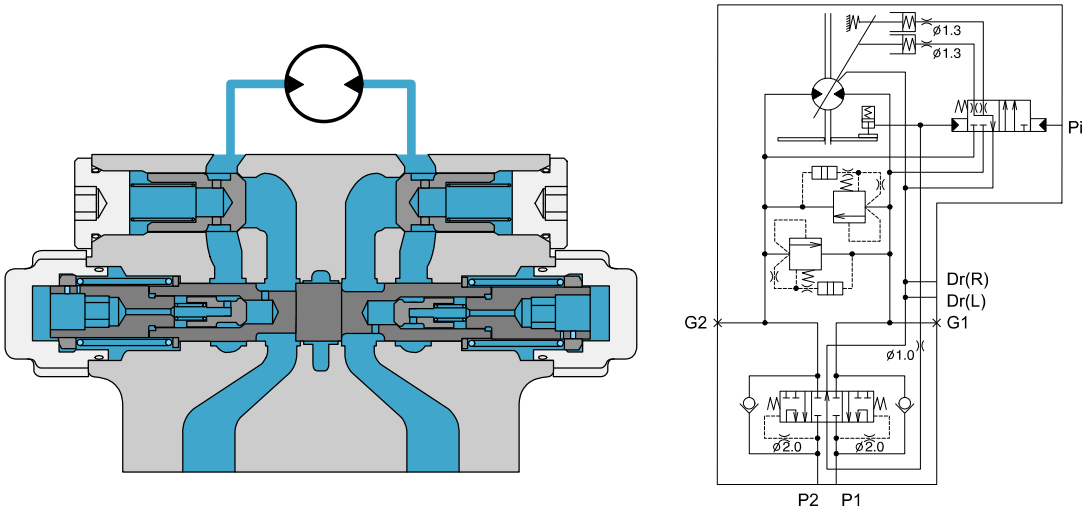
Picture text:

Sectional View



Sectional View

Picture text:



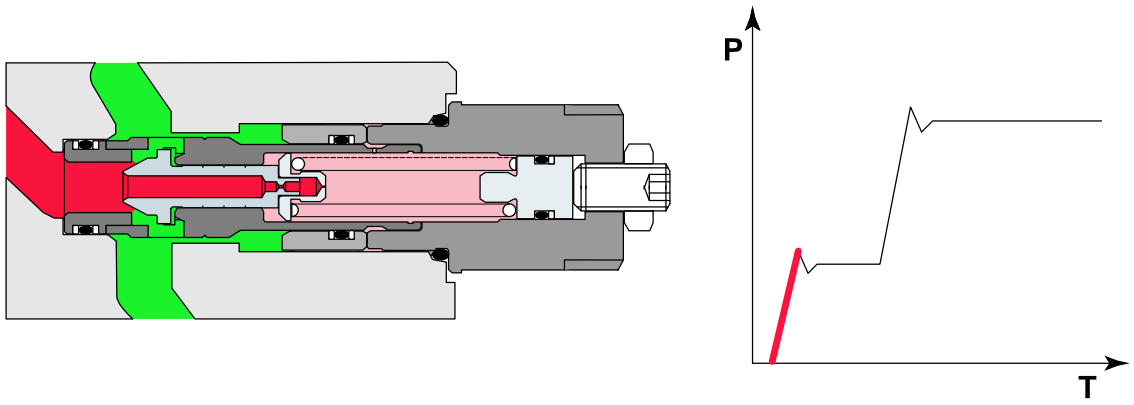
Brake Valve Operation

1 : Neutral position

2 : Normal travelling
The supplied oil push the counterbalance valve to the right direction. and open its return passage.

3 : Downhill travelling
During downhill operation, the motor is driven by machine's weight. The supply port pressure drop and the counter balance valve return to its neutral position(Blocked return passage). And travel speed decrease.

Picture text:



Relief Valve Operation

1 : Pressure increase

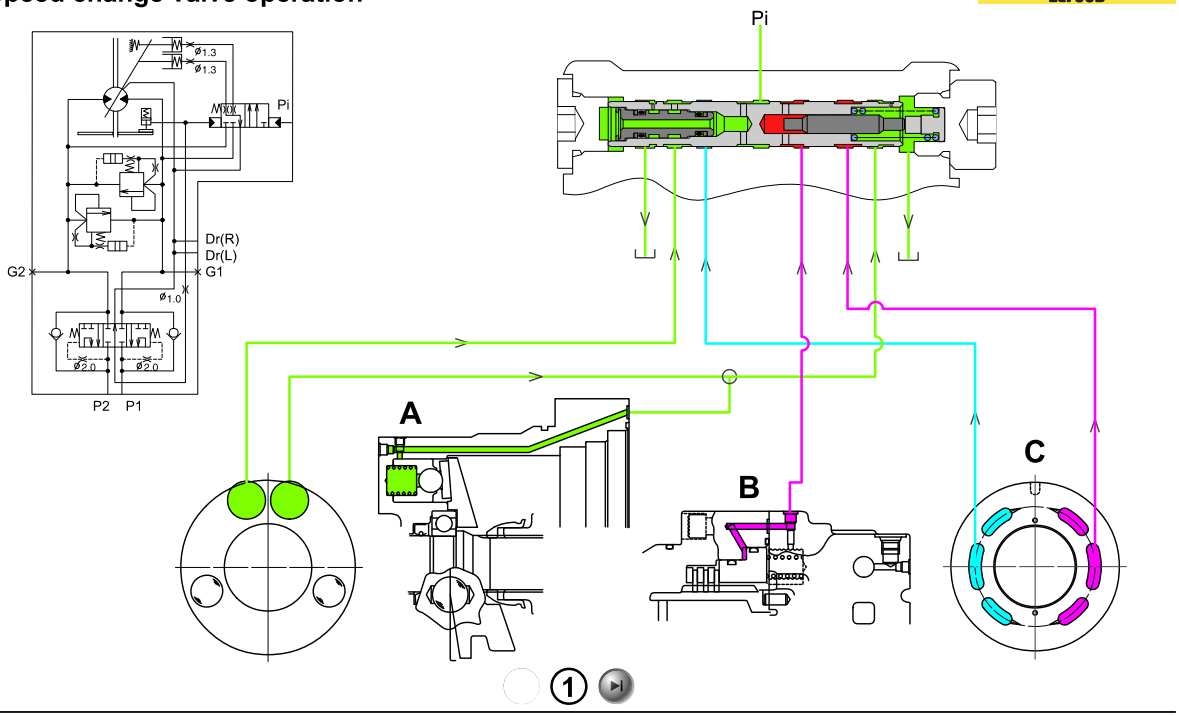
2 : During the free piston movement,the pressure is maintained stable as low.

3 : If the free piston pushed to its stroke end, the pressure increase to its set pressure.

Picture text:

Speed change valve operation

EC700B



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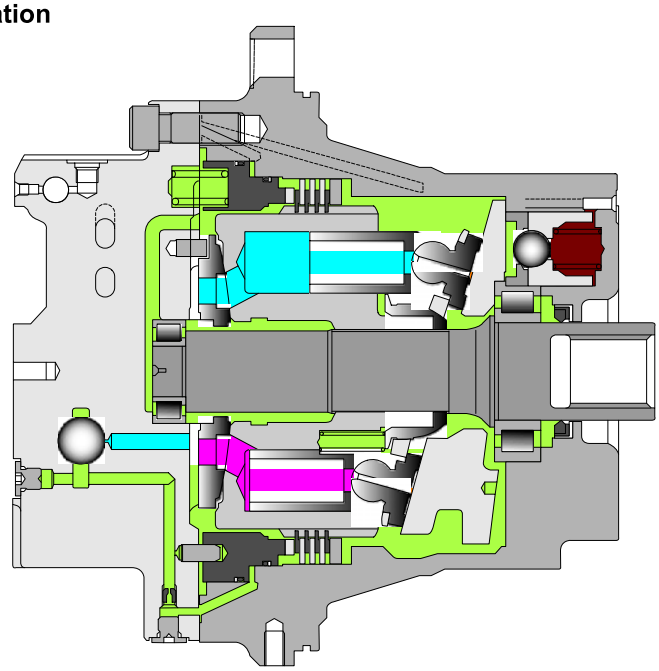
Speed Changeover Valve Operation

1 : Low speed fixed
The tilting piston chambers are connected to tank(Max. angle & low speed)

2 : High speed
If there is Pi,travel speed valve is pushed to the right.
And high pressure is supplied to tilting piston chamber. (Min. angle & high speed)

3 : Automatic down-shift
If the main pressure(red color)is increased, travel speed valve is pushed to the left. And the tilting piston chamber is connected to tank.

Picture text:



Parking Brake Operation

1 : The brake chamber is connected to tank and springs push brake piston to the friction plates.

2 : The brake chamber is pressurized and pushed against spring tension.

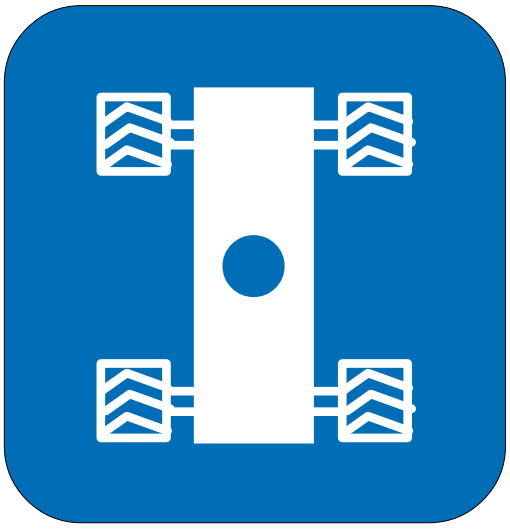
Picture text:

Brake system

Picture text:

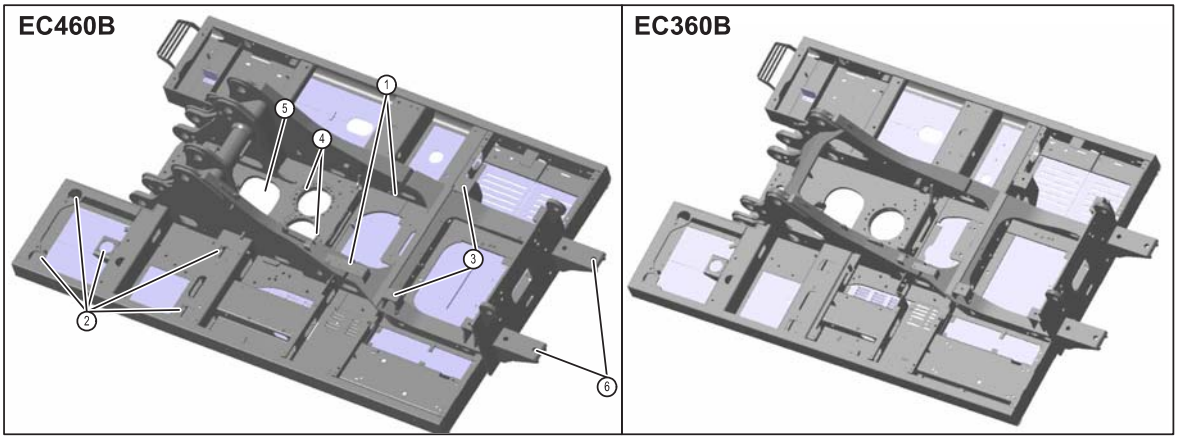
Steering system

Picture text:



Frame & Track Unit

Picture text:

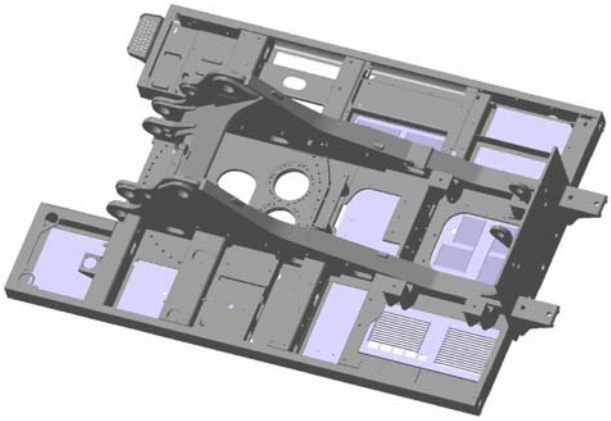


Upper frame(D12D engine)

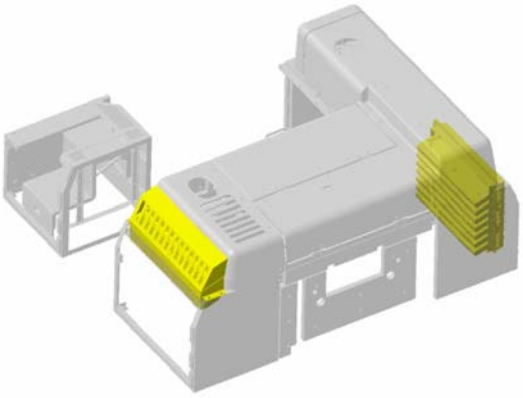
1. Center frame
2. Cabin mouting position
3. Engine mounting position
4. Swing motor mounting position
5. Turning joint mounting position
6. Counterweight mounting position

Picture text:

(1)



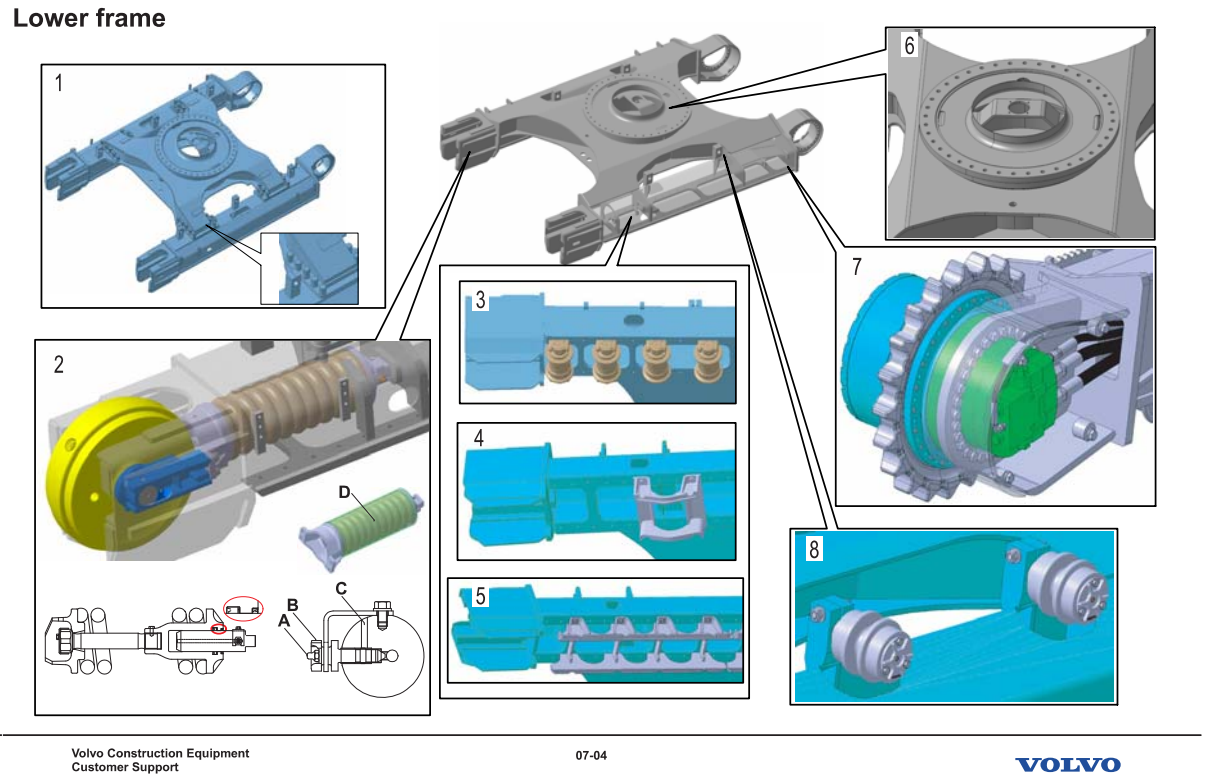
(2)



Upper frame(EC700B)

1. Upper frame(EC700B)
2. Low noise kit

Picture text:



Lower frame

1. Adjustable Lower frame(EC460B/EC700B)
2. Idler & Track tensioner

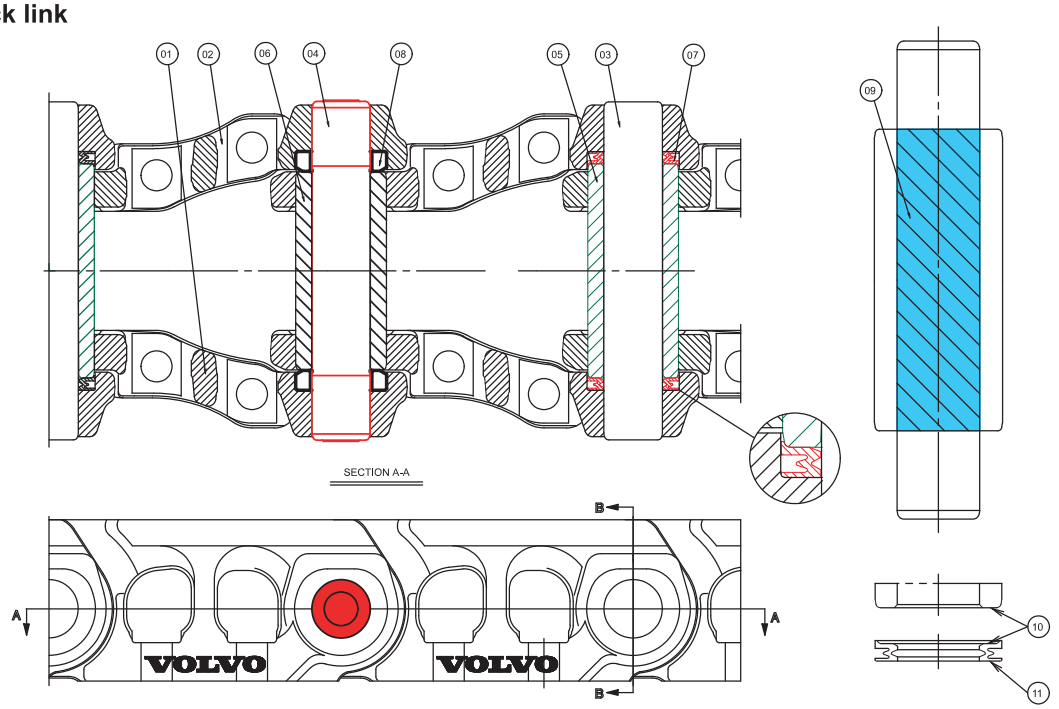
There is high pressure grease in track adjuster cylinder. Do not remove grease fitting or nut and valve assembly to release grease.

To decrease track sag, add multi-purpose grease to track adjuster cylinder through grease nipple(A) using a grease gun with a maximum capacity 690 bar (10000 psi). To increase track sag, loosen valve assembly (B) one turn so that grease in the track adjuster cylinder can be drained through rod hole (C). Tighten the valve assembly when track sag is correct.

3. Lower roller(ISO VG 220, EP Oil)
4. Roller guard(Standard)
5. Roller guard(Heavy duty)
6. Swing supporter area
7. Track drive & Sprocket
8. Upper roller(ISO VG 220, EP Oil)

Picture text:

Track link

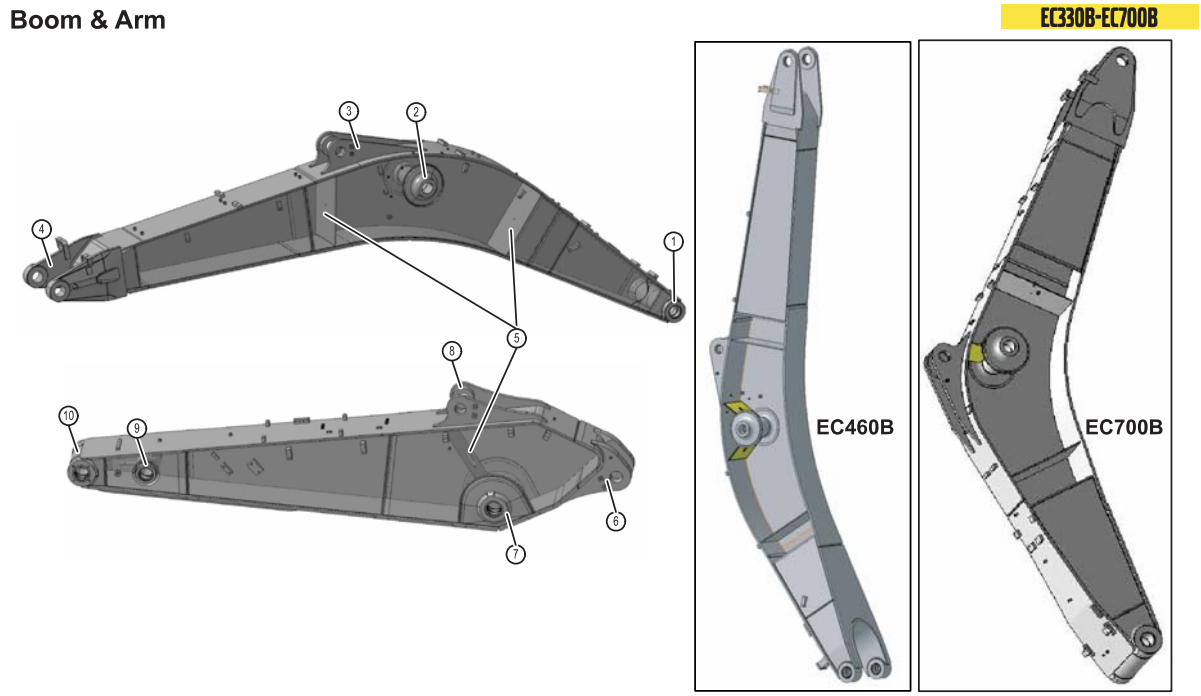


Track Link

1. Link LH
2. Link RH
3. PIN-Regular
4. PIN-Master
5. Bushing-Regular
6. Bushing-Master
7. Seal
8. Spacer
9. Greasing area
10. Greasing area
11. Do not apply grease here.

**EP2 Grease

Picture text:



Boom & Arm

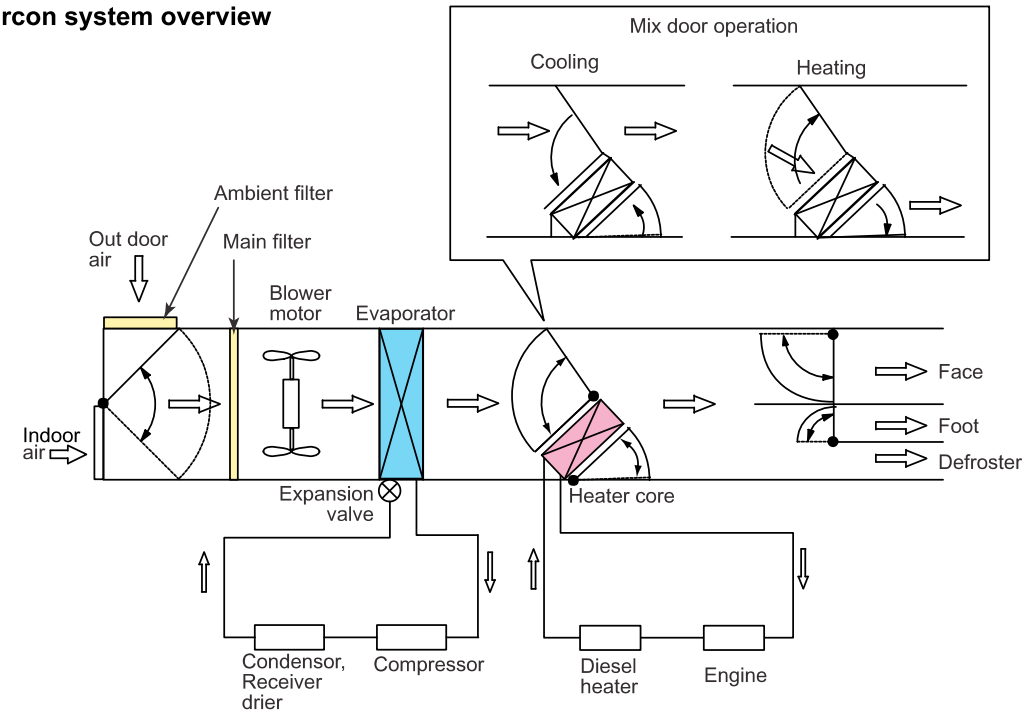
1. Boom-Rear Bearing
2. Boom-Center Bearing
3. Arm Cylinder Lug(Boom side)
4. Boom-Front Lug
5. Stiffener
6. Arm Cylinder Lug(Arm side)
7. Boom-Arm Bearing
8. Bucket Cylinder Lug
9. Yoke Bearing
10. Arm front Bearing

Picture text:

Air conditioning system

Picture text:

Aircon system overview

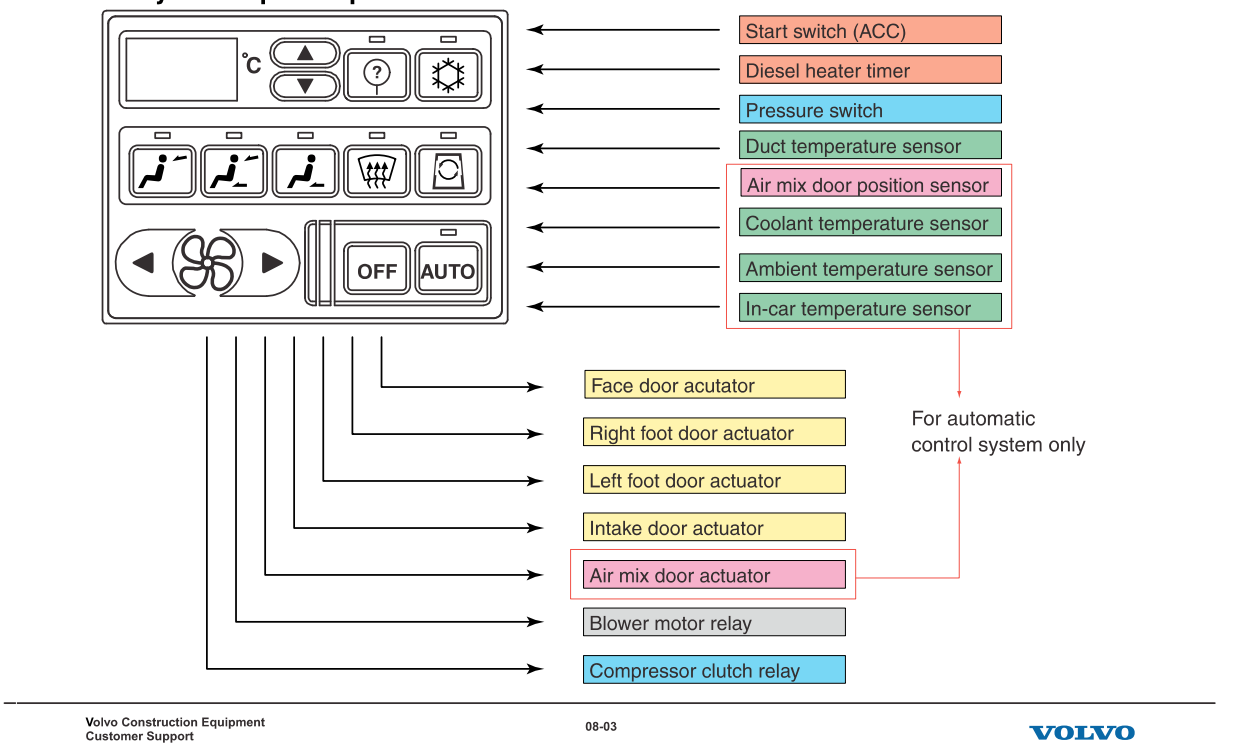


Air conditioning system overview

- Heating and cooling system is installed in a single unit.
- Can select indoor or outdoor air.
- Mix door controls target temperature of system by mixing cold and hot air.
- There are two filters.

Picture text:

Aircon system input-output



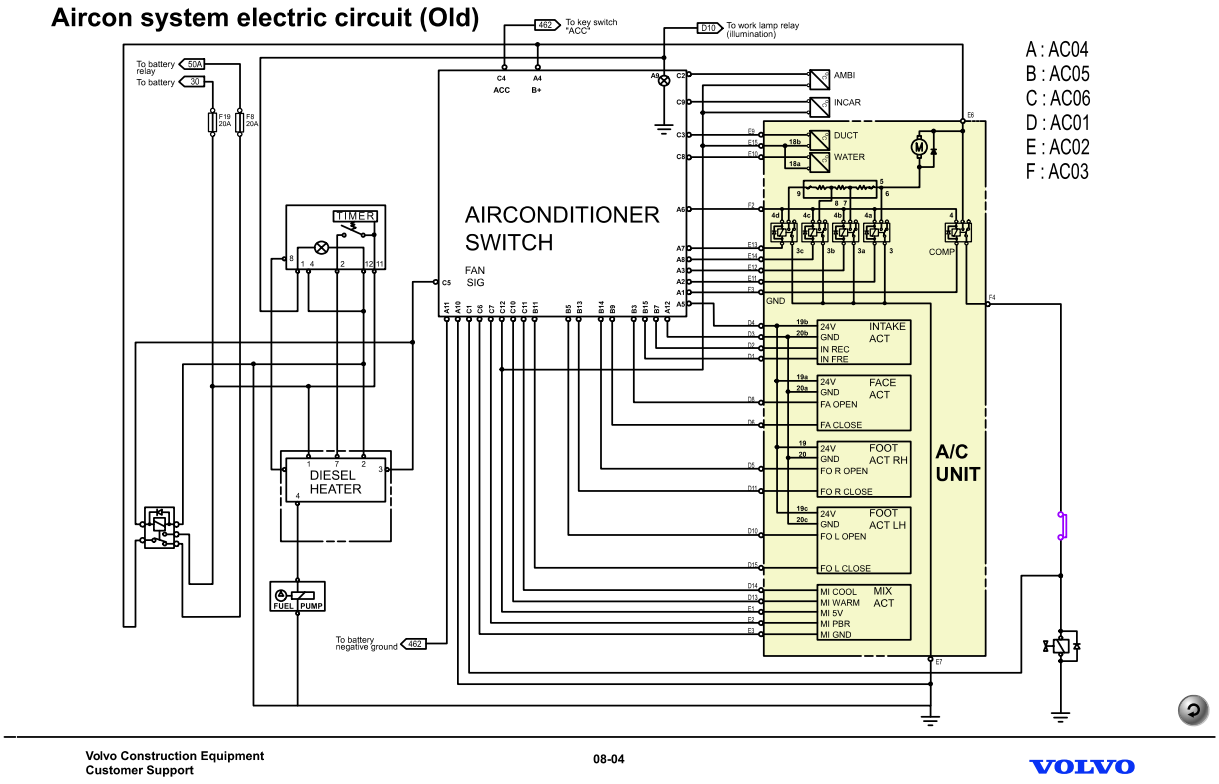
Air conditioning system input & output

When you equipped with Auto air conditioning system, you can operate system in auto-mode or manual-mode.

By pushing AUTO switch, system can be operated automatically. The only thing what operator has to do is setting the target temperature.

In auto-mode when other switches except temperature setting and trouble checking switch is operated, the control system is changed to the manual-mode.

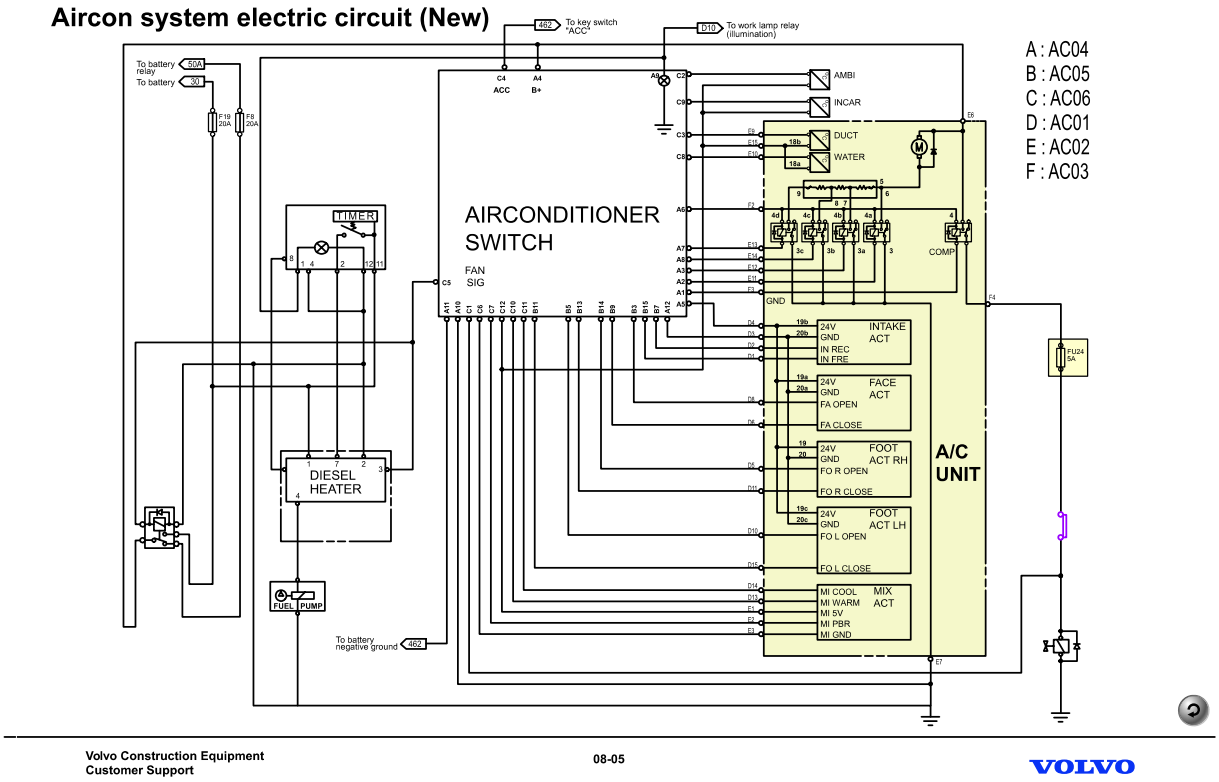
Picture text:



Aircon system electric circuit(Old)

By clicking the line, you can change the color of the line.

Picture text:



Aircon system electric circuit(New)

An additional 5A(FU24) fuse has been installed in the air conditioning compressor circuit to protect it from excessive current.

Picture text:

System status indication

Item	Indicate code	Display example	Unit	Remark
Target tempreature		25	ºC	Manual : C4 ~ C1, H0 ~ H4 Emergency : 1 ~ 9
Ambient temperature	A	A24	ºC	
Error code	E	E 1	-	No error : skip
*Coolant temperature	c	c27	ºC	
*Duct temperature	d	d10	ºC	
*Mix door open	F	F60	%	Full close : 0%, Full open : 99%
*Compressor clutch	1	1 0	-	1 : ON, 0 : OFF
*Pressure switch	2	2 0	-	1 : ON, 0 : OFF
*Mix actuator moving direction	3	3 0	-	0 : Stop, 1 : to Cold, 2 : to Hot

* Depress check switch more than 5 sec. than these items can be displayed.(check LED blink)

** When sensor failure, temperature value '99' is displayed.

System status indication

The status display has two modes. (Operator mode and Service mode)

In operator mode, you can check only target temperature, ambient temperature and error code.

In service mode, you can check all of items.

Picture text:

Error code

Error code	Component	Fault Cause
E1	Incar temperature sensor	Abnormal input
E2	Ambient temperature sensor	Abnormal input
E3	Mix position sensor	Abnormal input
E4	Coolant temperature sensor	Abnormal input
E5	Duct temperature sensor	Abnormal input
E6	Mix driver	Abnormal operation of Mix actuator

* When an error is detected
- Air conditioning controller automatically switched to emergency mode.
- Temperature control step
  . 1~ 4 : Same as manual mode C4 ~ C1
  . 5 : Same as manual mode H0
  . 6 ~ 9 : Same as manual mode H1 ~ H4

** Error code E5 : Compressor clutch OFF

Error code

Picture text:

Manual mode control

Compressor and Mix door control

Switch step	Compressor clutch / Mix door control
C4	Duct temp <= 1 °C : OFF, Duct temp >= 6 °C : ON
C3	Duct temp <= 3 °C : OFF, Duct temp >= 10 °C : ON
C2	Duct temp <= 6 °C : OFF, Duct temp >= 15 °C : ON
C1	Duct temp <= 9 °C : OFF, Duct temp >= 17 °C : ON
H0	Neutral
H1	Mix door : 25% open
H2	Mix door : 50% open
H3	Mix door : 75% open
H4	Mix door : 100% open

Mode door control

Mode	Face Actuator	Foot(LH) Actuator	Foot(RH) Actuator
Foot	0%	100%	100%
Face/Foot	100%	100%	100%
Face	100%	0%	0%

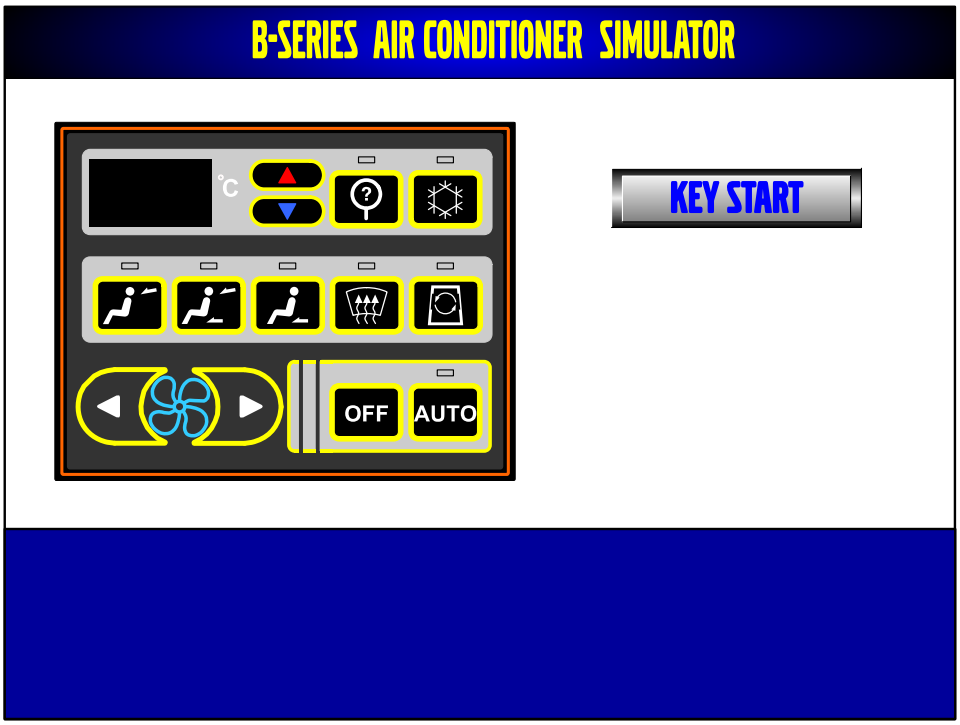
Intake door control

Mode	In door air	Out door air
Out door	50%	50%
In door	90%	10%

Manual mode control

Picture text:

Aircon animation

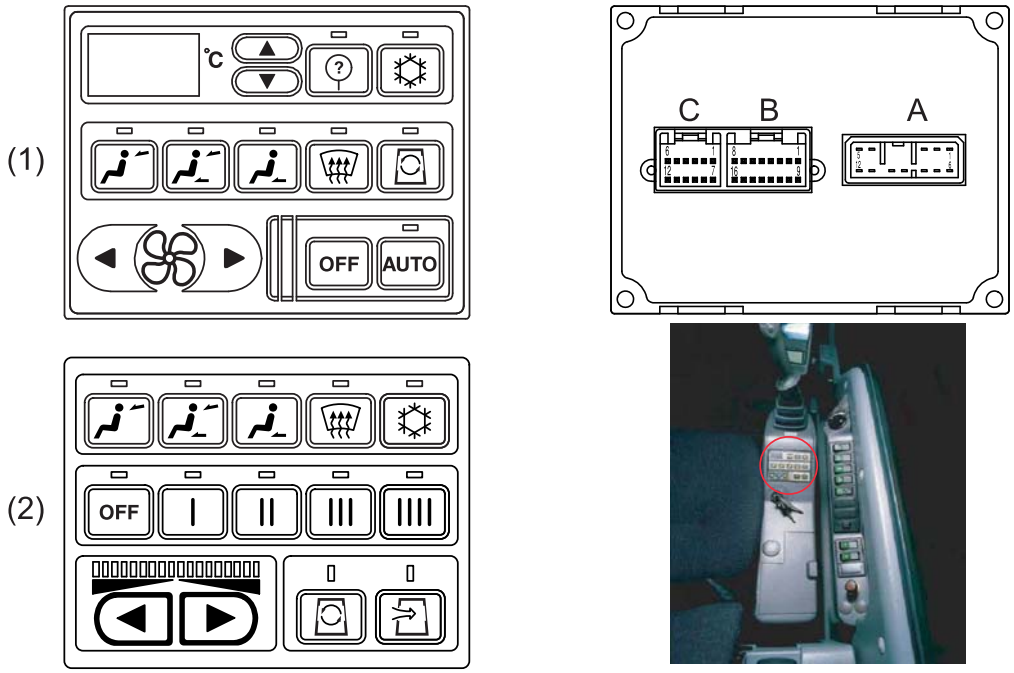


Air conditioning switch animation

Press button step by step.

Picture text:

Controller Auto & Manual(Option)



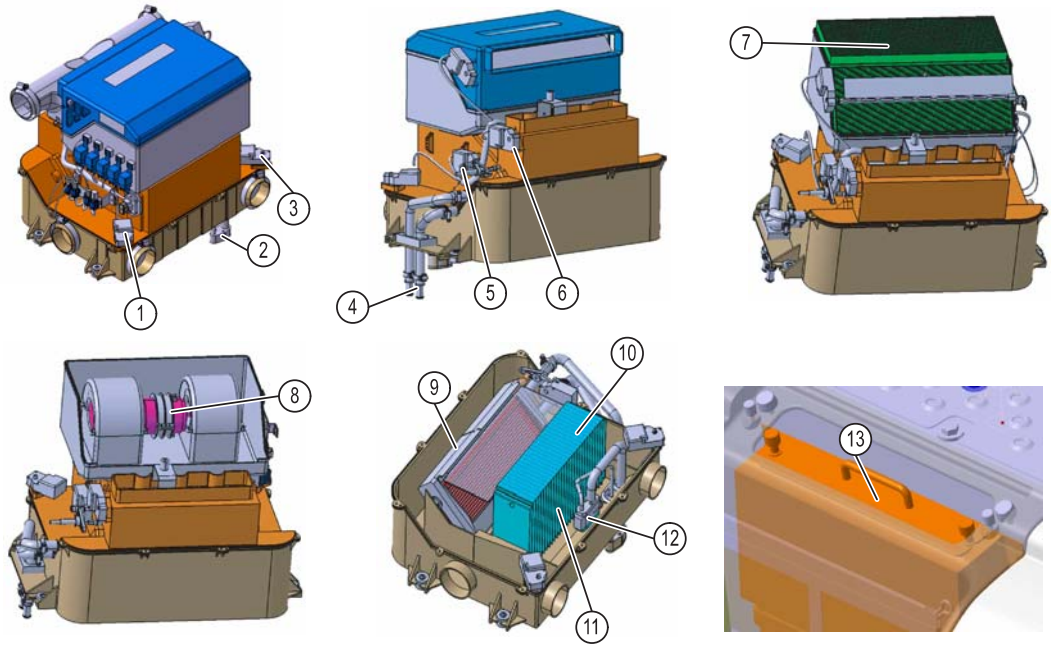
Controller- Auto and Manual(Option)

(1) Auto controller
(2) Manual controller

Manual type controller is an option for tropical area.
It has only cooling unit. There is no heating unit so there is also no mix-door actuator and coolant temperature sensor.
And for this option, there is no in-car & ambient temperature sensor

Picture text:

Air conditioner unit

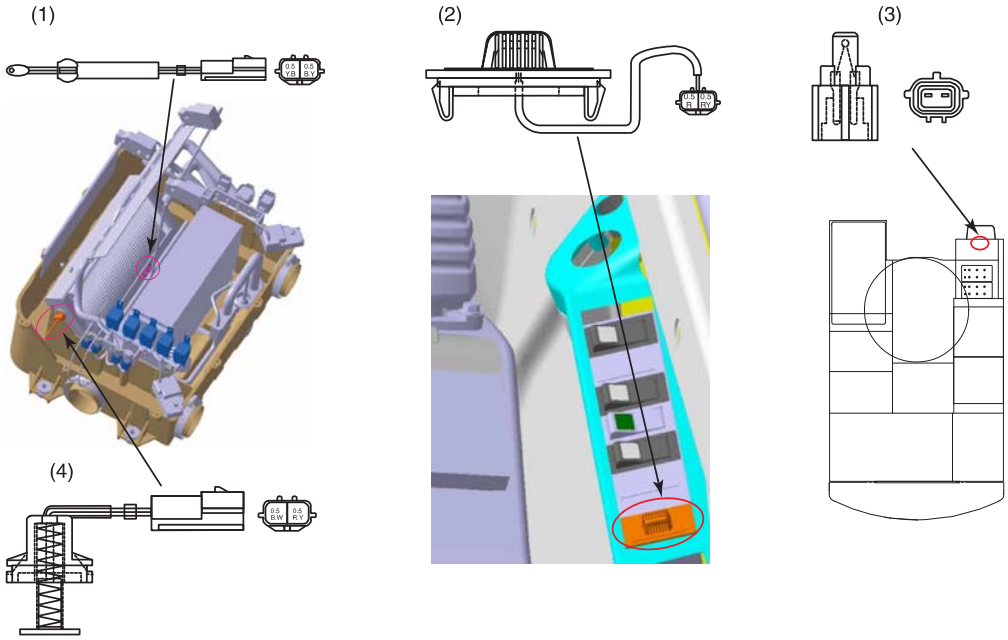


Air conditioner unit

1. Actuator - RH foot
2. Connection point - Refrigerant
3. Actuator - LH foot
4. Connection point - Coolant
5. Actuator - Mix door
6. Actuator - Face door
7. Filter - Main
8. Blower fan
9. Heater core
10. Evaporator
11. Duct temp. sensor
12. Expansion valve
13. Filter - Ambient

Picture text:

Sensors



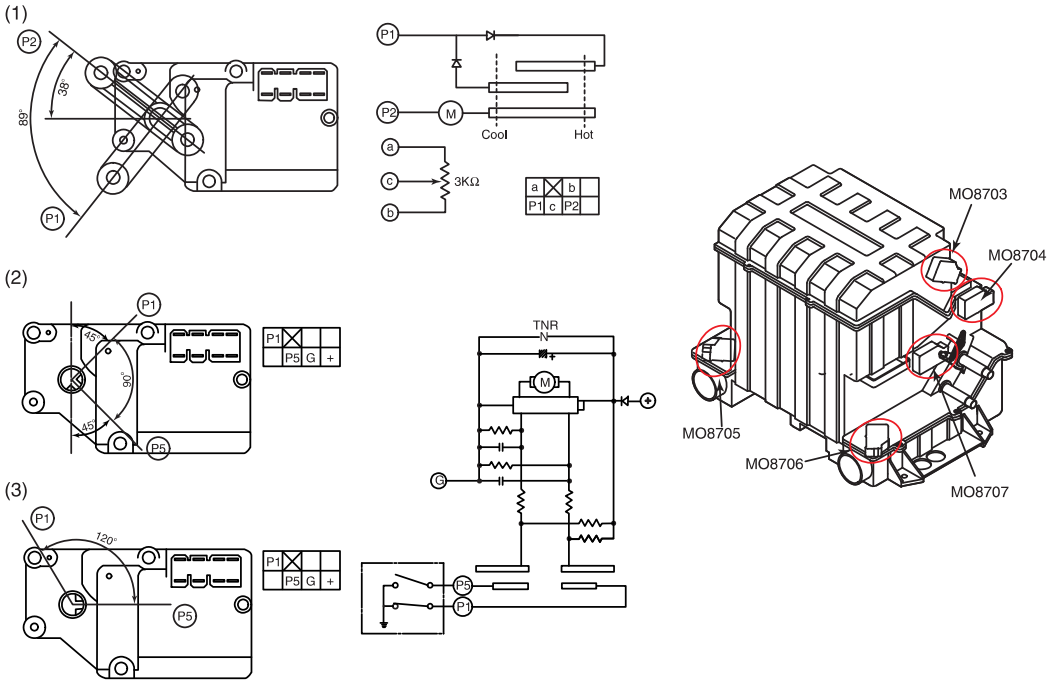
Sensors

Duct temperature sensor is installed at the core of evaporator.
If sensor is failed, compressor clutch will be disabled.

1. Duct temperature sensor
2. In-car temperature sensor
3. Ambient temperature sensor
4. Coolant temperature sensor

Picture text:

Acutuator



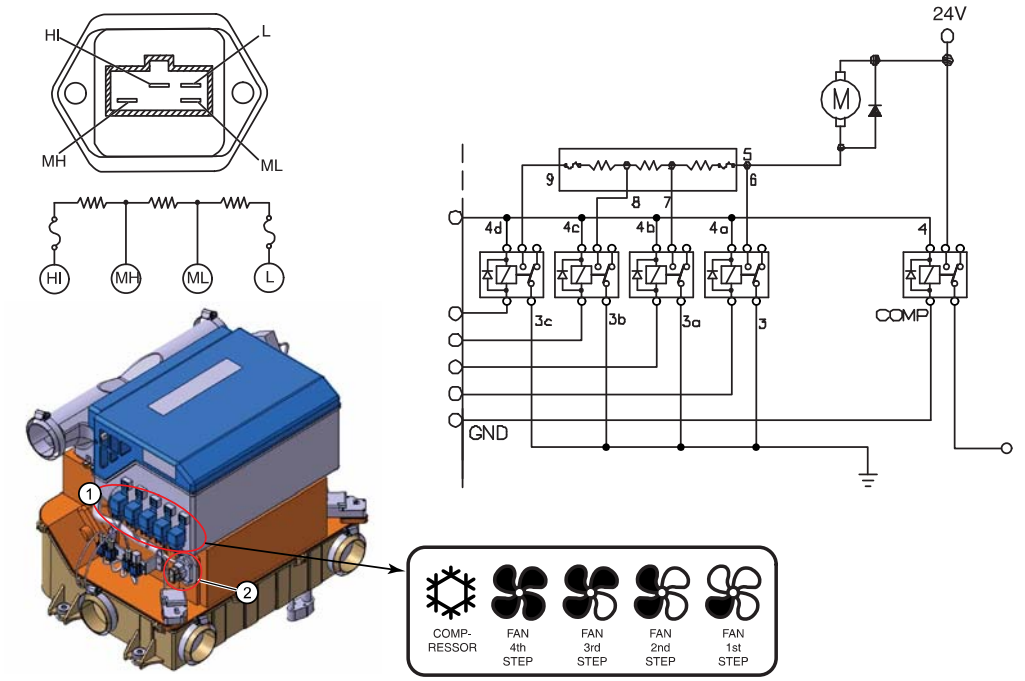
Actuator

1. Mix door actuator(MO8707)
- Inside of mix-door actuator, there is a position sensor. This informs the real-position to controller for precise positioning.(Feedback control)

2. Foot, Face door acutator(MO8704-6)
- Opeating angle= 90 degree

3. Intake door acutator(MO8703)
- Operating angle= 120 degree

Picture text:



Resistor and relays

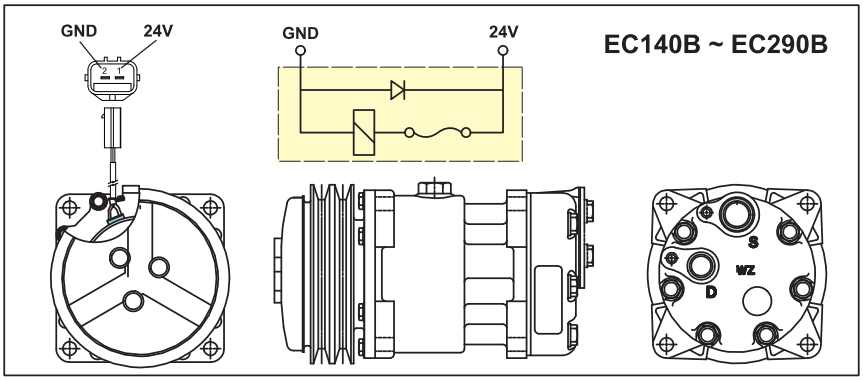
The resistor and 4 relays are used for controlling blower speed. And 1 relay is used for compressor clutch control.

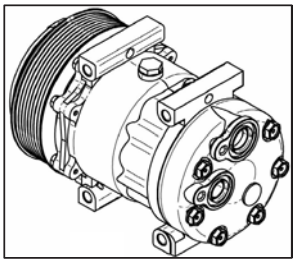
Inside of resistor, there is two lead fuses. If there is problem with this resistor, we can use only maximum fan speed.

1. Relay
2. Resistor

Picture text:

Compressor





EC330B ~ EC700B

Compressor

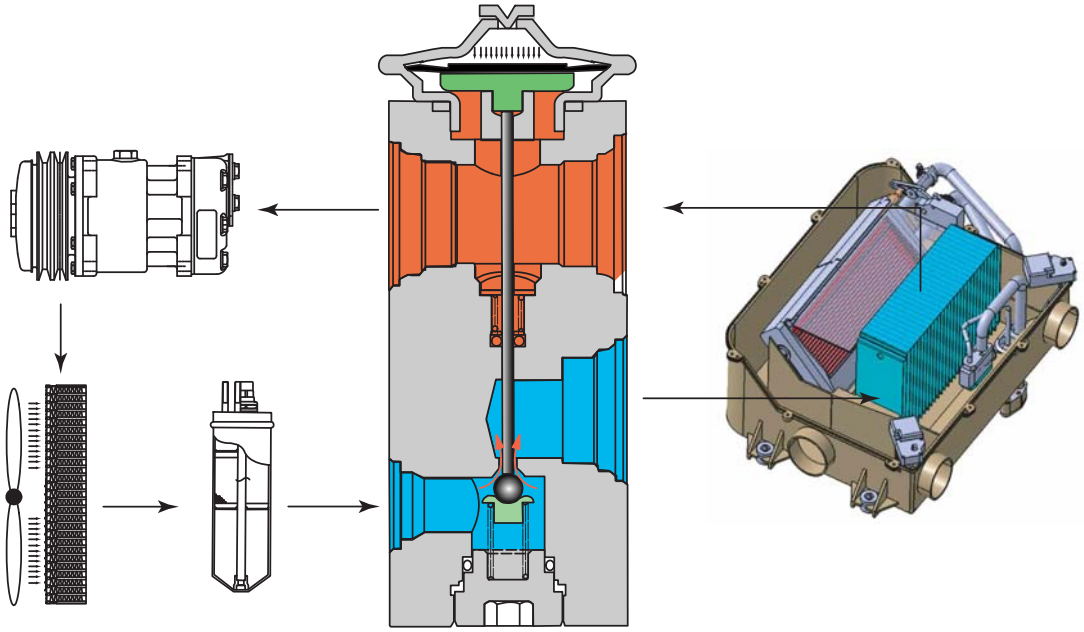
S: Suction port(bigger port)
D: Delivery port(high pressure side,smaller port)

New compressor has 2 pin connector.(+,GND)

Old type has one pin connector.(+, body GND)

Picture text:

Expansion valve



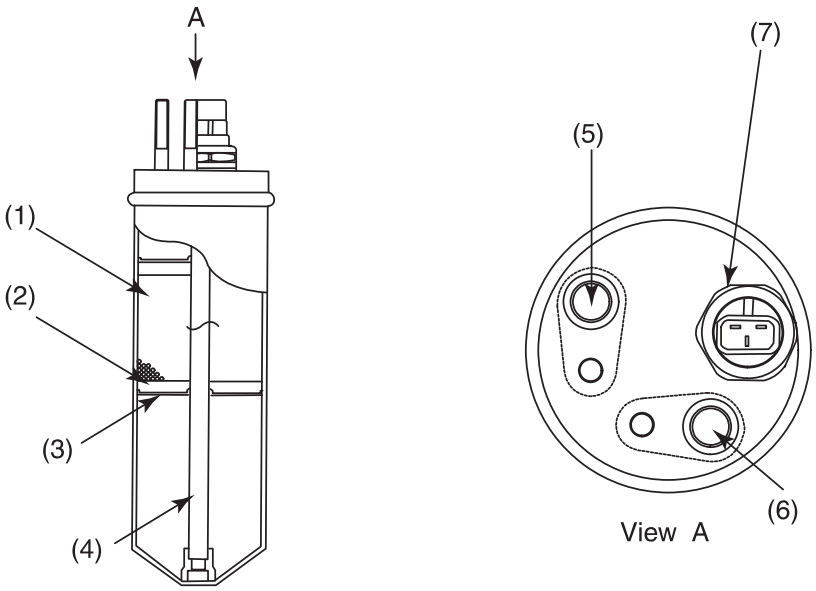
Expansion valve

This is a kind of feedback system.
From output temperature from evaporator, System decides the amount of refrigerant.

Output temp. high ---> More flow
Output temp. low ---> Less flow

Picture text:

Receive dryer



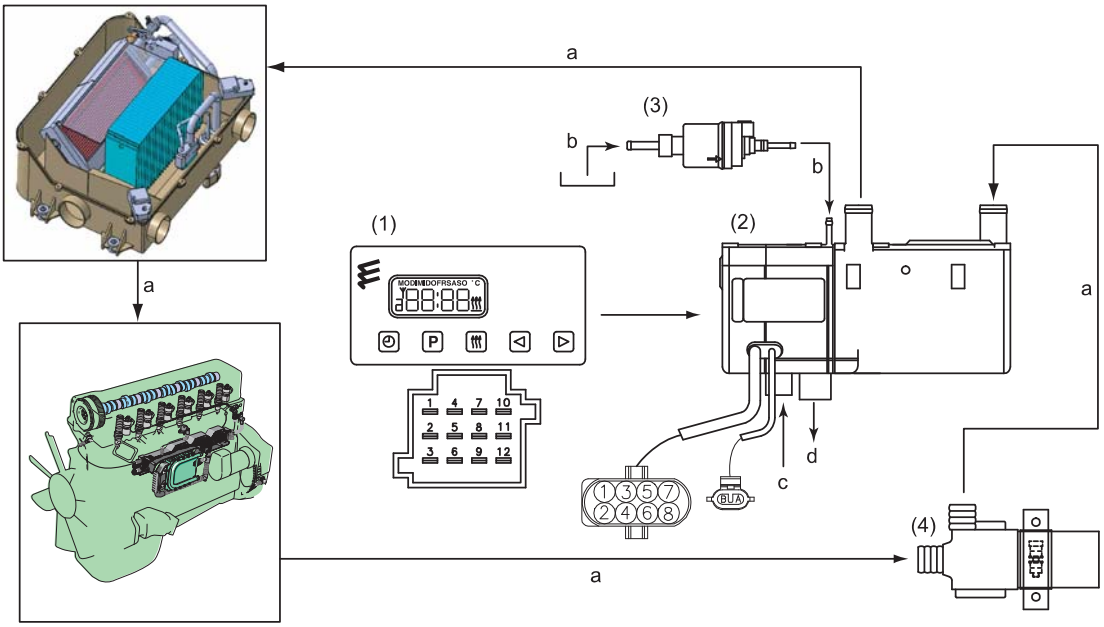
Receive dryer

Receive dryer
- Is a kind of reservoir to store excess liquid refrigerant in the system.
- Is a strainer or filter to remove particles from the system.
- Has desiccant to absorb moisture from the refrigerant.
- Has a built in pressure switch to protect system from excessive high or low pressure.

1. Desiccant
2. Filter
3. Baffle plate
4. Inner tube
5. Outlet port
6. Inlet port
7. Pressure switch
- Low pressure OFF : 2.0 +/- 0.2 kgf/cm^2
- High pressure OFF : 32 +/- 2 kgf/cm^2

Picture text:

Diesel heater components



Diesel heater components

1. Timer
The timer controls the diesel heater, and displays the operating status. The display shows current date, current time and operating time.

2. Controller & Heating unit
The heating unit raises the temperature of the coolant using the fuel combustion unit, consists of the glow plug, the thermostats, the flame sensor, the controller, the electric motor and the fuse. The case of the unit has the fuel supplying port, the coolant inlet/outlet port, the air inlet port and the exhaust port.

3. Fuel pump
The fuel pump supplies the diesel heater with the fuel from the tank.

4. Water pump
The water pump is located between the diesel heater and the engine block, and supplies the diesel heater with the coolant from the engine block.

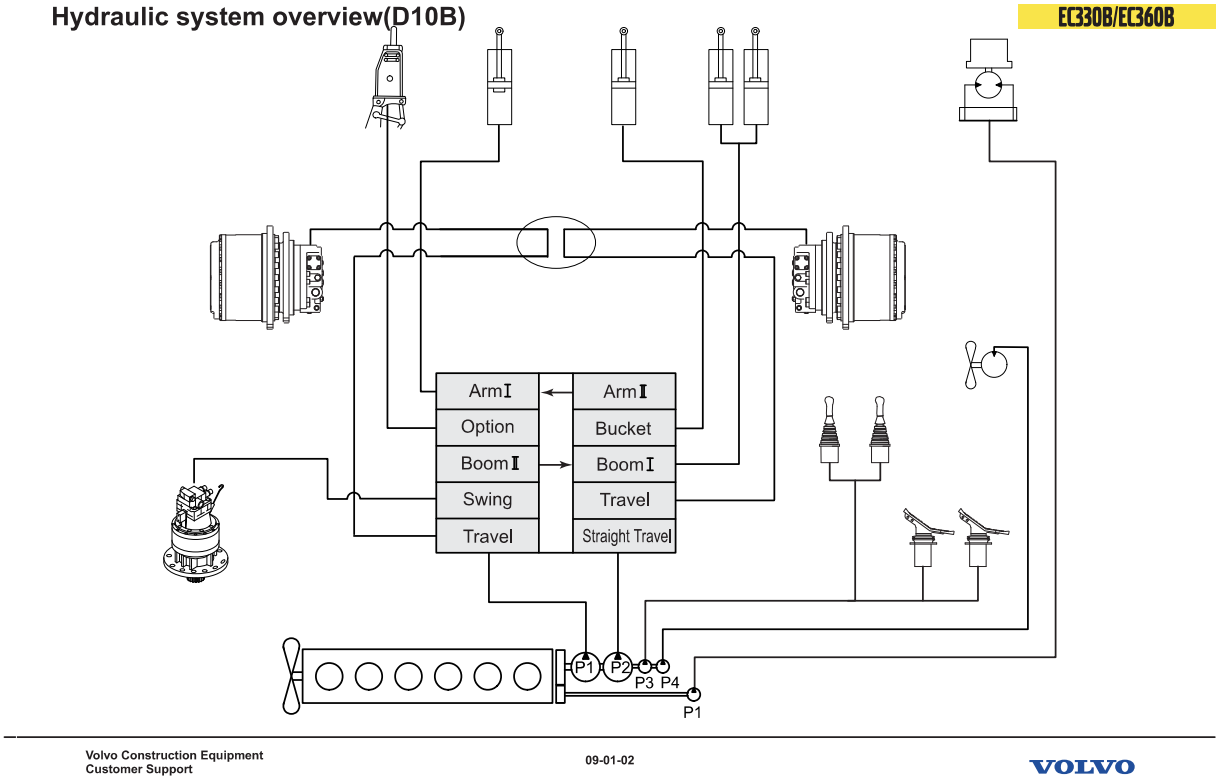
a: Water flow
b: Fuel
c: Fresh air
d: Exhaust gas

Picture text:

EC330B/EC360B(D10B & D12C)

Hydraulic System(EC330B-EC360B)

Picture text:

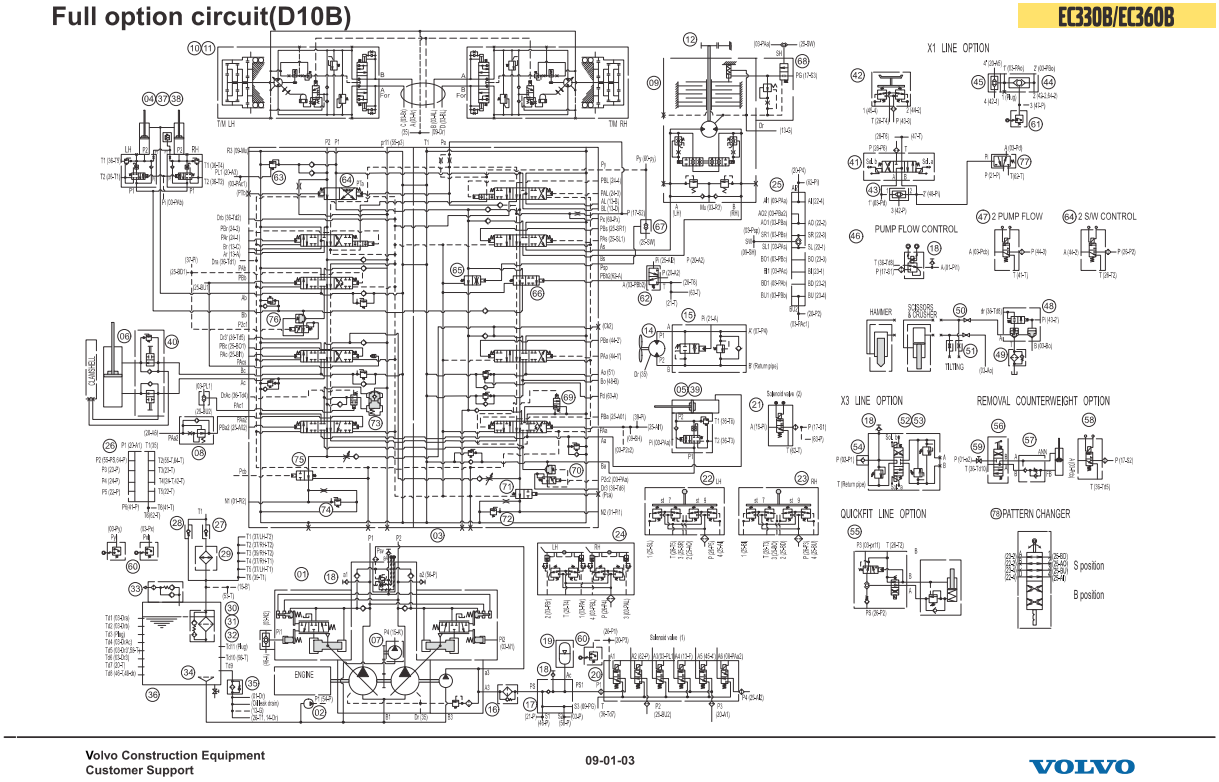


Hydraulic system overview

The mechanical power from engine converted to hydraulic power.
Machine has two main pumps that are variable displacement piston pump.
And it has 3 fixed gear pumps. P3 is for servo system. P4 is for hydraulic oil cooler fan motor. P1 is for X3.

Travel: straight travel function
Boom-up: 2-pump flow
Boom-down: Regeneration
Boom: Holding function
Arm-in & out: 2-pump flow
Arm: Holding function
Arm-in: Regeneration
Option: 2-pump flow (selectable)
Swing: priority against arm during simultaneous operation

Picture text:

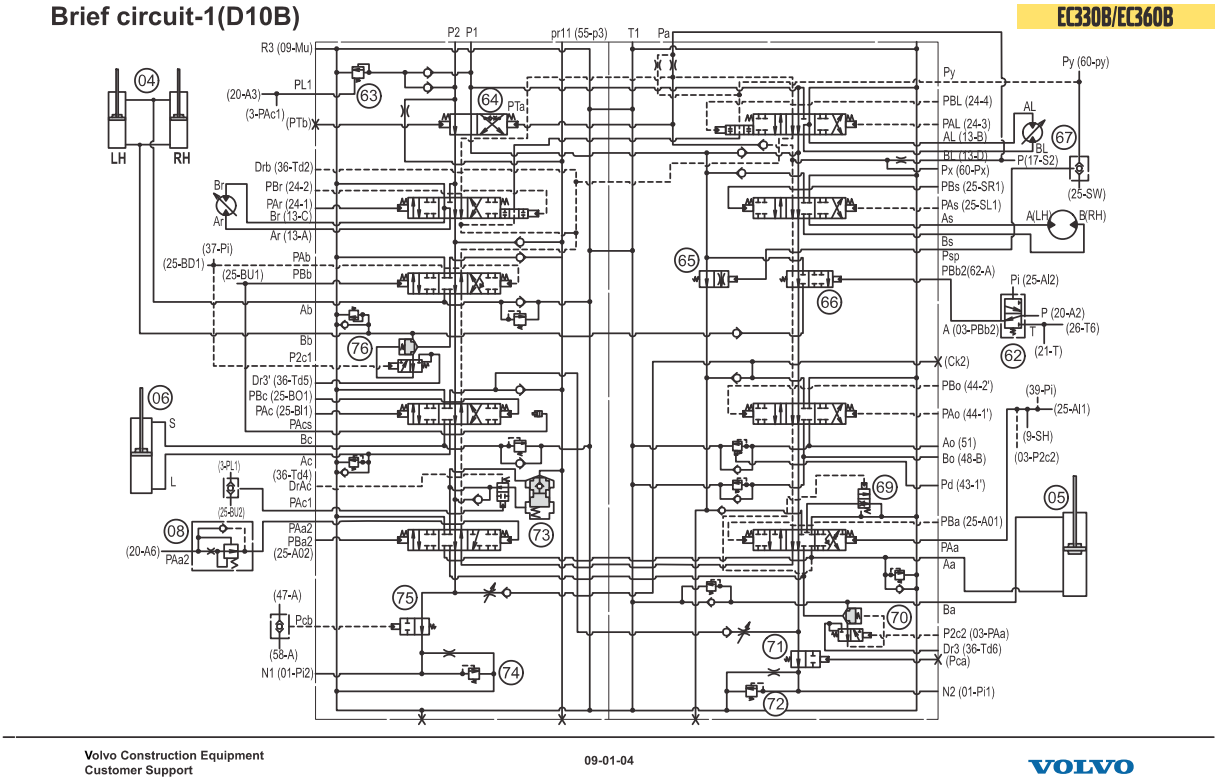


Full option circuit

This is the circuit that covers all of option.
In the circuit diagram, every component has unique number and there are many parentheses.

For example N1(01-Pi2). This means that the port N1 is connected to the port Pi2 of the component 01(Main pump). This is the way how to read our circuit diagram.

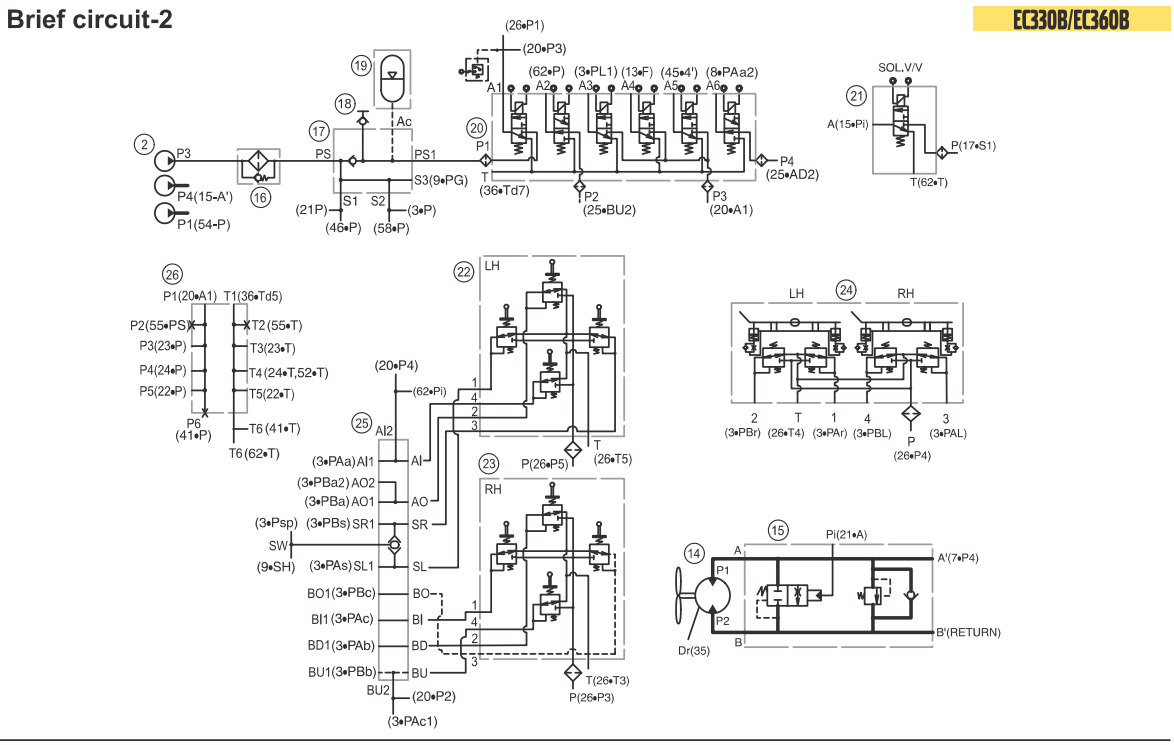
1. Main pump
2. Rotator pump
3. MCV
4. Boom cylinder
5. Arm cylinder
6. Bucket cylinder
7. Pump for Hyd. oil cooling
8. Flow control valve
9. Swing Drive unit
10. Track motor
11. Track gear box
12. Slewing ring gear
13. Turning joint
14. Fan motor
15. Shunt valve
16. Pilot filter
17. Accumulator block
18. Quick coupler
19. Accumulator
20. Solenoid valve(1)
21. Solenoid valve(2)
22. RCV-Lever(LH)
23. RCV-Lever(RH)
24. RCV-Pedal
25. Shuttle assy
26. Pilot block



Brief circuit-1(D10B)

Brief circuit for main line

Picture text:



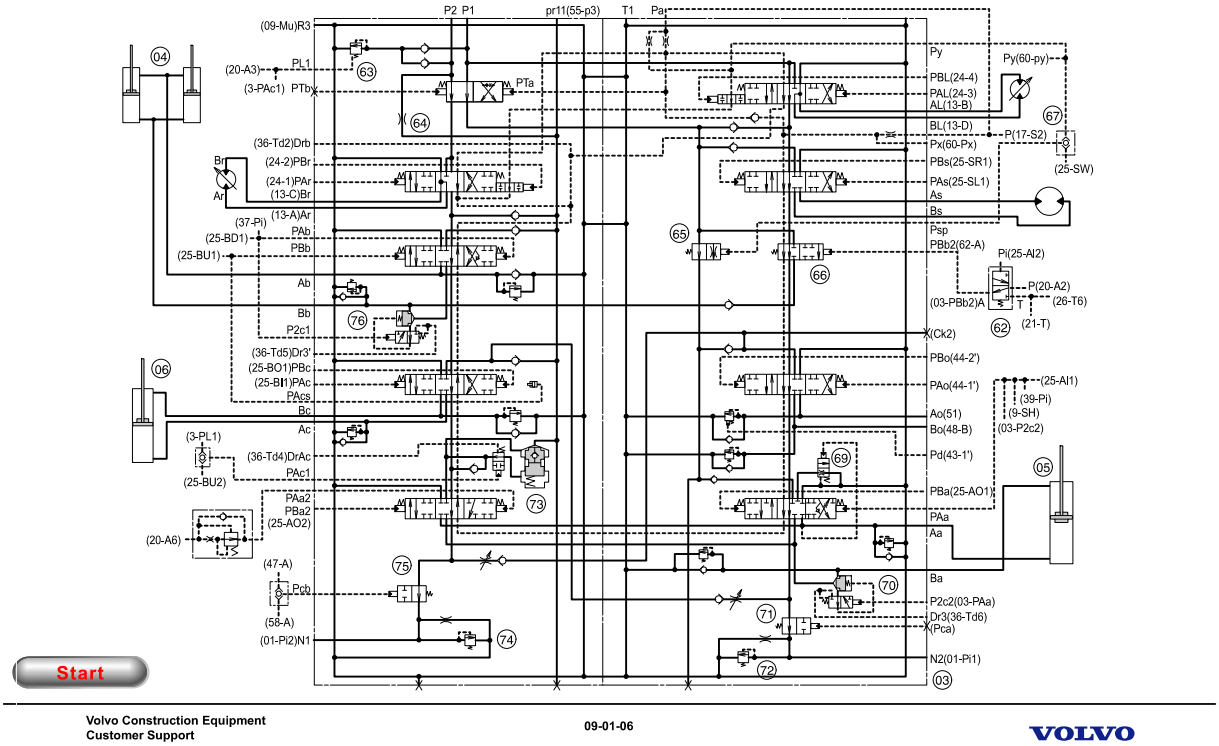
Brief circuit-2(D10B)

Brief circuit for pilot(servo) line

Picture text:

Circuit animation(D10B)

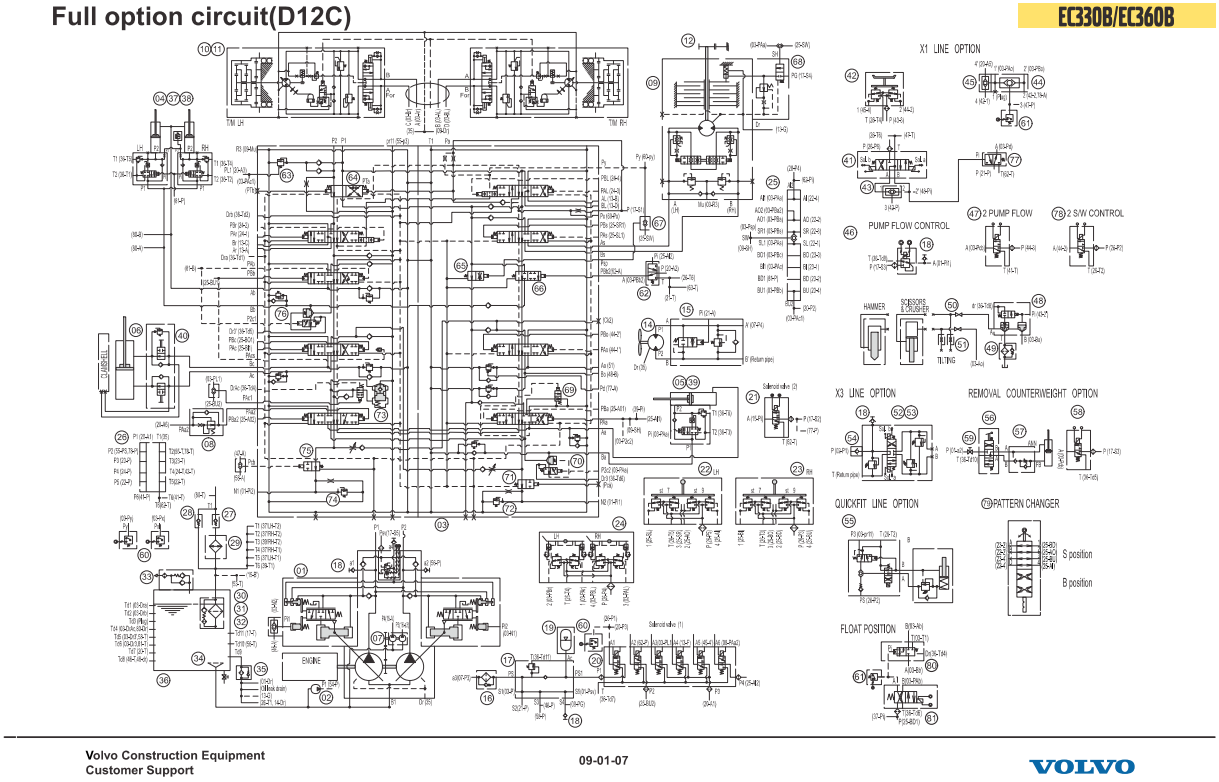
EC330B/EC360B



Circuit animation(D10B)

This animation can be used when you explain or study the hydraulic circuit. By pressing the lines, character or spool with mouse, you can change the colour of lines and spool location.

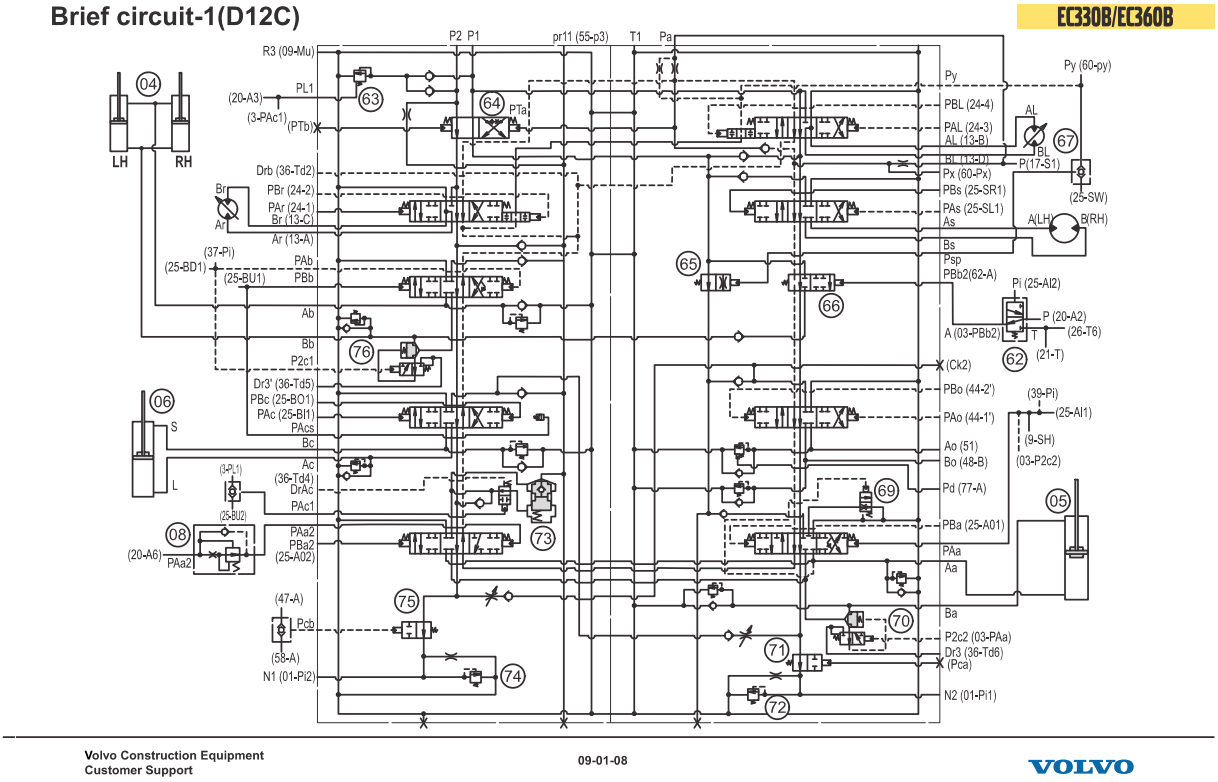
Picture text:



Full Option Circuit(D12C)

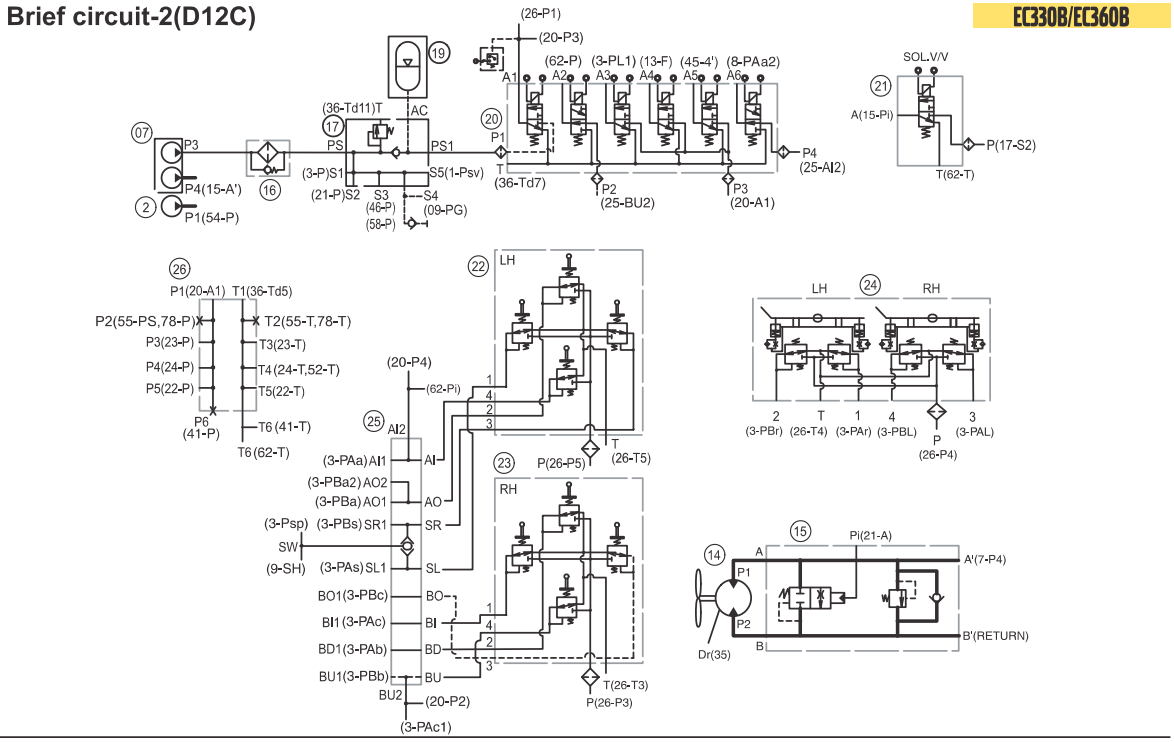
Due to D12C application, there was some changes at the hydraulic system.
Major change is pump.

Picture text:



Brief circuit-1(D12C)

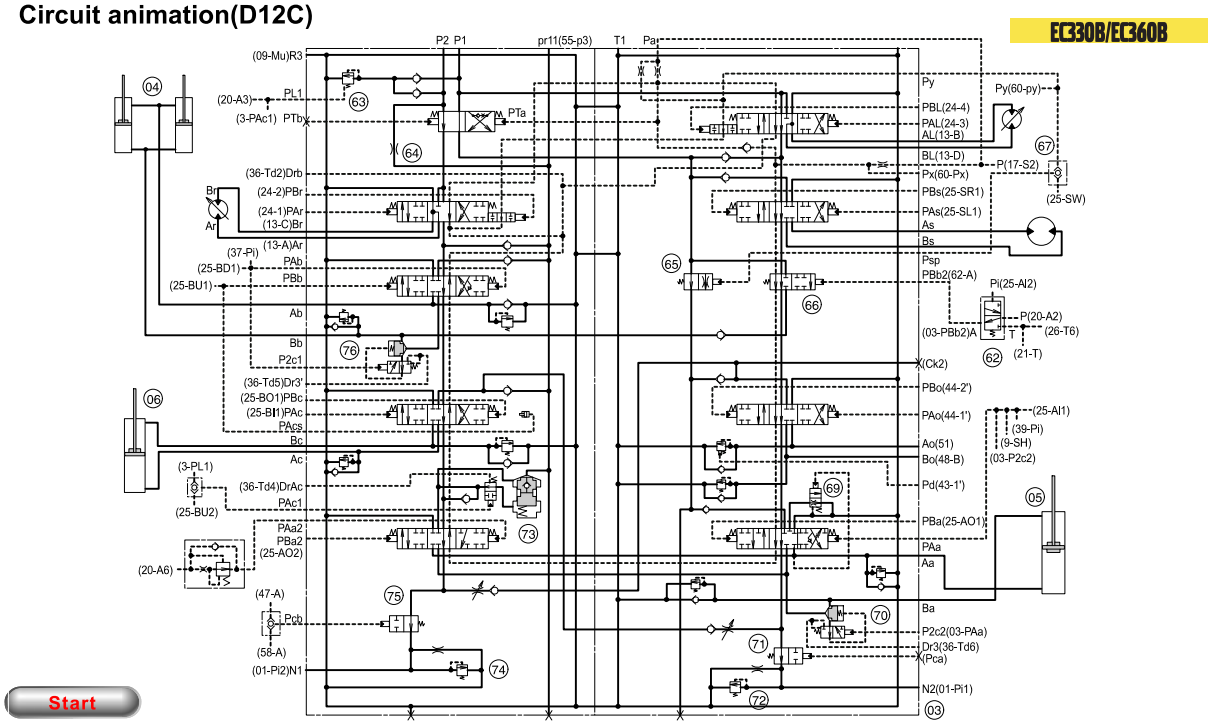
Picture text:



Brief Circuit-2(D12C)

Picture text:

Circuit animation(D12C)



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Circuit Animation(D12C)

Picture text:

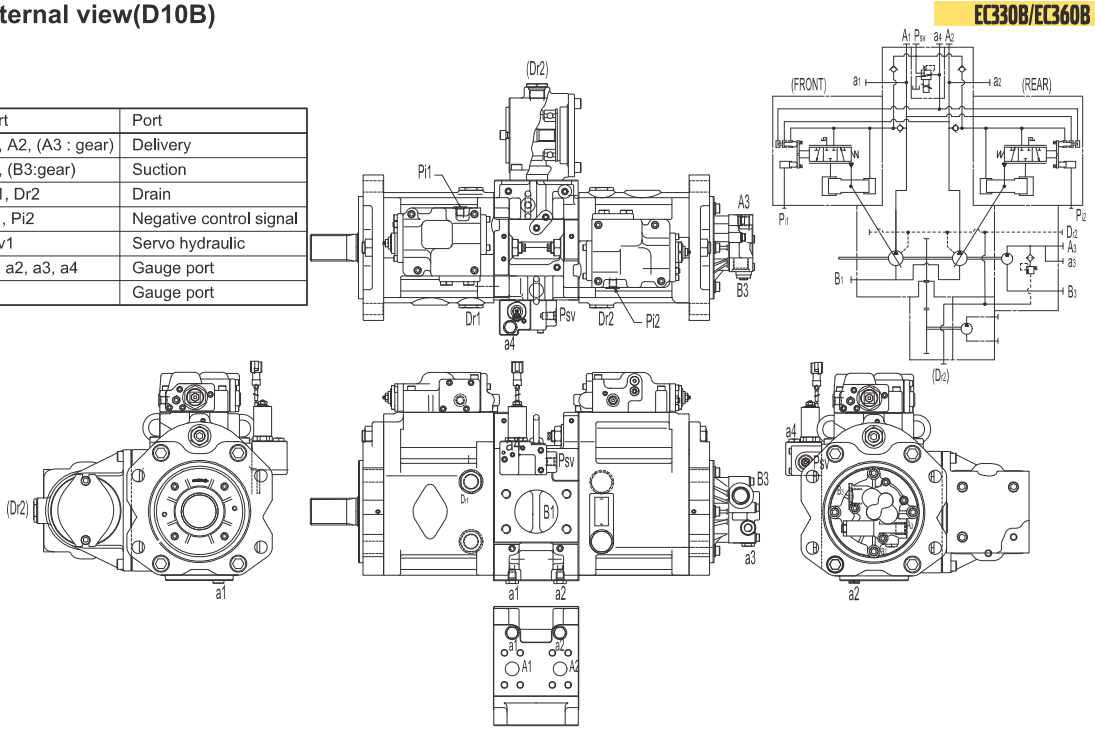
EC330B/EC360B(D10B & D12C)

Hydraulic pump

Picture text:

External view(D10B)

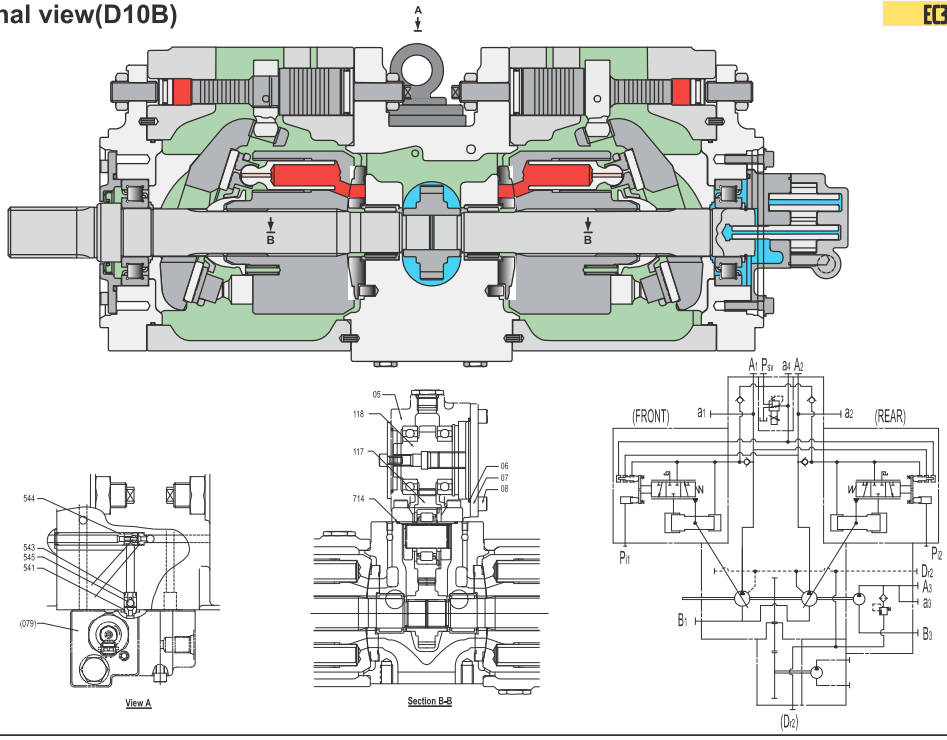
Port	Port
A1, A2, (A3 : gear)	Delivery
B1, (B3:gear)	Suction
Dr1, Dr2	Drain
Pi1, Pi2	Negative control signal
Psv1	Servo hydraulic
a1, a2, a3, a4	Gauge port
PB	Gauge port



External veiw(D10B)

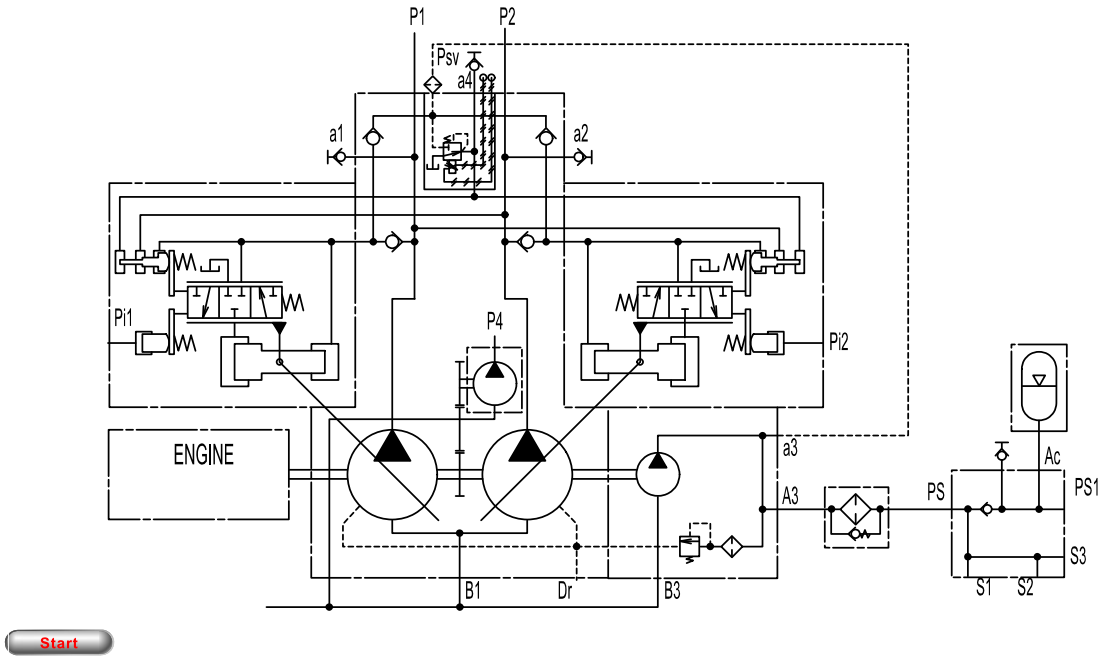
Check the port location and compare with the circuit diagram.

Picture text:



Sectional view(D10B)

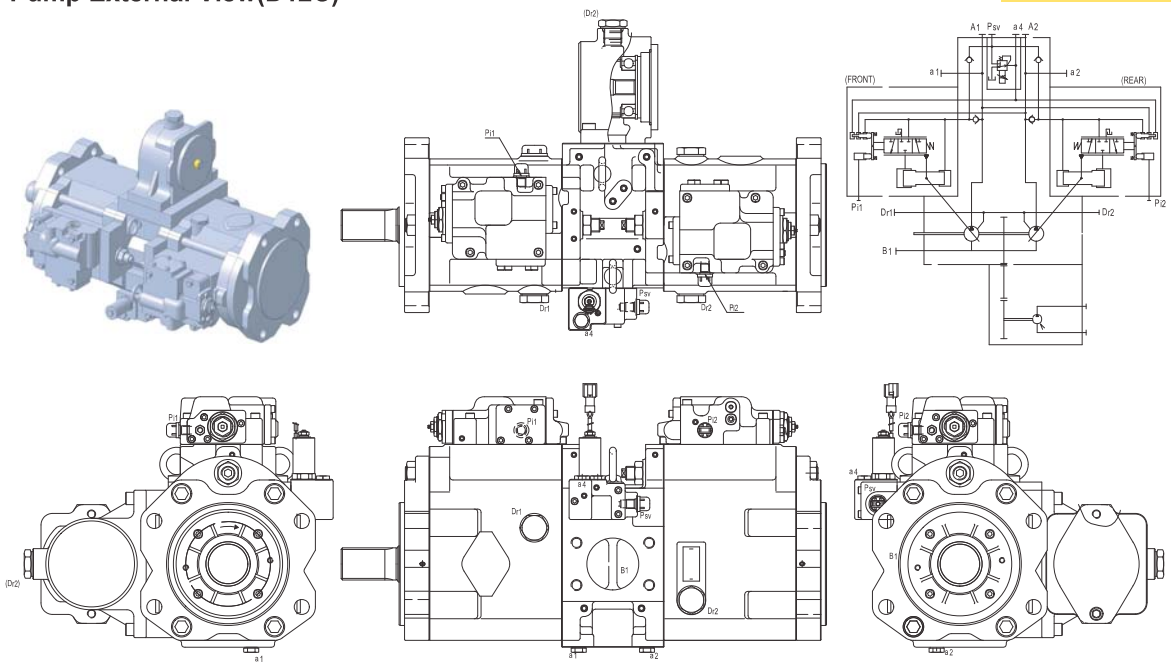
Picture text:



Pump circuit(D10B)

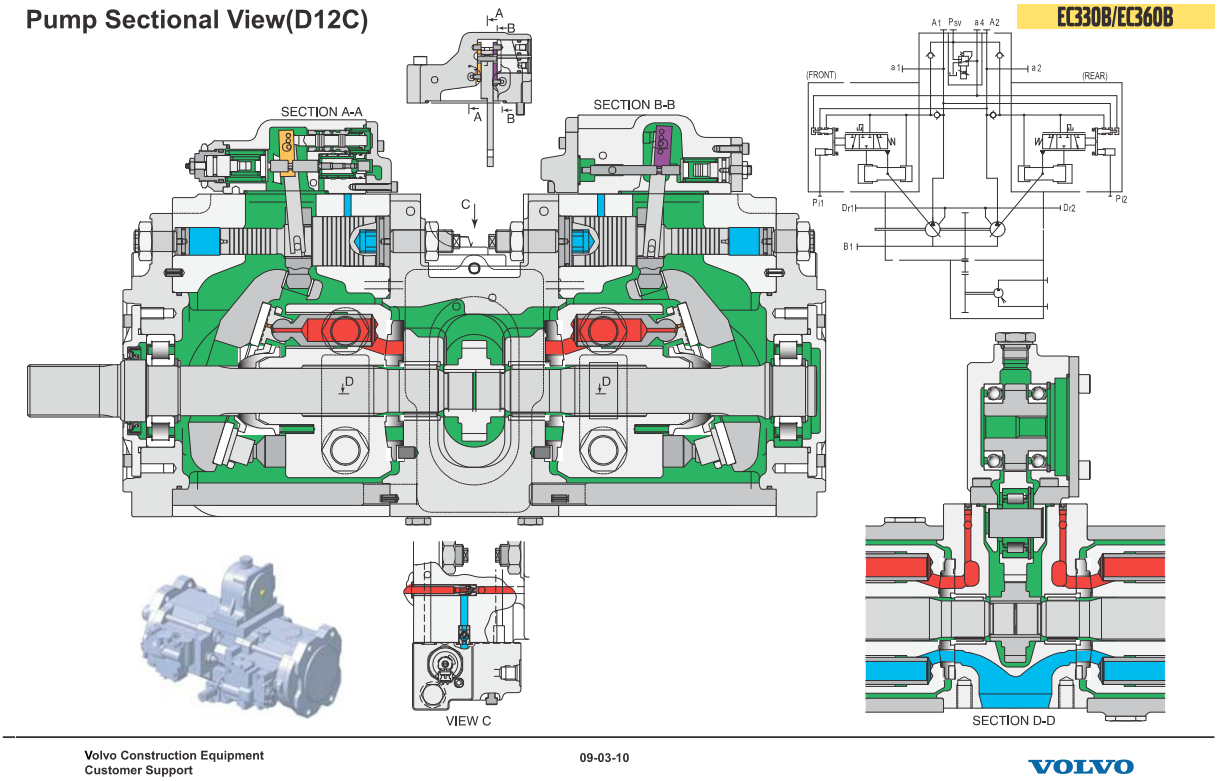
Picture text:

Pump External View(D12C)



External veiw(D12C)

Picture text:



Sectional view(D12C)

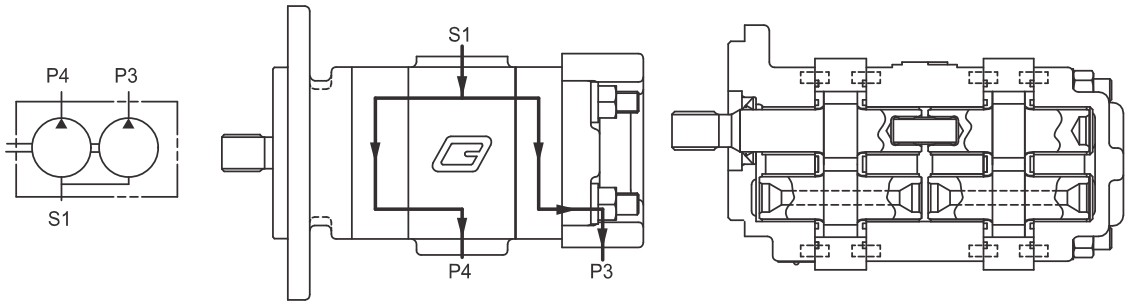
This pump assembly consists of two pumps connected by spline coupling.
The suction and delivery ports are integrated at the connecting section of the two pumps: The common suction port serves both the front and rear pumps.
The pump consists of rotary group, swash plate group and valve block group.

The rotary group consists of front drive shaft, cylinder block, piston and shoe, set plate, spherical bushing, and cylinder spring. The drive shaft is supported by bearings. The shoe is caulked to the piston to form a spherical coupling. It has a pocket to relieve thrust force generated by loading pressures and create a hydraulic balance so that it slides lightly over shoe plate.
The sub group composed of a piston and a shoe is pressed against the shoe plate by the action of the cylinder spring through the set plate and spherical bushing. Similarly, the cylinder block is pressed against valve plate by the action of the cylinder spring.

The swash plate group consists of swash plate, shoe plate, swash plate support, tilting bushing, tilting pin and servo piston.The servo piston moves to the right and the left as hydraulic oil controlled by the regulator flows to a hydraulic chamber located on both sides of the servo piston. The force exerted on the tilting pin by the servo piston causes the swash plate to slide on support to change the tilting angle.

The valve block group consists of valve block, valve plate and valve plate pin. The valve plate which has two crescent ports is attached to the valve block to feed oil to and collect oil from the cylinder block. The oil discharged via the valve plate is routed to an external pipe line by way of the valve block.

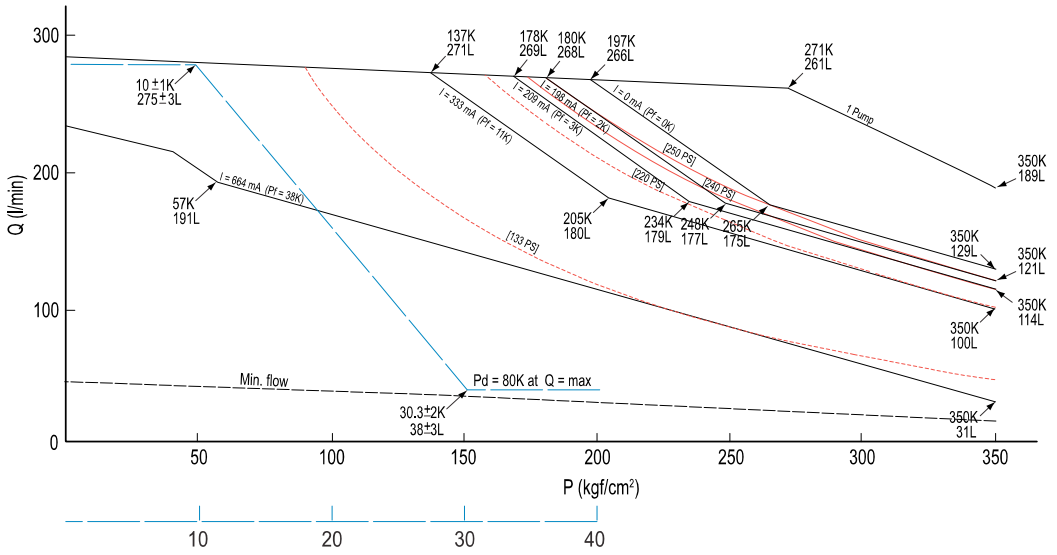
Picture text:



Classification	Unit	Specification	
Model		P315BB15.2+15.2R	
Type		Fixed gear	
Displacement	cc/rev	P4(cooling fan)	15.2
		P3(servo)	15.2
Relief pressure	kgf/cm²[psi]	P4(cooling fan)	200[2845]
		P3(servo)	40[569]

New gear pump(D12C)

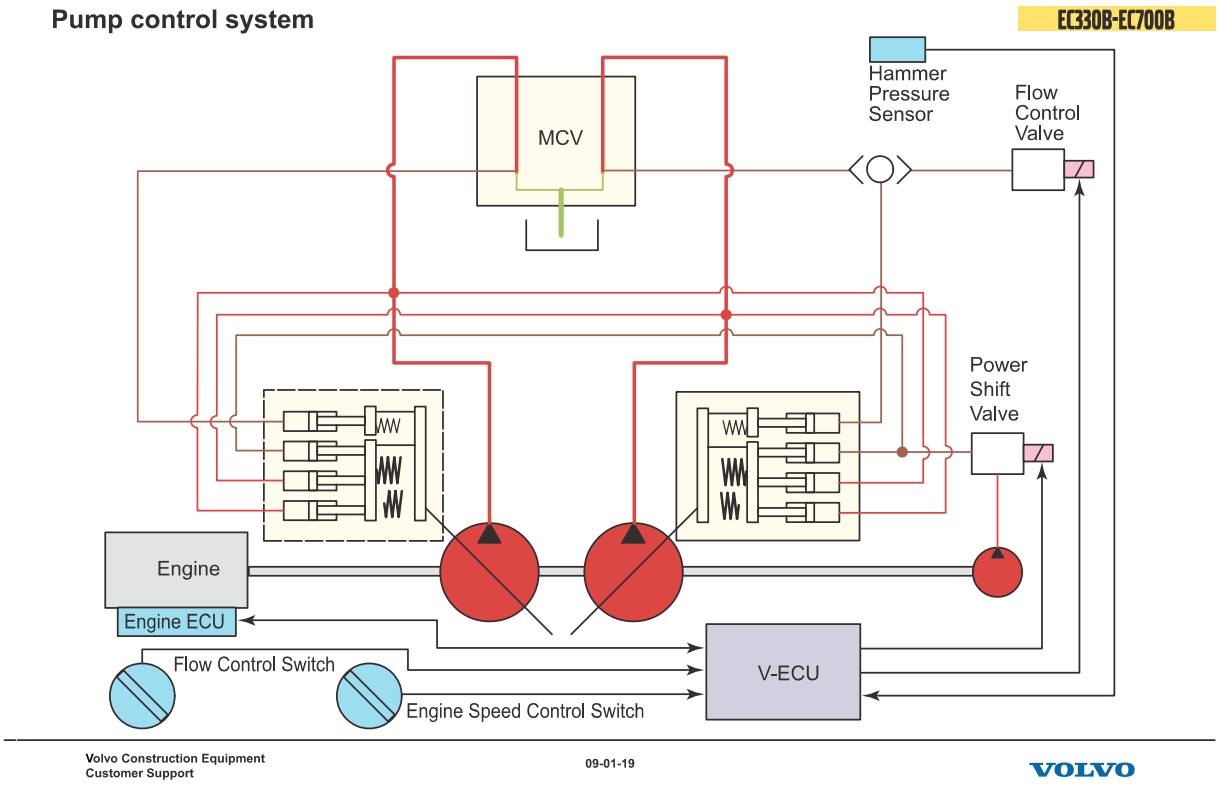
Picture text:



P-Q curve

Hp= T X rpm = P X Q

Picture text:



Pump control system

In this picture, there are 4 pistons.

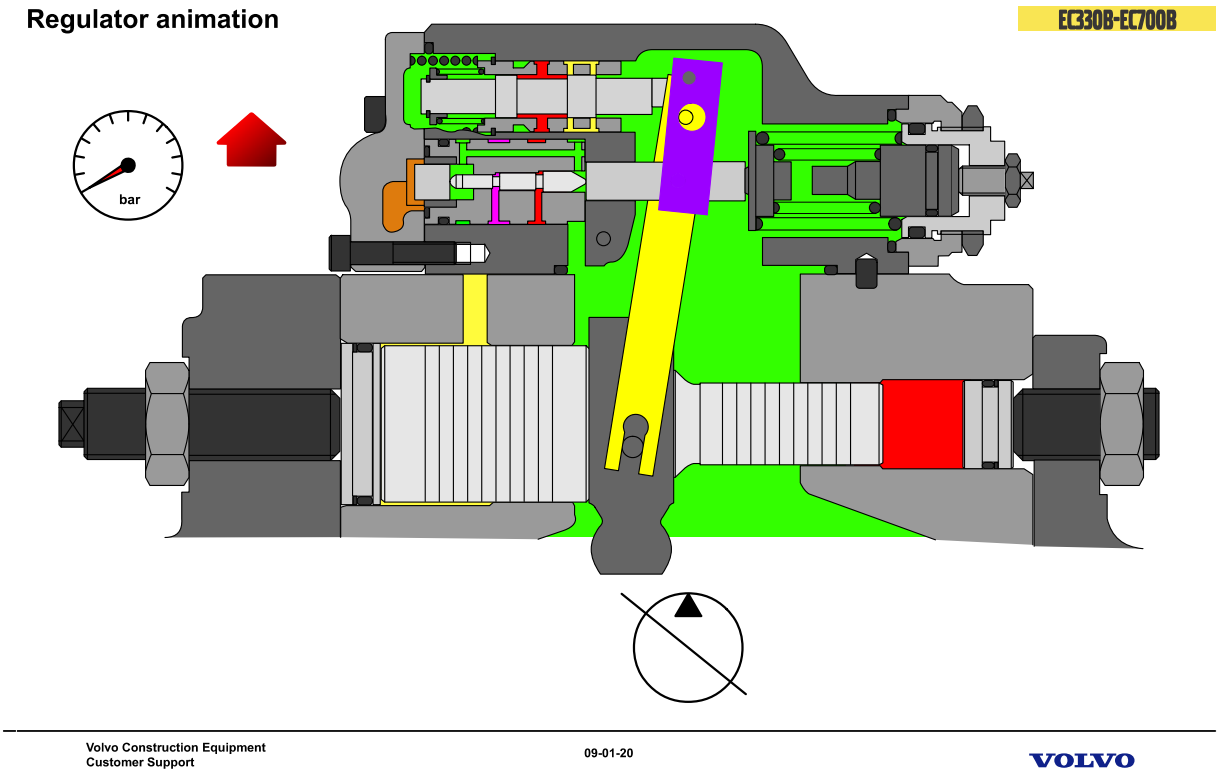
From the top side,
First one: Negative control
Second one: Power shift control
3rd & 4th: Full horsepower control

**Actually 2nd,3rd,4th pistons are integrated into one component.

Full Horsepower control
As the delivery pressure of the pump P1 and mate pump P2 goes high, the delivery flow rate will be reduced automatically, so the input torque will be regulated to a certain value. The regulator is the total cumulative horsepower type that operates by the sum of load pressures of the two pumps in the tandem double pump system. Therefore the engine can be automatically prevented from being overloaded regardless of the loading conditions on the two pumps.
Power shift control
Changing the current of the proportional solenoid valve attached to the regulator will change the horsepower setting. Only one proportional solenoid valve is provided. However, secondary pressure Pf (power shift pressure) flows into the horsepower control portion of each pump regulator through an inner passage, and shifts it to same horsepower setting, respectively. Delivery flow rate of the pump can be changed, so the proper power level suitable for the work conditions can be acquired.
Negative flow control
Varying the servo hydraulic pressure Pi can control delivery rate of the pump. This regulator is the negative flow control type that reduces delivery rate Q according to the increase of servo hydraulic pressure Pi. As the servo hydraulic pressure corresponds to the flow required for the work designated, the pump will deliver only the required oil so unnecessary power consumption will be prevented.

This regulator has 3 control functions, however when different control functions act at the same time, low oil flow instruction will have priority by the mechanical operation.

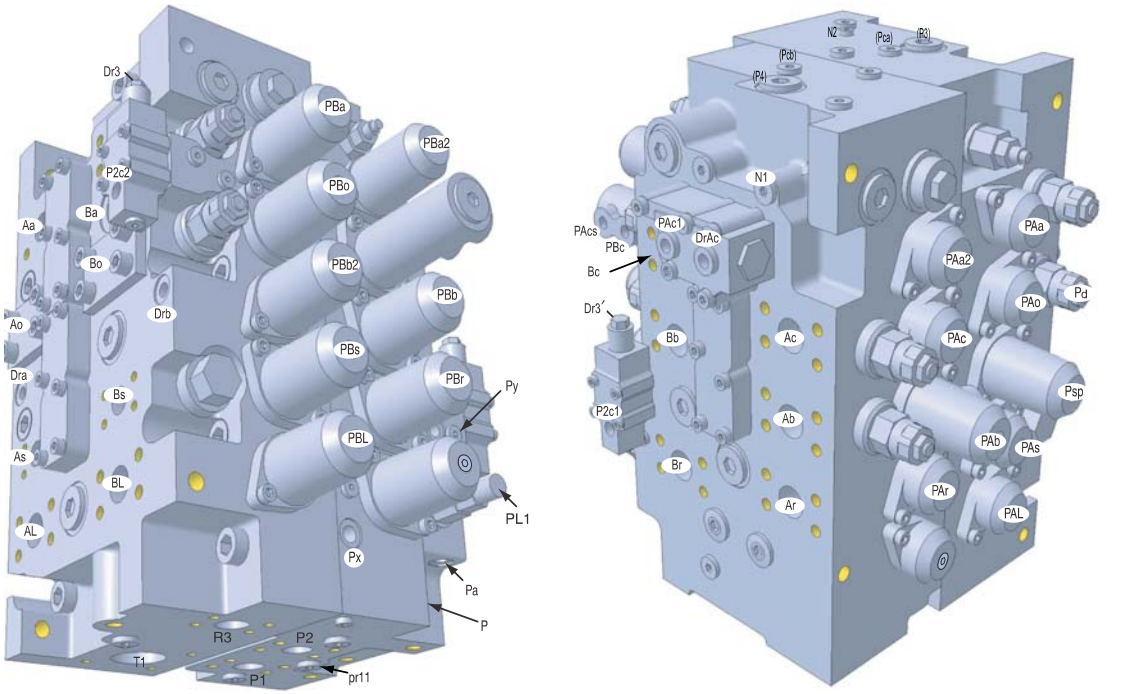
X1 flow control
When we use X1 option, flow control valve will be activated and send signal to negative control piston. So



Regulator animation

By pressing the arrow button, you can increase or decrease control pressure.
Pay attention to the movement of feedback lever.

Picture text:



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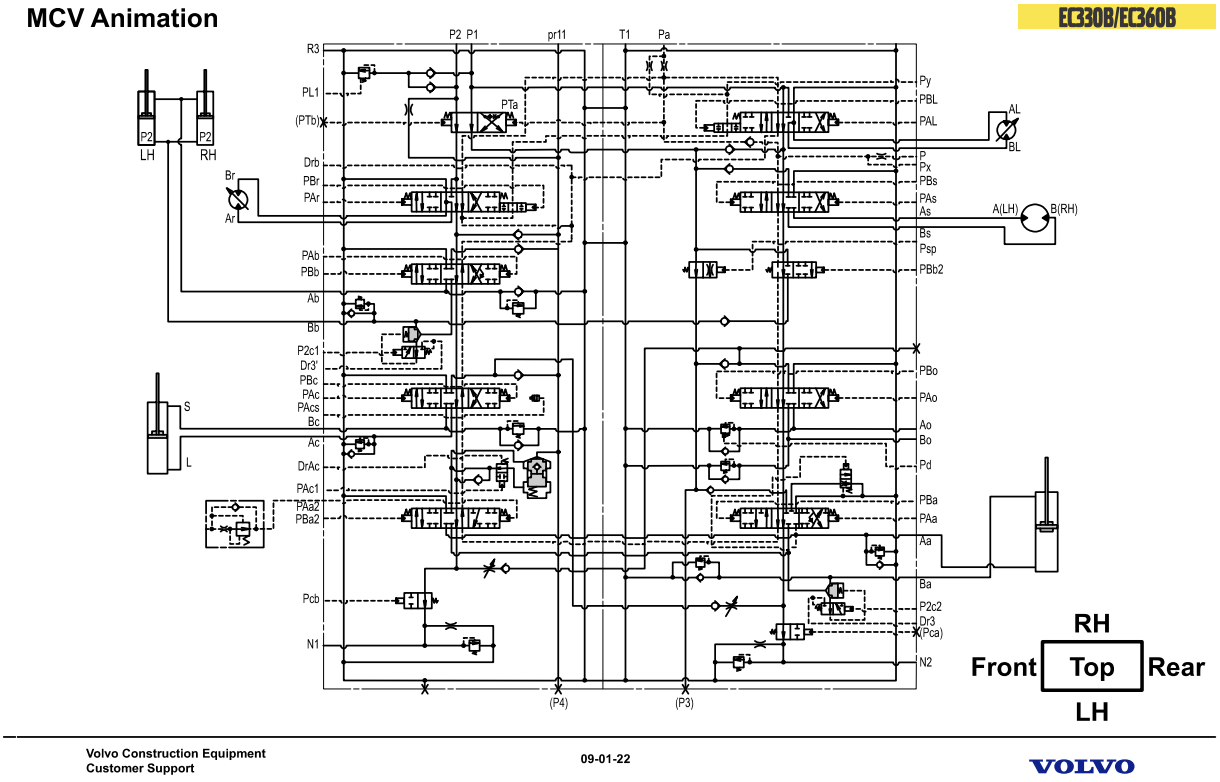
Main Control Valve

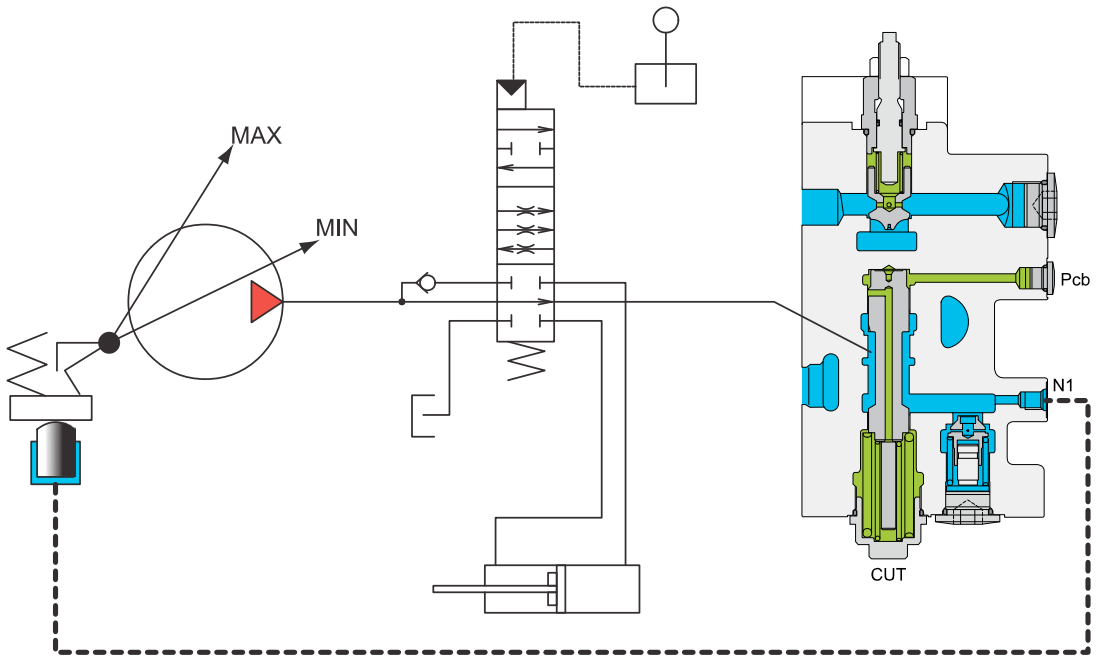
Picture text:



Main Control Valve

Push the component in the circuit diagram with mouse then you can see the location of that components or disassembled components and section view.

Picture text:



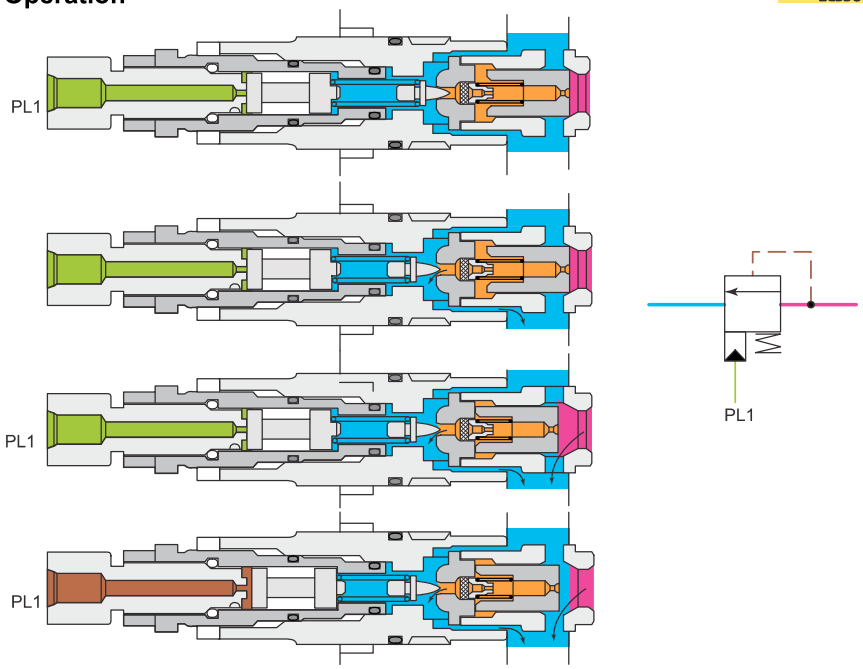
Flow sensing valve operation

The function of flow sensing valve is to control the amount of flow from pump according to the joystick stroke.

1. Neutral condition(Central passage fully open -> High Pi -> Minimum flow)
2. Half stroke(Central passage partially open -> Medium Pi -> Medium flow)
3. Full stroke(Central passage fully close -> the lowest Pi -> Maximum flow)

Picture text:

Main Relief Valve Operation



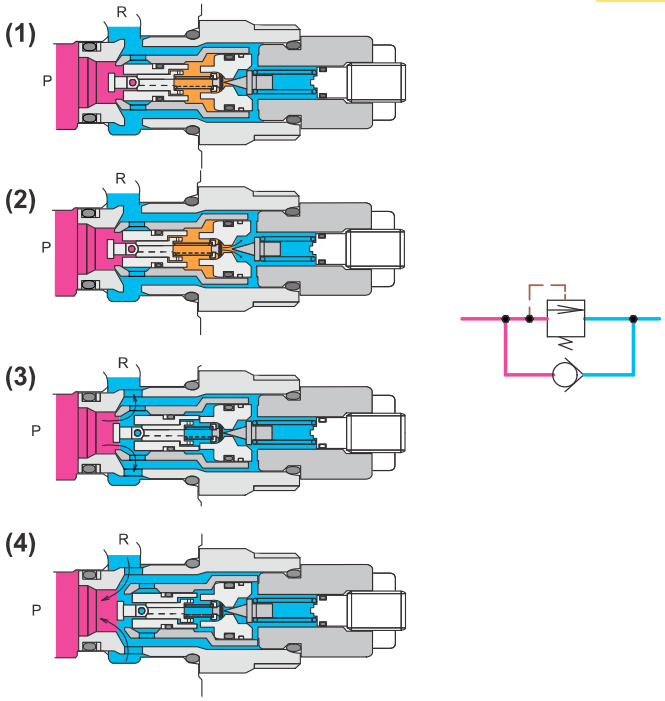
Main relief valve operation

The function of main relief valve is limit the maximum system pressure.

PL1-OFF
1. Pump pressure is lower than the set-pressure.(close)
2. Pump pressure is reached to the set-pressure.(pilot poppet open)
3. Main poppet open and pump line has tank-connection.
4. Pressure drop down.(pilot poppet close)
5. Main poppet close.

PL1-ON
1. Boost signal comes from port PL1 and push the piston to increase the tension of spring.

Picture text:



Port relief valve operation

The function of port relief valve is to release the shock pressure inside of actuator during neutral condition

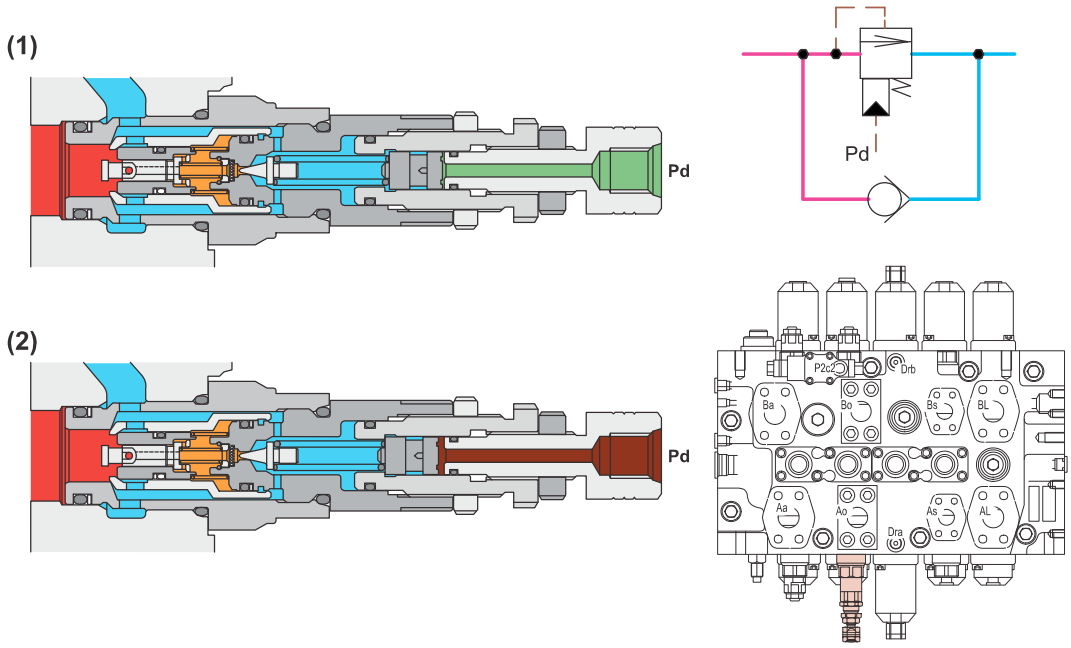
Overload
1. Cylinder pressure is lower than set-pressure.(close)
2. Cylinder pressure is reached to set-pressure.(pilot poppet open)
3. Small piston which is inside of main poppet moves to right and sit on the pilot poppet. Main poppet open and makes tank-passage.

Make-up (anti-cavitation)
4. Cylinder pressure drop down to the vacuum pressure. Main poppet will be opened by tank pressure and fill up the cylinder chamber.

Picture text:

2-stage Port Relief Valve Operation

EC330B/EC360B

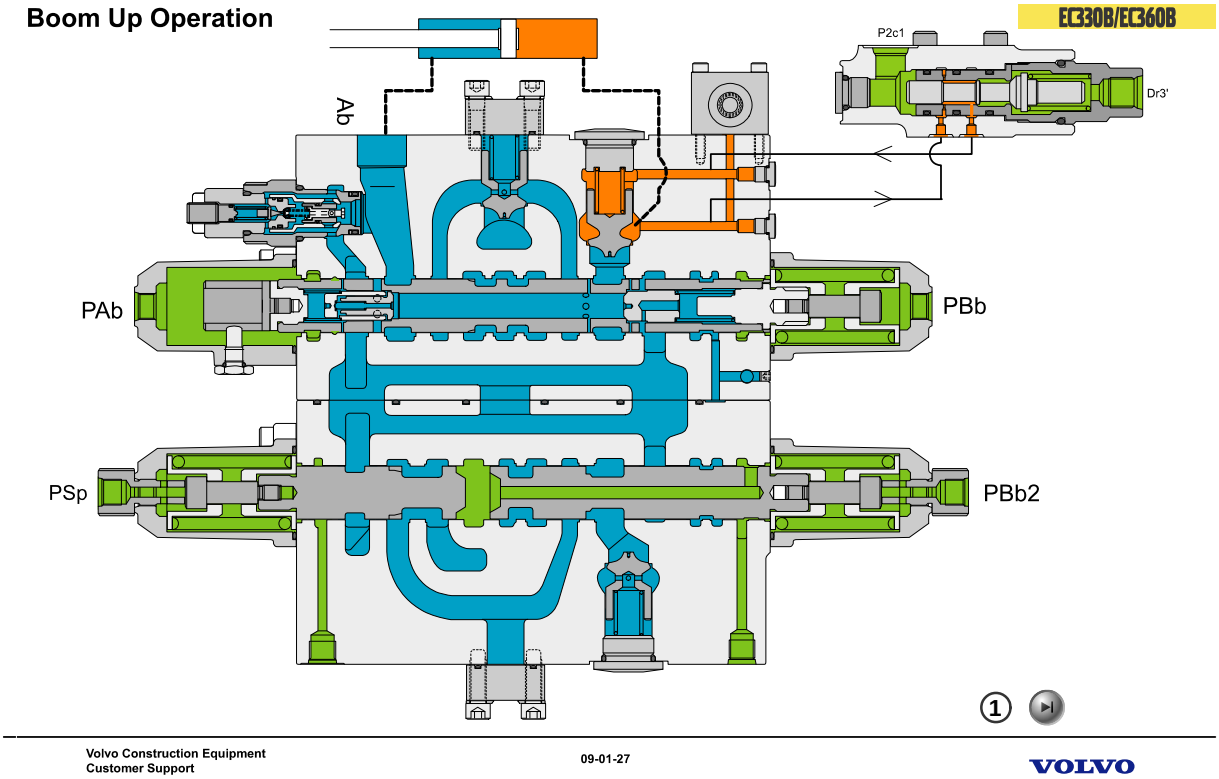


2-stage port relief valve operation

(1) 1-way (Hammer)
- When x1 selection switch is ON and X1 uses 1way, releif valve goes to low pressure setting without pilot pressure.

(2) 2-way (Shear)
- When x1 selection switch is ON and X1 uses 2way, releif valve goes to high pressure setting due to pilot pressure ON.

Picture text:



Boom up operation

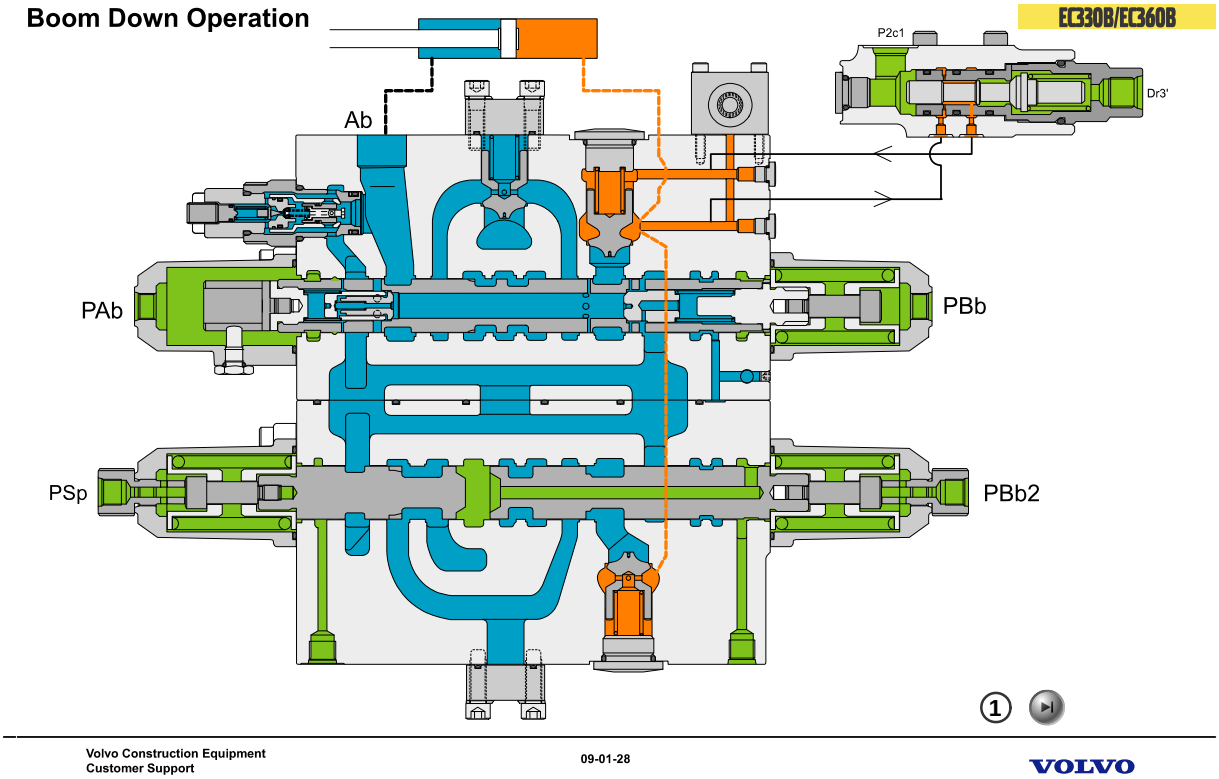
1. Neutral
- Center passage open
- Holding valve closed

2. Joystick signal on(BU)
- Boom1 & Boom2 Spool move to LH side
- Center passge close & pressurize

3. Open load check
- Oil from parallel passage open load check.

4. Holding valve open and supply oil to cylinder

Picture text:



Boom down operation

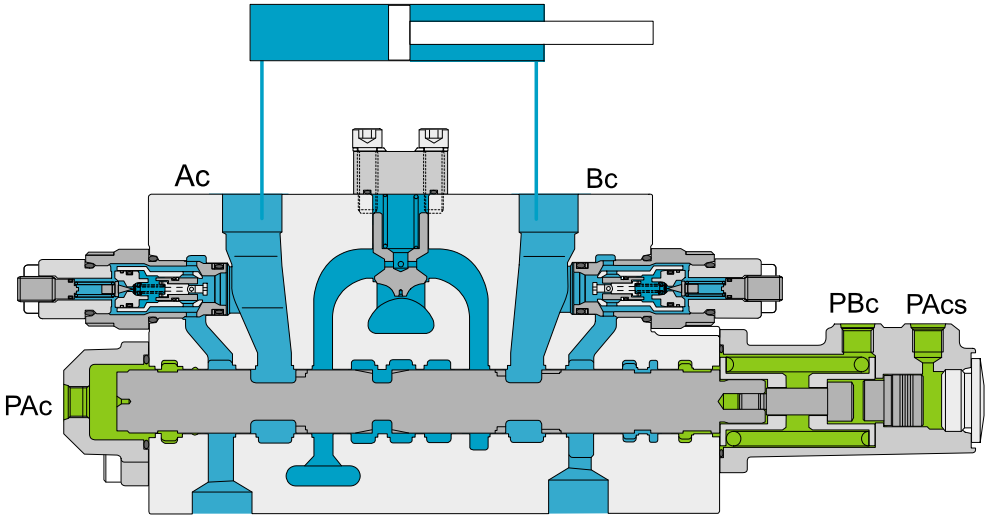
1. Neutral

2. Joystick signal(BD) ON
- Spool move and close center passage.
- P2c1 oil make drain passage by moving holding spool

3. Oil supplied to the small chamber and return oil try to return to tank

4. Holding valve open
- Return oil go through the hole of spool and open back-pressure check valve then return to tank. valve. Build-up return pressure.
- When supply pressure is low,internal check valve can be open and make passage to the supply side.

Picture text:



Bucket curl

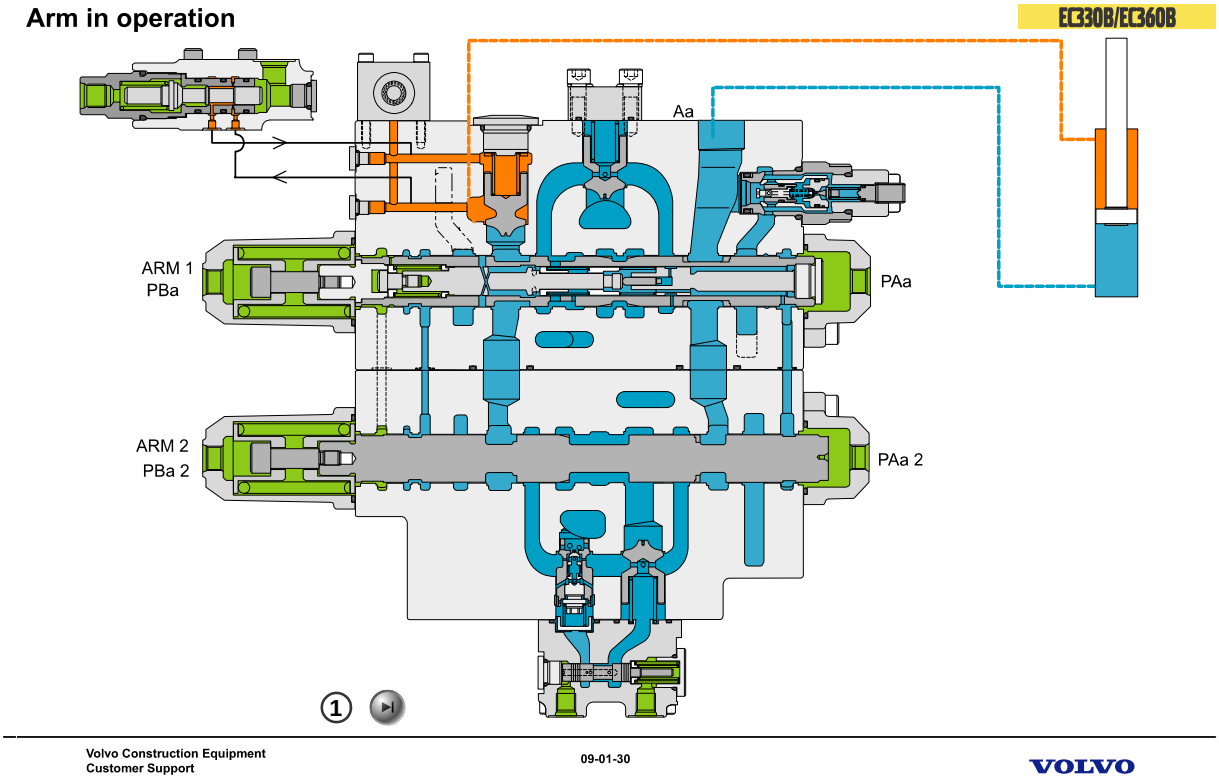
1. Neutral

2. Bucket-IN(BI) signal ON
- Spool move
- Center passage block

3. Supply oil to the cylinder

4. When using Boom-Up at the same time, PAcs signal limit the stroke of the bucket spool.(Boom priority)

Picture text:



Arm-IN operation

1. Neutral
- Holding condition

2. Joystick Arm-IN(AI) ON
- The Arm1 & Arm2 spool block center passage block
- Holding valve spool move to make holding valve free.

3. Load check open and return line is blocked by holding valve.

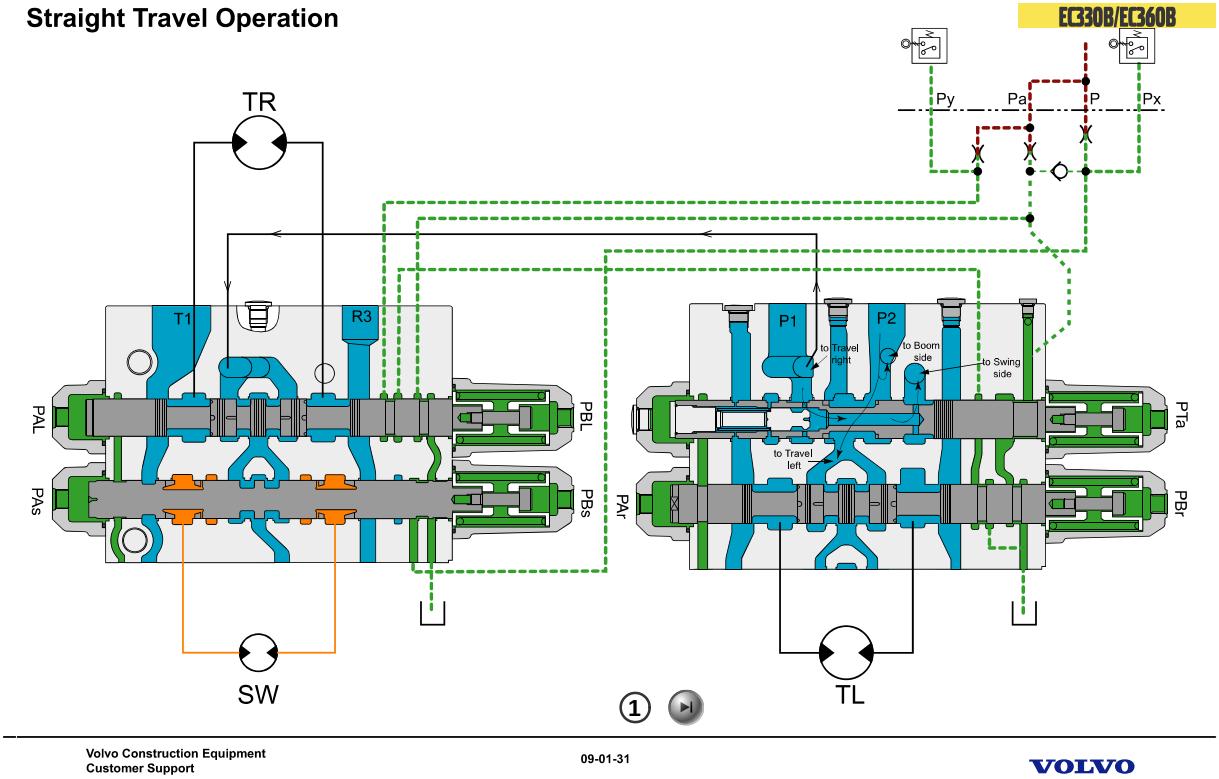
4. Holding valve open.
- Return line is restricted by arm regeneration valve when supplying pressure is low.
- Internal check open and return line is connecting to supply line.

5. When supplying pressure is high, arm regeneration valve make wide hole for return line to reduce back pressure.

6. When using Boom-up at the same time.
- Center passge is blocked by boom1-spool
- Arm2 logic valve is closed by boom up signal.

Picture text:

Straight Travel Operation



Straight travel

1. All spools are in neutral condition.
- 40 bar enters in port-P and Pa which has orifice.
- oil from one orifice connected to Py port and then pass through two travel spool and go to the return line.
- oil from the other orifice pass through the straight travel spool and two travel spool and go to the return line.
- Oil from the other orifice pass through every other attachment.
- P1 is goint to supply TR side and Swing side through the straight travel valve.
- P2 is going to supply TL side and Boom1 side.

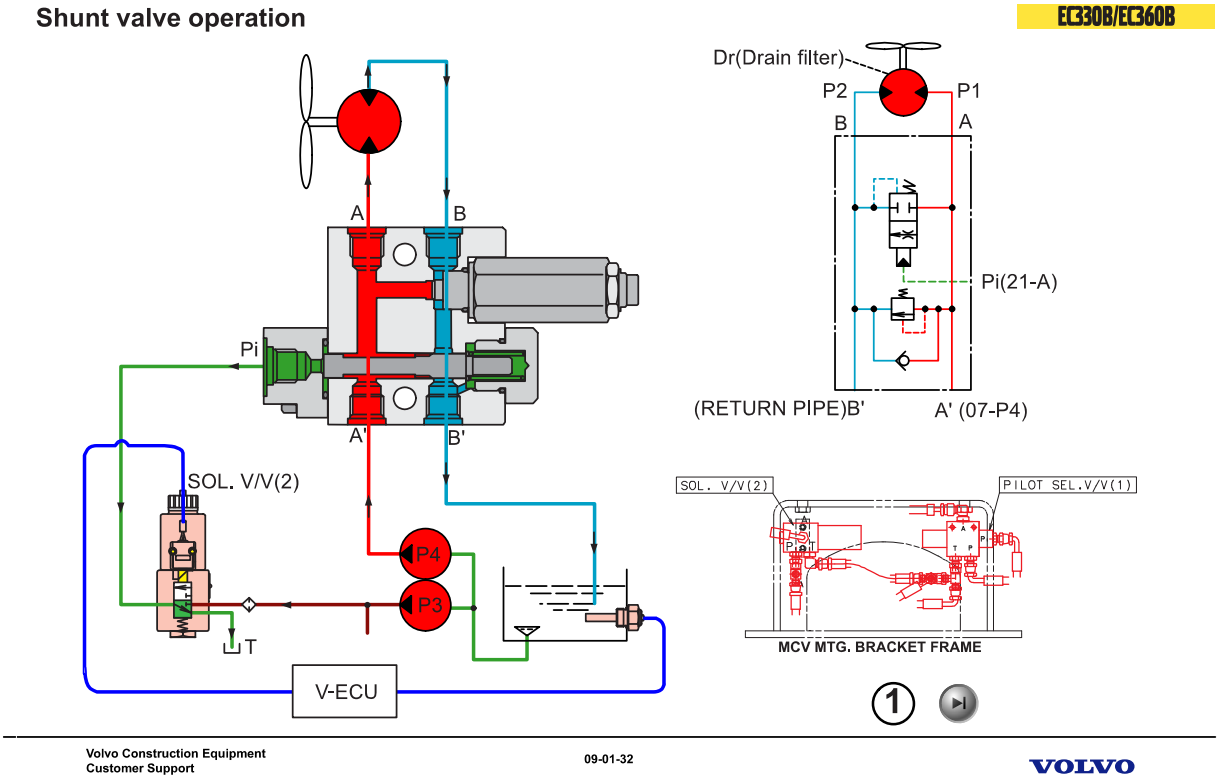
2. Travel (RH)
- Spool movement block the line from orifice and bulid up pressure.
- Travel pilot pressure switch ON
- P2 oil goes to TL side directly and Boom1 side parallel passage.

3. Travel (LH)
- Spool movement block the line from orifice and bulid up pressure.
- P1 oil goes to TL side directly and Boom1 side parallel passage

4. Swing operation
- Swing spool movement block the line from the other orifice and build up pressure.
- Attachment pilot pressure switch ON
- Block the back side of check valve
- Straight travel spool spring side will be pressurized.

5. Straight travel spool move to LH side.
- Inside check valve will be closed.

From this point
- P1 oil goes to TR side directly and TL side through the straight travel spool.
- P2 oil goes to Boom1 side and swing side.



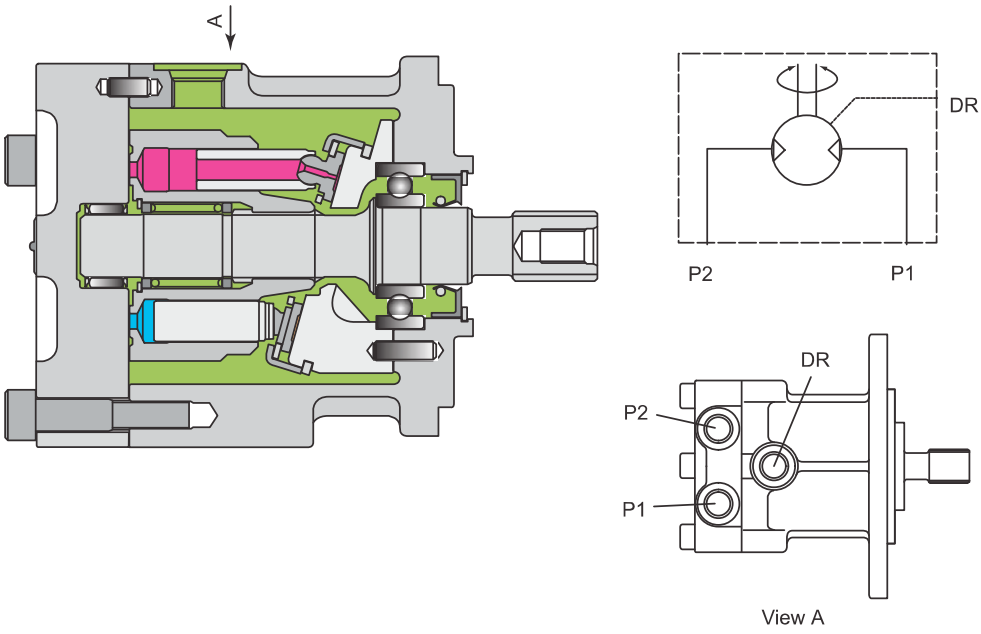
Shunt valve operation-1

When the hydraulic oil temperature is higher than 70 celsius, the solenoid valve relay is at OFF position due to hydraulic oil temperature sensor. P1 pump does not flow through the solenoid valve.
All of P2 pump oil flows to shunt valve A' port, then through shunt valve A port, rotating fan motor to high speed. The fan motor speed maintains to high speed until the hydraulic oil temperature reaches 50 celsius.

Shunt valve operation-2

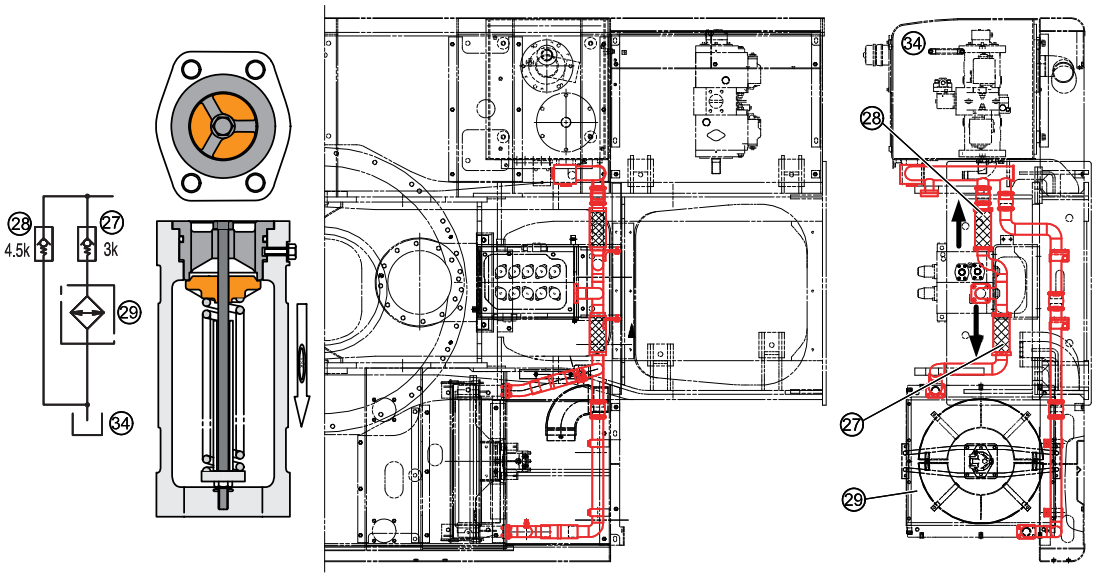
When the hydraulic oil temperature is lower than 70 celsius, the solenoid valve relay is at ON position due to hydraulic oil temperature sensor. P1 pump flow to solenoid valve, then through shunt valve Pi port, moves shunt valve spool to the right. Some amount of oil supplied from P2 pump to shunt valve A' port flows to B' port through shunt valve spool and is drained to tank. Therefore the oil supplied to fan motor (M) is decreased, the fan motor rotates at low speed until the hydraulic oil temperature reaches 70 celsius.

Picture text:



Fan motor

Picture text:

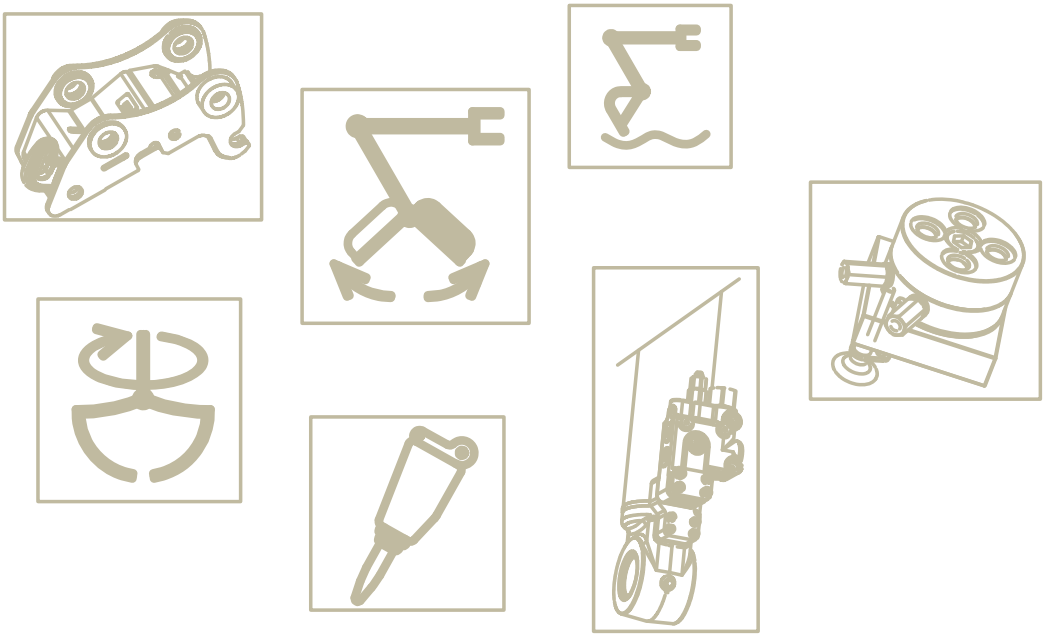


Return Piping

Return check valve produce some amount of backpressure, which is used for make-up function. 4.5bar check valve is used for bypass function when hydraulic oil cooler is clogged.

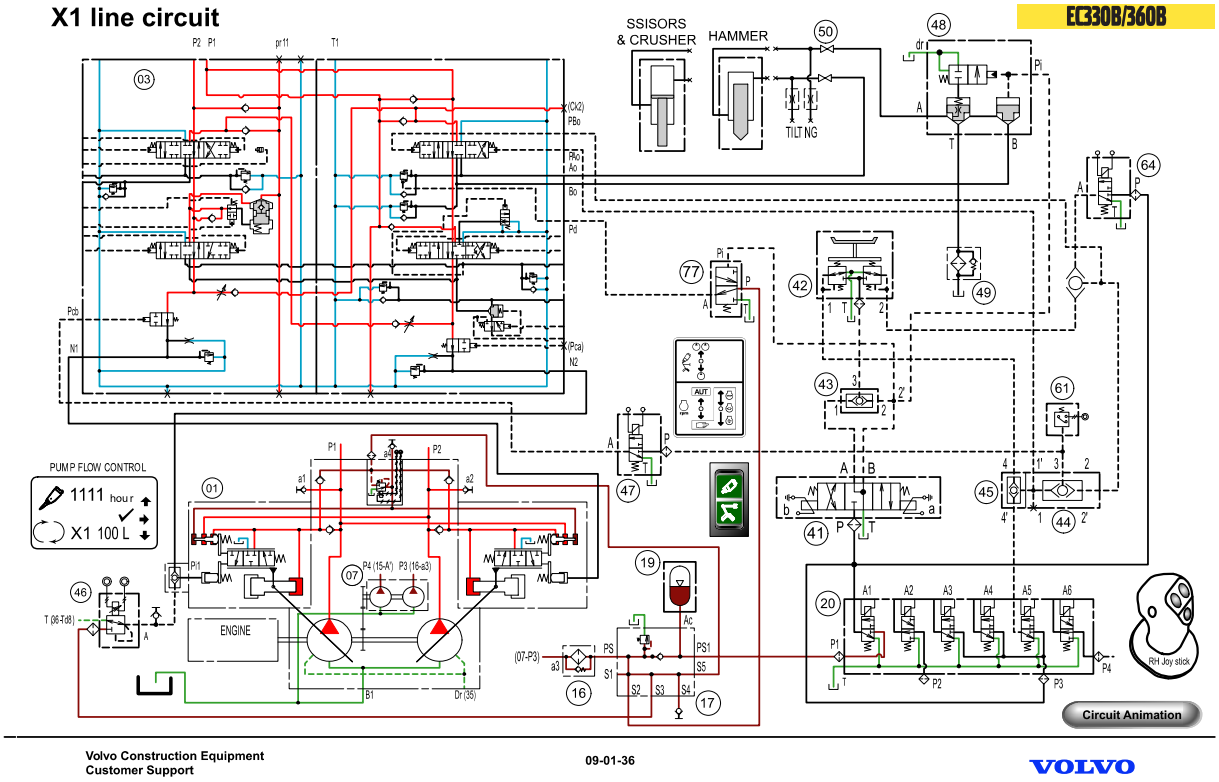
27: 3.0k Return check valve
28: 4.5k Return check valve
29: Hydraulic oil cooler
34: Hydraulic tank

Picture text:



Option hydraulics

Picture text:



X1 line circuit

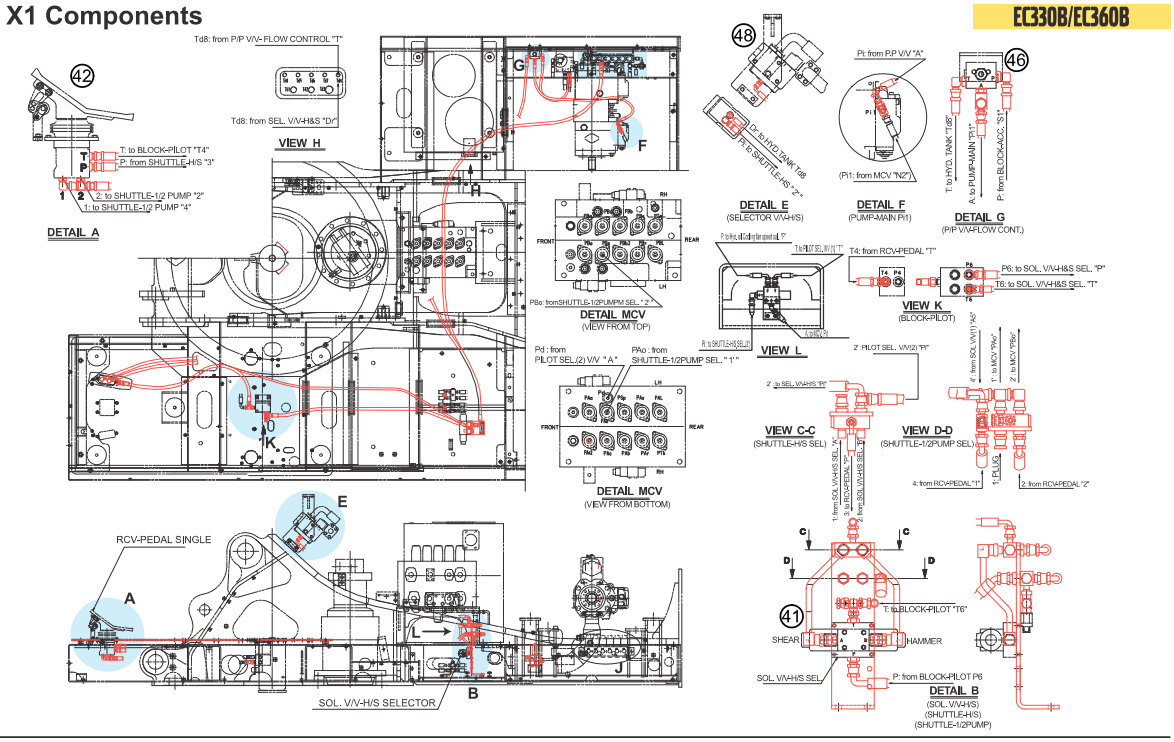
X1 option is used for hammer & shear.

- Main line change:
When it is used for hammer, return line directly goes to tank. But shear uses double action. So we need 3-way valve

- 2-step port relief valve:
2-step port relief valve always maintains high pressure except hammer use.

- X1 option pedal
- Flow control function
- Option 2-pump flow
- 2-switch control without pedal

Picture text:



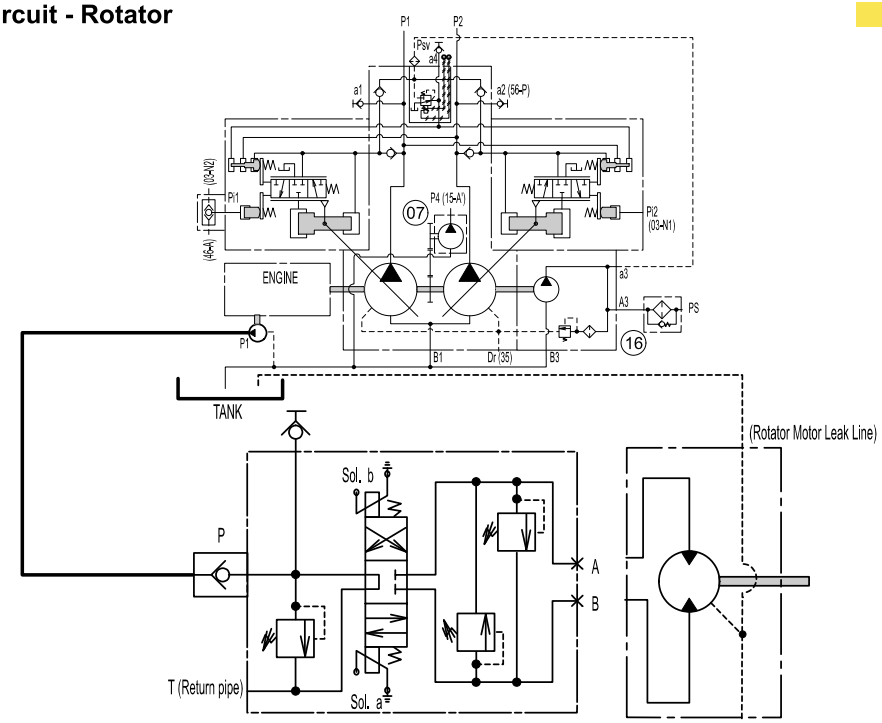
X1 Components

41: Hammer/ Shear select solenoid valve
46: X1 Flow control valve
48: Hammer/ Shear select valve
42: Option pedal

Picture text:

X3 line circuit - Rotator

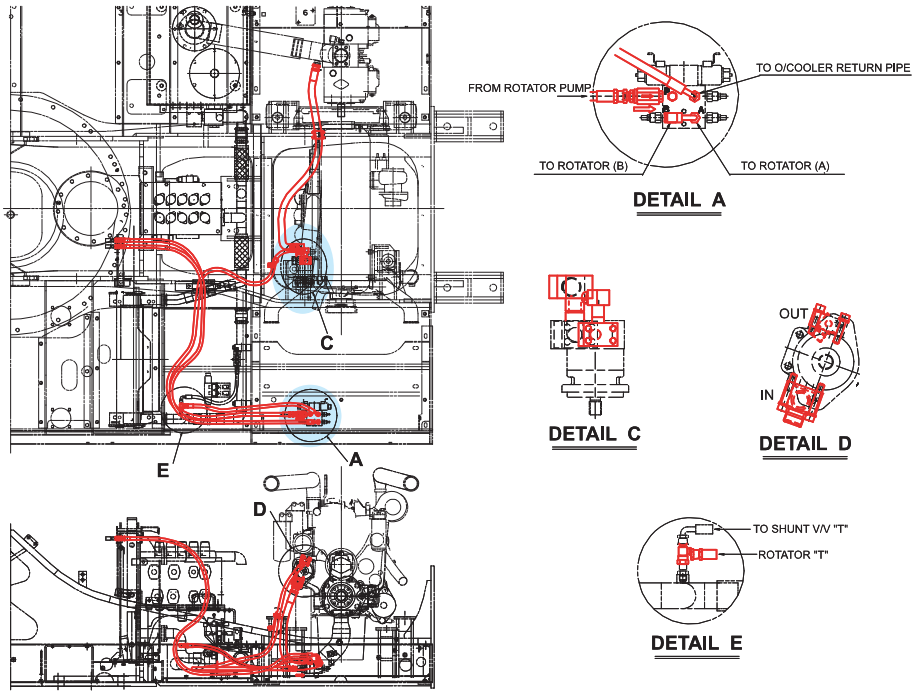
EC330B/EC360B



Rotator circuit

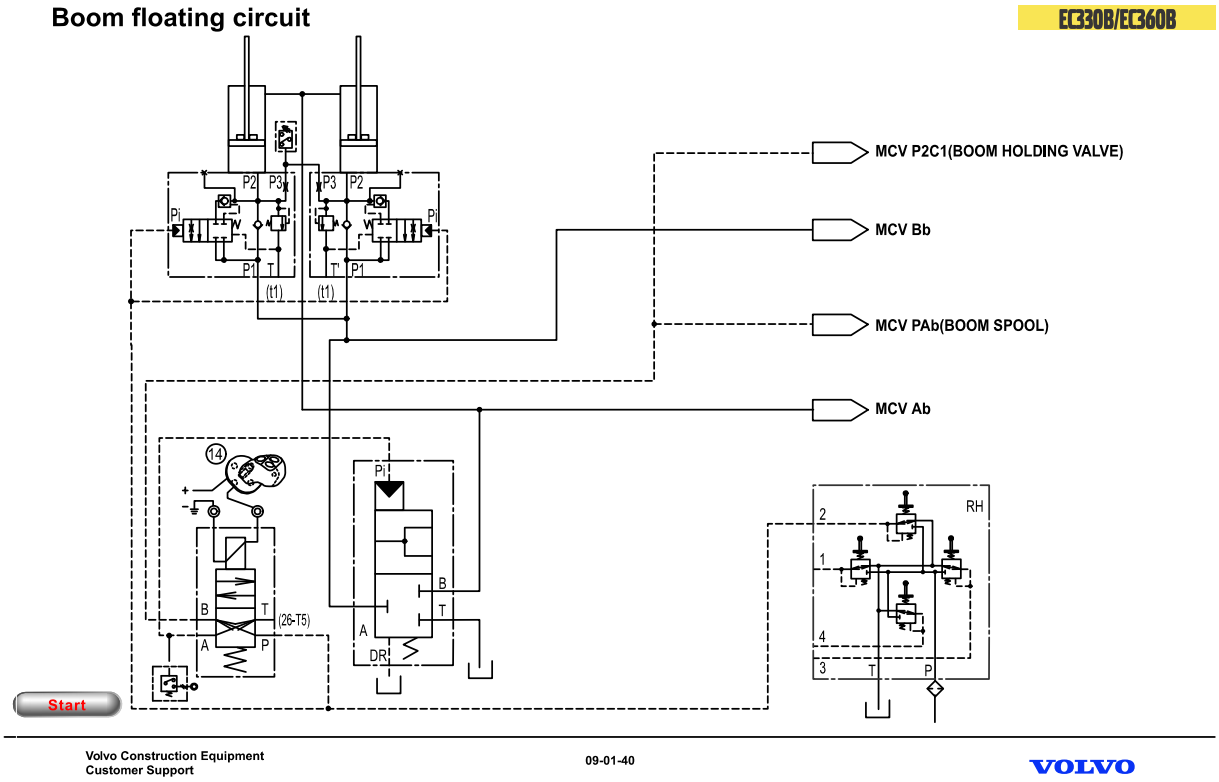
This is X3 option.
X3 option is composed of gear pump at PTO, rotator valve and additional case drain line for motor. This is operated using LH joystick button.

Picture text:



X3 line piping

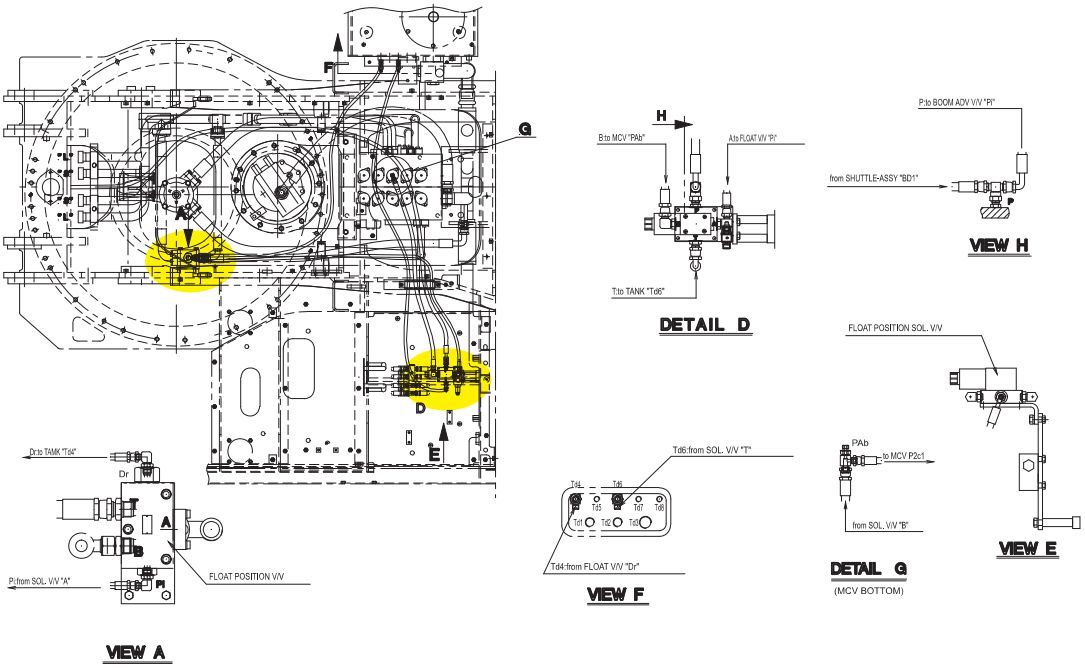
Picture text:



Boom floating circuit

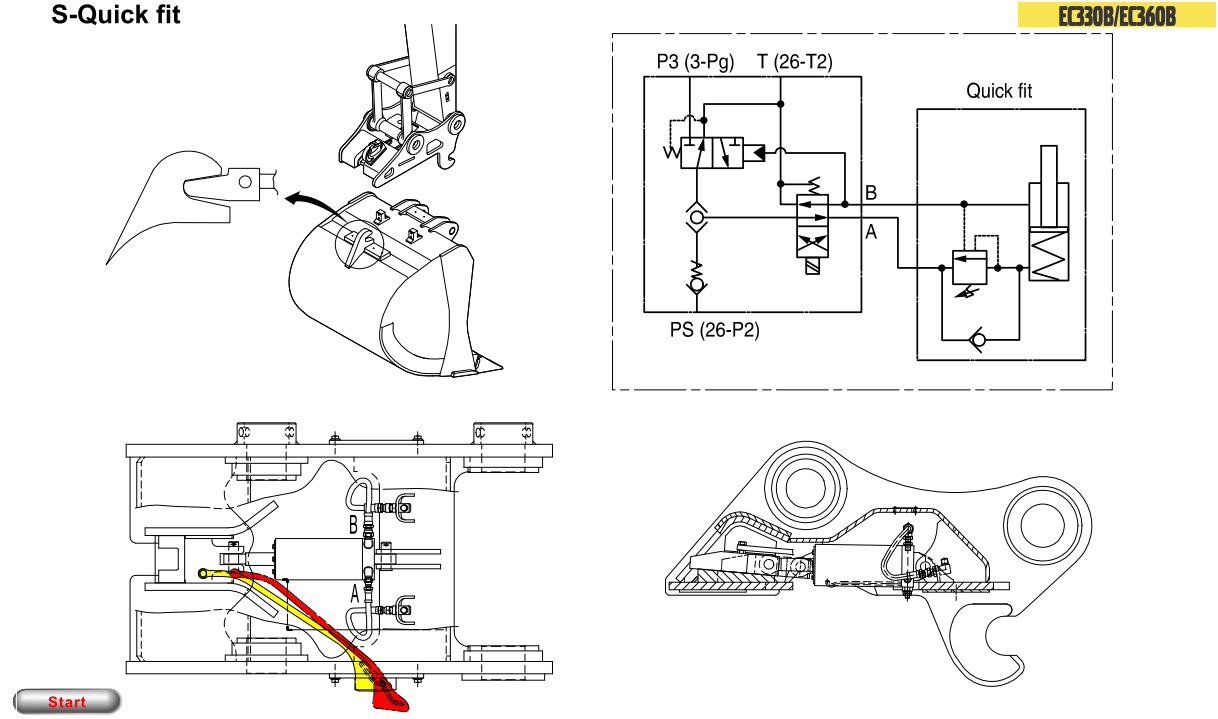
When joystick button is pushed, this signal goes to VECU. VECU energize the solenoid. When joystick is in boom-down position, this signal operate hose rupture valve and boom floating valve. This makes boom cylinder piston side and rod side go to tank. So boom can drop down by its weight.

Picture text:



Boom floating components

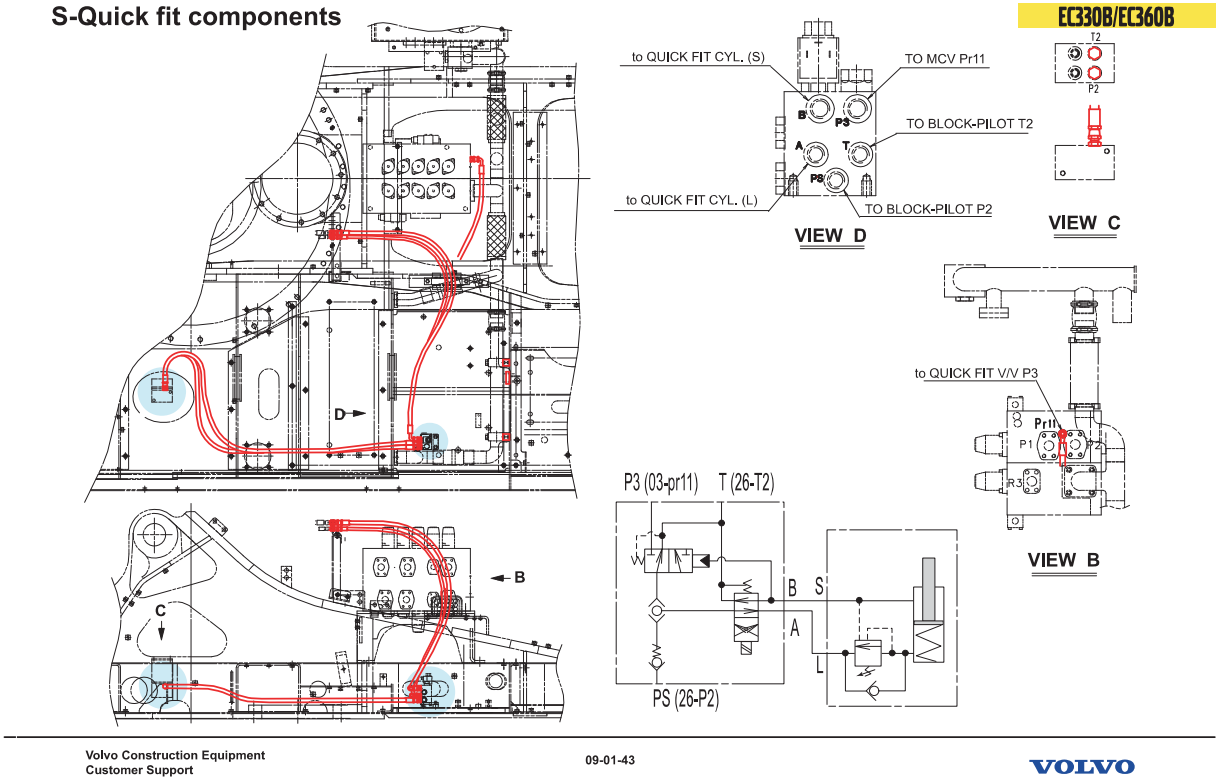
Picture text:



Quick fit

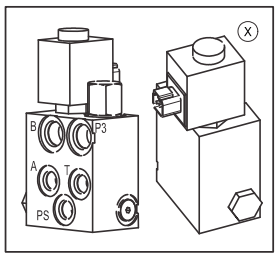
The quick-fit attachment is fitted to the arm end and bucket link. The connection between the quick-fit and bucket is like figure.
The quick-fit attachment is equipped with a double acting hydraulic cylinder. The quick-fit locking wedge is fitted to the piston rod. Servo pressure acts on the piston side of the lock cylinder, locking the bucket in place against the rear hook. This means that the lock wedge adjusts itself and provides gap-free locking. When lock wedge is released, the servo pressure is transferred to the piston rod side. If necessary, the release pressure can be increased by loading the bucket cylinder in its end position.
There is a red marker on the left side of the quick-fit attachment, which is folded in when the lock wedge is in the locked position and folded out when the lock wedge is released.

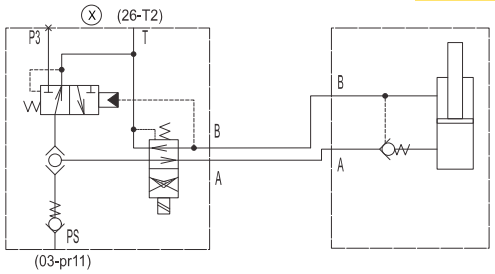
Picture text:

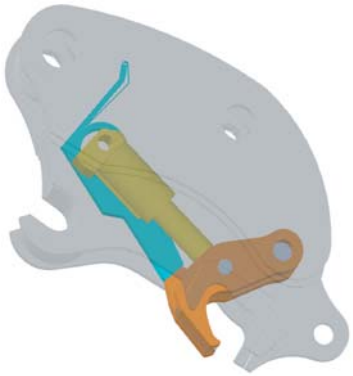


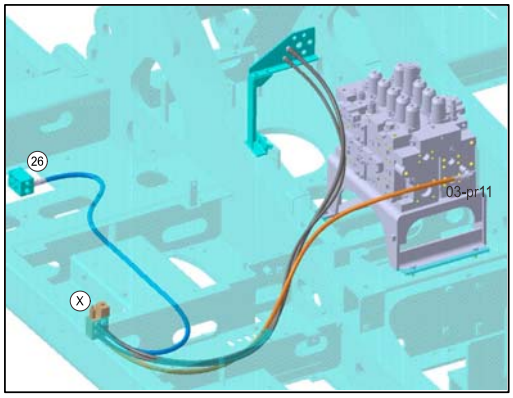
S-Quick fit Components

Picture text:





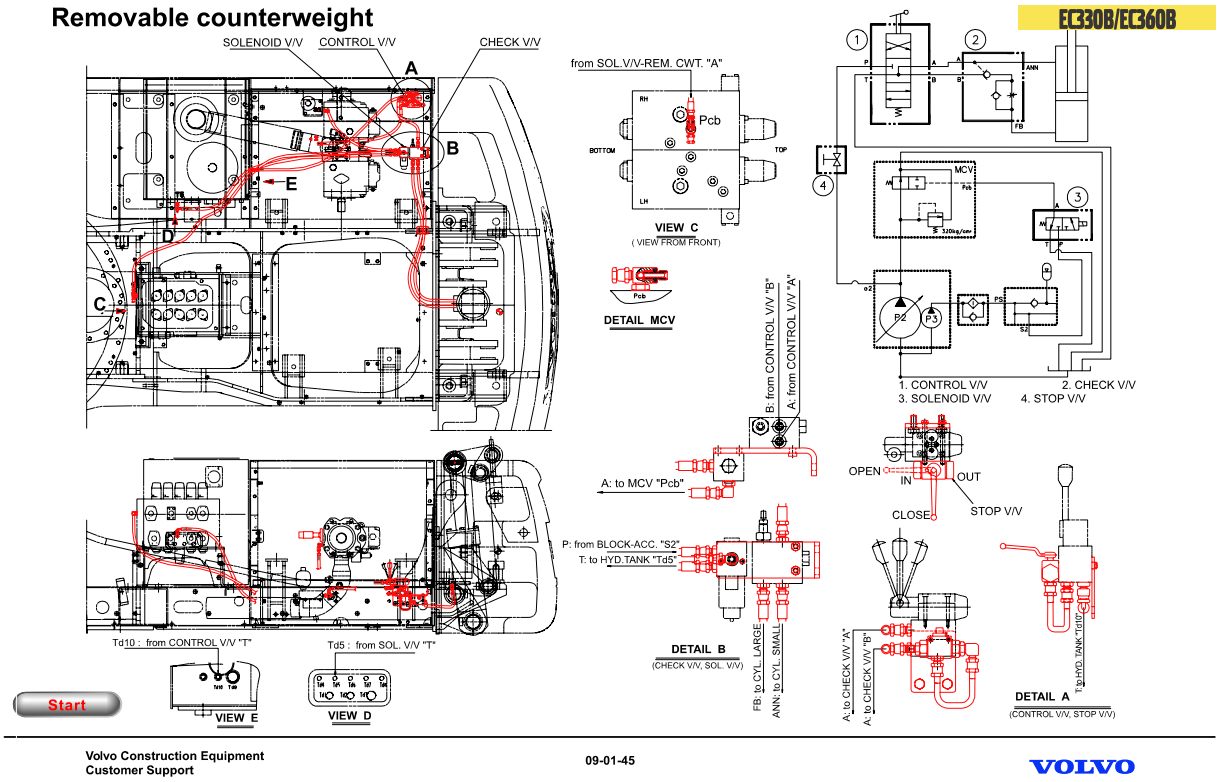




U-Quick fit

X: Quick fit valve
26: Pilot block

Picture text:



Removal counterweight

P2 pump oil can be supplied by blocking center bypass valve.
For safety, large chamber oil is restricted to out.

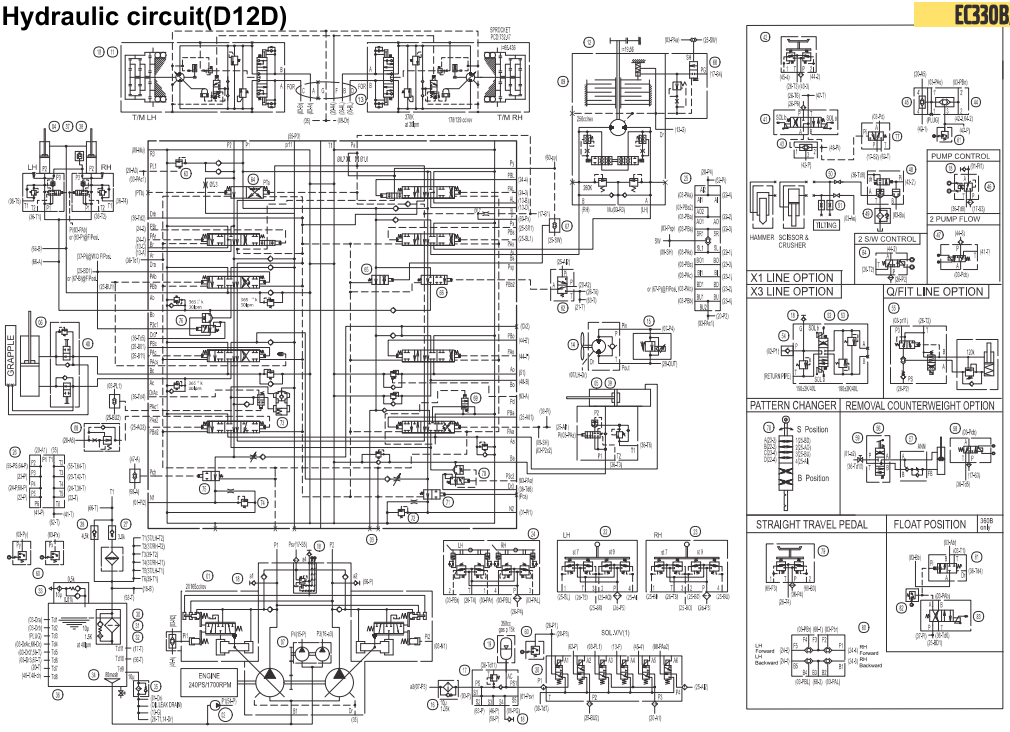
Picture text:

EC330B/EC360B(D12D)

Hydraulic System(EC330B-EC360B)
-D12D engine application

Picture text:

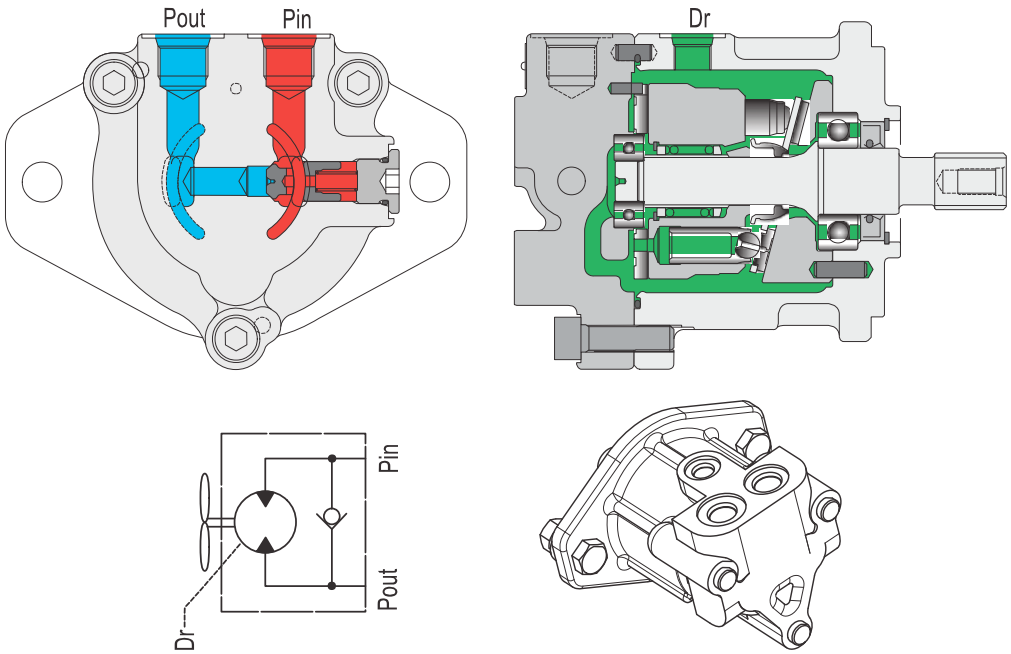
Full Hydraulic circuit(D12D)



Full option circuit

Straight travel function is added.

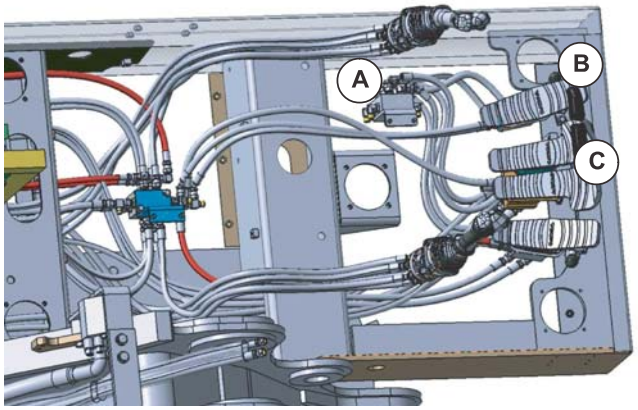
Picture text:

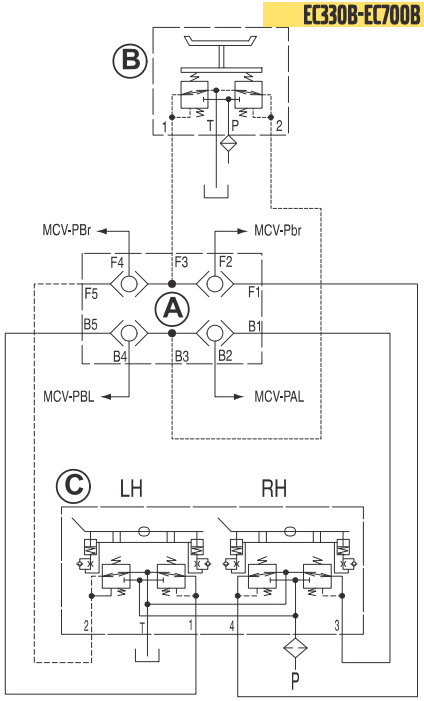


Fan motor

There is a check valve to prevent motor from cavitation.

Picture text:





Straight travel pedal

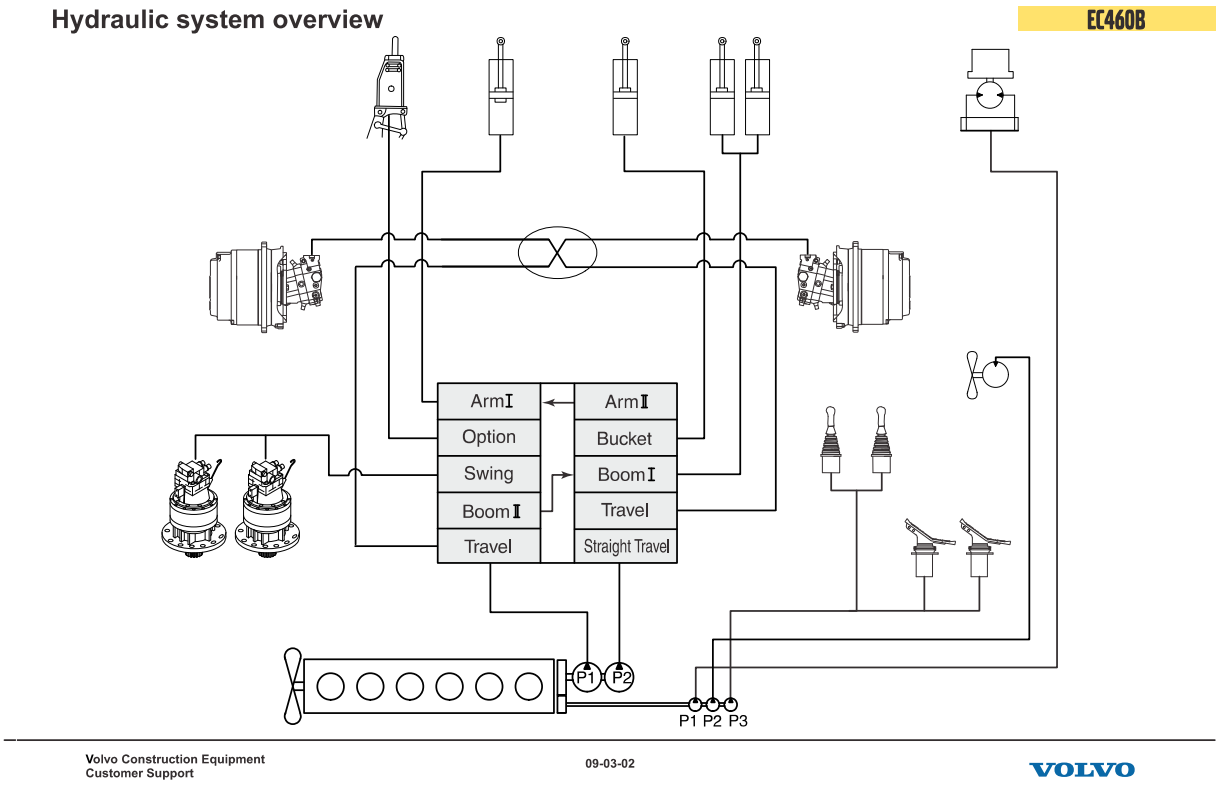
Without operating two travel pedals (C) for straight travel, we can use only option pedal (B).

Picture text:

EC460B(D12C)

Hydraulic System(EC460B)
-D12C engine application

Picture text:



Hydraulic system overview

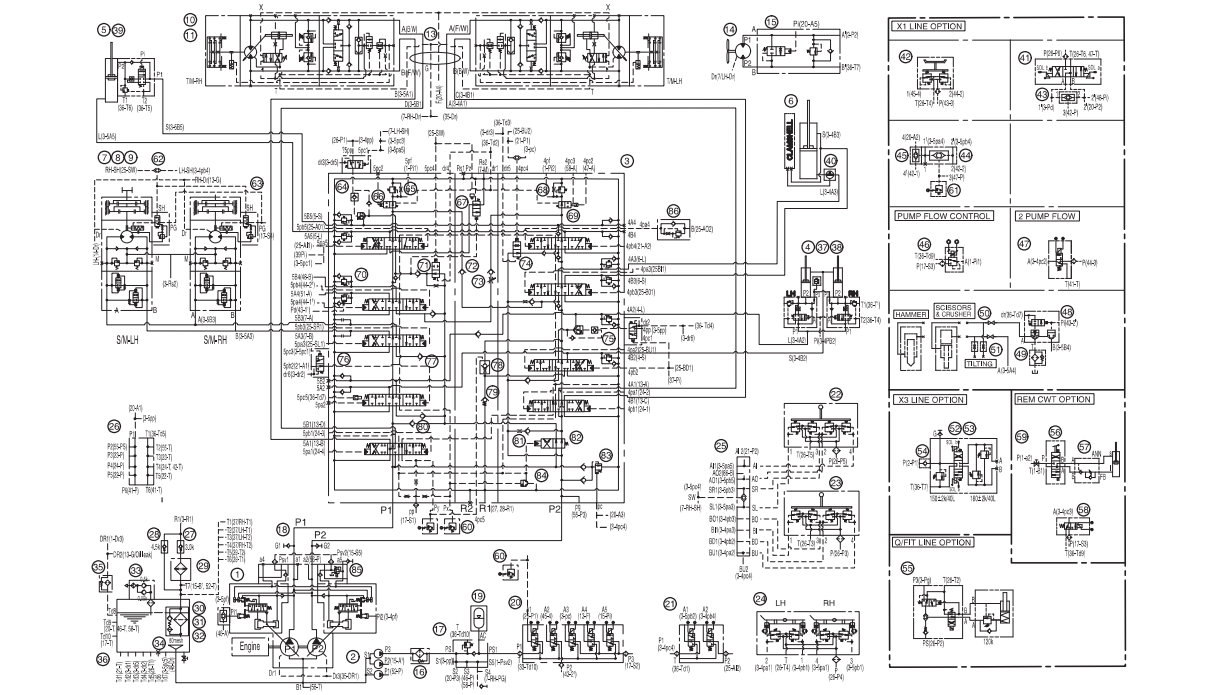
The mechanical power from engine converted to hydraulic power.
Machine has two main pumps that are variable displacement piston pump.
And it has 3 fixed gear pumps. P3 is for servo system. P2 is for hydraulic oil cooler fan motor. P1 is for X3.

Travel: straight travel function
Boom-up: 2-pump flow
Boom-down: Regeneration
Boom: Holding function
Arm-in & out: 2-pump flow
Arm: Holding function
Arm-in: Regeneration
Option: 2-pump flow (selectable)
Bucket: 2-pump flow (selectable)
Swing: priority against arm during simultaneous operation

Picture text:

Full option circuit-Old(D12C)

EC460B

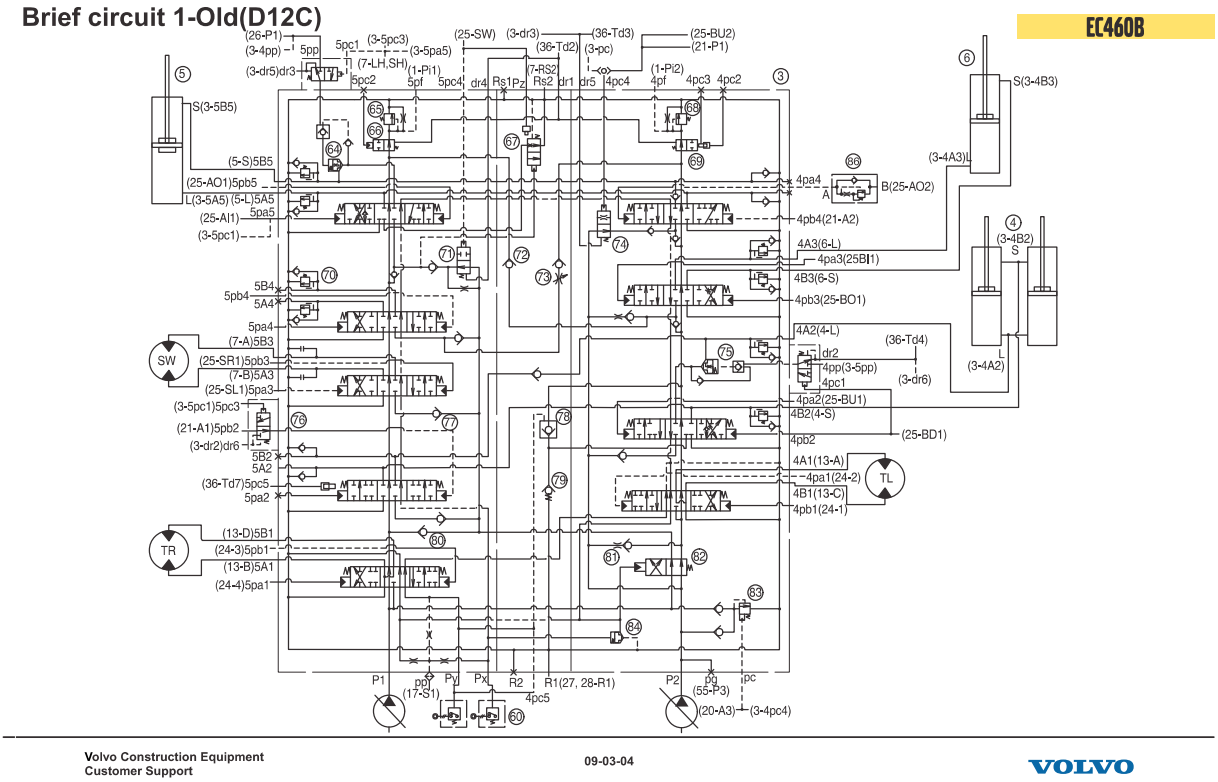


Full option circuit(Old)

This is the circuit that covers all of option.
In the circuit diagram, every component has unique number and there are many parentheses.

For example 5B4(48-B). This means that the port 5B4 is connected to the port B of the component 48.
This is the way how to read our circuit diagram.

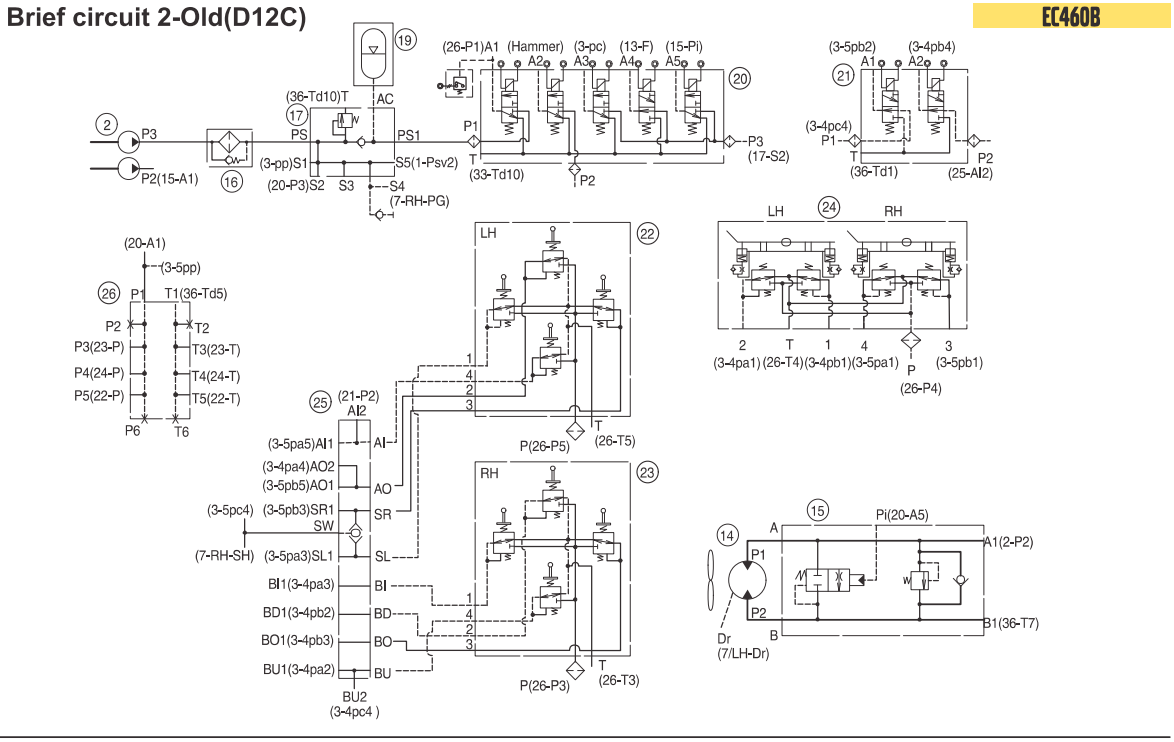
1. Main pump
2. Servo pump
3. Main control valve
4. Boom cylinder
5. Arm cylinder
6. Bucket cylinder
7. Swing motor
8. Swing gear box
9. Swing drive unit
10. Travel motor
11. Travel gear box
12. Swing ring gear
13. Turning joint
14. Fan motor
15. Shunt valve
16. Pilot filter
17. Accumulator block
18. Quick coupler
19. Accumulator
20. Solenoid valve(1)
21. Solenoid valve(2)
22. RCV LH
23. RCV RH
24. RCV pedal
25. Shuttle block
26. Pilot block



Brief circuit-1(Old)

Brief circuit for main line

Picture text:



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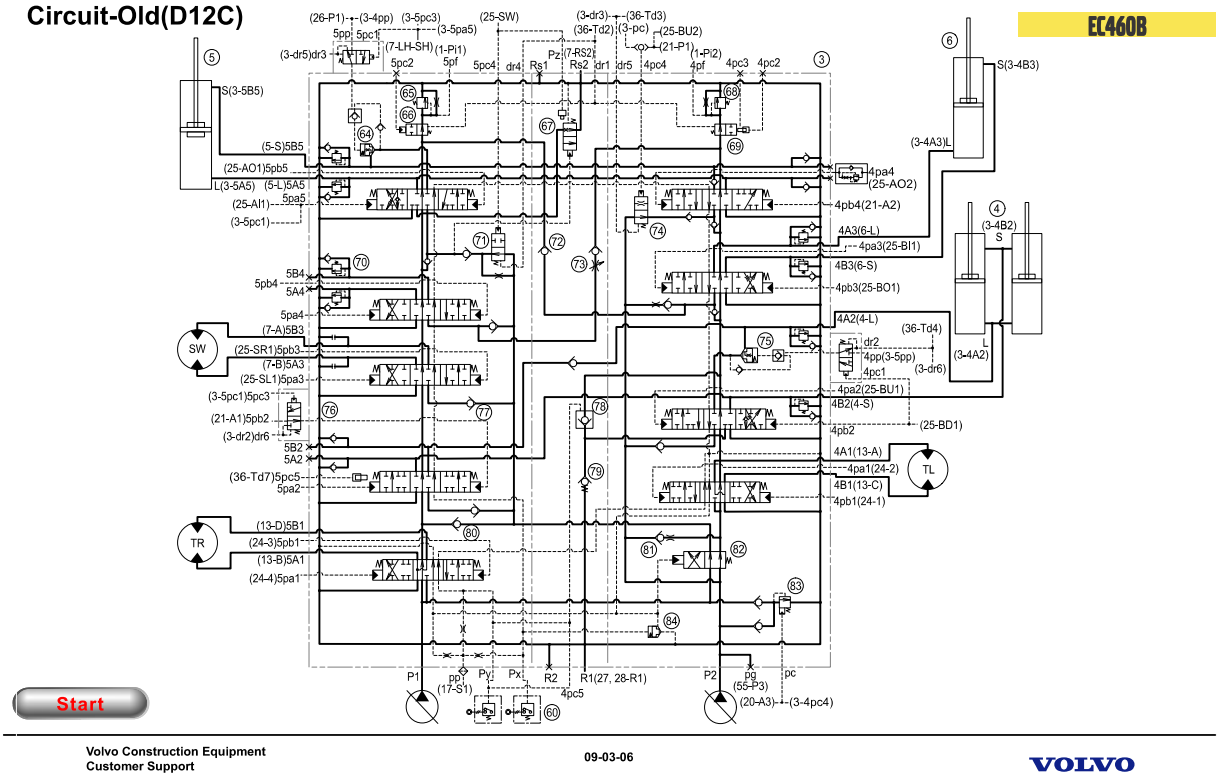
Brief circuit-2(Old)

Brief circuit for pilot(servo) line

Picture text:



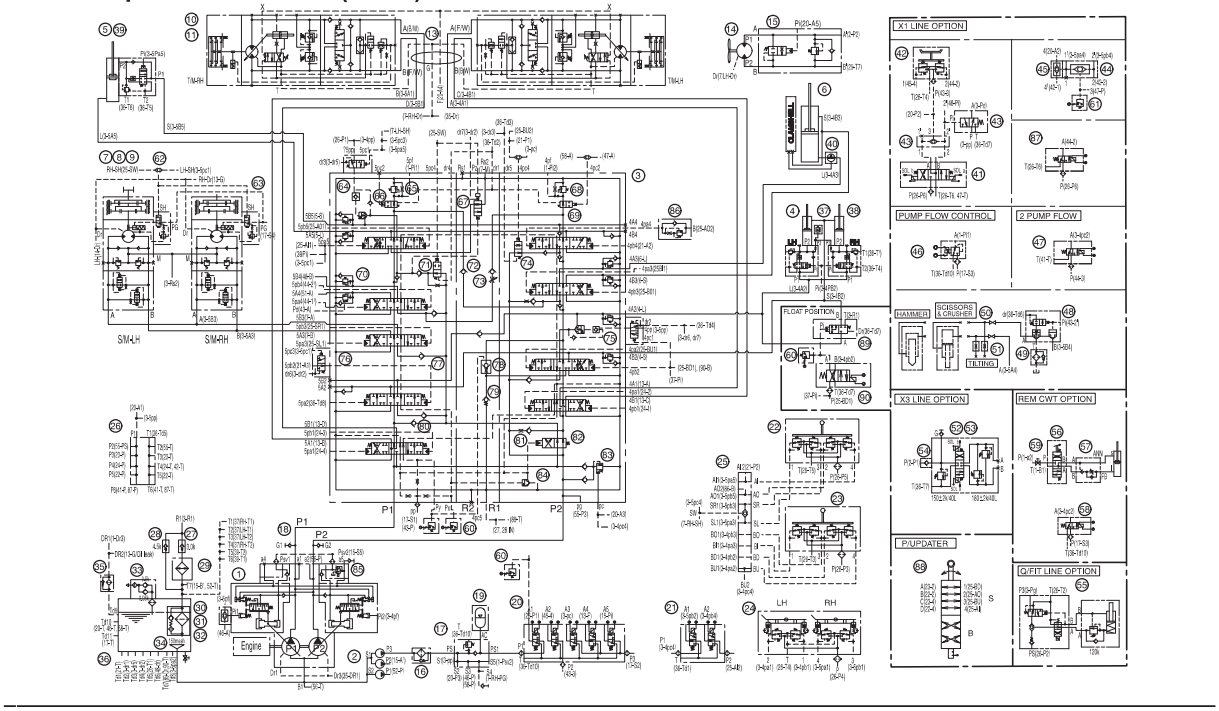
Circuit animation(Old)

This animation can be used when you explain or study the hydraulic circuit. By pressing the lines, character or spool with mouse, you can change the colour of lines and spool location.

Picture text:

Full Option Circuit-New(D12C)

EC460B



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09-03-07

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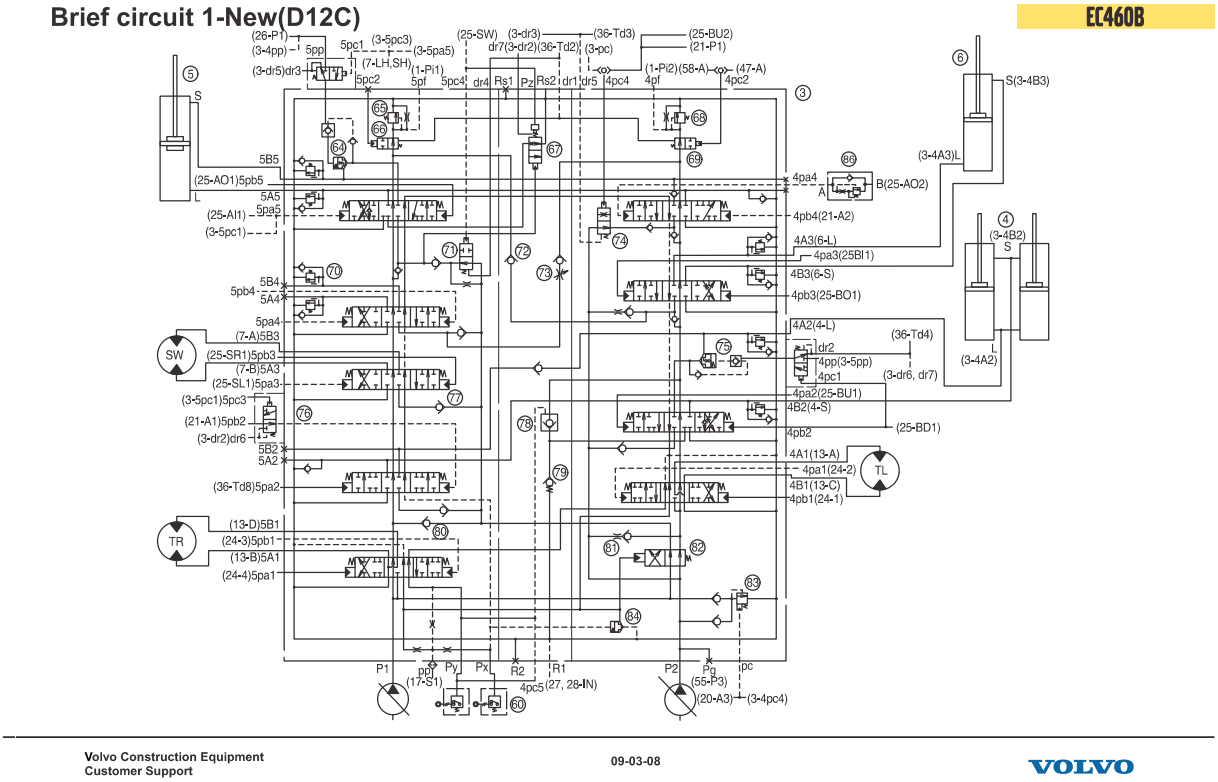
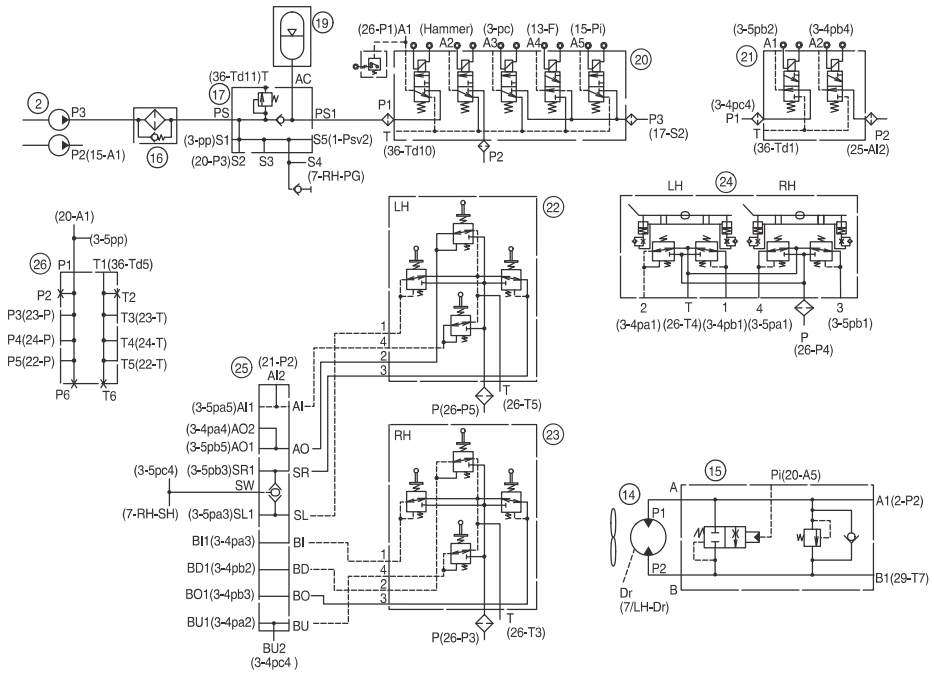
Hydraulic circuit-full option(New)

1. Main pump
2. Servo pump
3. Main control valve
4. Boom cylinder
5. Arm cylinder
6. Bucket cylinder
7. Swing motor
8. Swing gear box
9. Swing drive unit
10. Travel motor
11. Travel gear box
12. Swing ring gear
13. Turning joint
14. Fan motor
15. Shunt valve
16. Pilot filter
17. Accumulator block
18. Quick coupler
19. Accumulator
20. Solenoid valve(1)
21. Solenoid valve(2)
22. RCV LH
23. RCV RH
24. RCV pedal
25. Shuttle block
27. Check valve
28. Check valve
29. Hyd. oil cooler
30. Return filter
31. Bypass valve
32. Bypass strainer
33. Air breather



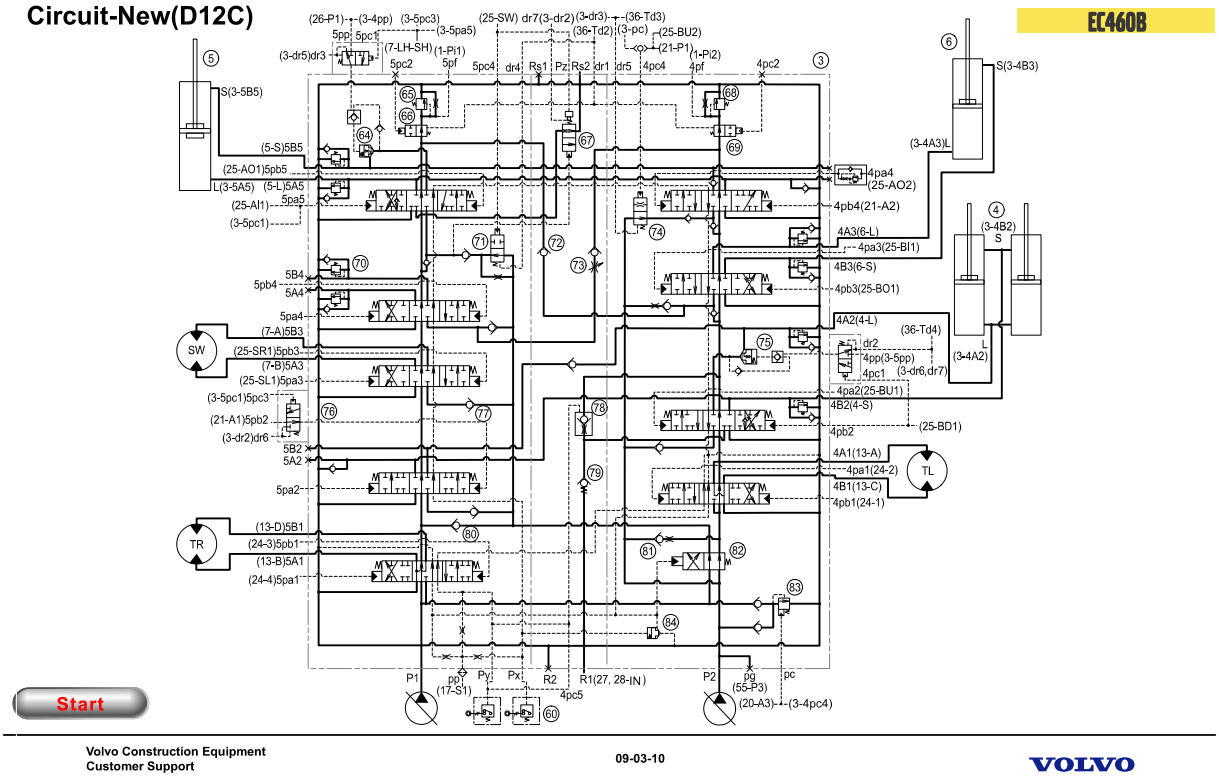
Brief circuit-1(New)

Picture text:



Brief circuit-2(New)

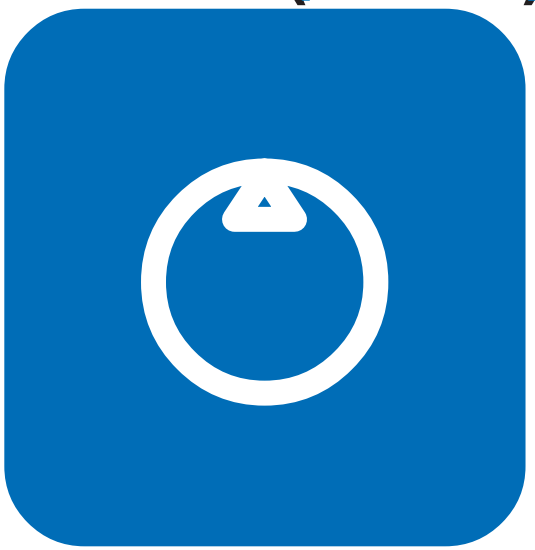
Picture text:



Circuit animation(New)

Picture text:

EC460B(D12C)

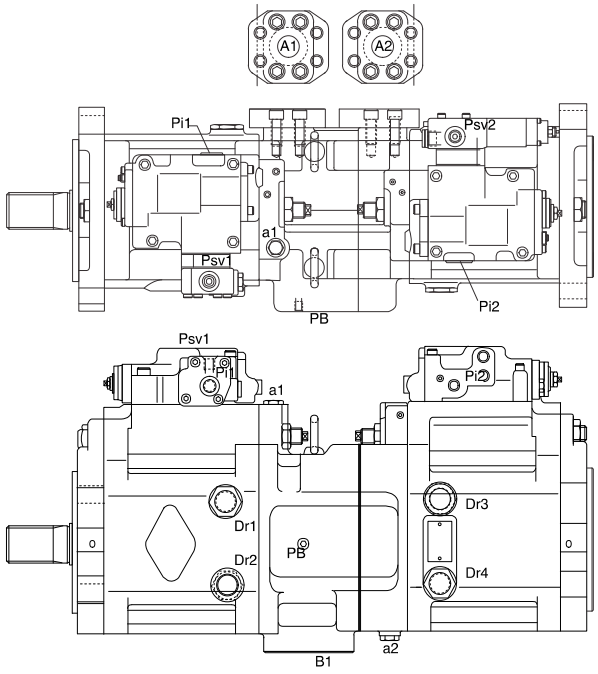


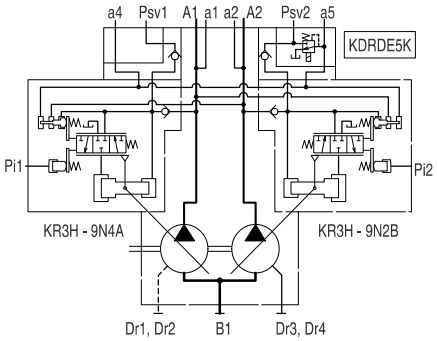
Hydraulic pump

Picture text:

External view

EC460B



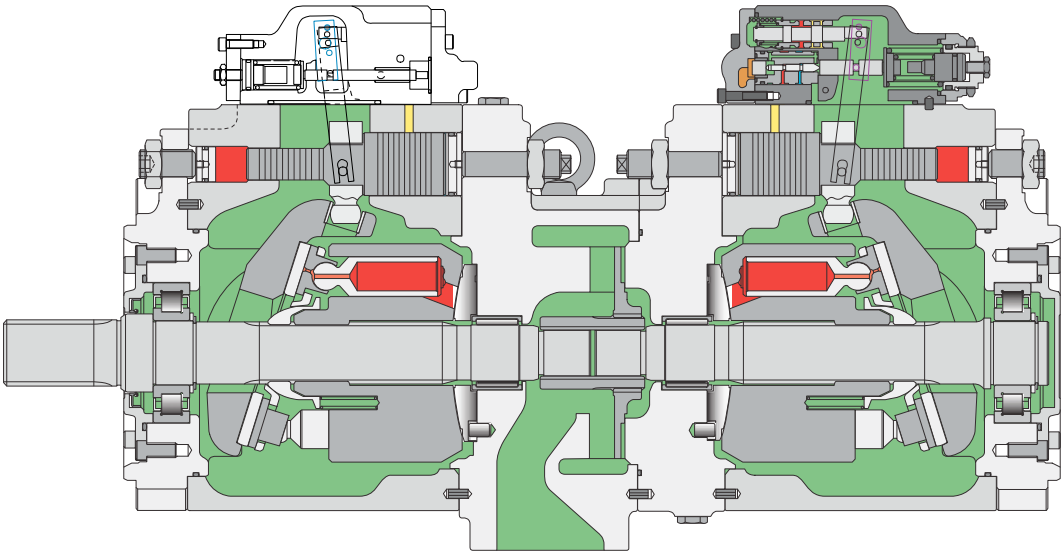


Port	Port
A1, A2	Delivery
B1	Suction
Dr1, Dr2, Dr3, Dr4	Drain
Pi1, Pi2	Negative control signal
Psv1, Psv2	Powershift pressure
a1, a2, a4, a5	Gauge port
PB	Gauge port

External veiw

Compare the circuit diagram with the external view.

Picture text:



Sectional view

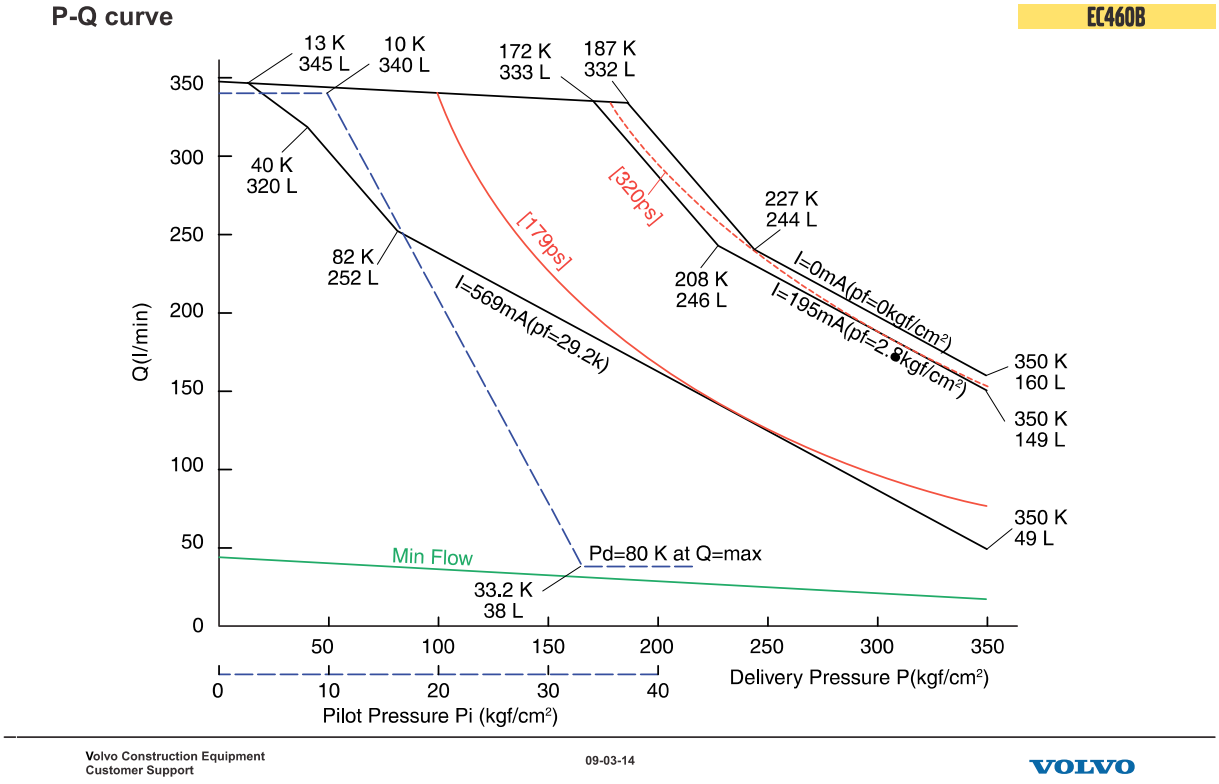
This pump assembly consists of two pumps connected by spline coupling.
The suction and delivery ports are integrated at the connecting section of the two pumps: The common suction port serves both the front and rear pumps.
The pump consists of rotary group, swash plate group and valve block group and has booster.

The rotary group consists of front drive shaft, cylinder block, piston and shoe, set plate, spherical bushing, and cylinder spring. The drive shaft is supported by bearings. The shoe is caulked to the piston to form a spherical coupling. It has a pocket to relieve thrust force generated by loading pressures and create a hydraulic balance so that it slides lightly over shoe plate.
The sub group composed of a piston and a shoe is pressed against the shoe plate by the action of the cylinder spring through the set plate and spherical bushing. Similarly, the cylinder block is pressed against valve plate by the action of the cylinder spring.

The swash plate group consists of swash plate, shoe plate, swash plate support, tilting bushing, tilting pin and servo piston.The servo piston moves to the right and the left as hydraulic oil controlled by the regulator flows to a hydraulic chamber located on both sides of the servo piston. The force exerted on the tilting pin by the servo piston causes the swash plate to slide on support to change the tilting angle.

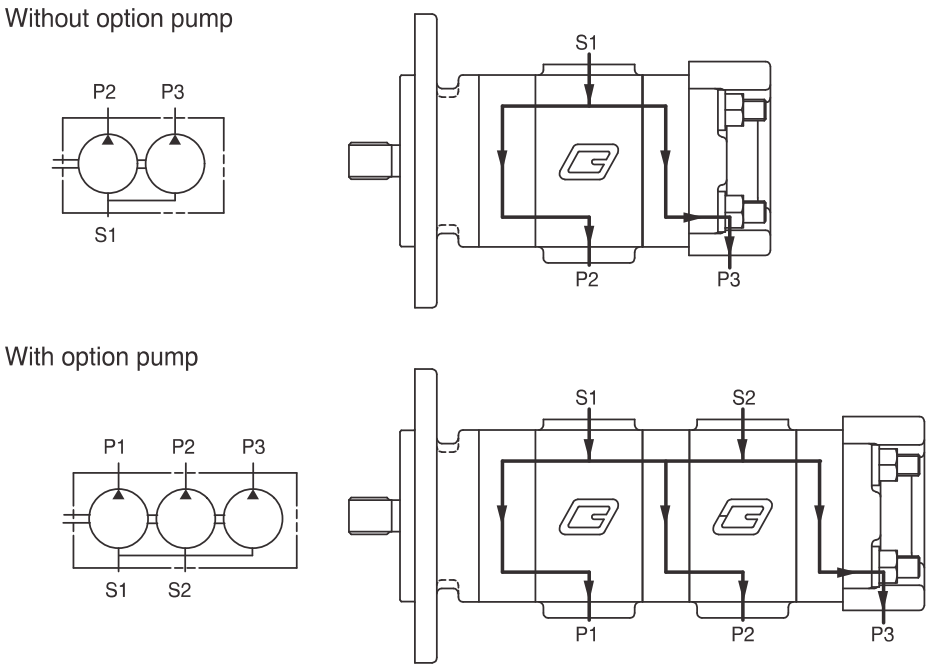
The valve block group consists of valve block, valve plate and valve plate pin. The valve plate which has two crescent ports is attached to the valve block to feed oil to and collect oil from the cylinder block. The oil discharged via the valve plate is routed to an external pipe line by way of the valve block.

Picture text:



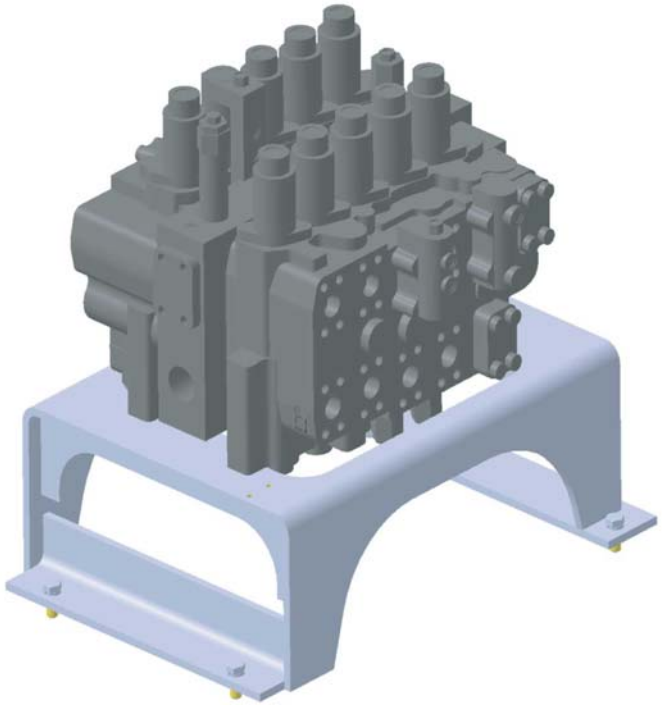
P-Q curve

Picture text:



Gear pump

Picture text:



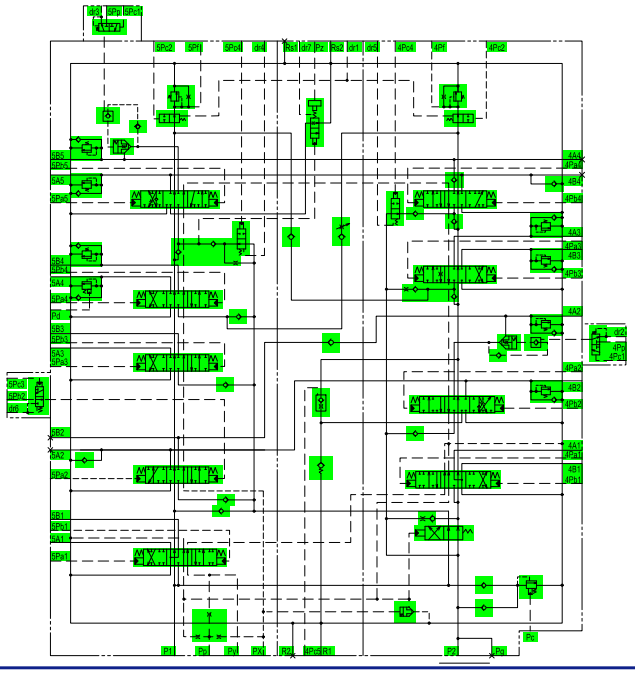
Main Control Valve

Picture text:

MCV Animation (EC460B)

External view

EC460B



A click at finger pointer gives you more informations

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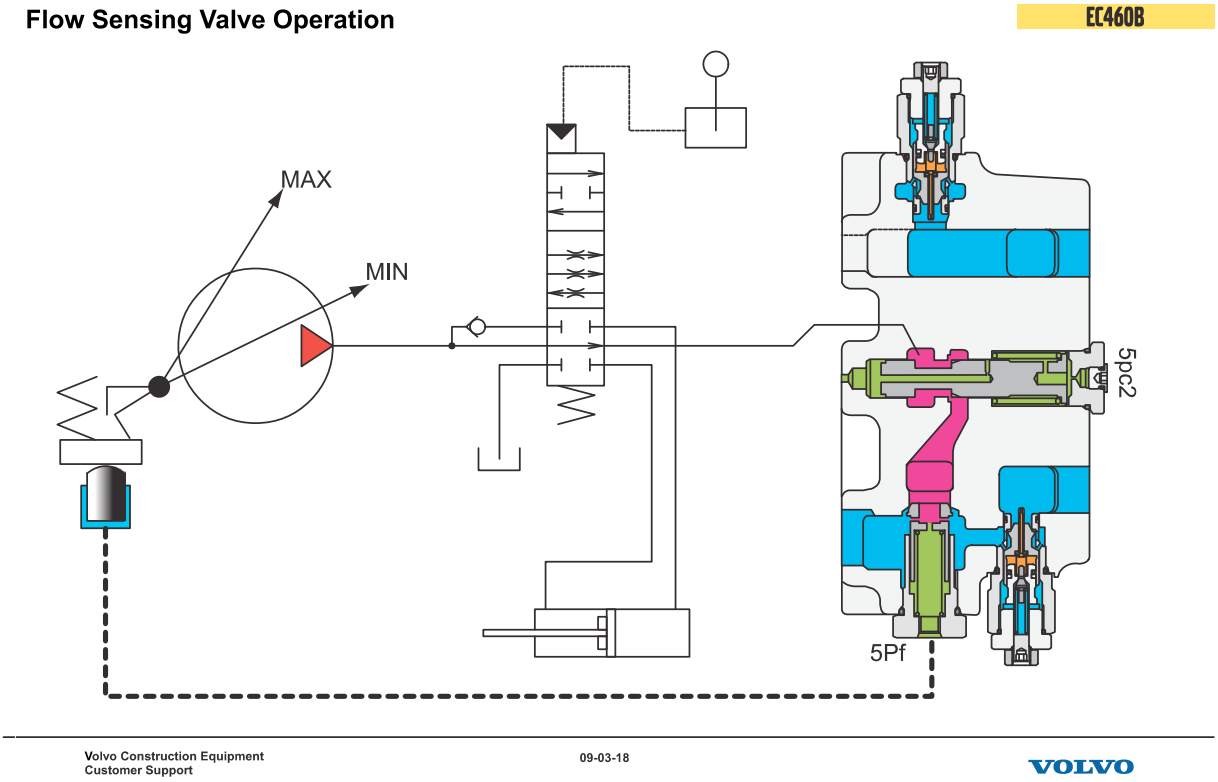
Main Control Valve Animation

Push the component in the circuit diagram with mouse then you can see the location of that components.

Picture text:

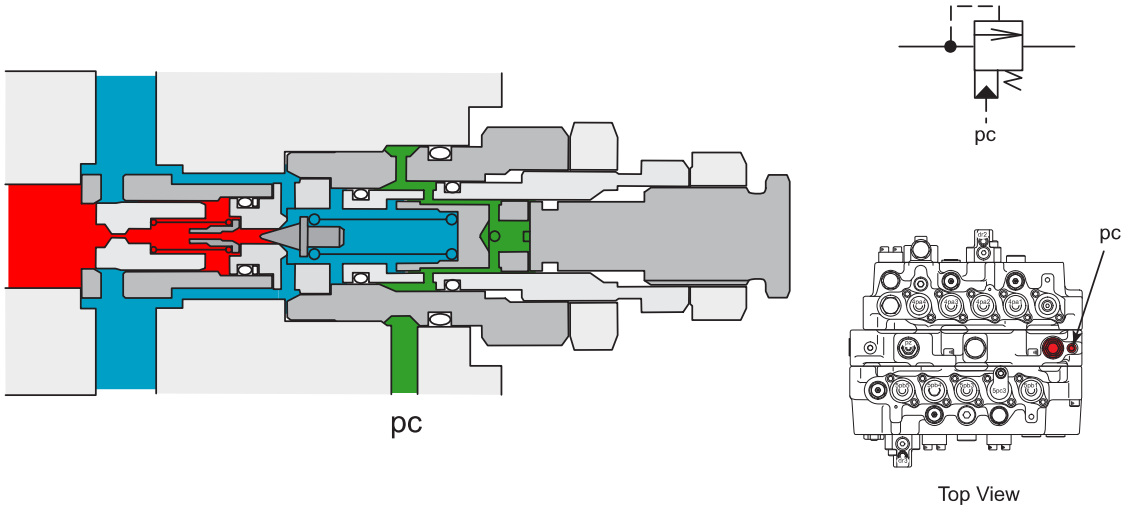


Flow sensing valve operation

The function of flow sensing valve is to control the amount of flow from pump according to the joystick stroke.

1. Neutral condition(Central passage fully open -> High Pi -> Minimum flow)
2. Half stroke(Central passage partially open -> Medium Pi -> Medium flow)
3. Full stroke(Central passage fully close -> the lowest Pi -> Maximum flow)

Picture text:

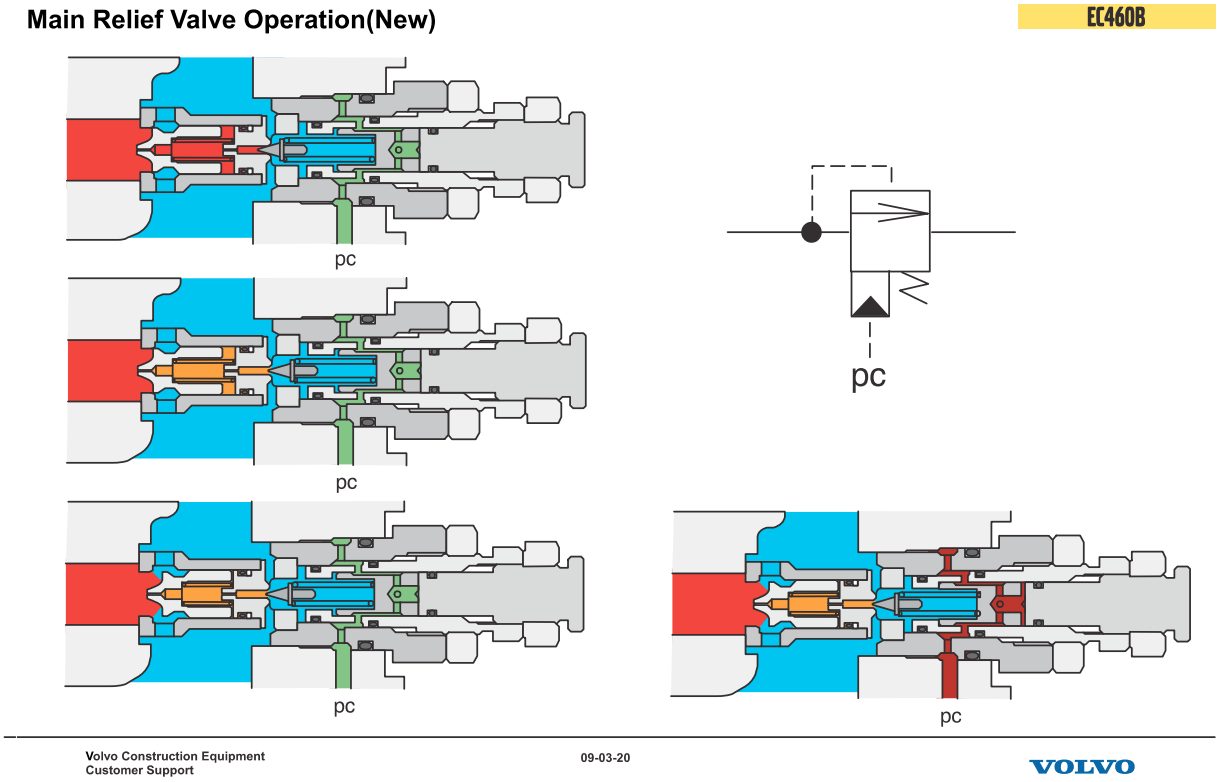


Main relief valve operation-1(Old)

(1) Pump pressure is lower than the set-pressure.
(2) Pump pressure is reached to the set-pressure.

Main relief valve operation-2(Old)
(3) Main poppet open and pump line has tank-connection
(4) Boost signal comes from port pc and push the piston to increase the tension of spring.

Picture text:



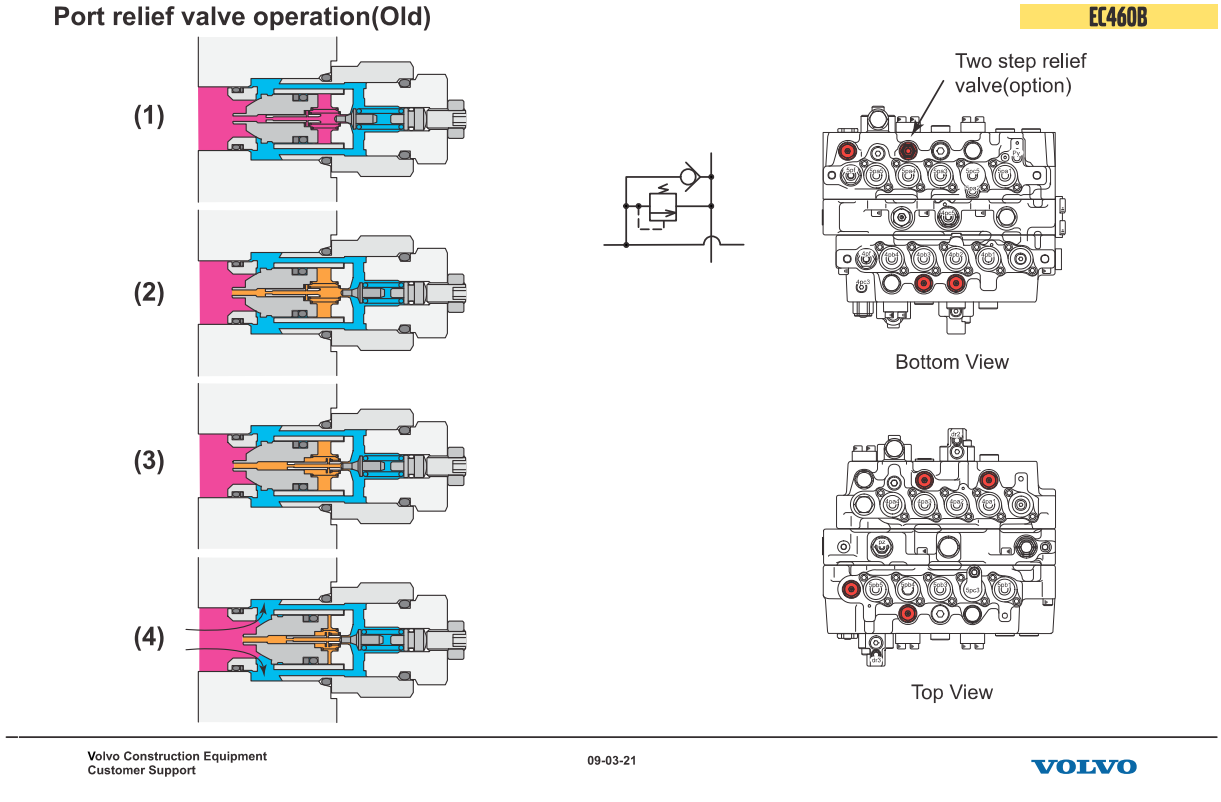
Main relief valve operation(New)

The function of main relief valve is limit the maximum system pressure.

pc-OFF
1. Pump pressure is lower than the set-pressure.(close)
2. Pump pressure is reached to the set-pressure.(pilot poppet open) Main poppet open and pump line has tank-connection.

pc-ON
1. Boost signal comes from port pc and push the piston to increase the tension of spring.

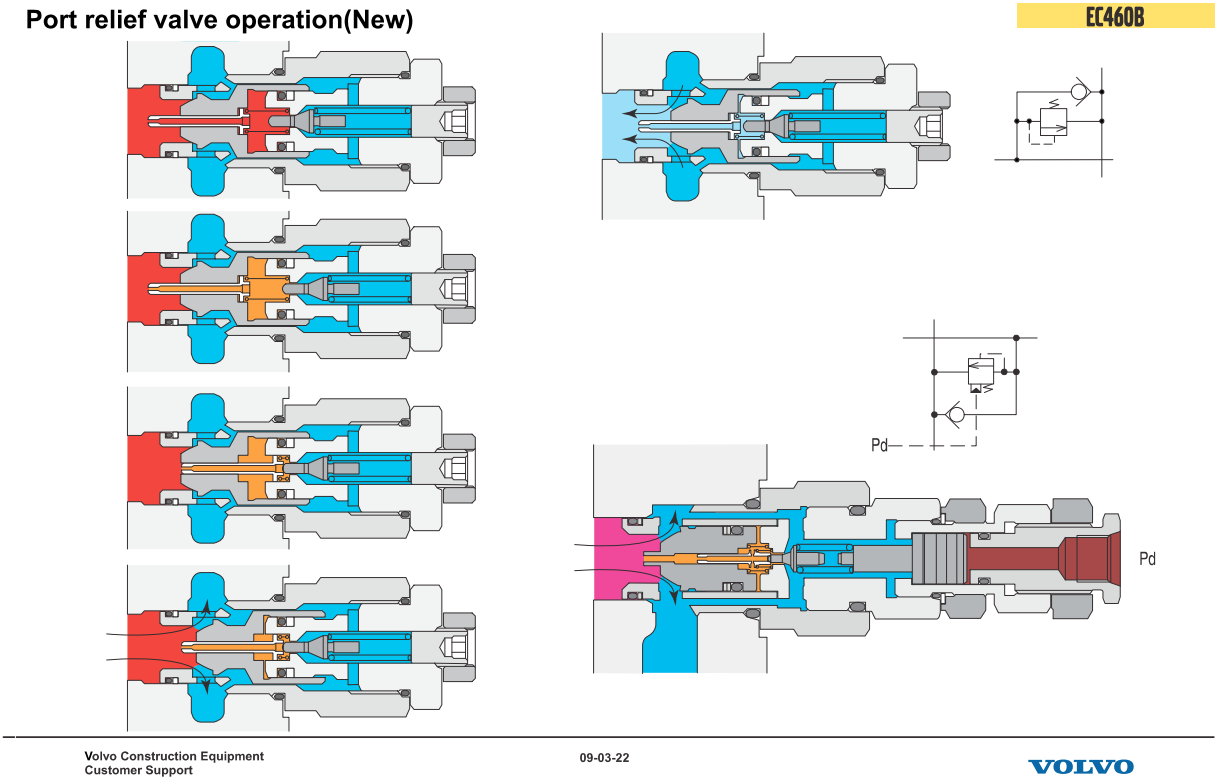
Picture text:



Port relief valve operation(Old)

(1) Cylinder pressure is lower than the set-pressure.
(2) Cylinder pressure is reached to the set-pressure.
(3) Piston inside of main poppet will move.
(4) Main poppet open and make tank-passage.

Picture text:



Port relief valve operation(New)

The function of port relief valve is to release the shock pressure inside of actuator during neutral condition

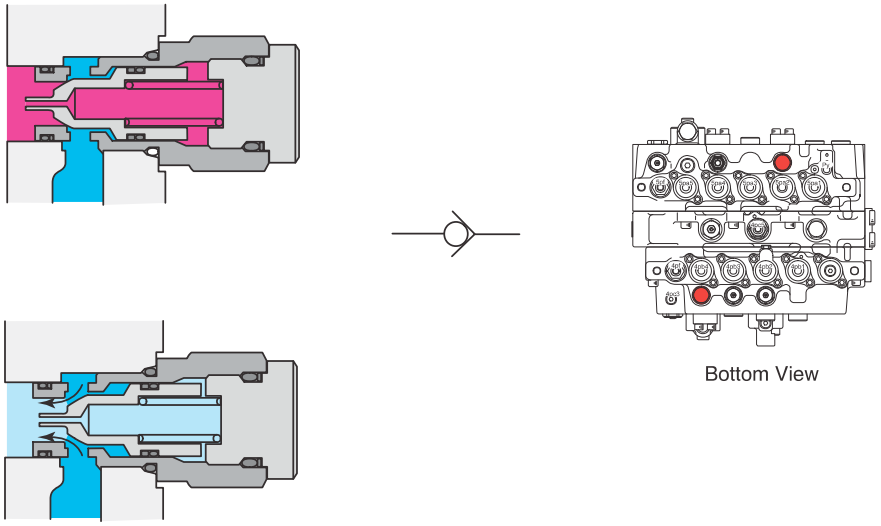
Overload
1. Cylinder pressure is lower than set-pressure.(close)
2. Cylinder pressure is reached to set-pressure.(pilot poppet open) Small piston which is inside of main poppet move to right and sit on the pilot poppet.
3. Main poppet open and makes tank-passage.

Anti-cavitation(Make up)
1. Cylinder pressure drop down to the vacuum pressure. Main poppet will be opened by tank pressure and fill up the cylinder chamber.

2-statge port relief valve operation
(1) Hammer
- Relief valve goes to low pressure setting without pilot pressure.

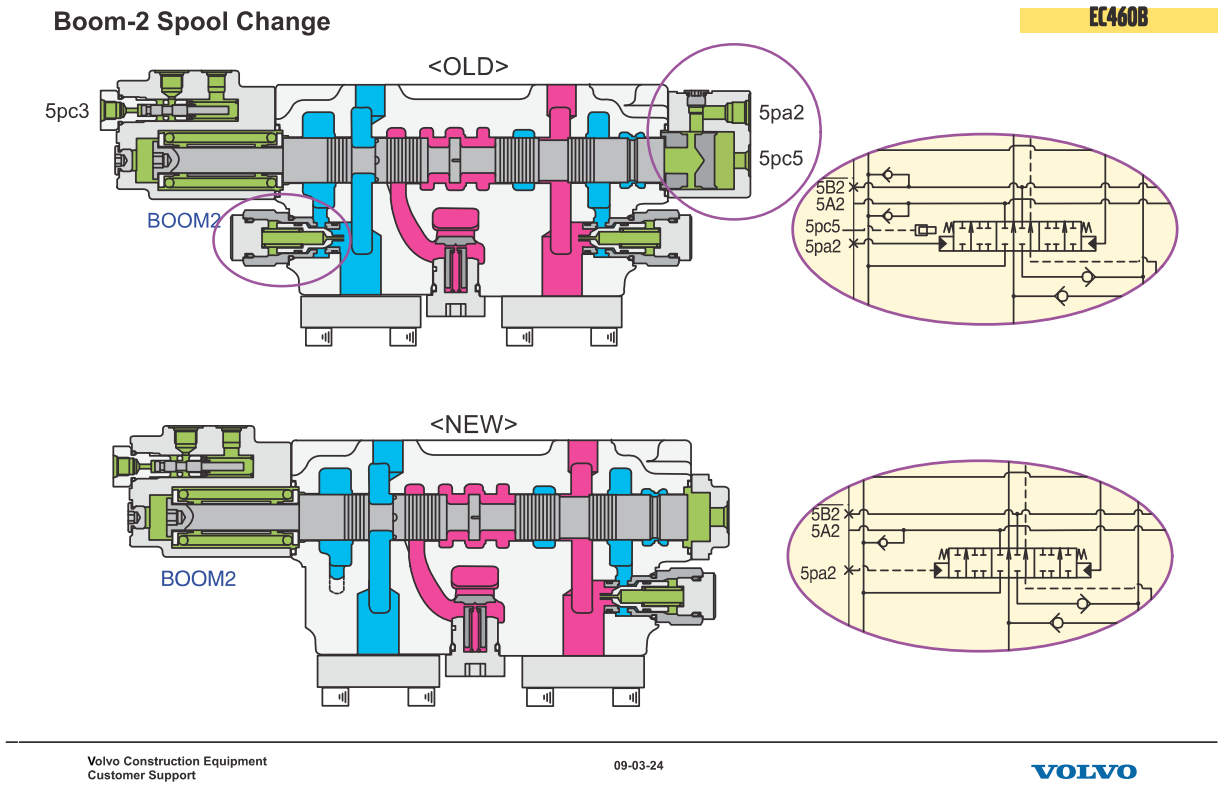
(2) Shear
- Relief valve goes to high pressure setting due to pilot pressure ON.

Picture text:



Makeup valve operation

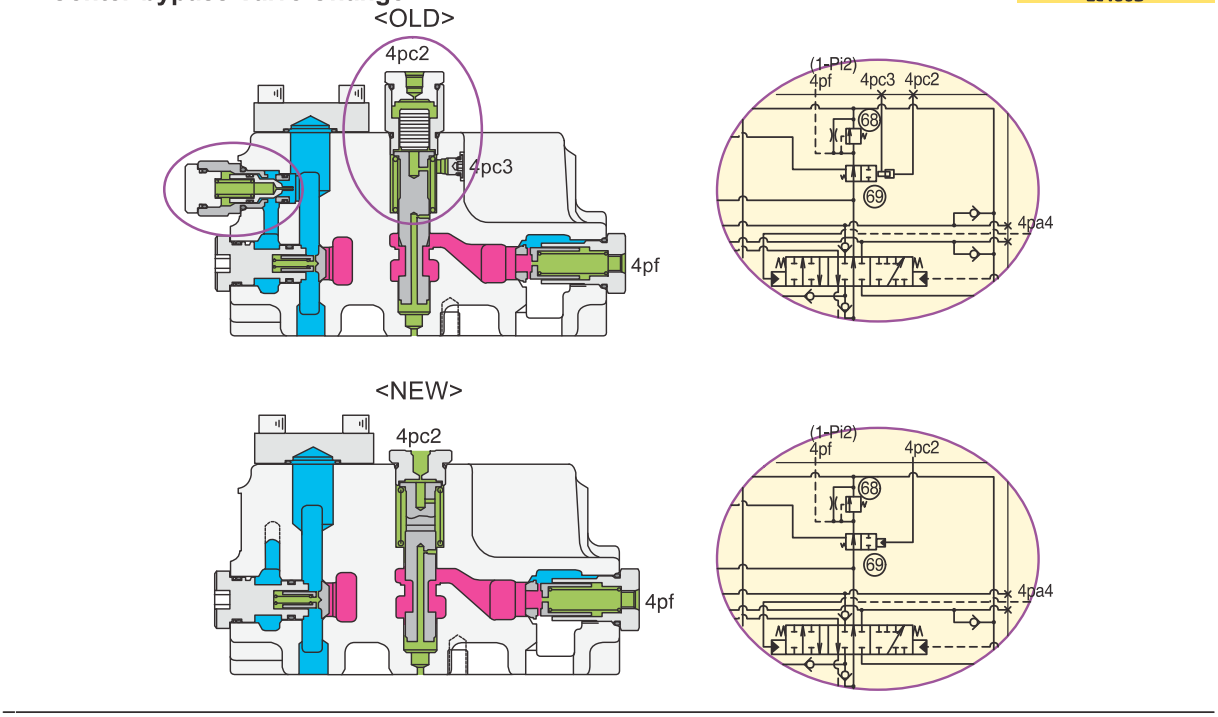
Picture text:



Boom-2 Spool Change

1. Remove the stroke limiter from Boom2 spool.
2. Remove the make-up valve from Boom2 head side.

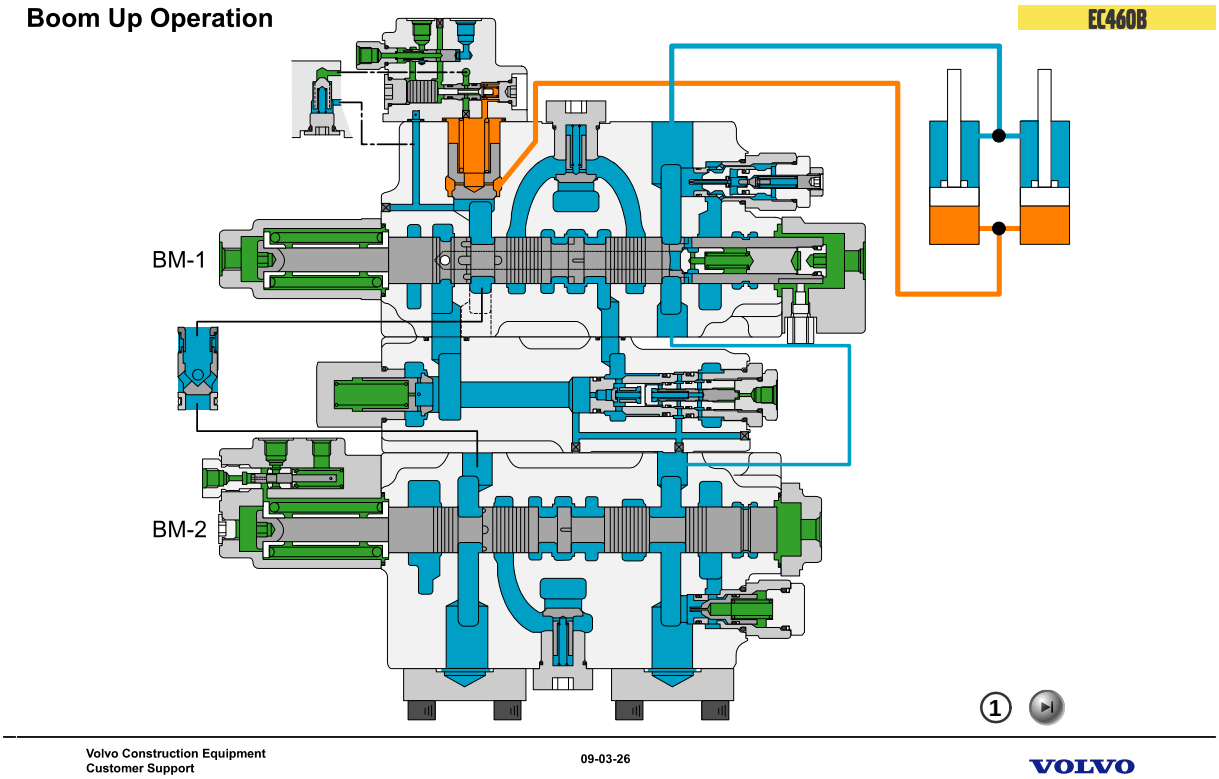
Picture text:



Center-bypass Valve Change

1. Simplification of the center-bypass valve
2. Remove the make-up valve from Arm2 rod side.

Picture text:



Boom up operation

1. Neutral
- Center passage open
- Holding valve closed

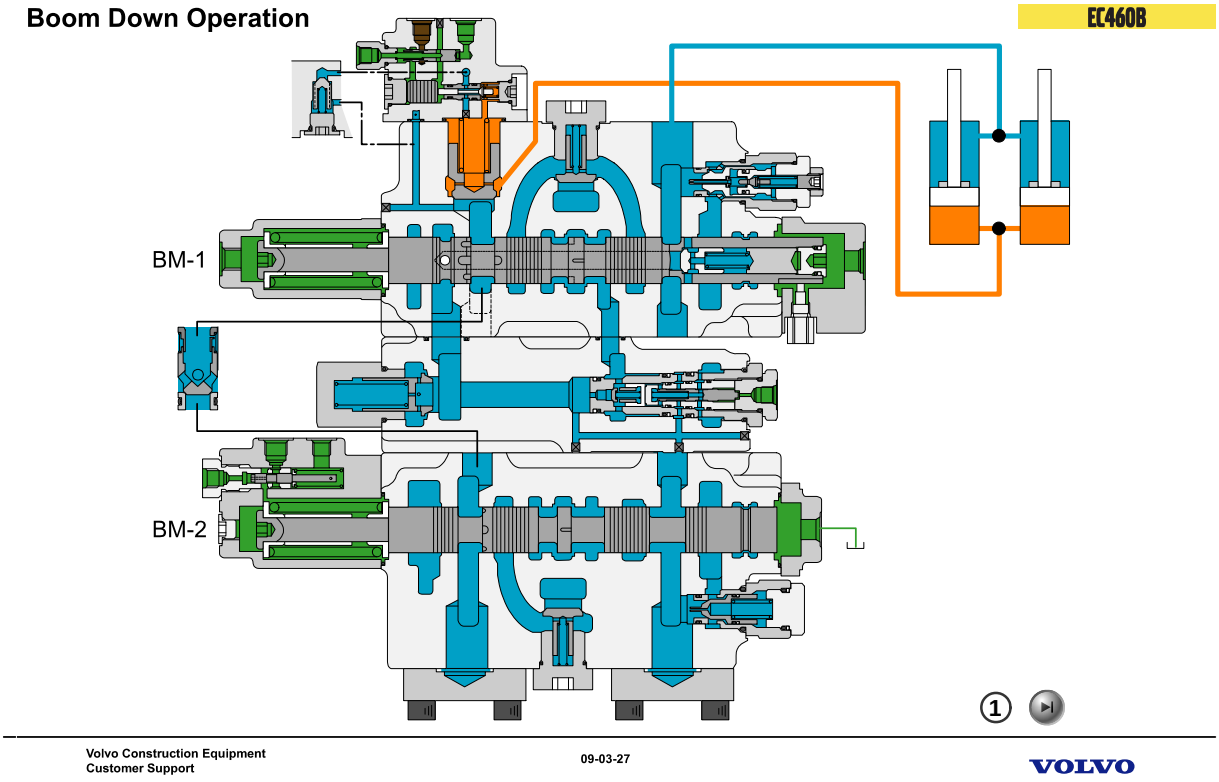
2. Joystick signal on(BU)
- Boom1 & Boom2 Spool move
- Center passge close & pressurize

3. Open load check
- Oil from parallel passage open load check.

4. Holding valve open and supply oil to cylinder

5. AI signal ON
- Boom2 spool returns to the neutral

Picture text:



Boom down operation

1. Neutral

2. Joystick signal(BD) ON
- Spool move and close center passage.

3. Oil supplied to the small chamber and return oil try to return to tank

4. 4pc1 oil make passage to the pilot check valve

5. Pilot check valve open and oil in the back side of the holding valve can be released.

6. Holding valve open

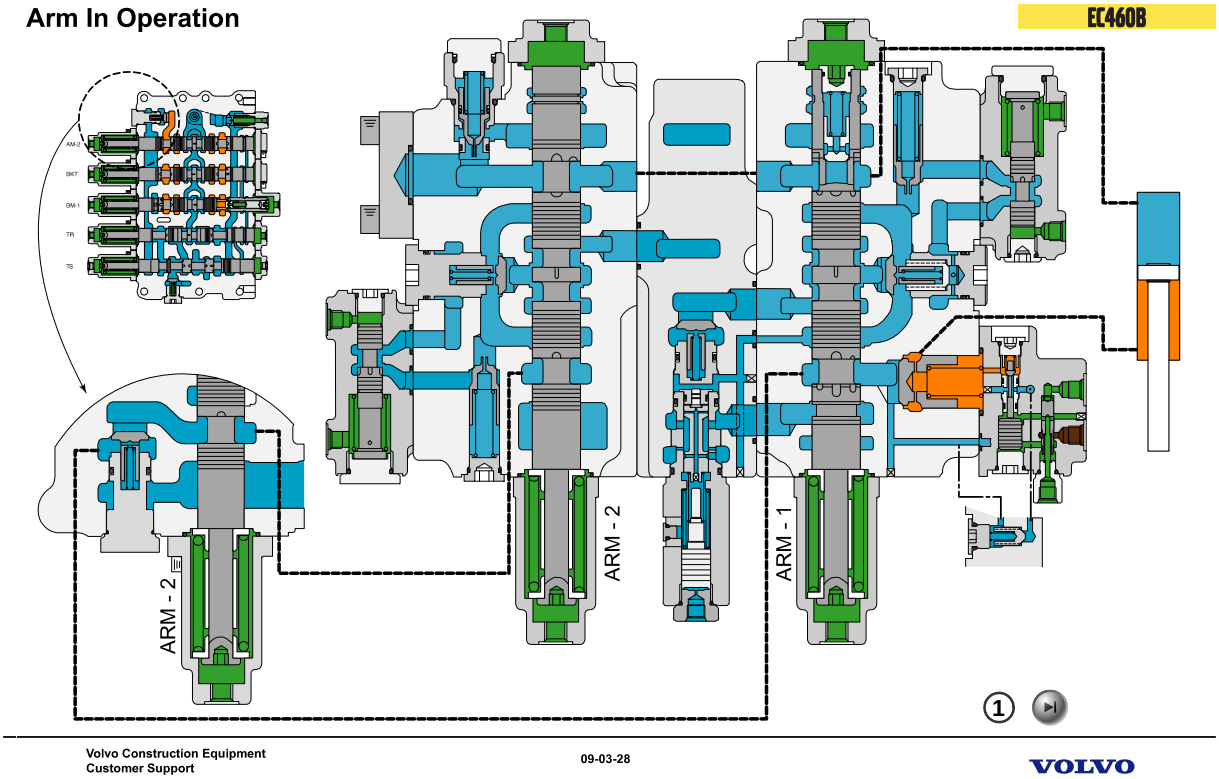
7. Regeneration
- Return oil go through the spool and open back-pressure check valve then return to tank. Build-up return pressure.

- When supply pressure is low,internal check valve can be open and make passage to the supply side.

- A small amount of oil go to the center passage through the boom regeneration pilot check valve to reduce the amount of pump flow.

8. Boom down + Travel
- The boom regenration pilot check valve close the passage to the center passage to increase the amount of pump flow.

Picture text:



Arm-IN operation

1. Neutral
- Holding condition

2. Joystick Arm-IN(AI) ON
- The Arm1 & Arm2 spool block center passage block
- Holding valve spool move to make holding valve free.

3. Load check open and return line is blocked by holding valve.

4. 5pc1 oil make passage to the pilot check valve

5. Pilot check valve open and oil in the back side of the holding valve can be released.

6. Holding valve open.

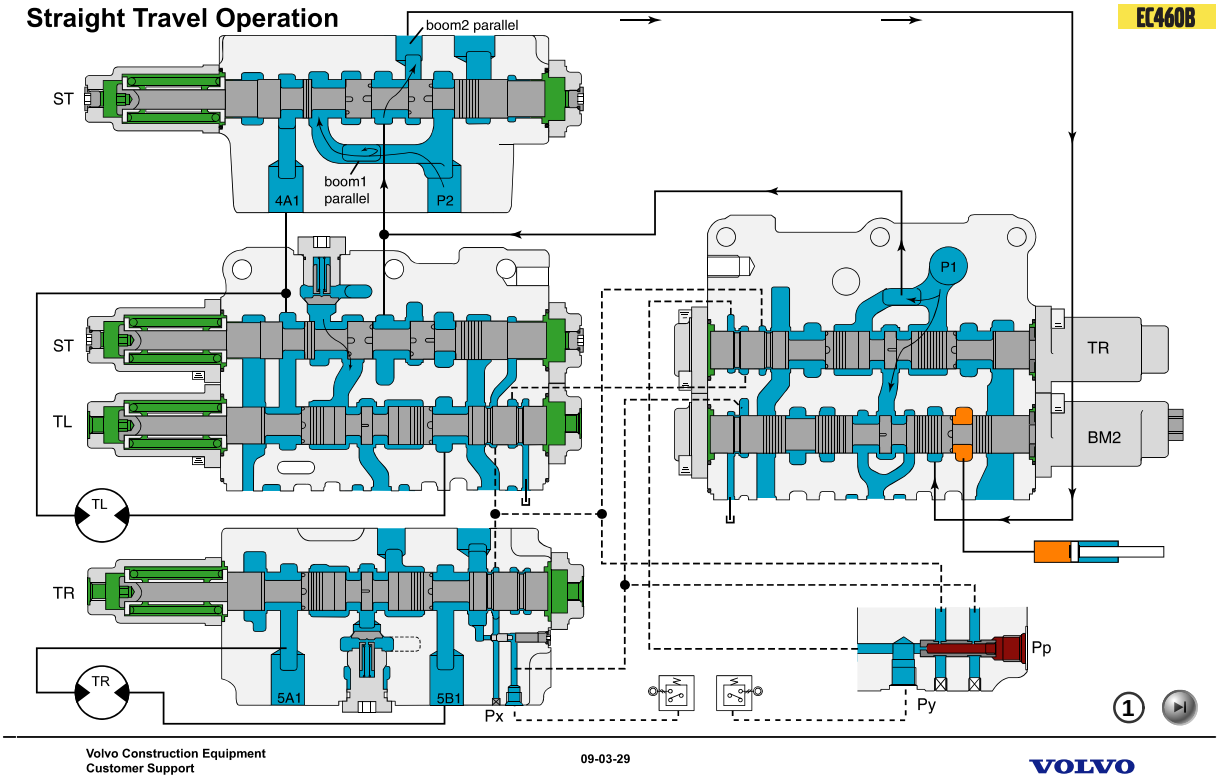
7. Regeneration
- Return line is restricted by arm regeneration valve when supplying pressure is low.
- Internal check open and return line is connecting to supply line.

8. When supplying pressure is high, arm regeneration valve make wide hole for return line to reduce back pressure.

9. When using Boom-up at the same time.
- Center passge is blocked by boom1-spool
- Arm parallel conflux changeover valve reduce the passage for the summation of flow.

10. When using swing at the same time.
- Center passge is blocked by the swing spool
- The swing priority valve closes the passage to the arm supply side.

- The double check valve for parallel passage is opened and using orifice.



Straight travel

1. All spools are in neutral condition.
- 40 bar enters in port-Pp which has three orifices.
- oil from one orifice connected to Py port and then pass through two travel spool and go to the return line.
- oil from the other orifice pass through the straight travel spool and two travel spool and go to the return line.
- Oil from the other orifice pass through every other attachment.
- P1 is going to supply TR side and Boom2 side through the straight travel valve.
- P2 is going to supply TL side and Boom1 side.

2. Travel (LH)
- Spool movement block the line from orifice and bulid up pressure.
- Travel pilot pressure switch ON
- P2 oil goes to TL side directly and Boom1 side parallel passage.

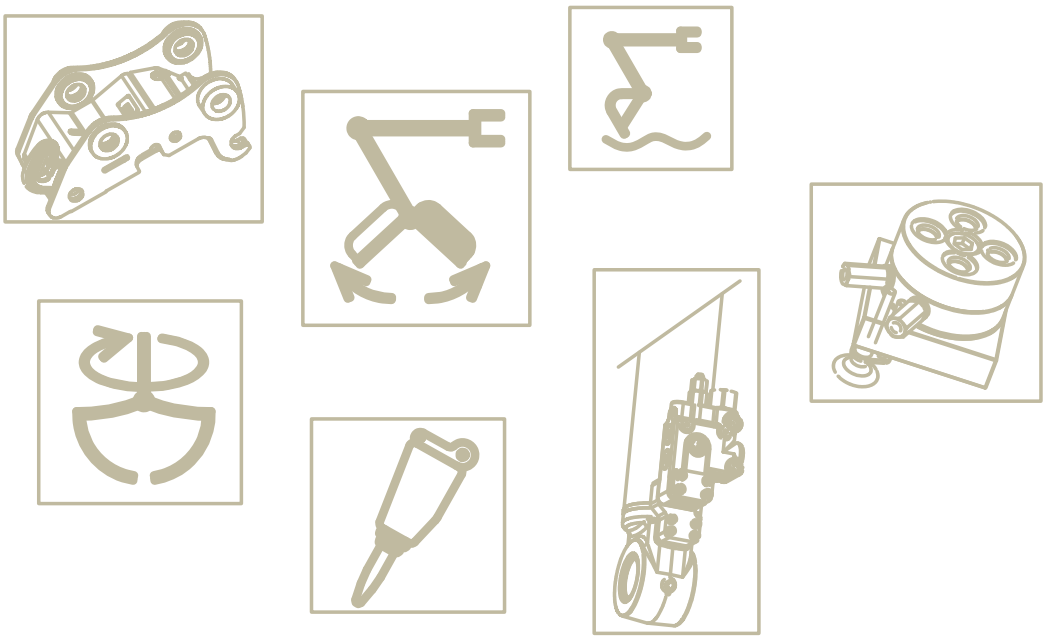
3. Travel (RH)
- Spool movement block the line from orifice and bulid up pressure.
- P1 oil goes to TR side directly and Boom1 side parallel passage

4. Boom-Up operation
- Boom spool movement block the line from the other orifice and build up pressure.

5. Attachment pilot pressure switch ON
- Block the back side of check valve

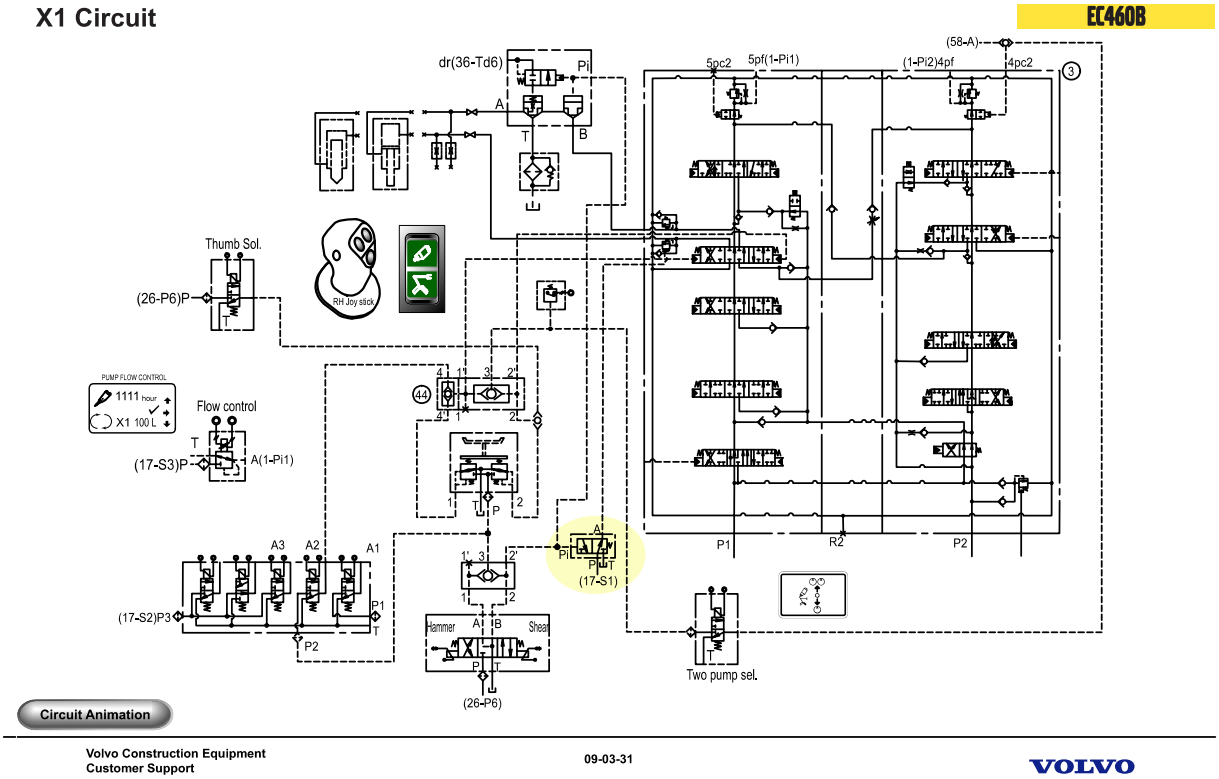
6. Straight travel spool side will be pressurized.

7. Straight travel spool move
From this point
- P1 oil goes to TR side directly and TL side through the straight travel spool.
- P2 oil goes to Boom1 side and Boom2 side.



Option hydraulics

Picture text:



X1 circuit

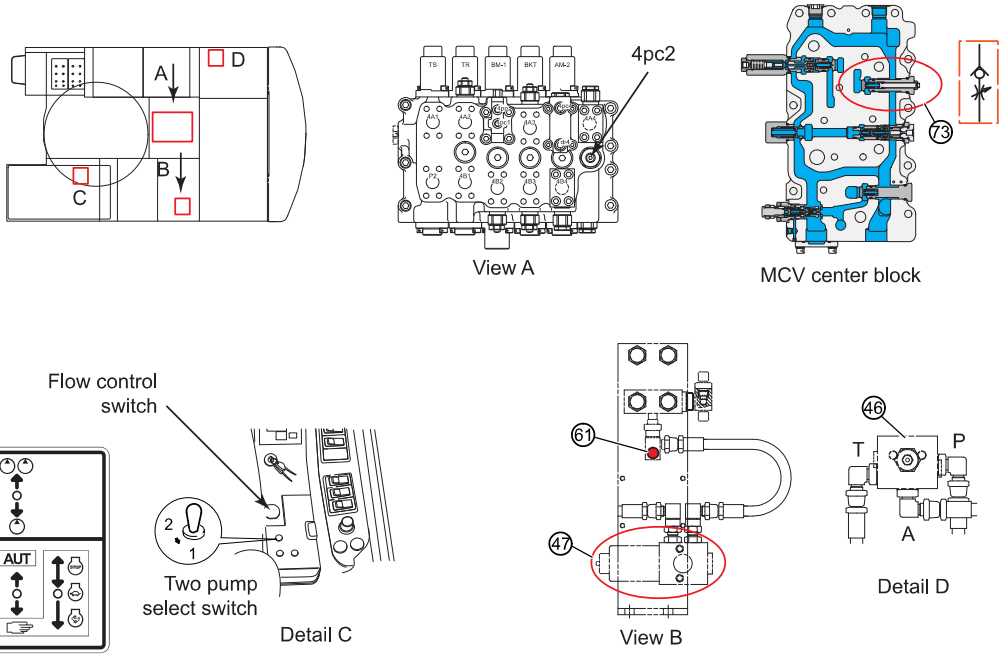
X1 option is used for hammer & shear.

- Main line change:
When it is used for hammer, return line directly goes to tank. But shear uses double action. So we need 3-way valve

- 2-step port relief valve:
2-step port relief valve always maintains high pressure except hammer use.

- X1 option pedal
- Flow control function
- Option 2-pump flow
- 2-switch control without pedal

Picture text:



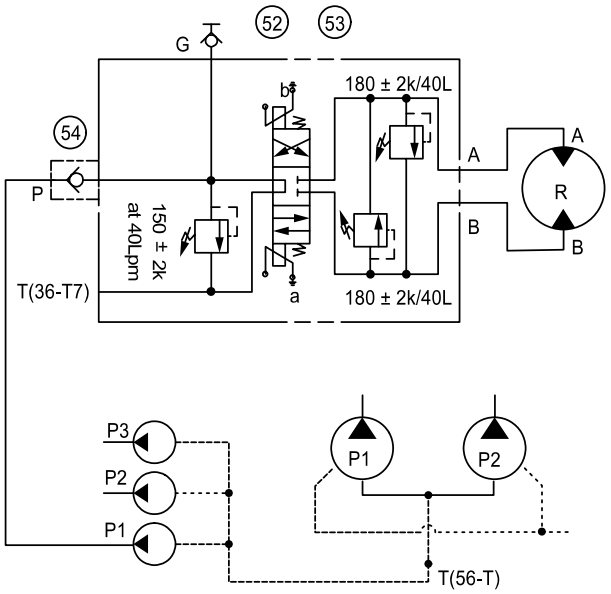
X1 Components

When we select 2-pump flow for option, you have to open the option conflux check valve fully.

Flow control starts the function after hammer pressure switch is on.

46: X1 flow control valve
47: X1 2 Pump select solenoid valve
61: X1 pressure switch
73: Option conflux check valve

Picture text:

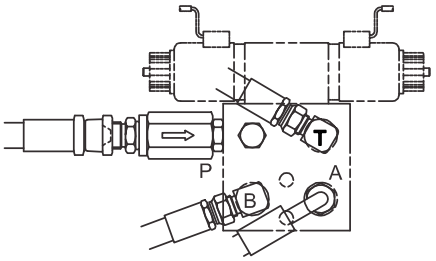


Start

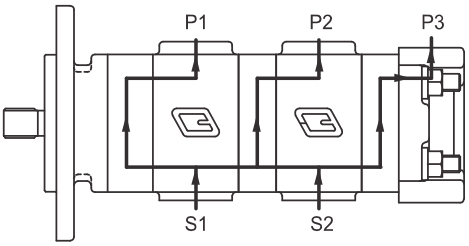
Rotator circuit(X3)

This is X3 option.
X3 option is composed of gear pump at PTO, rotator valve and additional case drain line for motor. This is operated using LH joystick button.

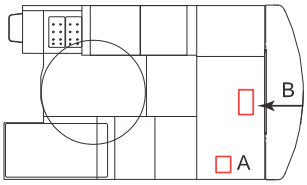
Picture text:



Detail A

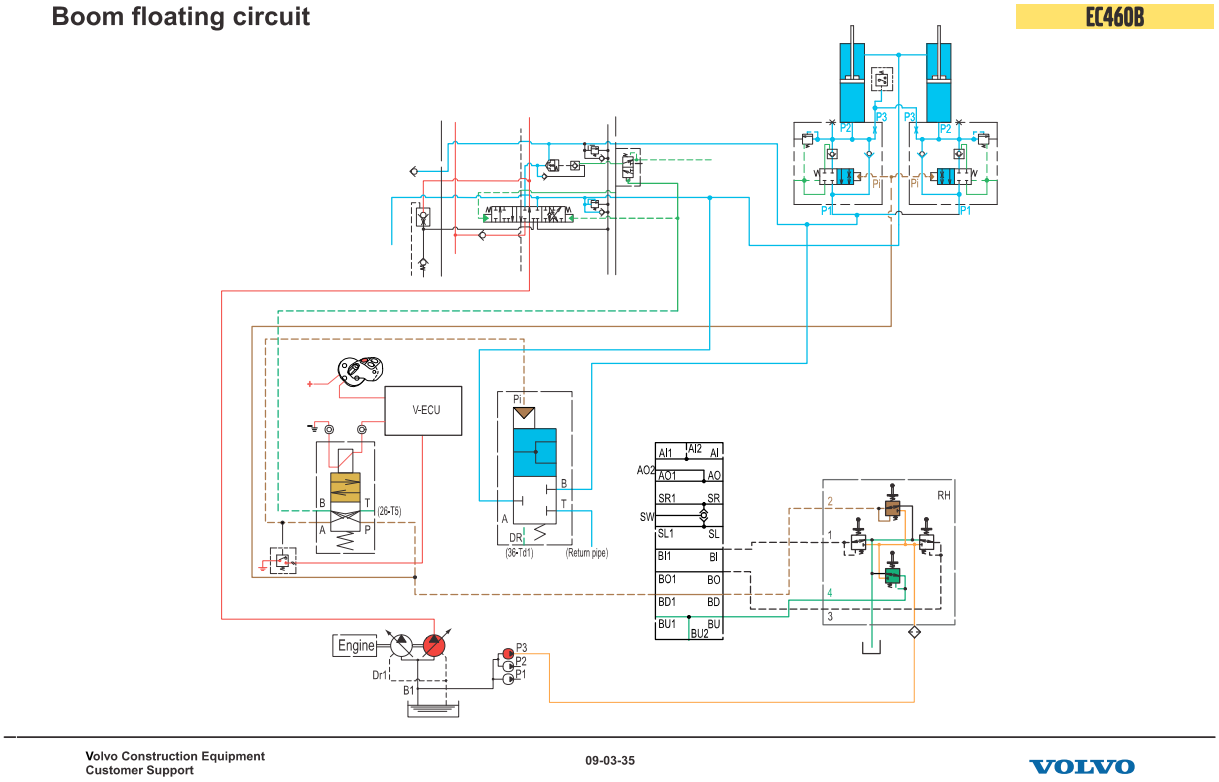


View B



X3 components

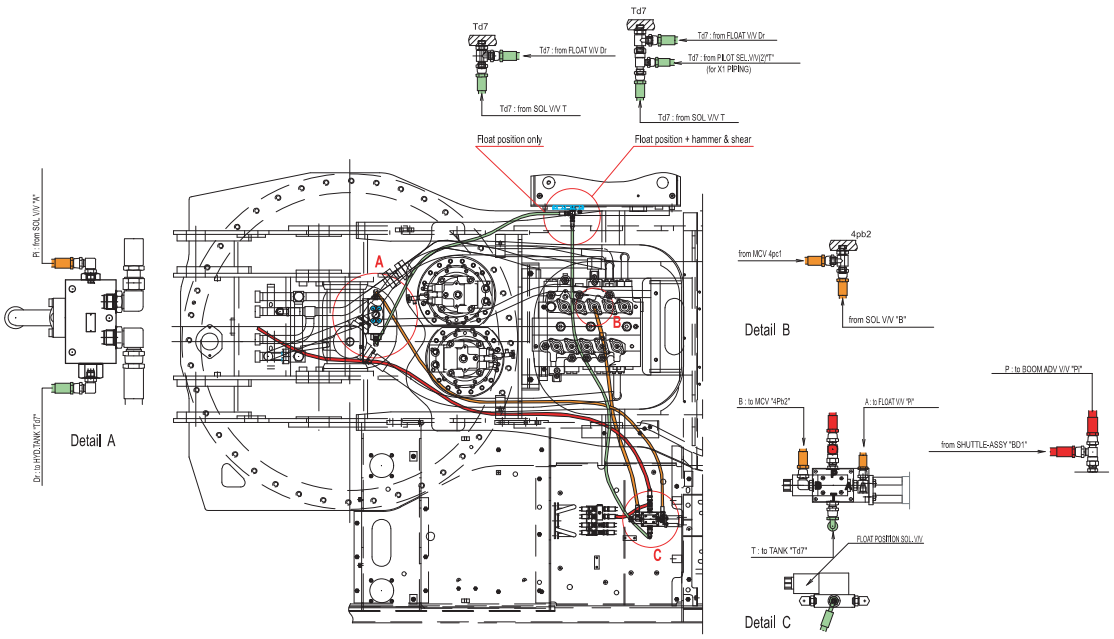
Picture text:



Boom floating circuit

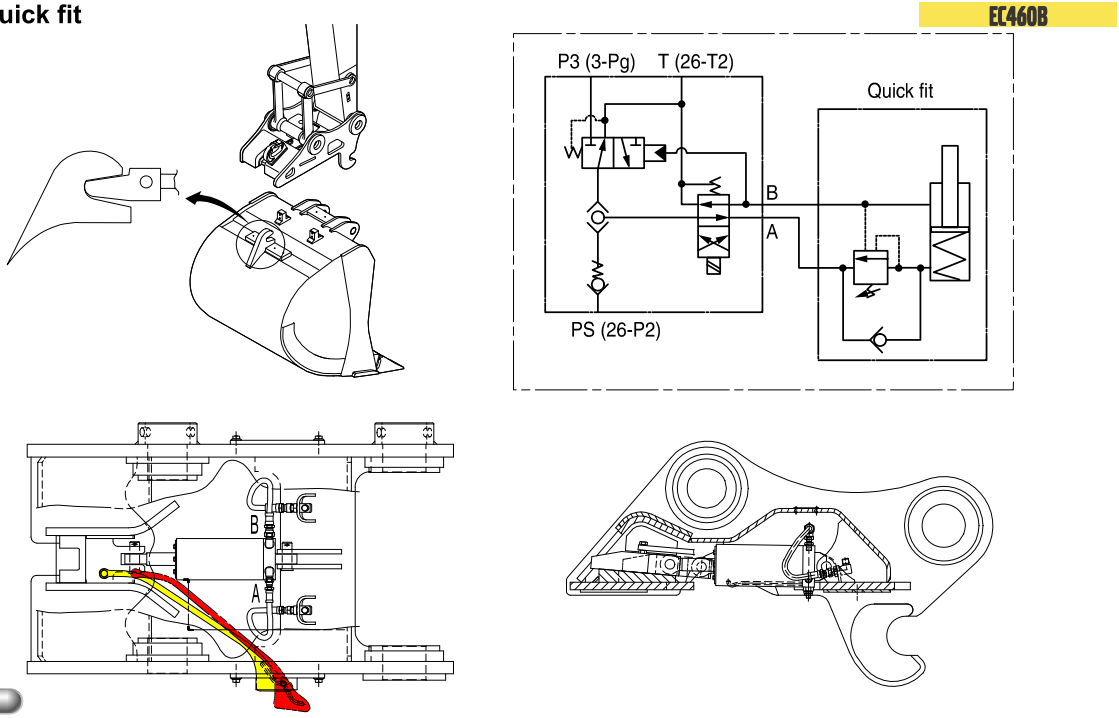
When joystick button is pushed, this signal goes to VECU. VECU energize the solenoid. When joystick is in boom-down position, this signal operate hose rupture valve and boom floating valve. This makes boom cylinder piston side and rod side go to tank. So boom can drop down by its weight.

Picture text:



Boom floating components

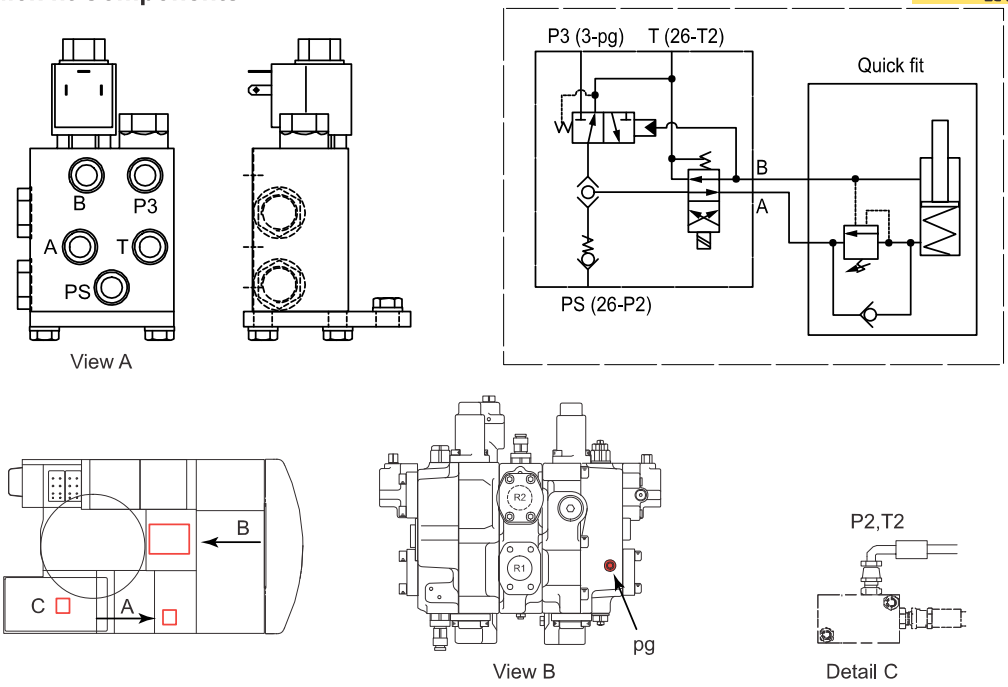
Picture text:



S-Quick fit

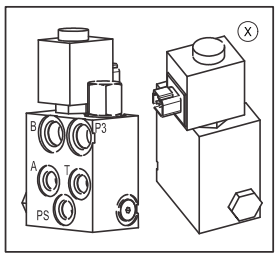
The quick-fit attachment is fitted to the arm end and bucket link. The connection between the quick-fit and bucket is like figure.
The quick-fit attachment is equipped with a double acting hydraulic cylinder. The quick-fit locking wedge is fitted to the piston rod. Servo pressure acts on the piston side of the lock cylinder, locking the bucket in place against the rear hook. This means that the lock wedge adjusts itself and provides gap-free locking. When lock wedge is released, the servo pressure is transferred to the piston rod side. If necessary, the release pressure can be increased by loading the bucket cylinder in its end position.
There is a red marker on the left side of the quick-fit attachment, which is folded in when the lock wedge is in the locked position and folded out when the lock wedge is released.

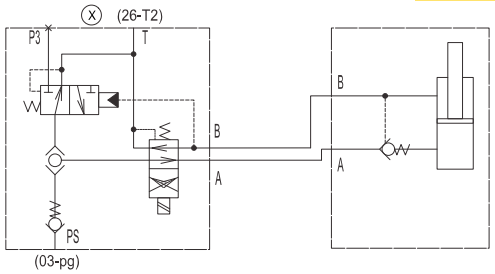
Picture text:

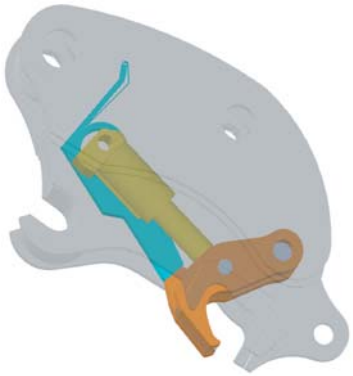


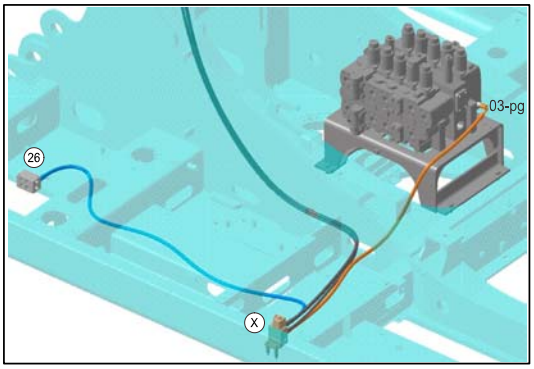
S-Quick fit Components

Picture text:









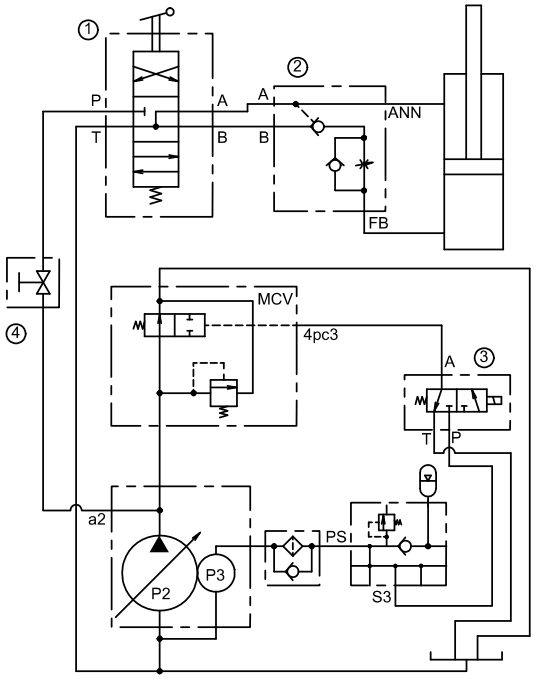
U-Quick fit

X: Quick fit solenoid valve
26: Pilot block

Picture text:

Removable counterweight

EC460B



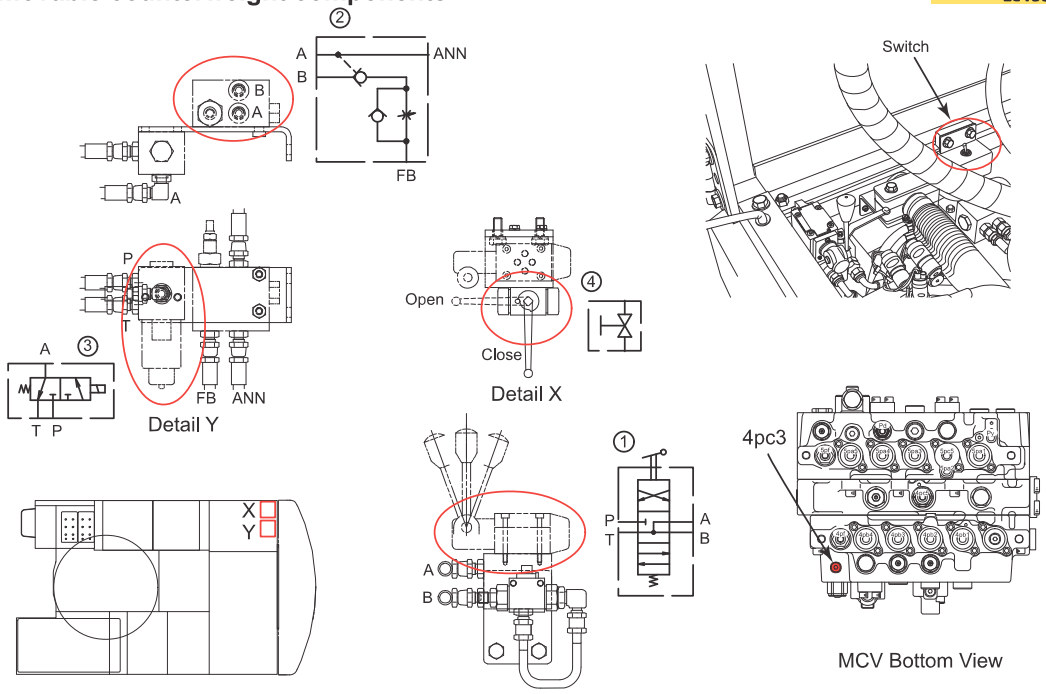
1. Control valve
2. Check valve
3. Solenoid valve
4. Stop valve

Start

Removable counterweight

The counterweight removal equipment consists of control valve, check valve, solenoid valve and stop valve. This equipment makes it easier to remove/install a counterweight to the machine.

Picture text:



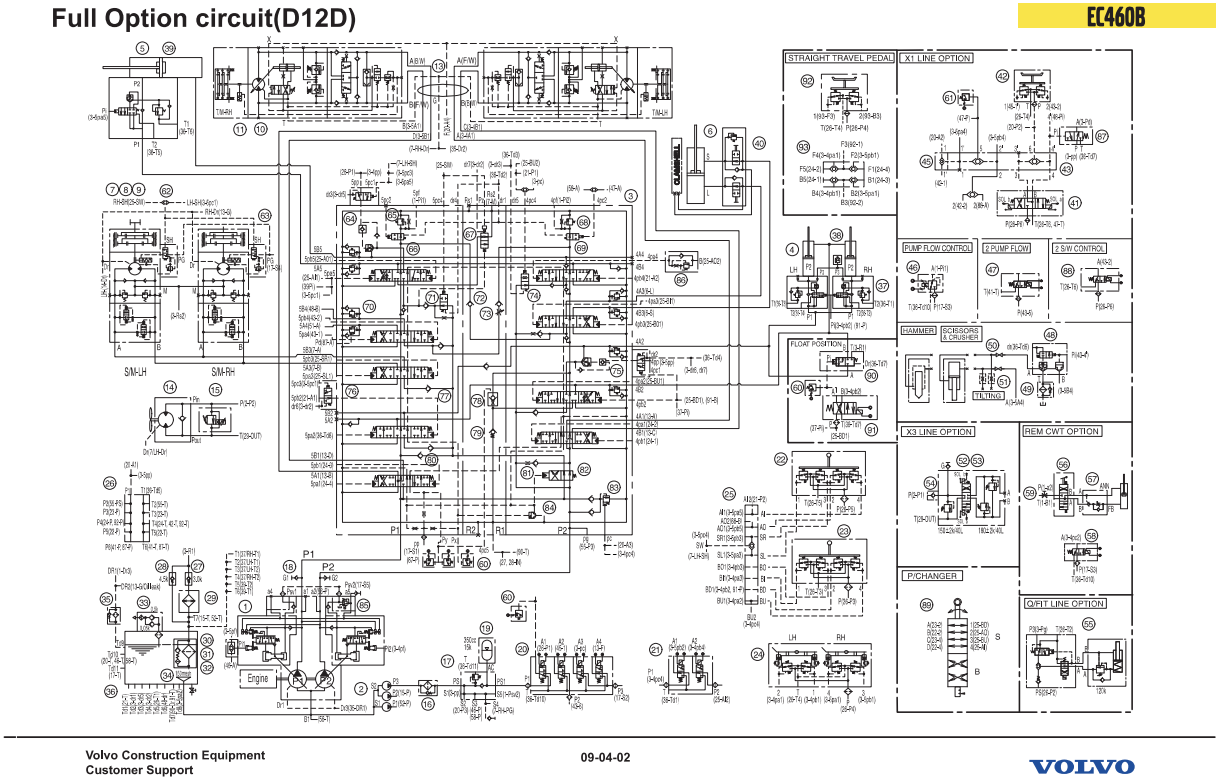
Removable counterweight components

Picture text:

EC460B(D12D)

Hydraulic System(D12D)

Picture text:

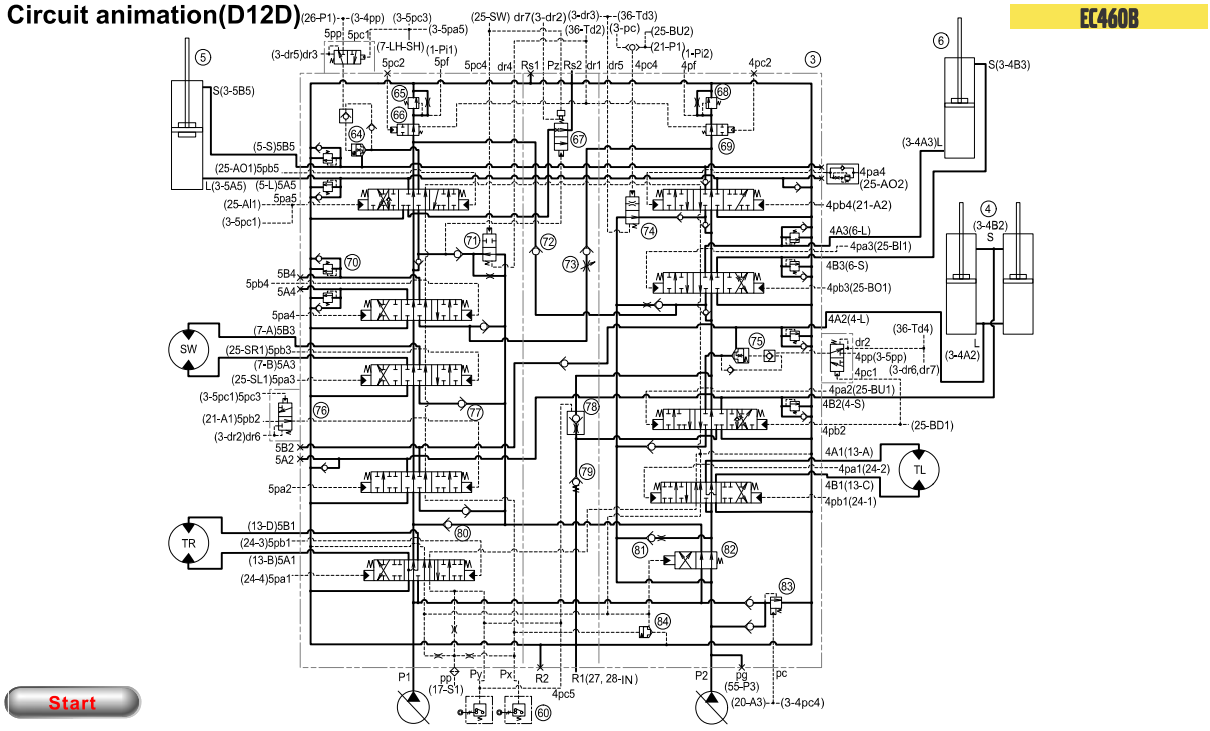


Full option circuit-EC460B(D12D)

Picture text:

Circuit animation(D12D)

EC460B



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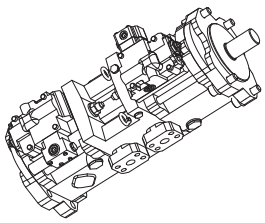
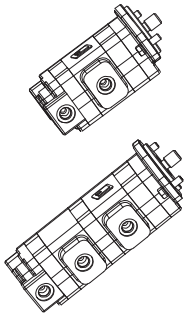
Hydraulic circuit animation(D12D)

Picture text:



Classification	Unit	Specification
Model		K5V200DTH10DR-9N0B-V
Type		Variable displacement, swash plate type, piston pump
Displacement	cc/rev	2 x 192.5
Flow-rate	L/min[gpm]	2 x 345[2 x 91] at 1800 rpm
Pressure (Normal/Boost)	kgf/cm²[psi]	320/350[4550/4978]
Pump case pressure		1.0[14.2]



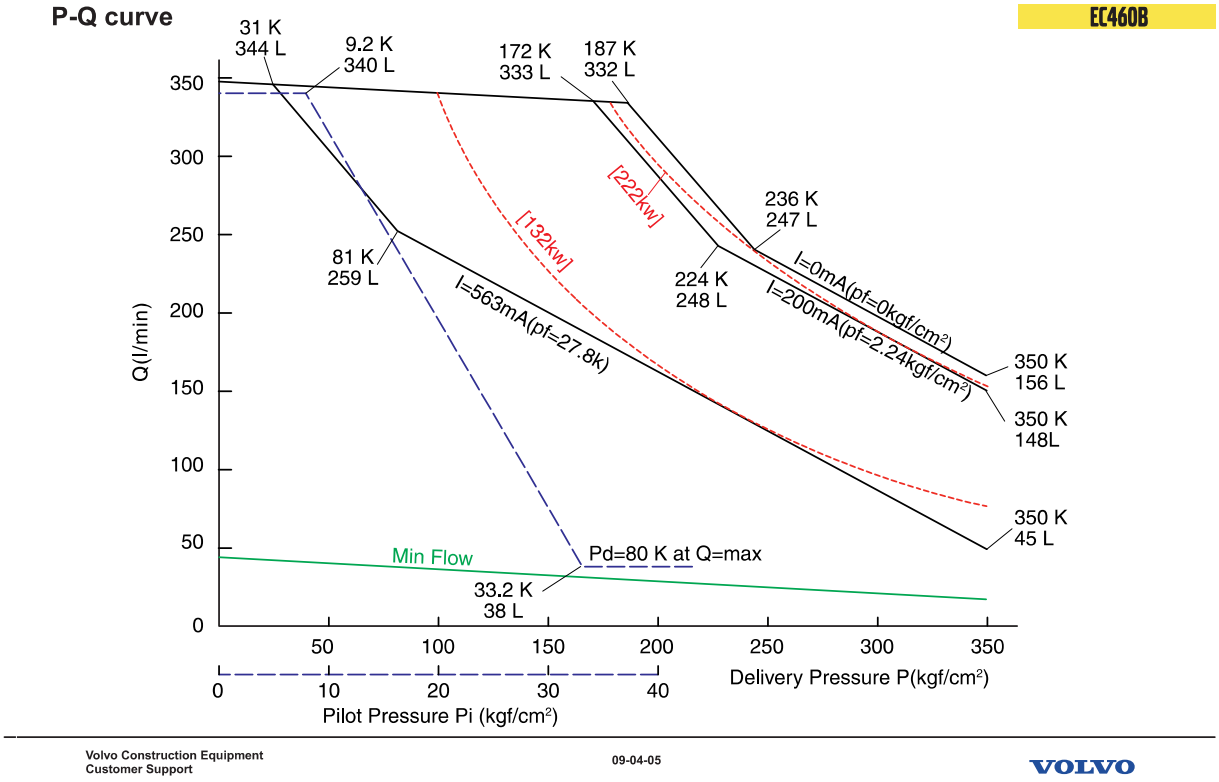
Classification	Unit	Specification	
Model		G200	
Type		Fixed gear	
Displacement	cc/rev	P1(X3 option)	22.8
		P2(fan)	20.3
		P3(servo)	17.8
Relief pressure	kgf/cm²[psi]	P1(X3 option)	150[2134]
		P2(fan)-Var.	8[114] - 160[2275]
		P3(servo)	40[569]

Hyd pump change

Main pump:
Displacement change from 182cc to 192.5cc due to engine max rpm reduction.

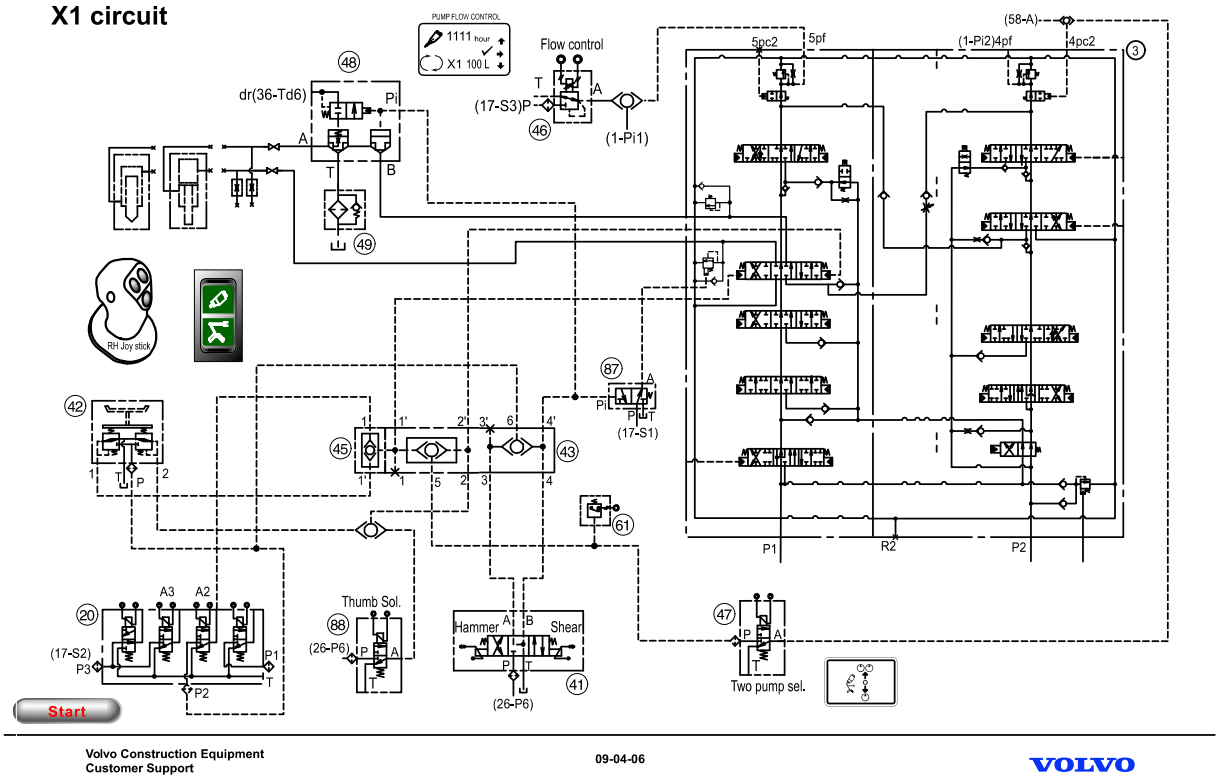
Gear pump:
Displacement increases due to engine max rpm reduction.
No tropical option at P2.

Picture text:



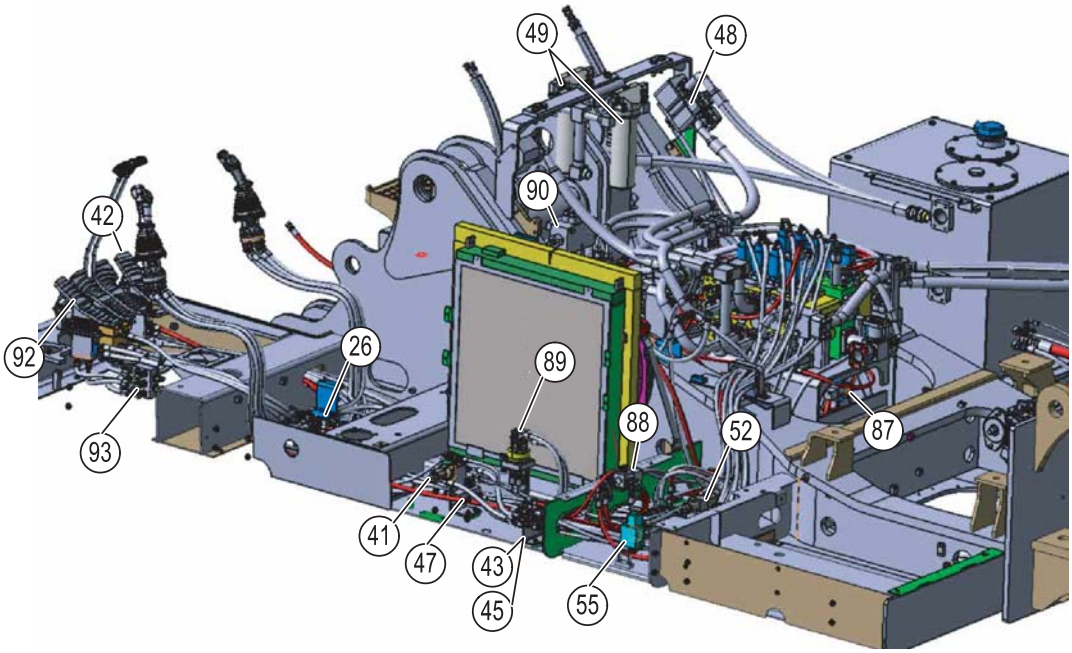
Pump P-Q curve

Picture text:



X1 circuit(D12D)

Picture text:

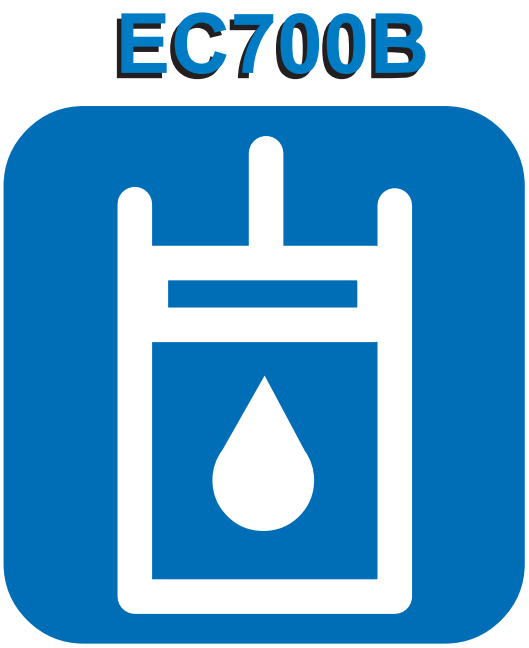


Hydraulic components

Layout changes of hydraulic components

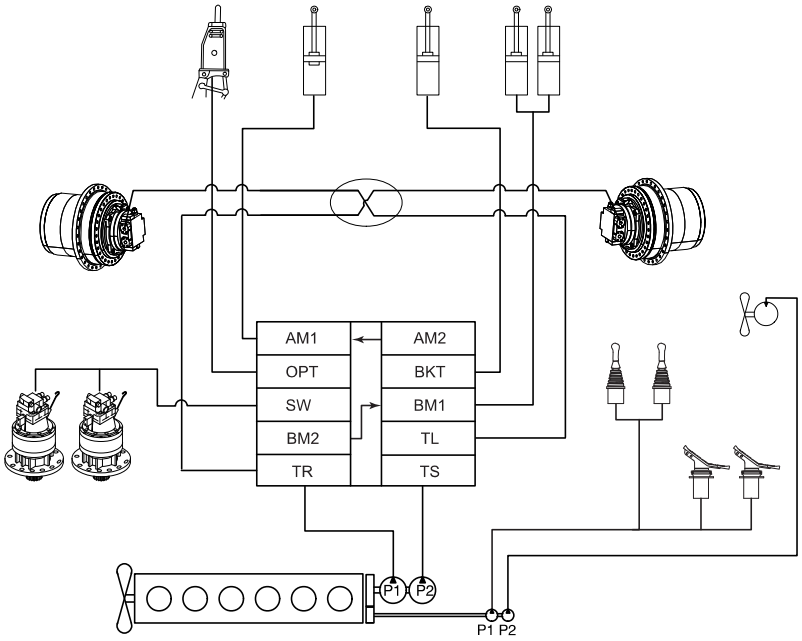
26: Pilot block
41: Hammer, Shear select sol.
42: X1 pedal
43,45: X1 shuttle block
47: 2-pump select sol.
48: X1 3-way valve
52: Rotator solenoid
55: Quick fit sol.
87: X1 pilot select valve for 2-step relief valve
88: Thumb sol.
89: Pattern change valve
90: Boom floating sol.
92: Straight travel pedal
93: Straight travel shuttle valve

Picture text:



Hydraulic System(EC700B)

Picture text:

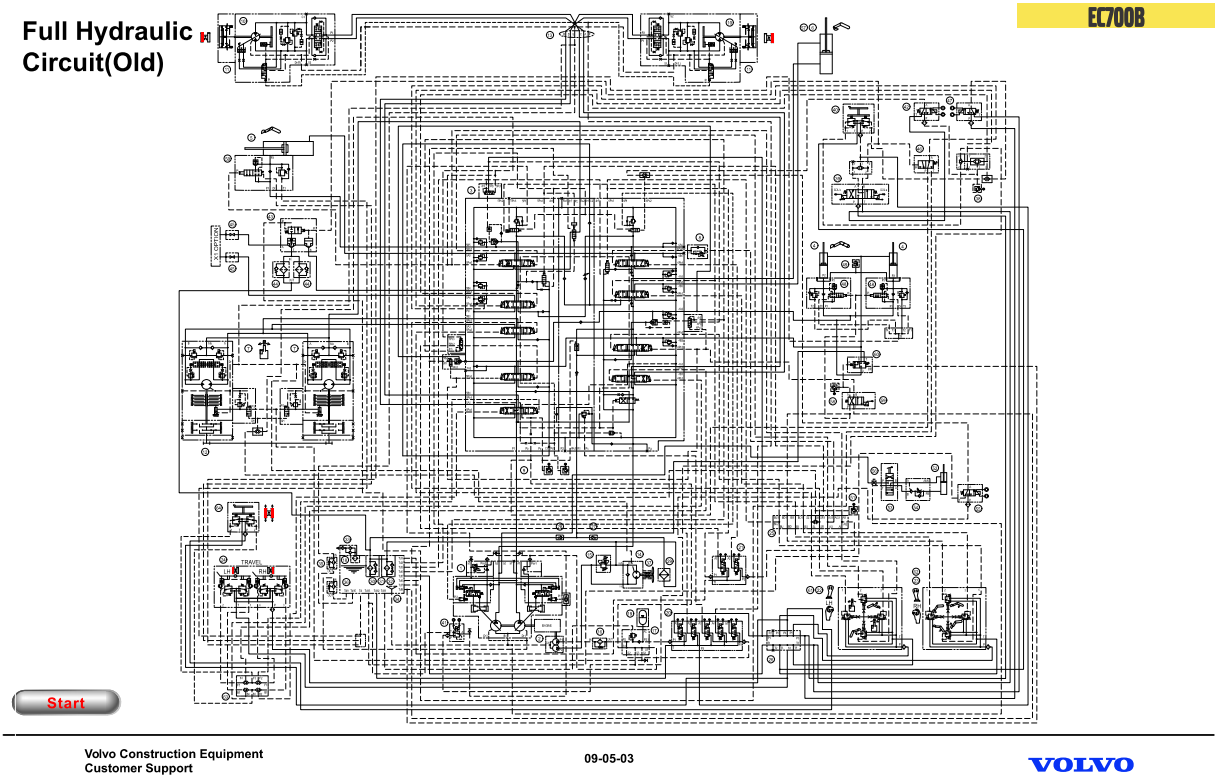


Hydraulic System Overview

The mechanical power from engine converted to hydraulic power.
Machine has two main pumps that are variable displacement piston pump.
And it has 2 fixed gear pumps. it is for servo system and cooling fan.

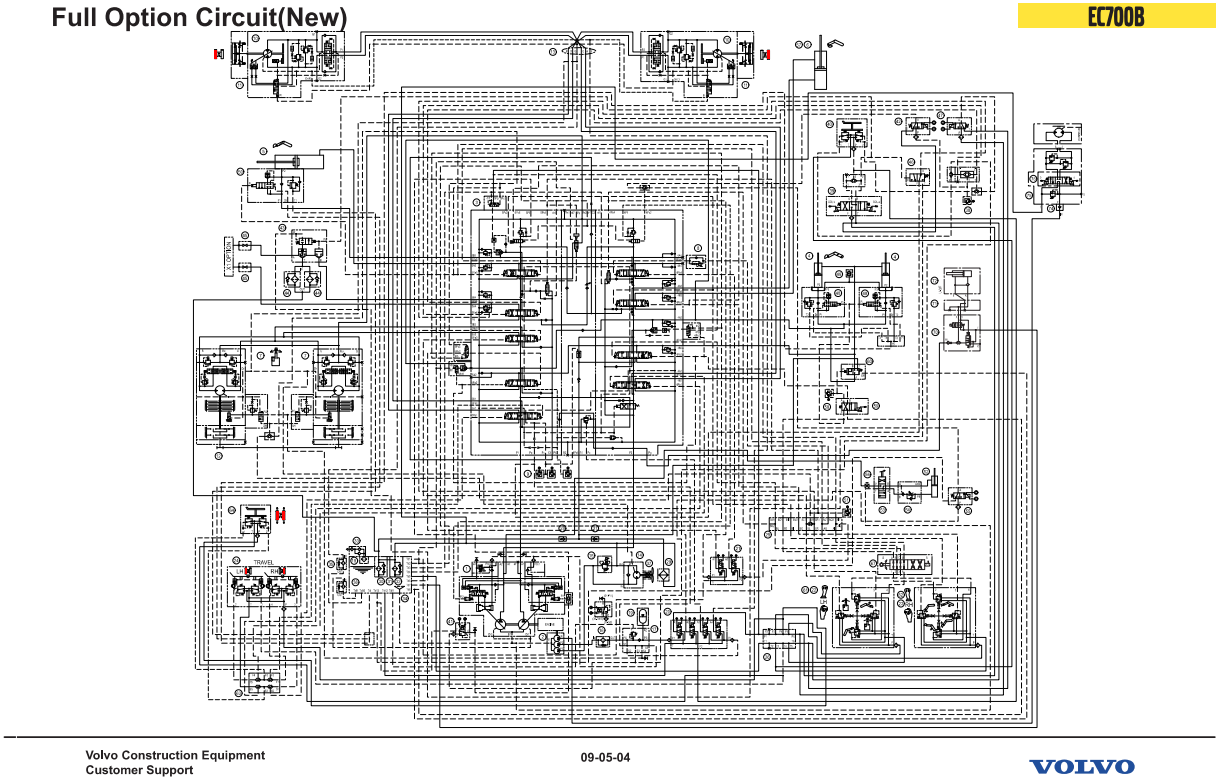
Two-Pump flow
- Boom-Up
- Arm-IN & Out
- X1(Option)

Picture text:



Full Hydraulic Circuit(Old)

1 Main pump
2Servo Pump
3Main control valve
4Boom cylinder
5Arm cylinder
6Bucket cylinder
7Swing motor
8Shockless valve
9Pressure switch
10 Travel motor
11 Travel gear box
12 Swing gear box
13 Turning joint
14 Fan motor
15 Proportional relief valve
16 Pilot filter
17 Accumulator block
18 Strainer in breather
19 Accumulator
20 Solenoid valve(1)
21 Solenoid valve(2)
22 RCV LH
23 RCV RH
24 RCV pedal
25 Shuttle block
26 Pilot block
27 Check valve_3.0 bar
28 Check valve_4.5 bar
29 Hyd. Oil cooler
30 Return filter
31 Bypass valve
32 Bypass strainer



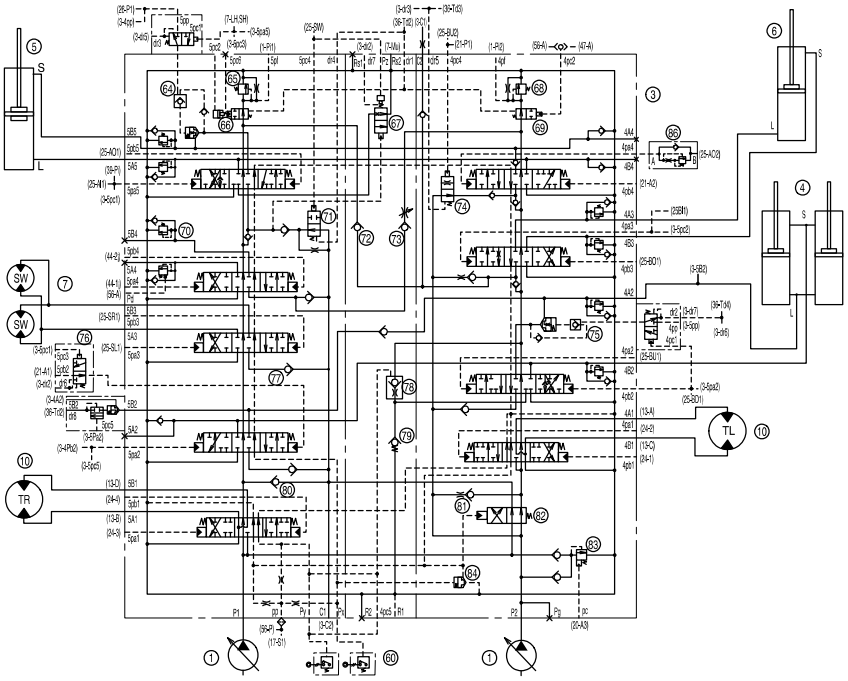
Full Hydraulic Circuit(New)

**C1 orifice change
**Following options are added
-U-Quick fit
-X3(Rotator)
-Bucket-out conflux
-Pattern change valve

1 Main pump
2Servo Pump
3Main control valve
4Boom cylinder
5Arm cylinder
6Bucket cylinder
7Swing motor
8Shockless valve
9Pressure switch
10 Travel motor
11 Travel gear box
12 Swing gear box
13 Turning joint
14 Fan motor
15 Proportional relief valve
16 Pilot filter
17 Accumulator block
18 Strainer in breather
19 Accumulator
20 Solenoid valve(1)
21 Solenoid valve(2)
22 RCV LH
23 RCV RH
24 RCV pedal
25 Shuttle block

Brief Circuit-1(New)

EC700B

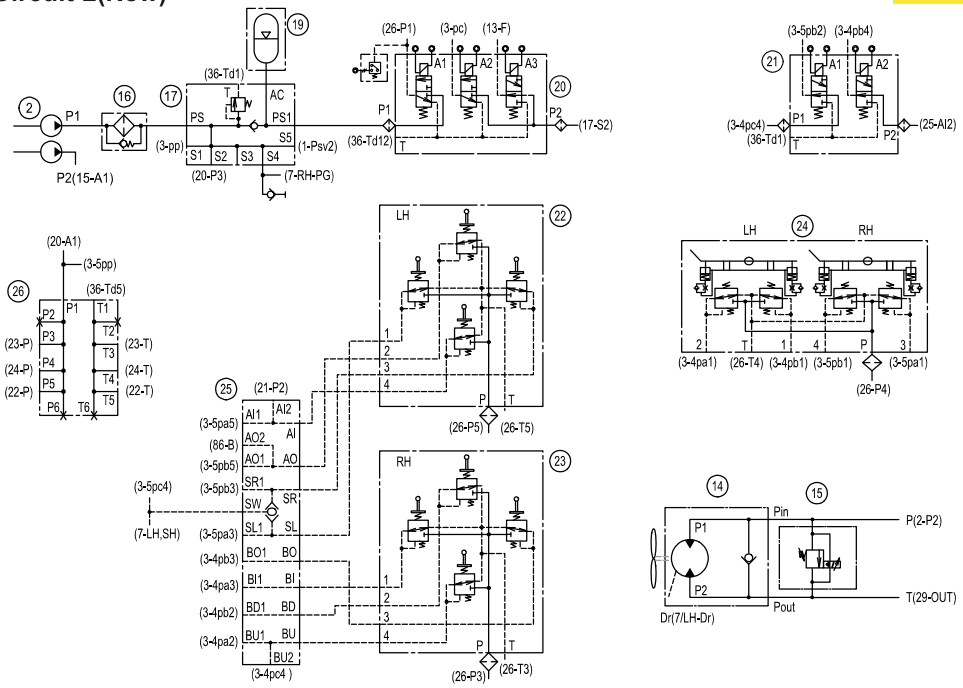


Brief Hydraulic Circuit-1(New)

Picture text:

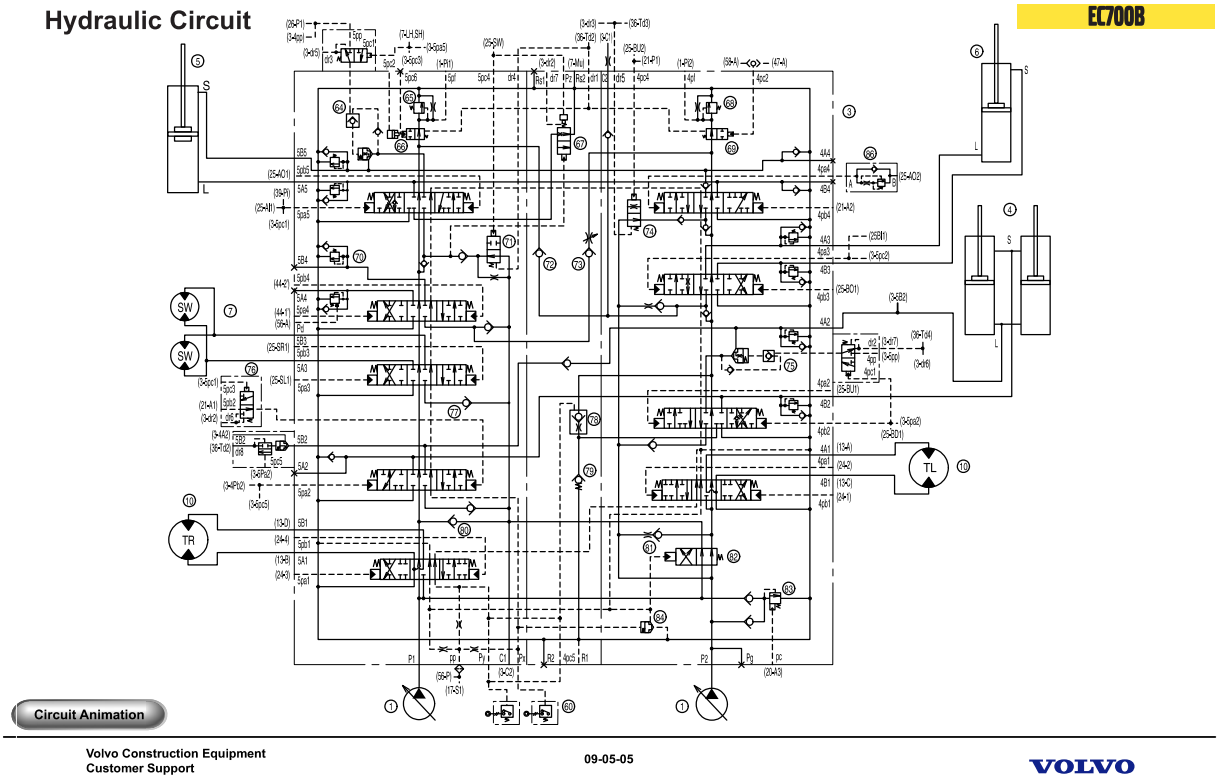
Brief Circuit-2(New)

EC700B



Brief Hydraulic Circuit-2(New)

Picture text:



Brief Hydraulic Circuit(New)

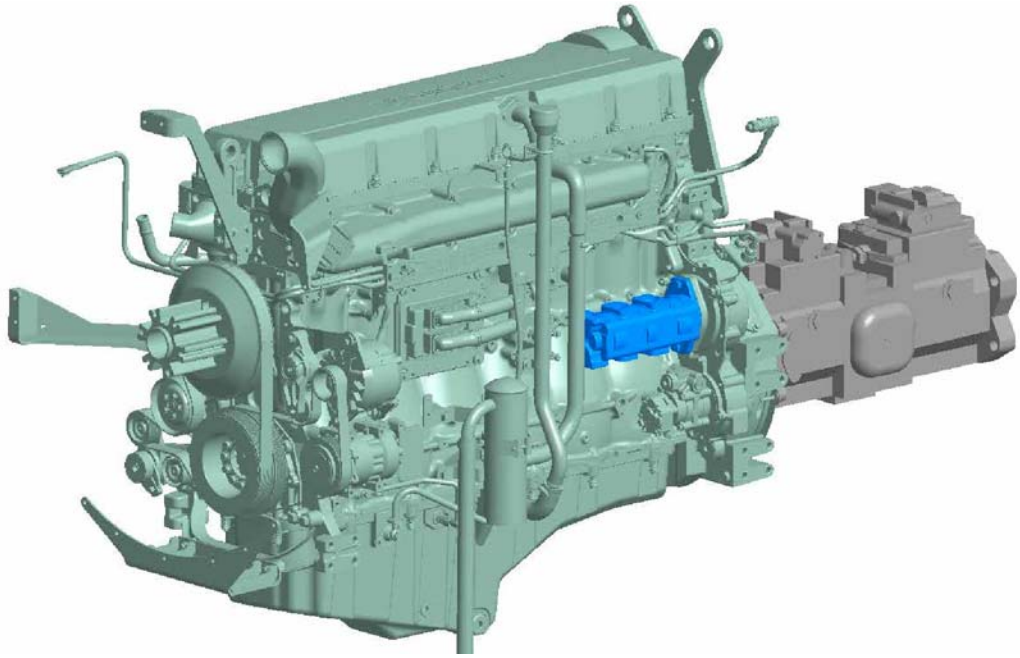
This page is a hydraulic circuit animation!

Servo circuit is displayed at a click "servo".
Main page is displayed at a click "main".

Line click change the color of the line.
Hyd. component symbol click may move the circuit symbol.

Port name : local port name
(Port name) : connected to "Port name",destination

Picture text:

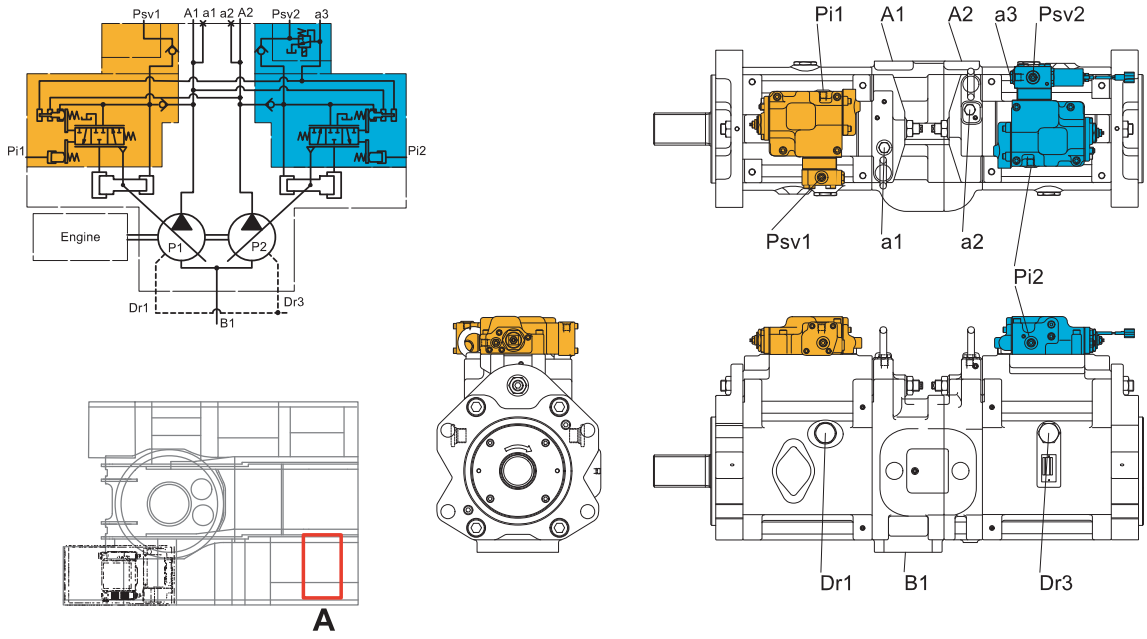


Hydraulic Pump

Picture text:

Pump External View

EC700B



Volvo Construction Equipment
Customer Support

09-05-09

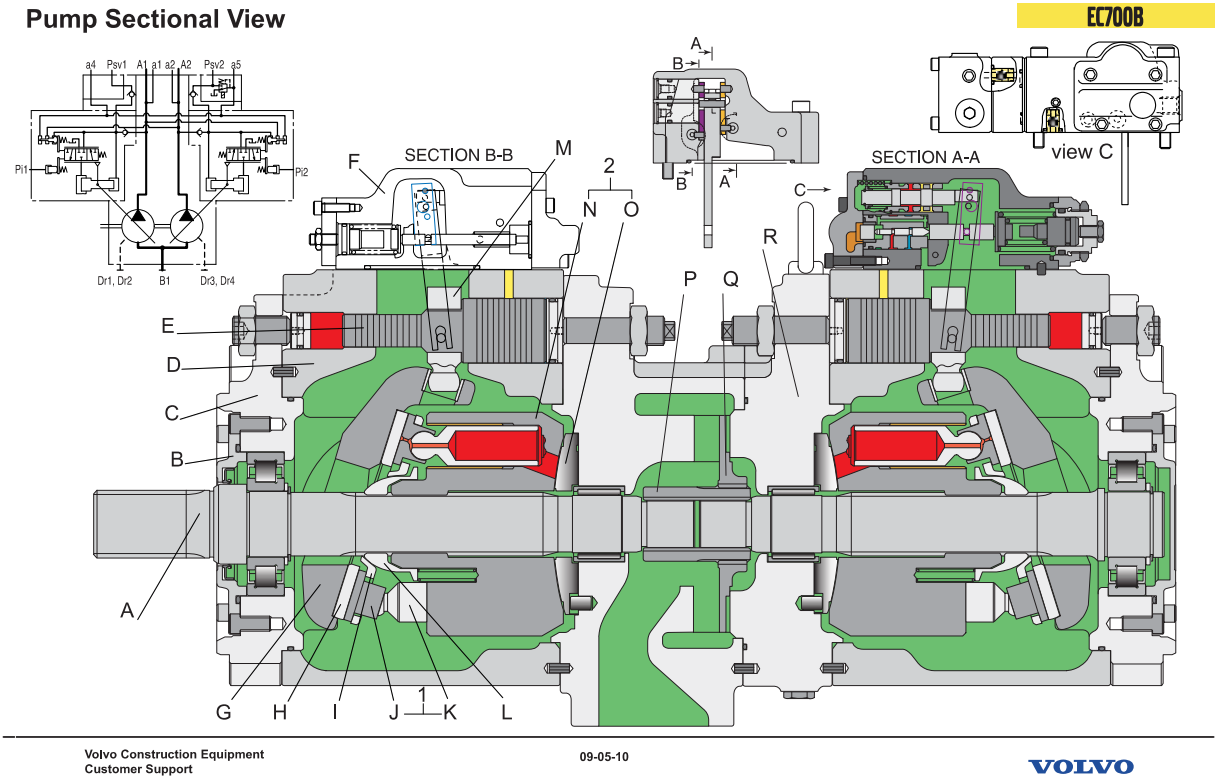
VOLVO

External view & Specification

Specification

Max. displacement : 242 x 2 cc/rev
Rated speed : 1800 (CW from shaft end)
Max. flow rate : 435 x 2 lpm
Min. flow rate : 38 x 2 lpm
Max. input torque : 171.1 kgf.m
Mean casing pressure : 1 kgf/cm2

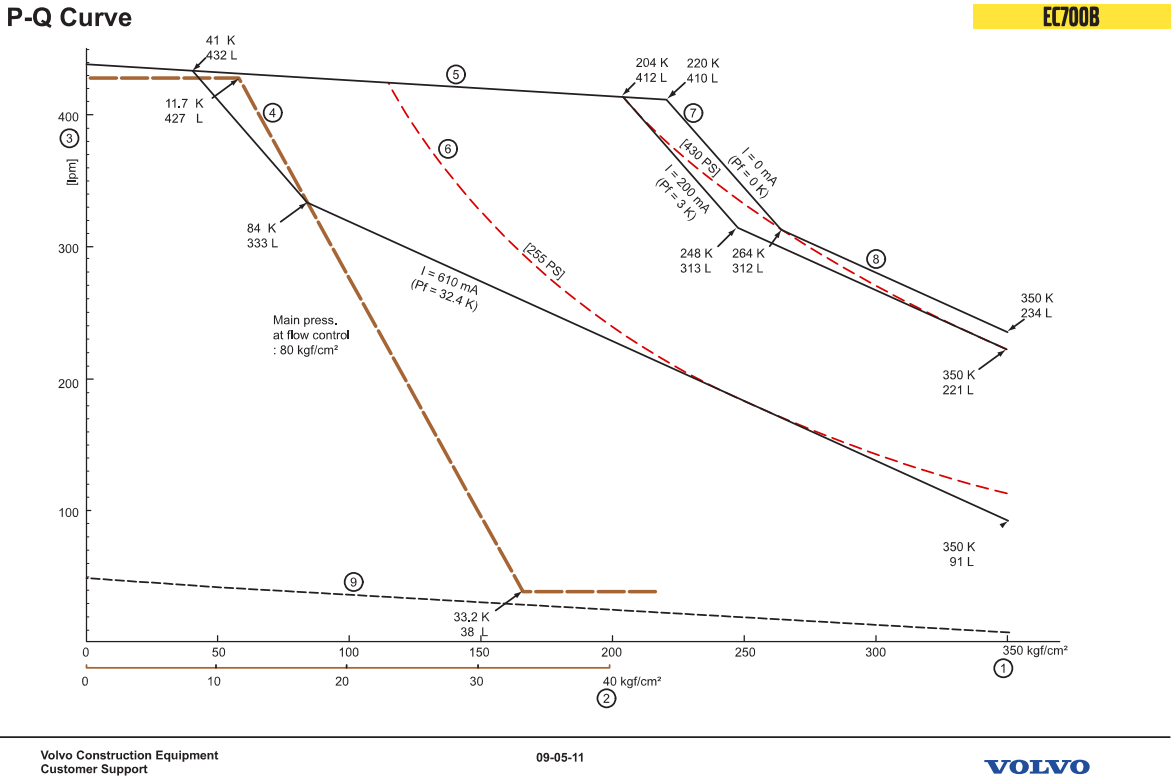
Picture text: A : location of main pump, A1&A2 : outlet
B1 : suction
Dr1,Dr3 : Drain
pi1 : pilot line for flow control(P1 pump)
pi2 : pilot line for flow control(P2 pump)
a1 : pluged, a2 : connected to removable counterweight
a3 : check port of power-shift 2nd pressure
Psv1,Psv2 : pilot servo pressure supply line



Sectional View

The pump type is variable displacement, swash plate type and tandem piston pump
- This pump assembly consists of two pump connected by a spline coupling (P).
- The suction and delivery ports are integrated at the connecting section of the two pumps.
- The rotary group consists of the front driving shaft (A), cylinder block (2), cylinder spring, piston (K) and shoe (J).
- The swash plate group consists of the swash plate (G), shoe plate (H) and tilting bushing and servo piston (E).
- The valve block group consists of valve block, valve plate pin.
- The pump shaft driven by the engine rotates the cylinder block (2) via the splined bore. If the swash plate is tilted the pistons arranged in the cylinder block make another 180 degree motion towards the valve plate (oil discharging stroke) as the cylinder block rotates. When the swash plate tilting angle is closer to zero, the piston does stroke very few angle nor discharge oil.
- There are two sets of adjustable screws & locking nuts on the top side of each pump. The larger screws & nuts that are mounted on the middle area are used to adjust the maximum flow. However, the screws & nuts mounted on the top end area are used to adjust the minimum flow.

A : Front shaft
B : Seal cover
C : Supporter
D : Casing
E : Servo piston
F : Regulator
G : Swash plate
H : Shoe plate
I : Push plate
J : Shoe
K : Piston
1 : Piston assy
L : Spherical guide
M : Tilting pin
N : Cylinder block
O : Valve plate

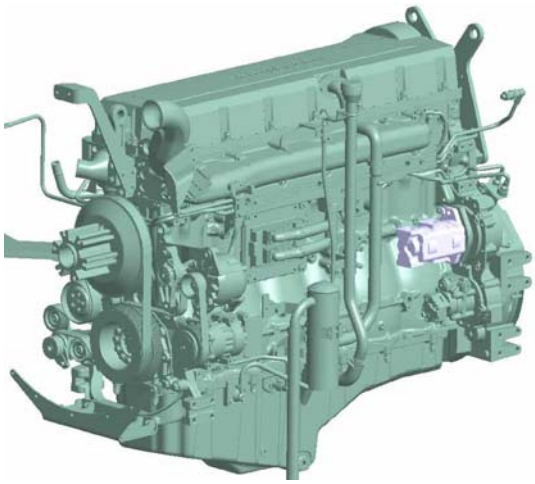


Main Pump Control Curve

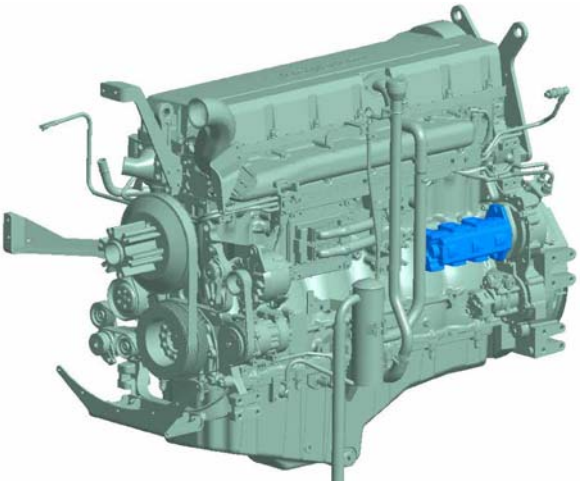
1 : horizontal-X axis(delivery pressure P=P1=P2)
2 : horizontal-X axis(pilot pressure P=Pi1=Pi2)
3 : vertical-Y axis(delivery flow (Q) quantity)
4 : Flow control curve(Q(3) vs Pi(2))
5 : Max. flow rate area(No pump control: regulator internal components don't move)
6 : Constant engine power curve
7 : 1st flow reduction area(outer spring compressed)
8 : 2nd flow reduction area(outer and inner springs compressed)
9 : Min. flow rate curve(pi=40 kgf/cm2 and variant delivery pressure)

Picture text:

(1)



(2)

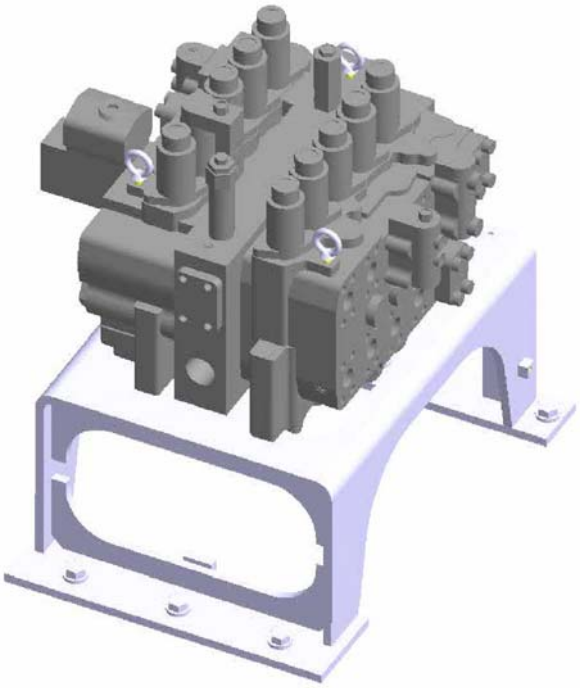


Gear pump

(1) Gear pump on PTO without X3
- G200(20.3+17.8 cc/rev)

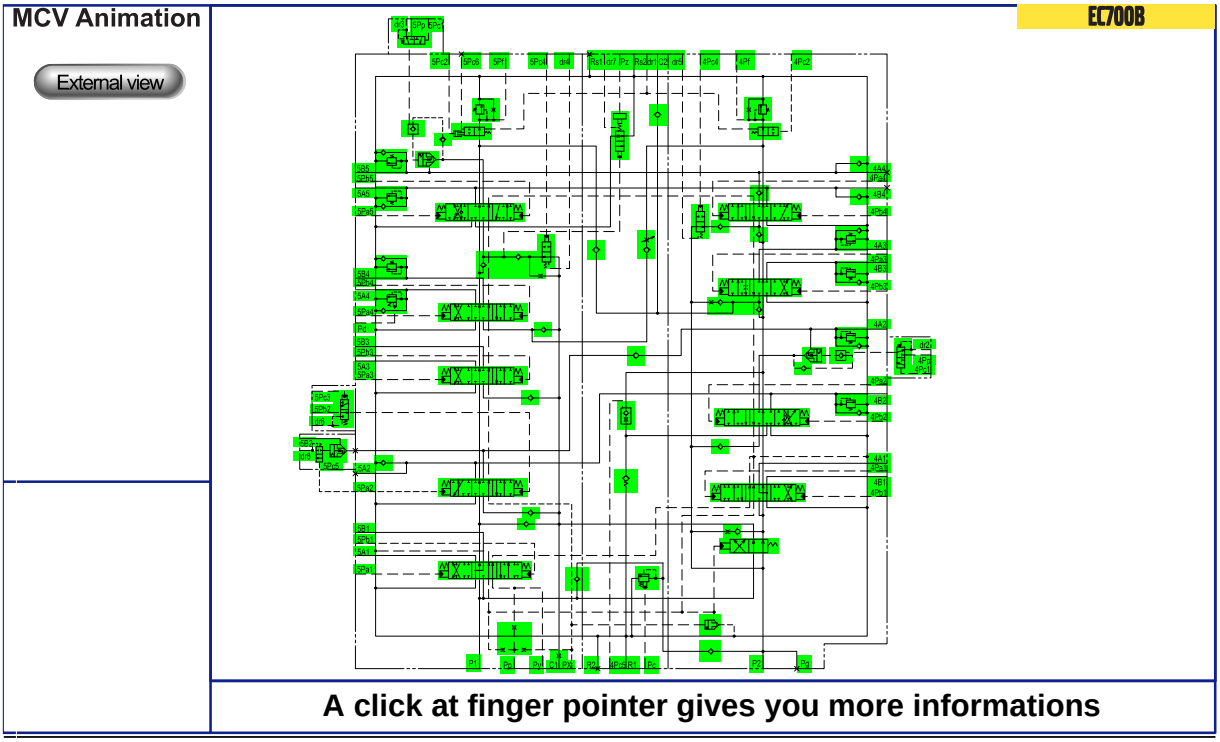
(2) Gear pump on PTO with X3
- Model : G200(35.6+20.3 + 17.8)

Picture text:



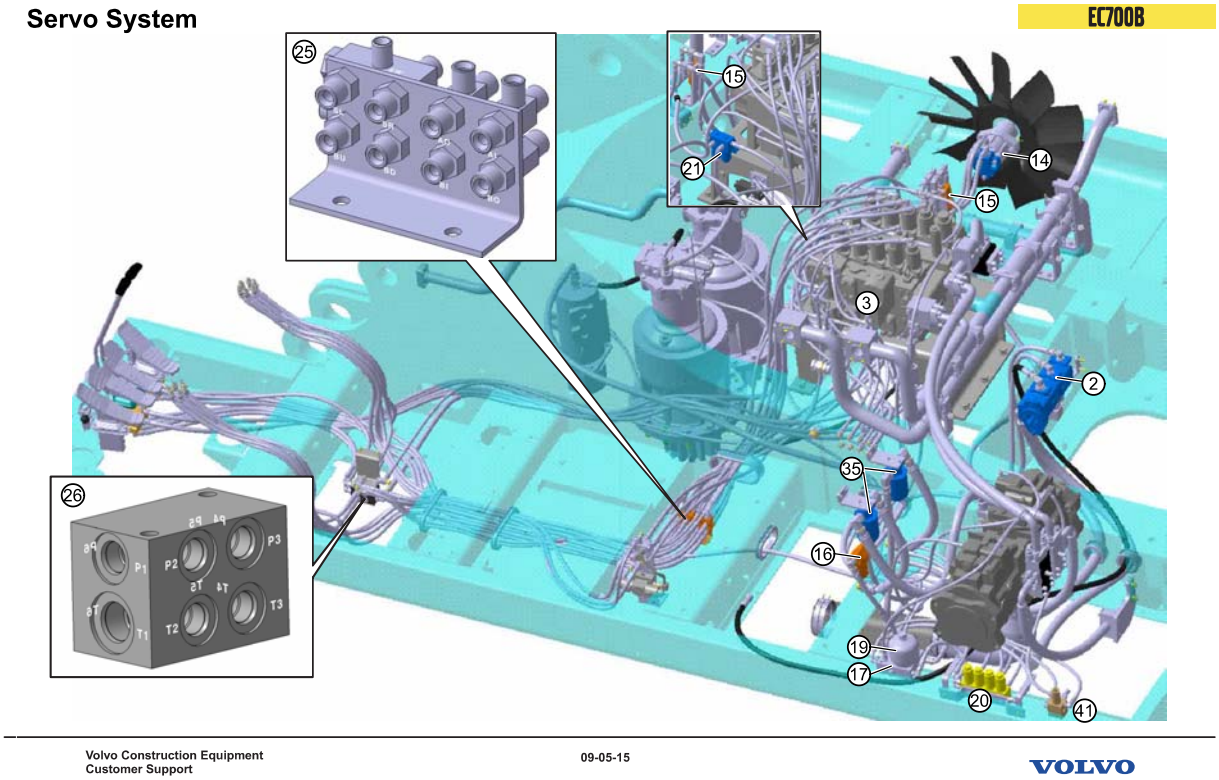
Main Control Valve

Picture text:



MCV animation

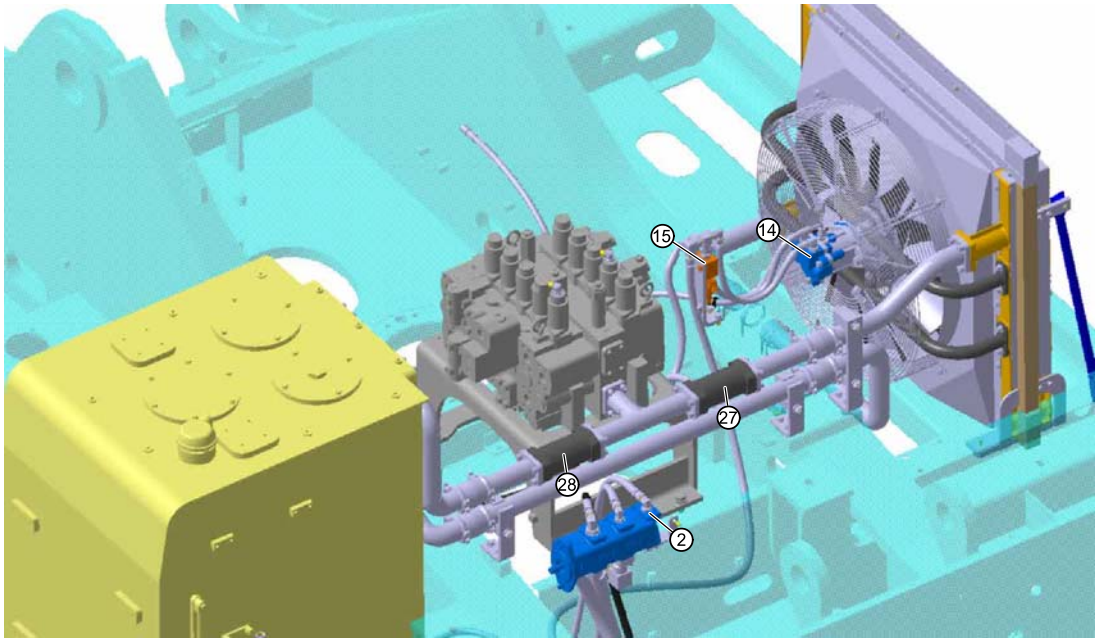
Picture text:



Servo system

2. Gear pump
3. Main control valve
14. Cooling fan motor
15. Proportional relief valve
16. Pilot filter
17. Accumulator block
19. Accumulator
20. Solenoid valve
21. Boom & Arm conflux cut-off solenoid valve
25. Shuttle block
26. Pilot block
41. X1 Flow control valve

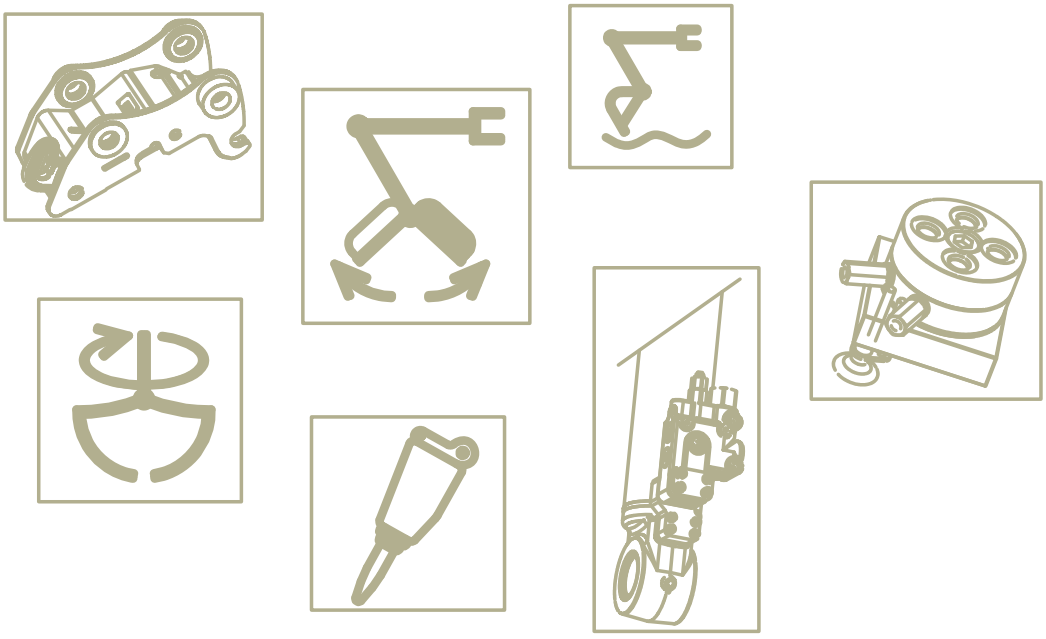
Picture text:



Hydraulic oil cooling system

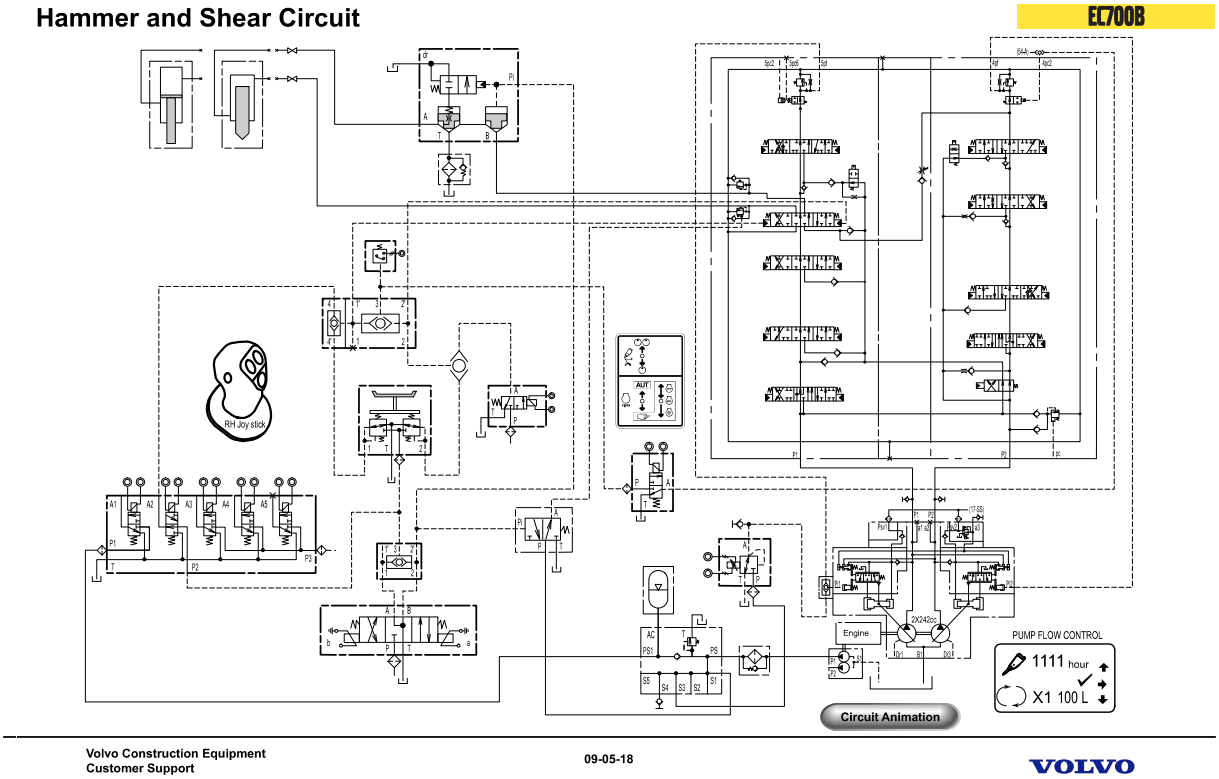
2. Gear pump
14. Cooling fan motor
15. Proportional relief valve
27. Return check valve(3.0 k)
28. Return check valve(4.5 k)

Picture text:



Option hydraulics

Picture text:



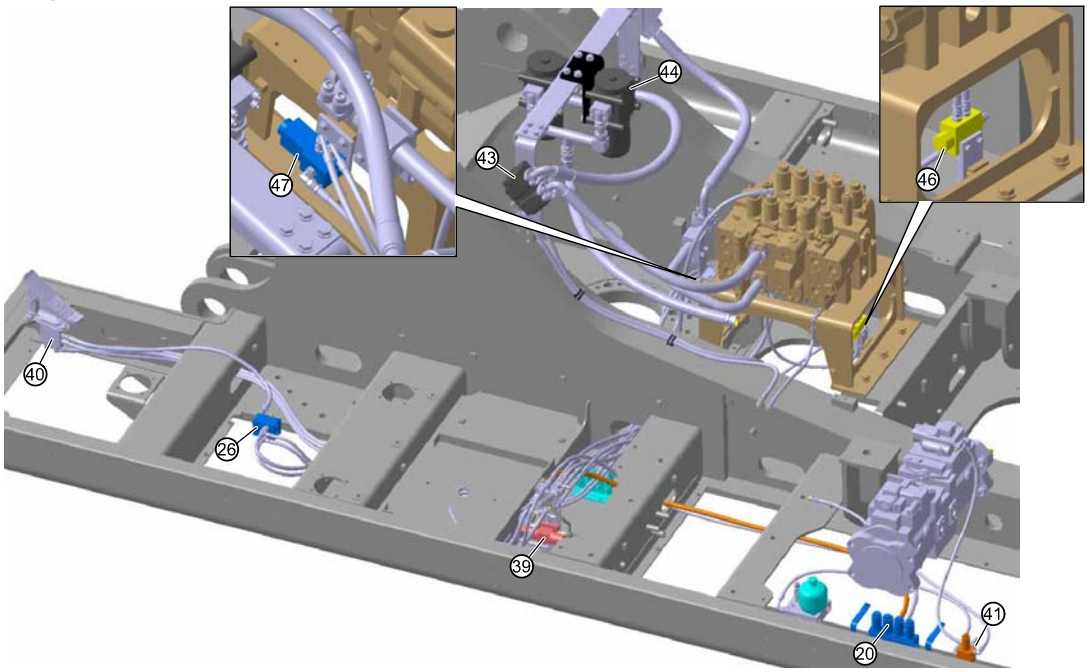
Hammer and Shear Circuit

This page is an animation!
If you click some line or valve or button, there may some change!

For hammer operation, pilot signal have to be supplied to the 3 way valve(Tank connection) and pilot selector valve(2 step port relief low pressure setting).
"Sol b" is a hammer position!

Even though 2 pump flow is set, if option spool doesn't move(No pilot pressure on the option spool),option conflux doesn't happen.

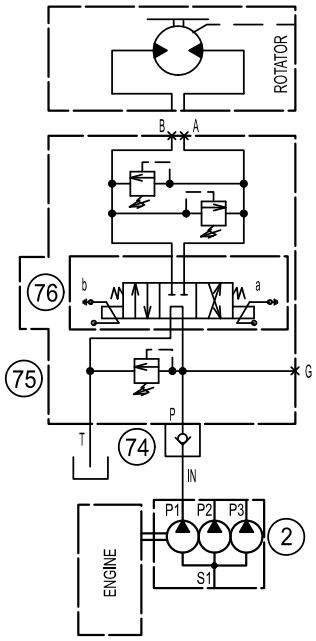
Picture text:

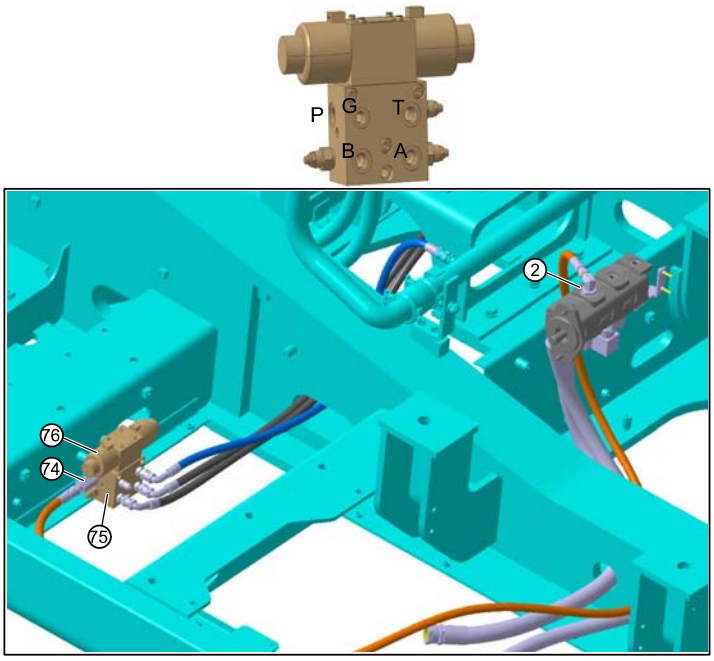


X1 Components

20 : Solenoid valve block(A2: Hammer solenoid valve)
26 : Pilot block
39 : Hammer/Shear select solenoid valve
40 : X1 Pedal
41 : X1 Flow control valve
43 : 3 way selector valve
44 : X1 return filter
46 : Pilot selector valve
47 : Solenoid valve(2 switch control)

Picture text:

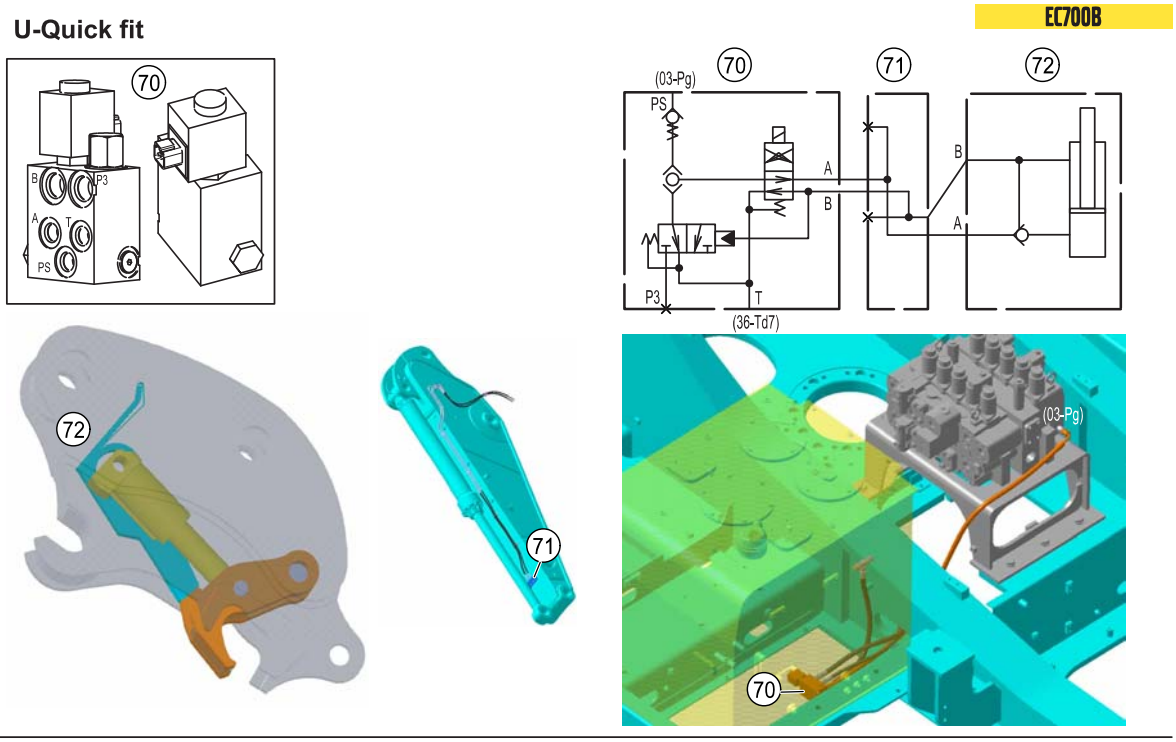




X3 Circuit

2 : Gear pump
74 : Check valve
75 : Rotator valve
76 : Rotator solenoid valve

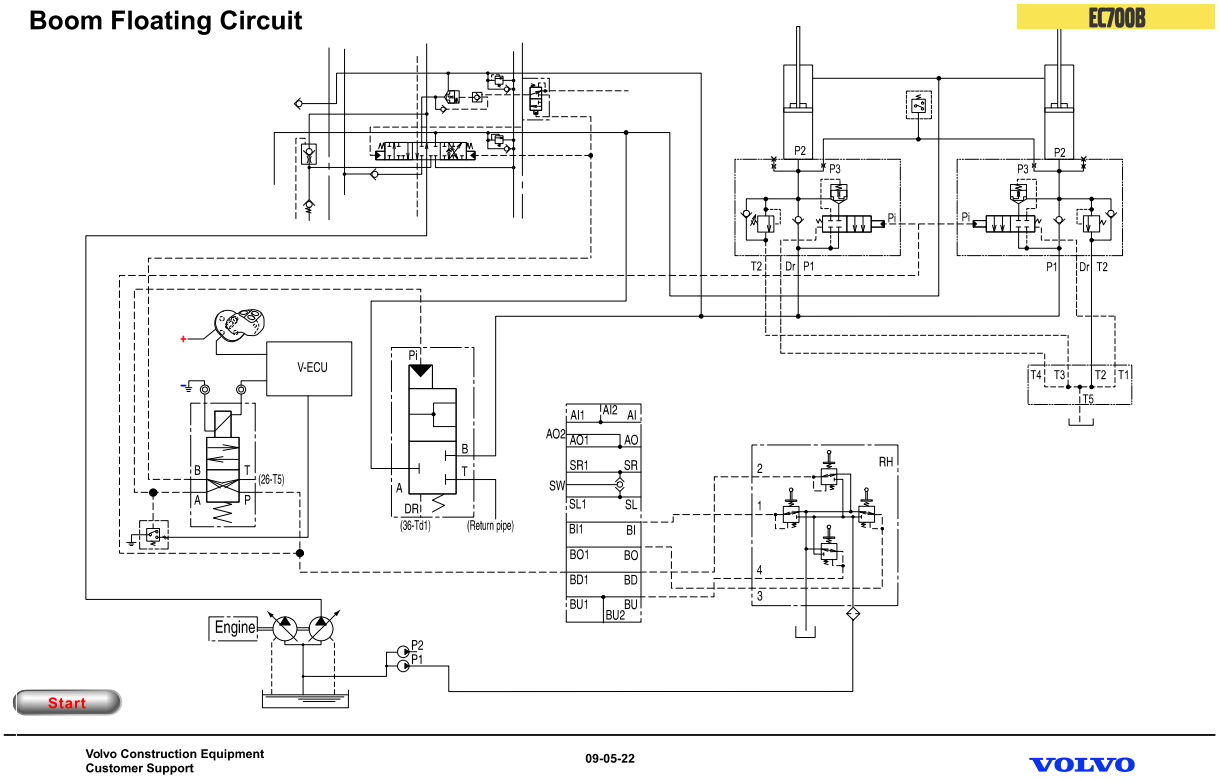
Picture text:



U-Quick fit

70 : Quick fit valve
71 : Block
72 : Quick fit cylinder

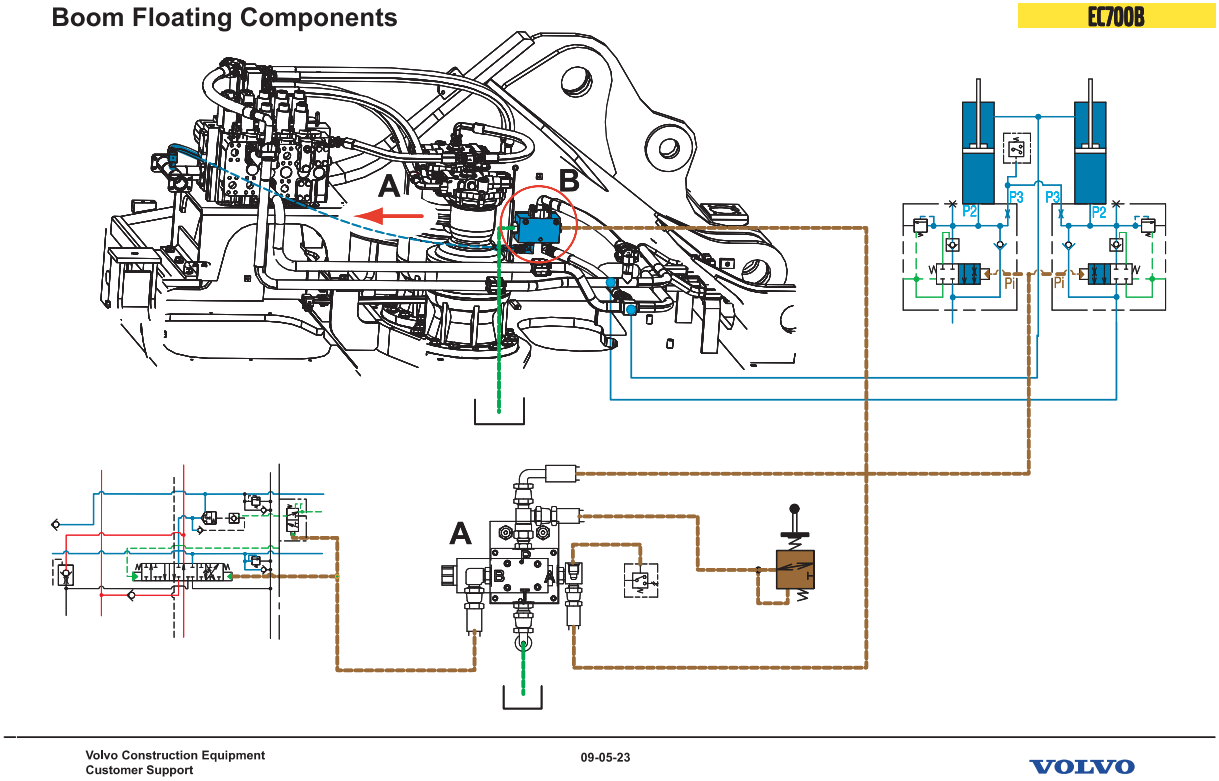
Picture text:



Boom Floating Circuit

The button on the joystick can make VECU energize floating solenoid. Floating pressure switch is activated and rupture valve and floating valve is proportionally pressurized according to the joystick operation.

Picture text:

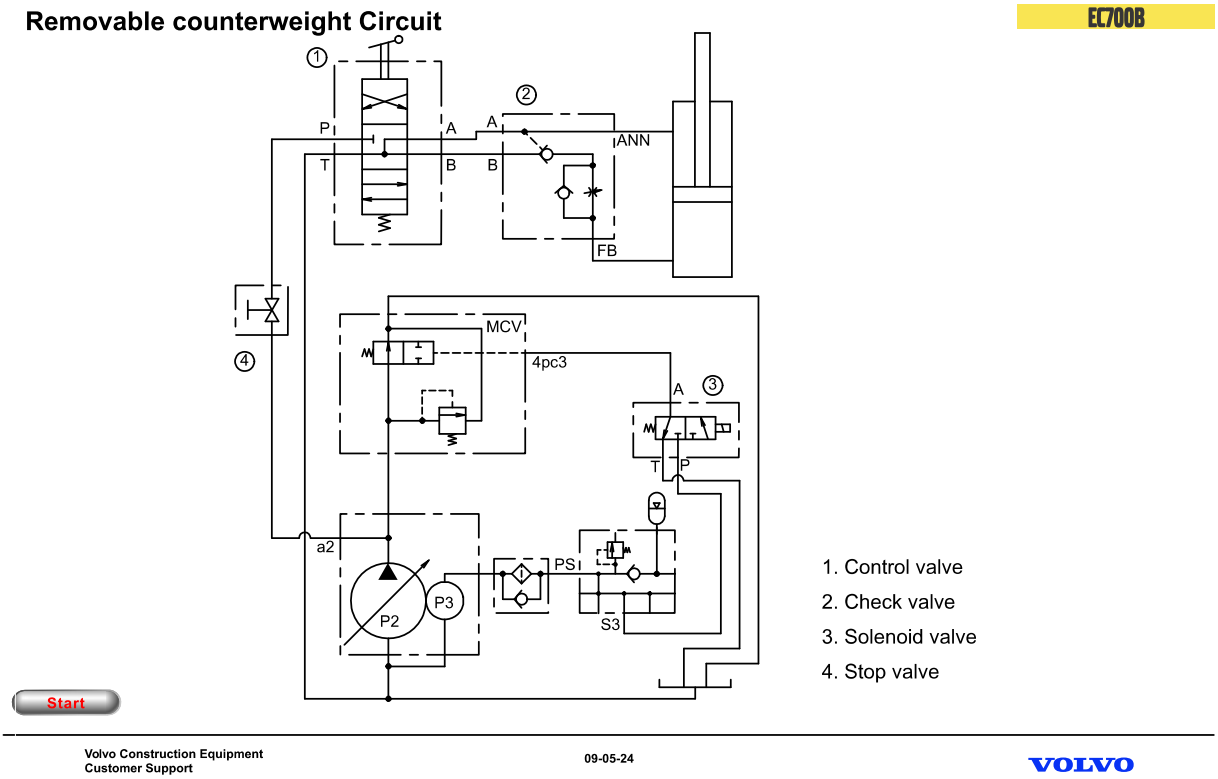


Boom Floating Components

The large and small chamber pipes are connected to floating valve(B).
The 2nd pressure of joystick is connected to rupture valve and floating valve.

A : Floating solenoid valve
B : Floating valve

Picture text:



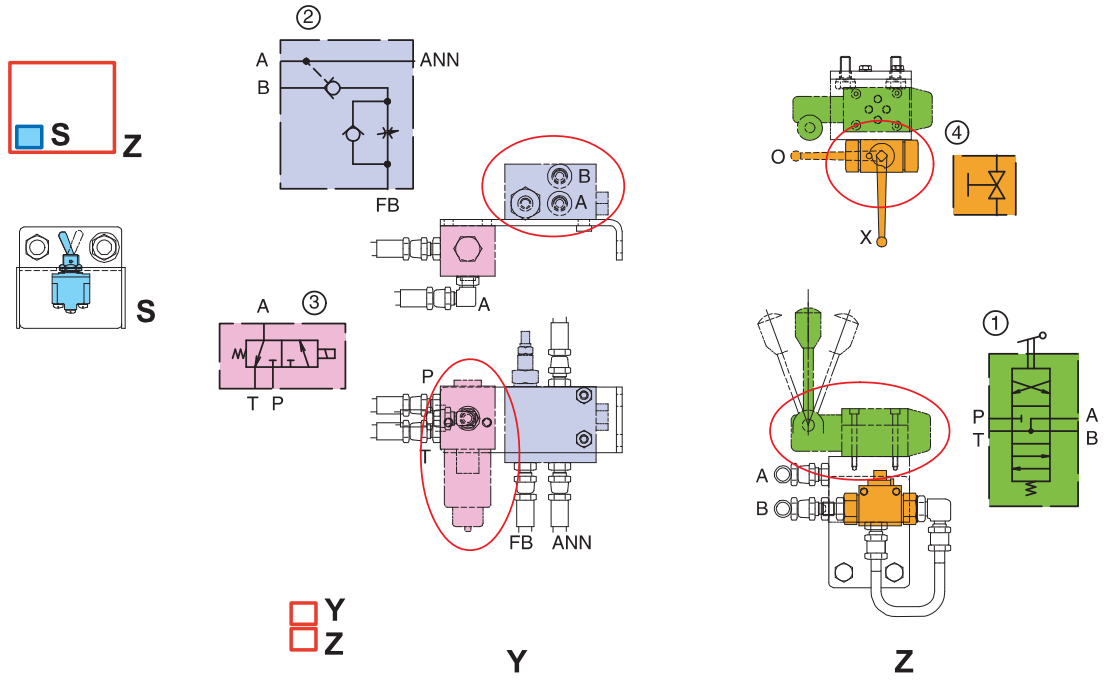
Removable Counterweight Circuit

To use this function, stop valve(4) must be open and center bypass valve must be blocked by pilot signal from selector solenoid valve(3).

The flow from B to FB is fast. But its opposite flow is slow from orifice restriction.

There is a pressurized flow at port P on the valve(1) all the time.

Picture text: 1 : Removable counterweight valve
2 : Slow return valve
3 : Pilot selector solenoid valve
4 : Stop valve



Removable Counterweight Components

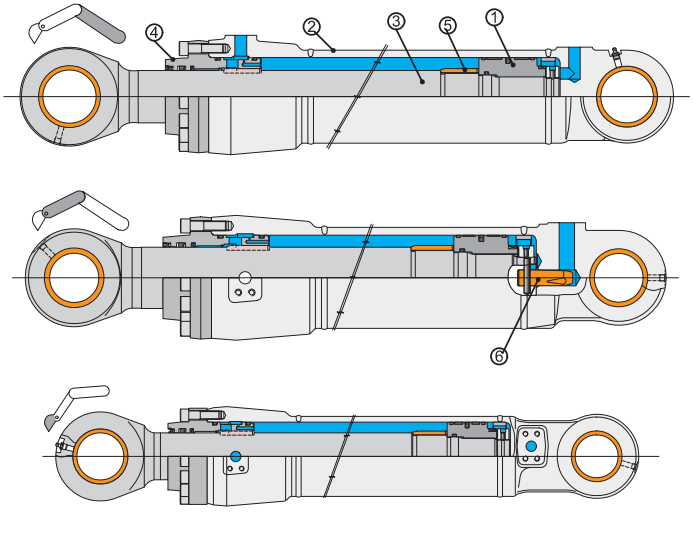
To use this function, stop valve(4) must be open(O) and center bypass valve must be blocked by pilot signal from pilot selector solenoid valve(3) by toggle switch(S) operation.

O : Open(Stop valve,4)
X : Closed(Stop valve,4)
Y : Pilot selector solenoid valve(3)
Z : Removable counterweight valve(1)
S : Switch for pilot selector solenoid valve(3)

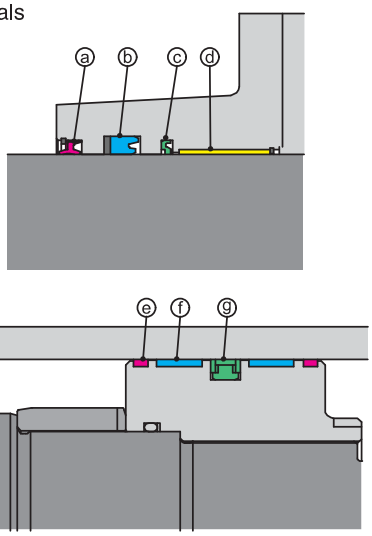
Picture text:

Hydraulic System(COMMON)

Picture text:



Seals



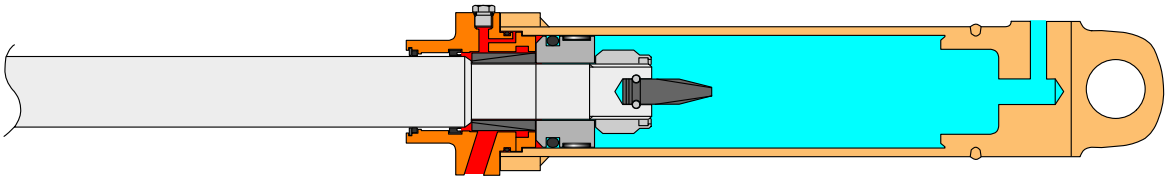
Cylinder

1. Piston
2. Tube
3. Rod
4. Gland
5. Cushion ring
6. Cushion plunger

a. Dust wiper
b. Rod packing
c. Buffer ring
d. Dry bearing
e. Contamination seal
f. Wear ring
g. Piston packing

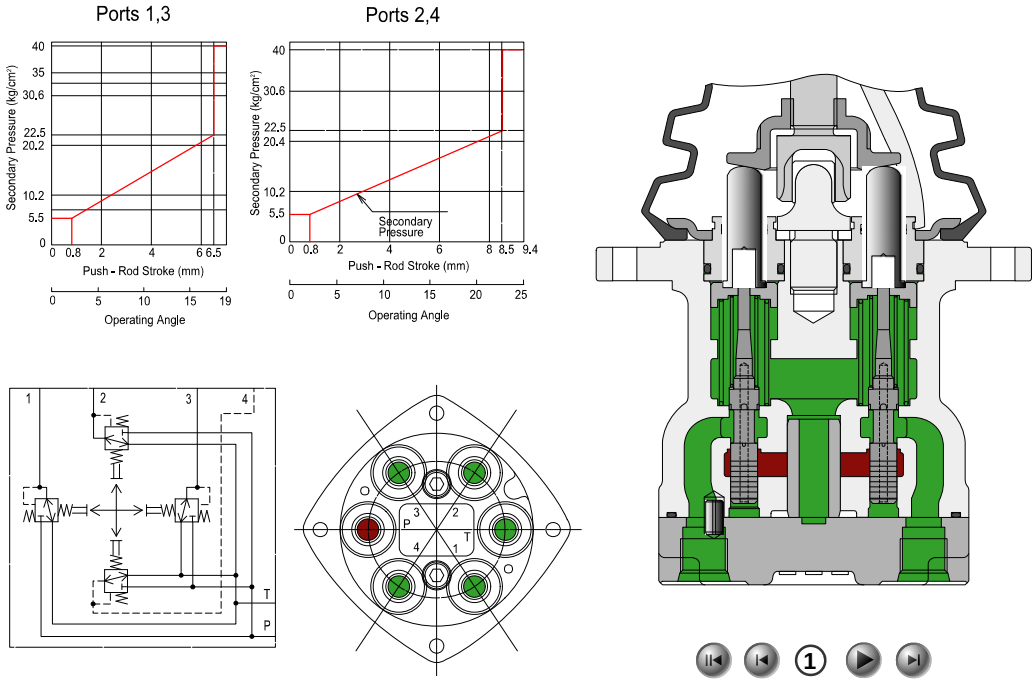
Picture text:

Cylinder cushion operation



Cushion operation

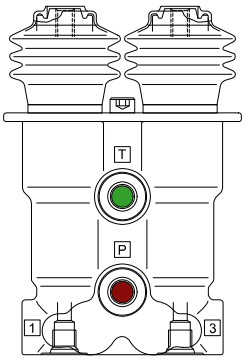
Picture text:

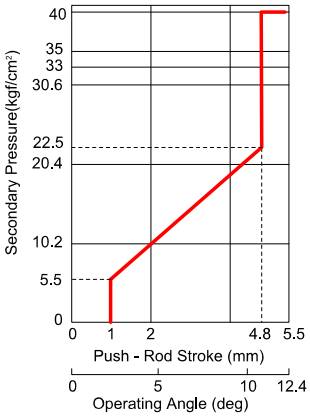


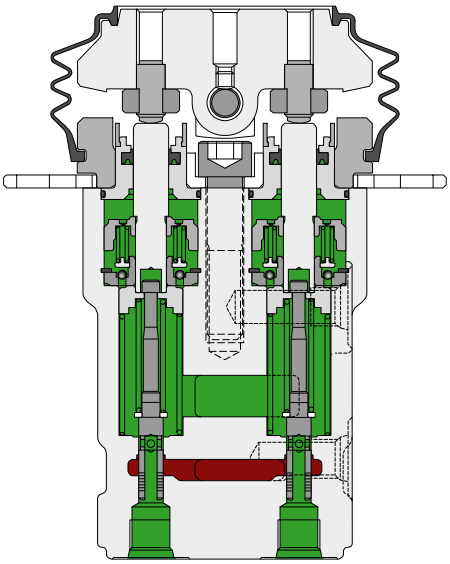
Joystick

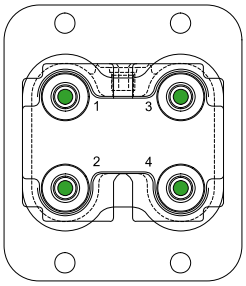
The remote control valve is a kind of the reducing valve and has four reducing valves controlling the secondary pressure in one valve casing. Its secondary pressure is controlled by adjusting the tilting angle of the handle. And the electric switches are equipped inside of joystick for various option.

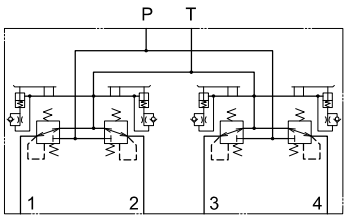
Picture text:











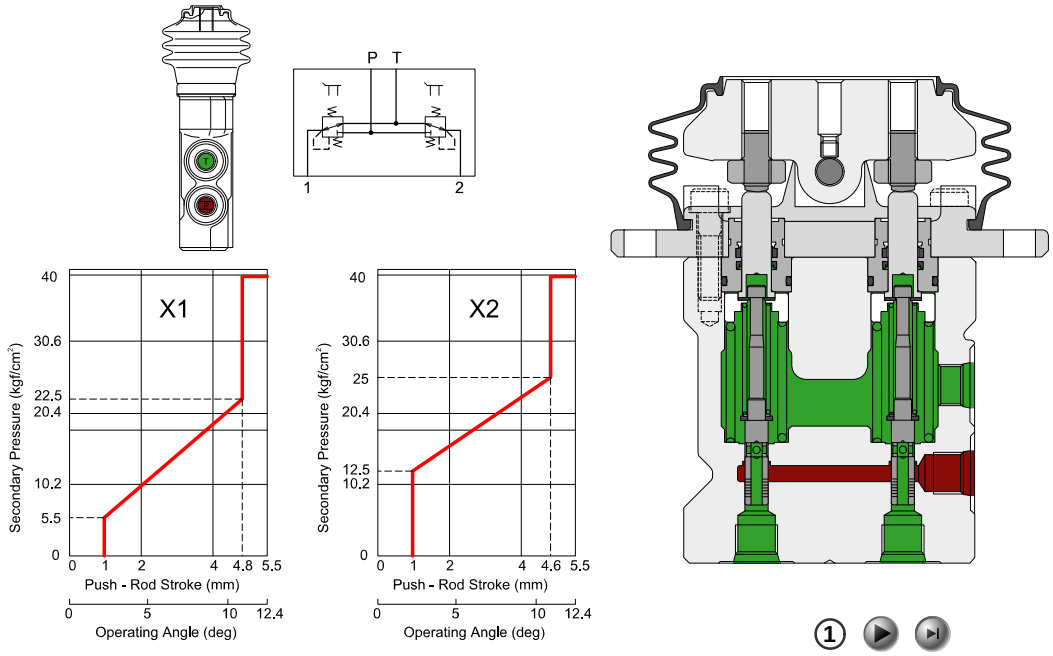
Travel pedal

Basic function is almost same with joystick and this pedal has damping function to prevent oscilation when releasing the lever.

Picture text:

Option Pedal

EC330B-EC700B



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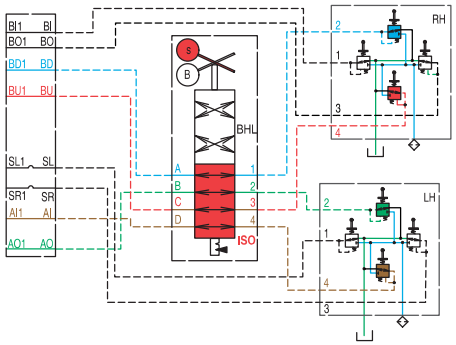
Option pedal

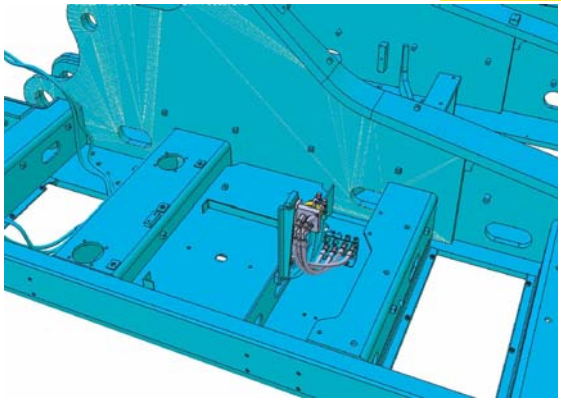
The component itself is almost same between X1 & X2 pedal but the characteristic curve is a little bit different.

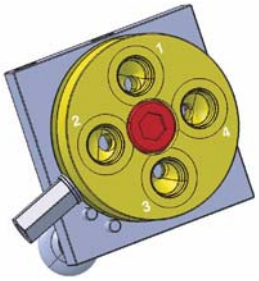
Picture text:

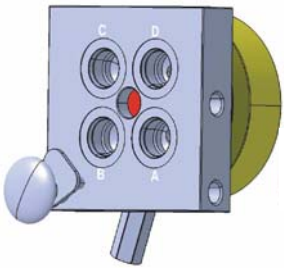
Pattern Change Valve

EC330B-EC700B



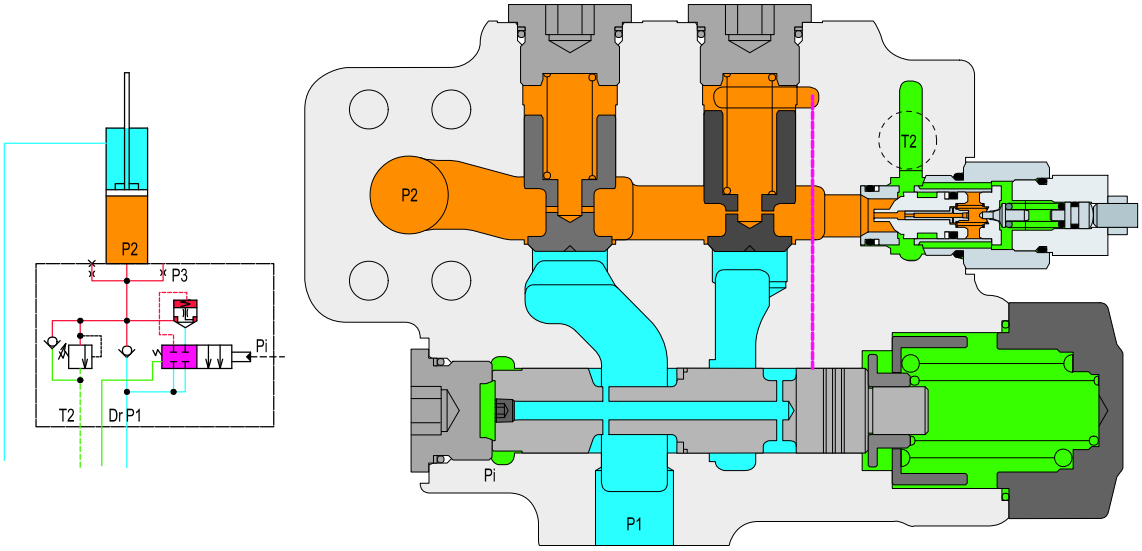






Pattern change

Picture text:



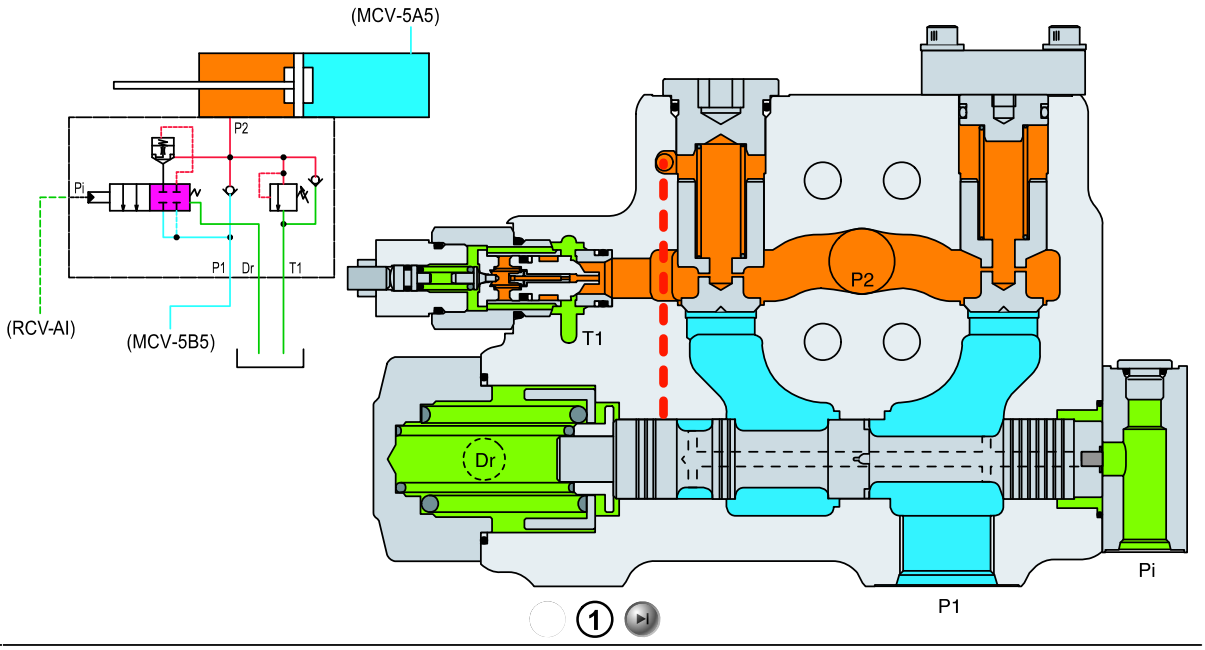
Boom Hose Rupture Valve Operation

P3 port is connected to overload pressure switch(A).
With Pi signal,boom lowering is possible.
The spool movement makes the tank connection of pilot check valve.

Picture text: 1 : Neutral condition
2 : Raising operation
3 : Lowering operation

Arm Hose Rupture Valve Operation (Neutral)

EC330B-EC700B



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Arm Hose Rupture Valve Operation

With Pi signal, arm in operation is possible.
The spool movement makes the tank connection of pilot check valve.

Picture text: 1 : Neutral condition
2 : Arm out operation
3 : Arm in operation