

Document Title: Power transmission, description	Function Group: 400	Information Type: Service Information	Date: 2014/7/17
Profile: EXC, EW160B [GB]			

Power transmission, description

The diesel engine drives the excavator's hydraulic system. The working pump for the working hydraulics, servo pump, fan pump as well as the brake and steering pump are driven directly by the diesel engine. The working pump and hydraulic transmission are controlled electronically by the T-ECU (Transmission electronic control unit).

The machine is driven forward by a hydraulic axial piston motor. This motor drives on both axles via a gearbox with two gears. The front axle is an oscillating axle. Both the front and rear axles are equipped with wet disc brakes. The parking brake is integrated in the gearbox.

The superstructure is slewed with a low-speed radial piston motor. There is a negative-action slew brake integrated in the radial piston motor. Between the motor and the slew ring, there is a slew pinion engaged with a ring gear on the inside of the slew ring. The slew ring connects the superstructure with the undercarriage and is lubricated with grease.

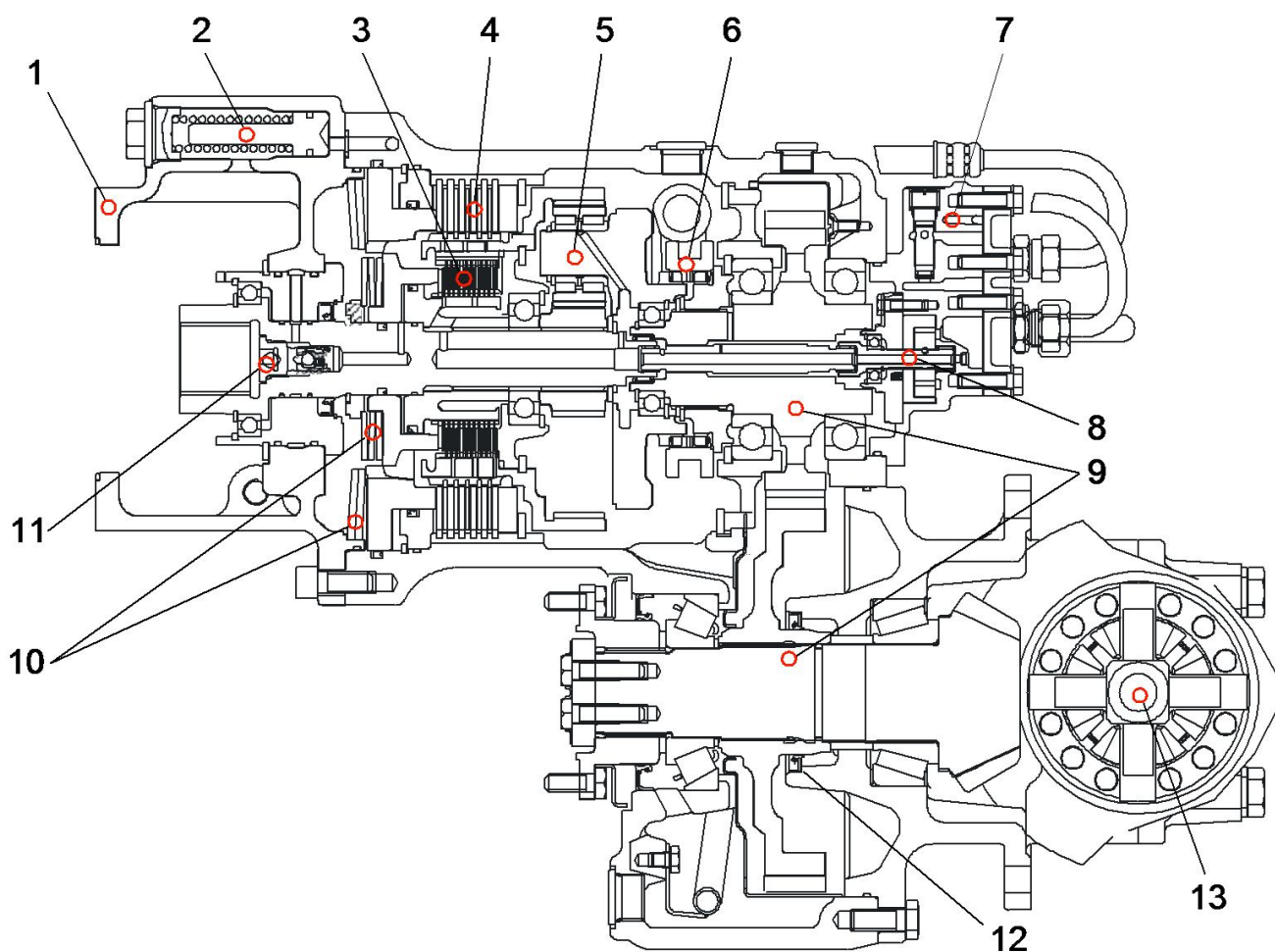
A centre passage connects the superstructure and undercarriage hydraulically and electrically.

Document Title: Travel gearbox, description	Function Group:	Information Type: Service Information	Date: 2014/7/17
Profile: EXC, EW160B [GB]			

Travel gearbox, description

General

The gearbox, with integrated differential **13**, is attached to the rear axle. The gearbox contains the planetary gear **5** with one planetary gear step and the gear wheel drive **9**. The speed gears are applied via the disc clutch **3** and the disc brake **4**. Both the clutch and the brake are negative, i.e. they are applied by the cup springs **10**. The clutch and the brake are released by hydraulic pressure which compresses the cup springs. The internal locking function **7** prevents engagement of the low gear when travelling at high speed until the rpm has dropped. This is controlled by the lubrication pump for the transmission **8**. The rear axle and the gearbox contain different types of oil and therefore a double seal **12** is installed.



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Figure 1
Gearbox 2 HL-100, cut-away view

- | | | |
|--|--|----------------------|
| 1 Connection for hydraulic motor | 6 Release device | 11 Restriction valve |
| 2 Reservoir for control pressure of disc brake | 7 Internal locking function | 12 Double seal |
| 3 Disc clutch | 8 Rotor pump for control pressure internal locking function and transmission lubrication | 13 Differential |

- | | | | |
|---|----------------|----|--|
| 4 | Disc brake | 9 | Gear drive |
| 5 | Planetary gear | 10 | Cup springs for disc clutch and disc brake |

Shifting, mechanical action

Off-road gear (turtle and snail)

The disc brake **4** (see fig. Gearbox 2 HL-100, cut-away view) is applied which means that the ring gear **1** is locked to the housing **2**. The sun gear **3** has the same rpm as the hydraulic motor. Thus, the sun gear drives the planetary gear **4** which in turn wanders on the locked ring gear **1**. Thus, the ring gear carrier **5** will rotate at a lower rpm than the input sun gear **B**.

On-road gear (rabbit)

The disc clutch **3** (see Fig. Gearbox 2 HL-100 cross section) is applied. The sun gear **3** is locked to the ring gear **1** (symbolised by the nail). This means that the whole planetary gear is locked as one unit. Thus the input speed of the sun gear **B** is the same as the output speed of shaft **A**.

Parking brake hydraulic system

Same as the on-road gear plus that the entire planetary gear assembly is locked to the housing with the brake **1**.

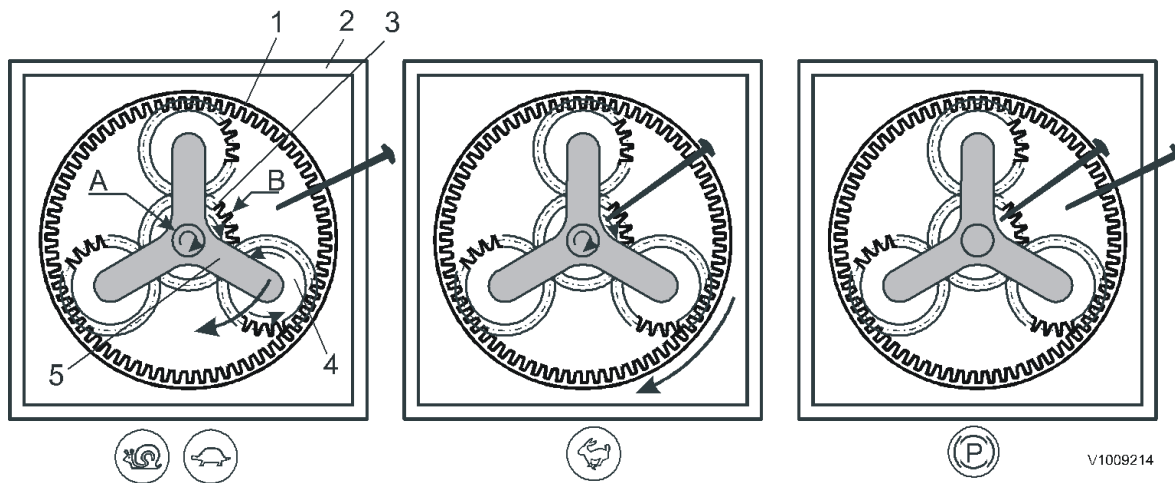


Figure 2

Shifting mechanical action

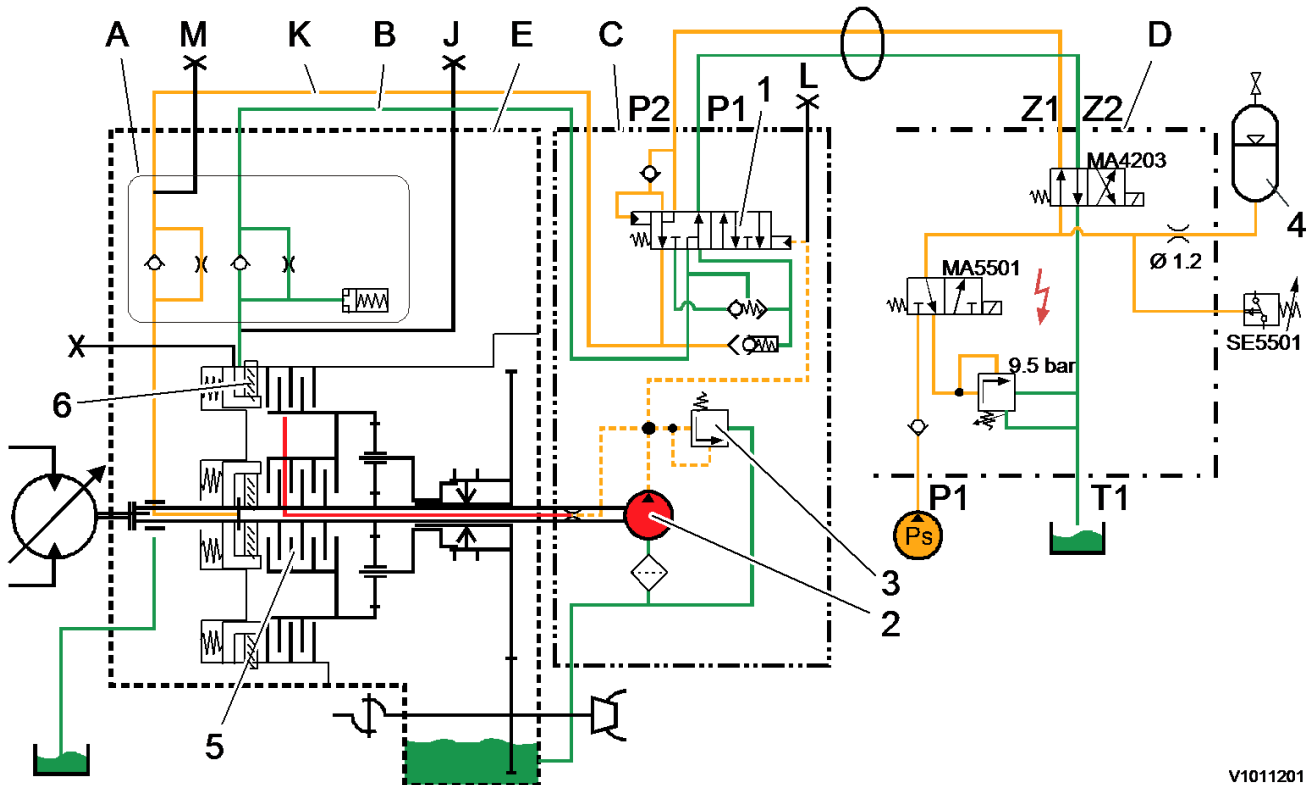
1. Ring gear
 2. Housing
 3. Sun gear
 4. Planetary gear
 5. Planetary gear carrier
- A. Output shaft, connected to final step
B. Sun gear connected to hydraulic motor

Shifting, hydraulic and electrical action

Off-road gear (turtle and snail)

When the solenoid valve **MA5501** receives voltage, the valve shifts position so that the right symbol engages. The servo pressure from **P1** passes the valve and charges the accumulator **4**. The pressure continues through line **Z1** and through the centre passage and then in line **P2**. The pressure passes the spool **1**, but acts on the spring side of the spool at the same time to keep the left symbol in. The disc clutch **5** is released out through line **K** and via a non-return valve.

Pressure monitor **SE5501** switches, if the pressure drops below 2.6 MPa, 377 psi, 26 bar (e.g. loss of servo pressure) and a signal is sent to the control unit (T-ECU). The control unit interrupts the voltage to solenoid valve **MA4202**, (see the conditions for travelling). This causes the control pressure from the pedal in the cab to be drained to tank and the machine stops.



V1011201

Figure 3
Off-road gear

- | | | |
|---------------------------|--------------------------|-----------------------------|
| 1 Spool | 5 Disc clutch | C Internal locking function |
| 2 Lubrication oil pump | 6 Disc brake | D Solenoid valve block |
| 3 Pressure limiting valve | A Clutches + accumulator | E Gearbox |
| 4 Accumulator | B Brake line | K Clutch line |

J, L, and M are plugged holes for eventual pressure measurement

On-road gear (rabbit)

Both solenoid valves **MA5501** and **MA4203** are energised (right symbol). The servo pressure passes through the line **Z2** to connection **P1**. Further, the pressure passes through spool **1** and out into line **B** and in to gearbox **E**, where the disc brake **6** is released. The disc clutch **5** is applied by spring force because the piston is connected to tank. As there is no pressure on the spring side of spool **1**, the spool is displaced over to the right symbol, when the lubricating oil pressure has risen to a certain value (see also extracted figure in the right corner). The restriction **7** provides a rising lubricating oil pressure with increasing rpm (speed). The lubricating oil pressure is limited by the overflow valve **3** to a maximum of 0.65 MPa (94 psi, 6.5 bar). The pressure in the line **P1** passes through the shuttle valve and keeps the disc brake **6** released.

If the operator, when operating at high speed with the on-road gear engaged, activates the off-road gear, the line **P2** is connected to the servo pressure. The pressure passes through the spool **1**. The spool cannot change position since there is a non-return valve. The oil (pressure) goes through a shuttle valve **8** which changes position, but there is still pressure out in line **B**, which results in no gear shifting until the travel speed has been reduced to such an extent that the pressure from the lubricating oil pump is so low that the left symbol in the spool **1** is activated and downshifting to the off-road gear can take place.

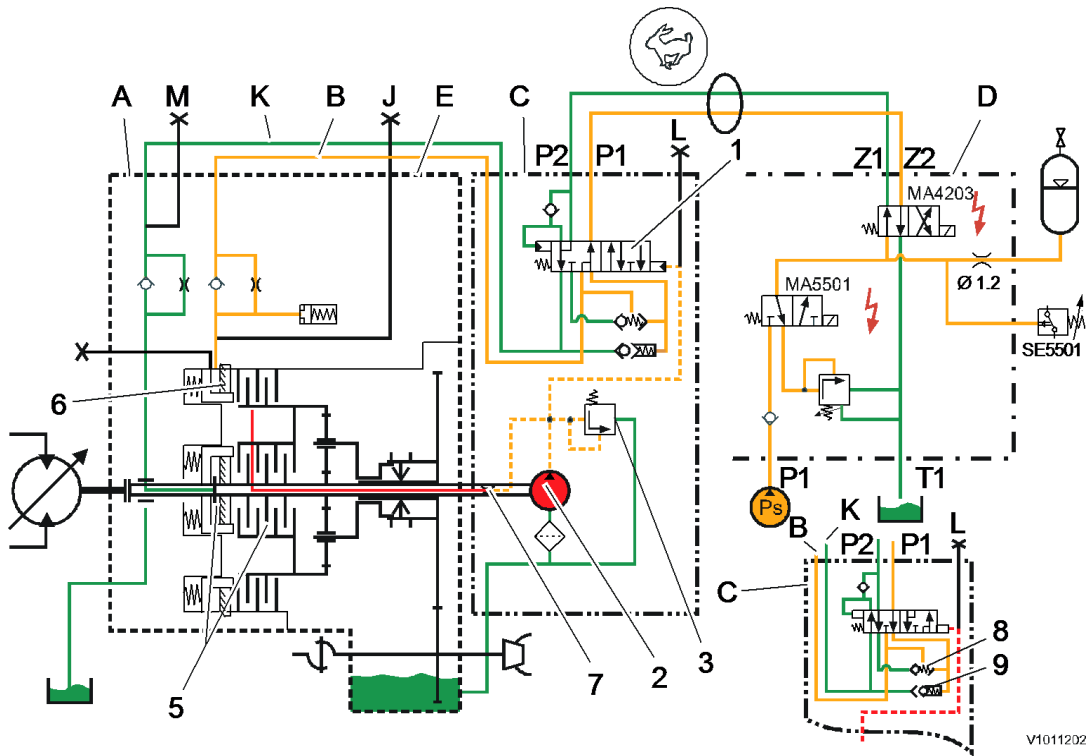


Figure 4
On-road gear

- | | | |
|------------------------|------------------|------------------------|
| 1 Spool | 7 Restriction | C Internal locking |
| 2 Lubrication oil pump | 8 Shuttle valve | D Solenoid valve block |
| 3 Overflow valve | 9 Leak-oil valve | E Gearbox |
| 5 Disc clutch | A Clutches | K Clutch line |
| 6 Disc brake | B Line | |

Conditions for operating

	MA9108	MA9152	MA5501	MA4202	MA4204	MA4203	MA9107

Figure 5

Conditions for operating in different modes

1. If the superstructure and undercarriage are in line, the voltage is interrupted
2. Low speed (turtle) and high speed (rabbit) interrupt the voltage
3. Inching (snail) low speed (turtle) interrupt the voltage
4. Brake pressure 5 MPa (725 psi, 50 bar) interrupts the voltage
5. Position P interrupts the voltage
6. Power Boost activated 10 seconds
7. Control pressure transport min. 0.7 MPa (102 psi, 7 bar) SE4201

Document Title: Travel gearbox, removal	Function Group:	Information Type: Service Information	Date: 2014/7/17
Profile: EXC, EW160B [GB]			

Travel gearbox, removal

Op nbr 431-012

Ratchet block

Sling 3 m (10 ft)

14360000 Vacuum pump / 24V

1. Place the machine in a suitable service position, see [091 Service positions](#).
2. Remove the doorstep on the right side.
3. Place the rear of the machine on stand jacks.

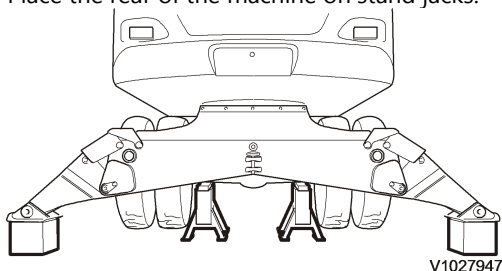


Figure 1
Machine on stand jacks

4. Remove the wheels, see step 7-9 in [771 Wheel removal](#).

NOTE!

If the machine are equipped with drum brakes, carry out step 5-9.

If the machine are equipped with wet multi-disc brakes, carry out step 10-15.

NOTE!

The following steps must be carried out on the both output sides.



To prevent an injury caused by a possible pressure build-up in the oil supply of the planet gear train, the following instructions must be followed carefully.

Drum brakes

5. Loosen the oil drain plugs 1 and drain the oil into a suitable vessel.
The oil filler respectively the drain plug 1 must first be brought into the uppermost position (12 o'clock) and then carefully unscrewed.
The drain bore 2 must then be brought into the lowest position (6 o'clock) and the oil will be drained.

NOTE!

Mark the position of the drums and of the planet carrier to secure that they are replaced on the right side and placed in the same position as before.

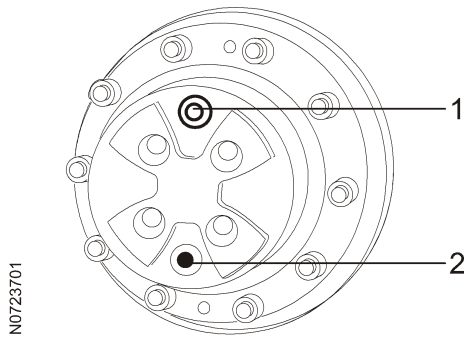


Figure 2
Oil drain

1. Oil drain plug in removal position
2. Oil drain bore in draining position

6. Separate the brake drum from the axle, using forcing screws.

NOTE!

In case of worn brake drums, the brake shoes can be reset by a corresponding rotation of the welded hexagonal nuts on the slack adjuster.

7. Loosen the drain plug 1 and drain the oil from the axle casing in a suitable vessel.

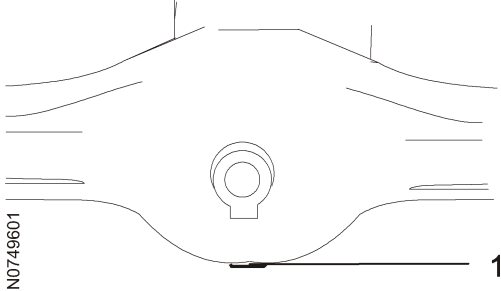


Figure 3
Drain plug, axle casing

1. Drain plug, axle casing

8. Loosen the screws and separate the planet carrier from the hub. Place a suitable vessel under the hub to collect oil.

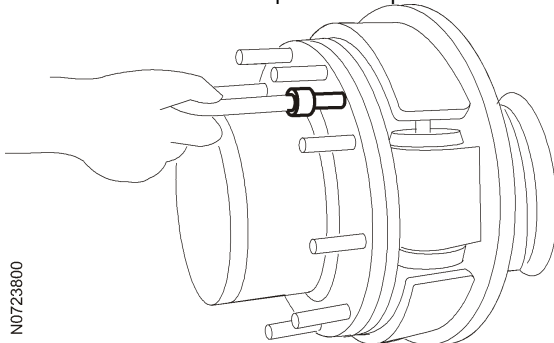


Figure 4
Loosening the screws from the planet carrier

9. Pull the complete stub shaft 1 (complete with collar 2 and sun gear shaft 3) out of the axle casing.

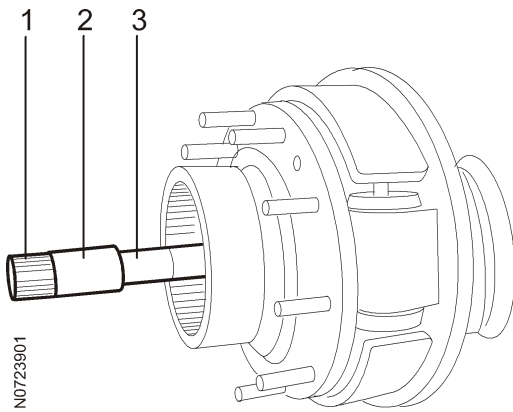


Figure 5
Removing the stub shaft from the axle casing

1. Stub shaft
2. Collar
3. Sun gear shaft

! WARNING

To prevent an injury caused by a possible pressure build-up in the oil supply of the planet gear train, the following instructions must be followed carefully.

Wet multi-disc brakes

10. Loosen the drain plug 1 and drain the oil.

NOTE!

The following steps must be carried out on the both output sides.

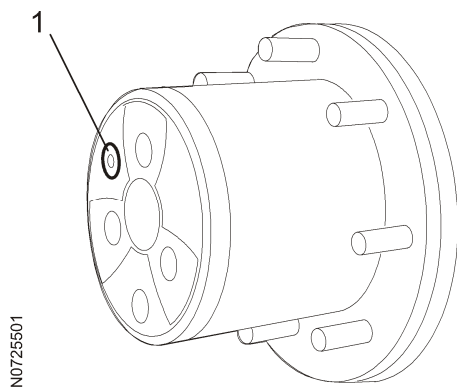


Figure 6
Oil drain, axle with wet multi-disc brake

1. Drain plug

11. Loosen the screws 1 and separate the planet carrier from the hub.

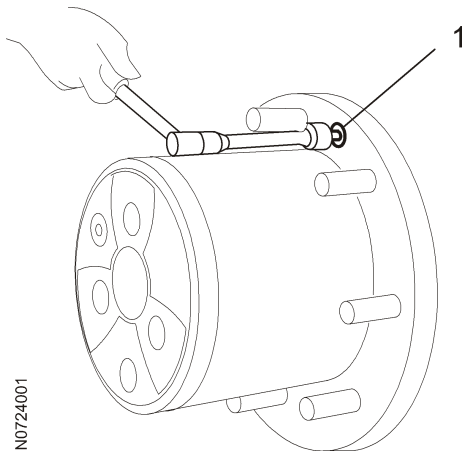


Figure 7
Loosening the planet carrier screws

1. Planet carrier screw
12. Loosen the drain plug **1** and drain the oil from the axle casing.

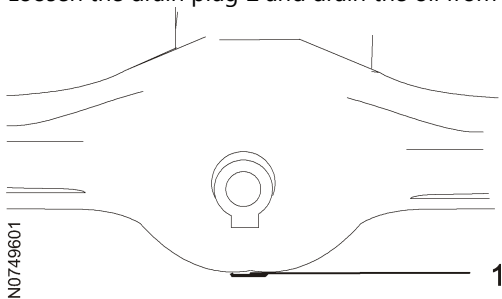


Figure 8
Drain plug, axle casing

1. Drain plug
 13. Pull the sun gear **1** out of the plate carrier **2**. Pull then the plate carrier **2** from the stub shaft.
- NOTE!**
Pay attention to the released thrust washers.

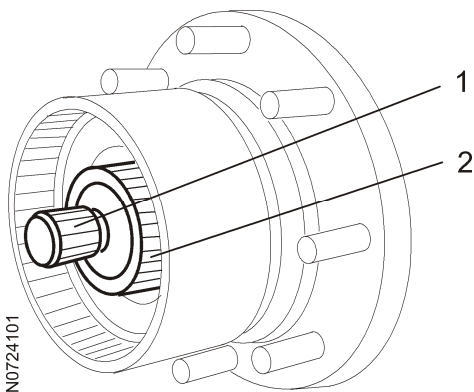


Figure 9
Hub with sun gear and plate carrier

1. Sun gear
2. Plate carrier
14. Pull the stub shaft out of the axle casing.

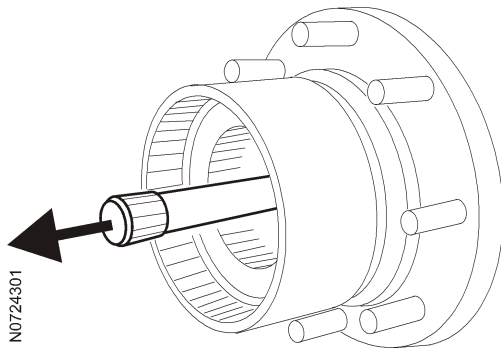


Figure 10
Pulling out the shaft

15. Squeeze the circlip out, pull the end shim and the plate pack out of the internal gear.

NOTE!

The previous step is necessary to allow the later installation of the inner plate carrier.

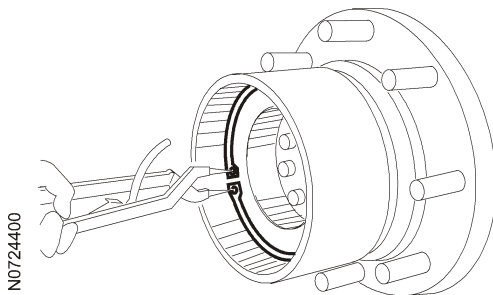


Figure 11
Removing circlip

16. Remove the rear propeller shaft.
17. Install the vacuum pump, see [900 Vacuum pump connection](#).
18. Remove the travel motor, see step 4-8 in [4411 Travel motor removal](#).
19. Loosen all attach bolts to the gearbox.
Secure the gearbox with sling and ratchet block and a lifting jack.
Remove the attach bolts.
20. Lower and remove the gearbox.

Document Title: Travel gearbox, installation	Function Group:	Information Type: Service Information	Date: 2014/7/17
Profile: EXC, EW160B [GB]			

Travel gearbox, installation

Op nbr 431-013

[1161053 Sealing fluid](#)

[Ratchet block](#)

[Sling 3 m \(10 ft\)](#)

[14360000 Vacuum pump / 24V](#)

1. Wet the installing surface with sealing fluid, use 1161053, Loctite 243 or similar.
2. Make two guiding pins by cutting the head of two M14x30 mm screws.
Fit the two guiding pins, position the gearbox on the axle (using a lifting device), and fit it with locking screws.

NOTE!

New locking screws must be used.

Tightening torque: **250 Nm**.

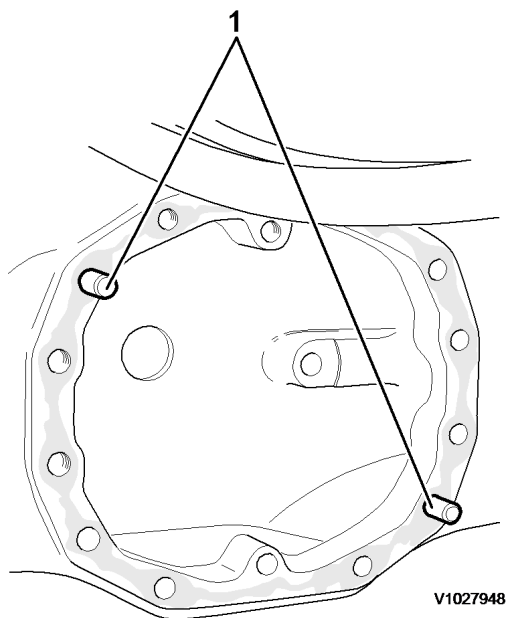


Figure 1
Rear axle with guiding pins installed

1. Guiding pins

NOTE!

If the machine are equipped with drum brakes carry out step 3-8.

If the machine are equipped with wet multi-disc brakes carry out step 9-16.

Drum brakes

3. Insert stub shaft along with sleeve and sun gear into the axle casing until the gearing is in contact with the differential (side gear).

NOTE!

The following steps must be carried out on both sides.

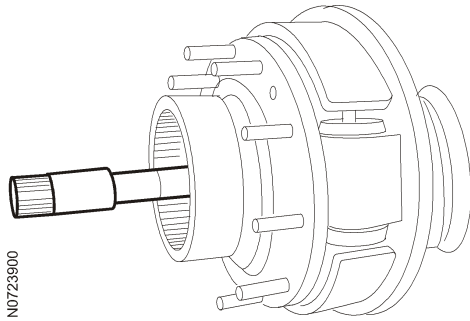


Figure 2
Inserting the stub shaft

4. Install the travel motor, see step 1-5 [4411 Travel motor, installation](#).
5. Install the rear propeller shaft, see step 5-7 [451 Propeller shaft, replacement](#).
6. Install planet carrier until contact is obtained, and fasten it.
Tightening torque: **55 Nm**.

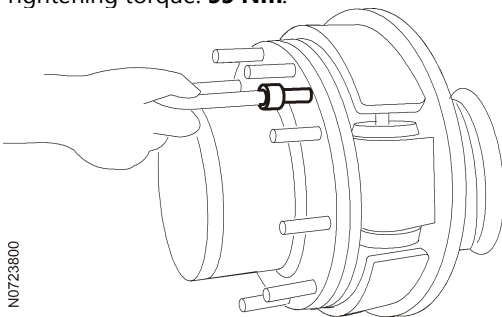


Figure 3
Fastening planet carrier screws



After the assembly of the brake drum, the brake must be adjusted on the slack adjuster.

7. Install drum brake until contact is obtained.
Fit the drum with two of the wheel nuts.

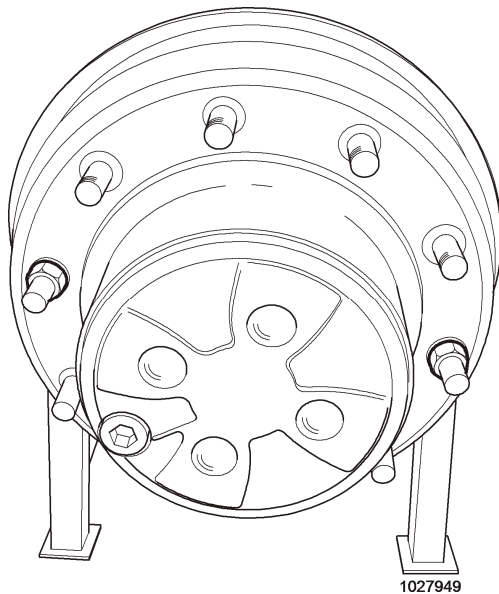


Figure 4
Drum fitted with two wheel nuts
NOTE!

Fill oil in the axle and hub reduction according to [160 Recommended lubricants](#).

8. Adjust the brakes by loosen the slack adjuster screws. Start the engine and press the brake pedal to the bottom 10 times.

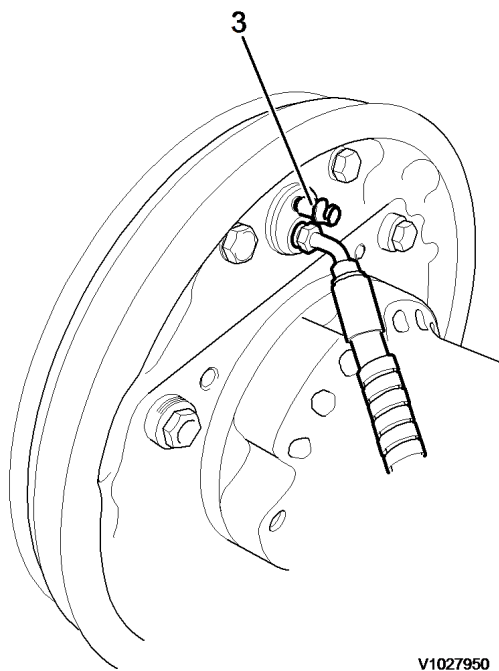


Figure 5
Drum brake, slack adjuster screws

1. Slack adjuster screws

Wet multi-disc brakes

9. Insert the stub shaft into the axle casing, with the smaller gearing facing the differential, until the gearing is in contact with the differential (side gear).

NOTE!

The following steps must be carried out on both sides.

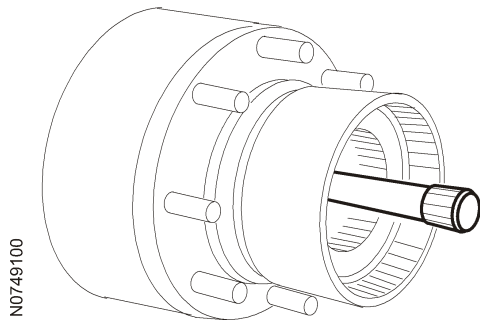


Figure 6
Inserting stub shaft

10. Install the travel motor, see step 1-5 [4411 Travel motor, installation](#).
11. Install the rear propeller shaft, see step 5-7 [451 Propeller shaft, replacement](#).
12. Assemble the thrust washer 2 on the plate carrier 1.
Assemble the plate carrier 1 on the stub shaft until contact is obtained.
Insert the sun gear into the plate carrier 2 until contact is obtained.

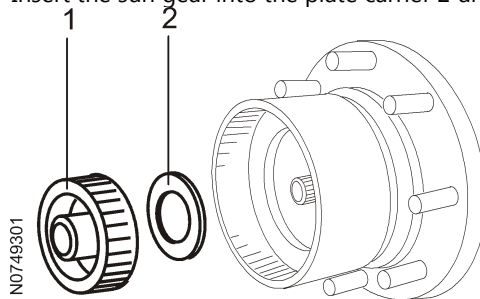


Figure 7
Plate carrier assembly

1. Plate carrier
2. Thrust washer

13. Install alternately outer and inner plates, starting with an outer plate.

NOTE!

At the installation of outer plates with different thicknesses, the thinner outer plates must be principally installed on the piston side and on the end shim side.

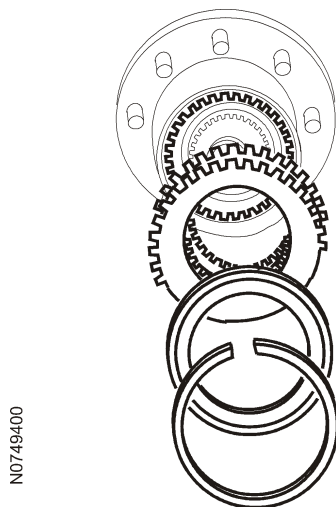


Figure 8
Multi-disc brake assembly

14. Oil the plates according to the table [160 Recommended lubricants](#).
15. Fix the plate pack with the end shim and a circlip.
NOTE!
Pay attention to the installation of the end shim.
16. Install the planet carrier and fasten it.
Tightening torque: **32 Nm**.
NOTE!
Prior to put the axle into service, fill oil according to the table [160 Recommended lubricants](#).

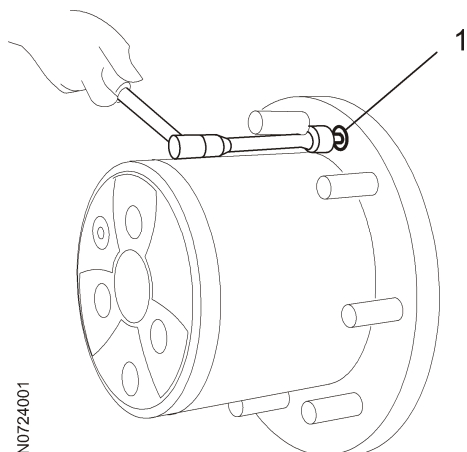


Figure 9
Fastening planet carrier screws

17. Remove the two wheel nuts and install the wheels, see [771 Wheel, installation](#).
18. Install the right side doorstep.

Document Title: Travel motor, description	Function Group: 441	Information Type: Service Information	Date: 2014/7/17
Profile: EXC, EW160B [GB]			

Travel motor, description

Forward travel

When the parking brake is not applied, see [550 Parking brake description](#) the solenoid valve **MA5501** for the parking brake receives current. The servo pressure passes via pressure monitor **SE5501**, and when the pressure has reached 2.6 MPa (377 psi, 26 bar), solenoid valve **MA4202** is energised via a signal from the transmission control unit **T-ECU**. The pressure also passes via the port **W** on the solenoid valve block **40** to the control valve **29**. When the operator depresses pedal **04** for operating forwards, the servo pressure is converted to control pressure, which passes via line **1** on the pedal valve. The control pressure continues in to the main valve block port **a3** via restriction / non-return valve **03** and actuates the spool.

The pump pressure (stand-by) passes into the block and out via the restriction **01** to the line **02** (LS) and on to the pump which increases its flow. The pressure increases and when the pressure is greater than in the travel motor (load pressure), the non-return valve **05** opens and the flow passes via the port **A3** and port **13** in the centre passage as well as port B to the travel motor **10**. The return flow passes through port **14** and into the block through port **B3** and on via restriction **06** to tank and the machine starts to move.

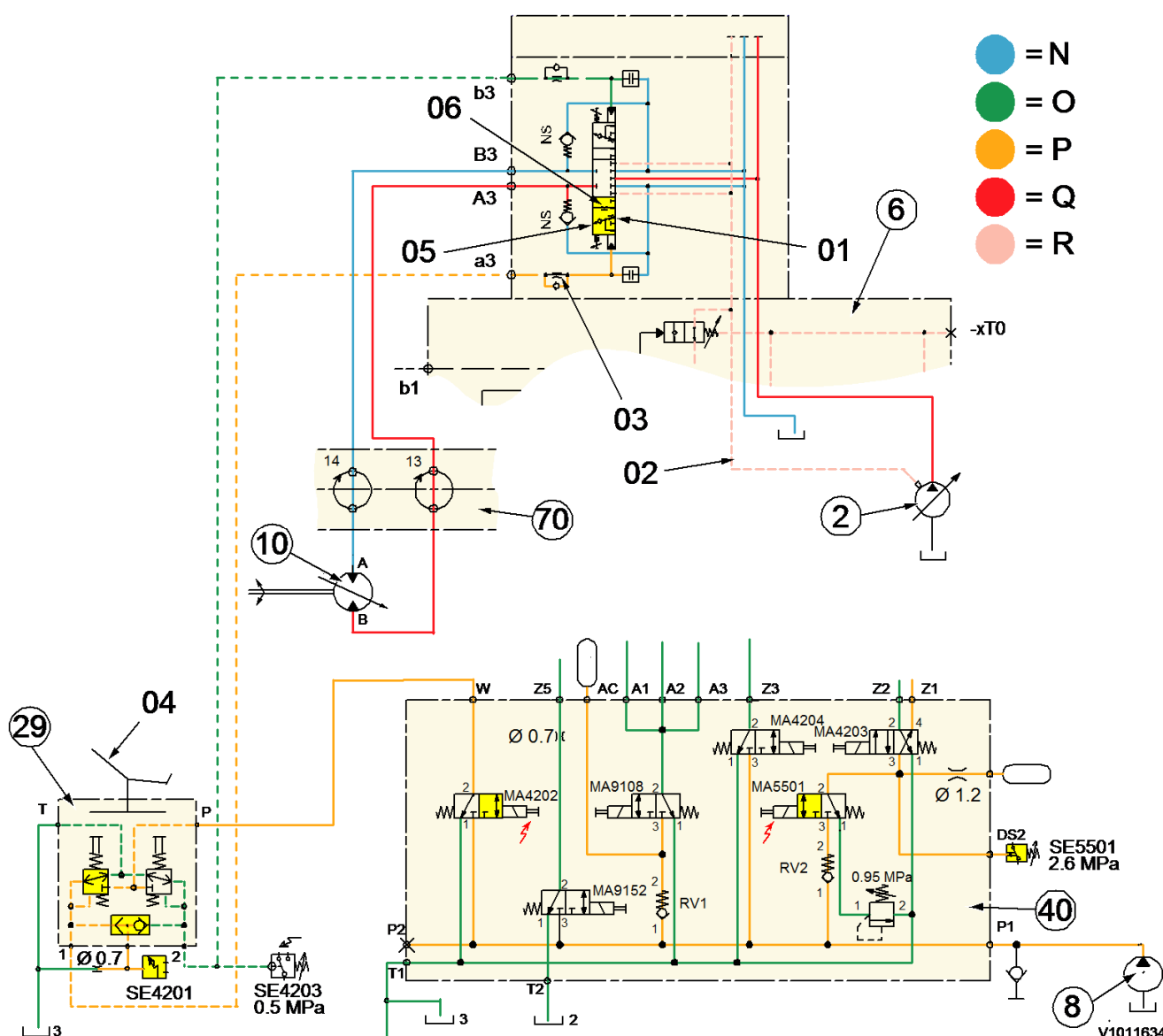


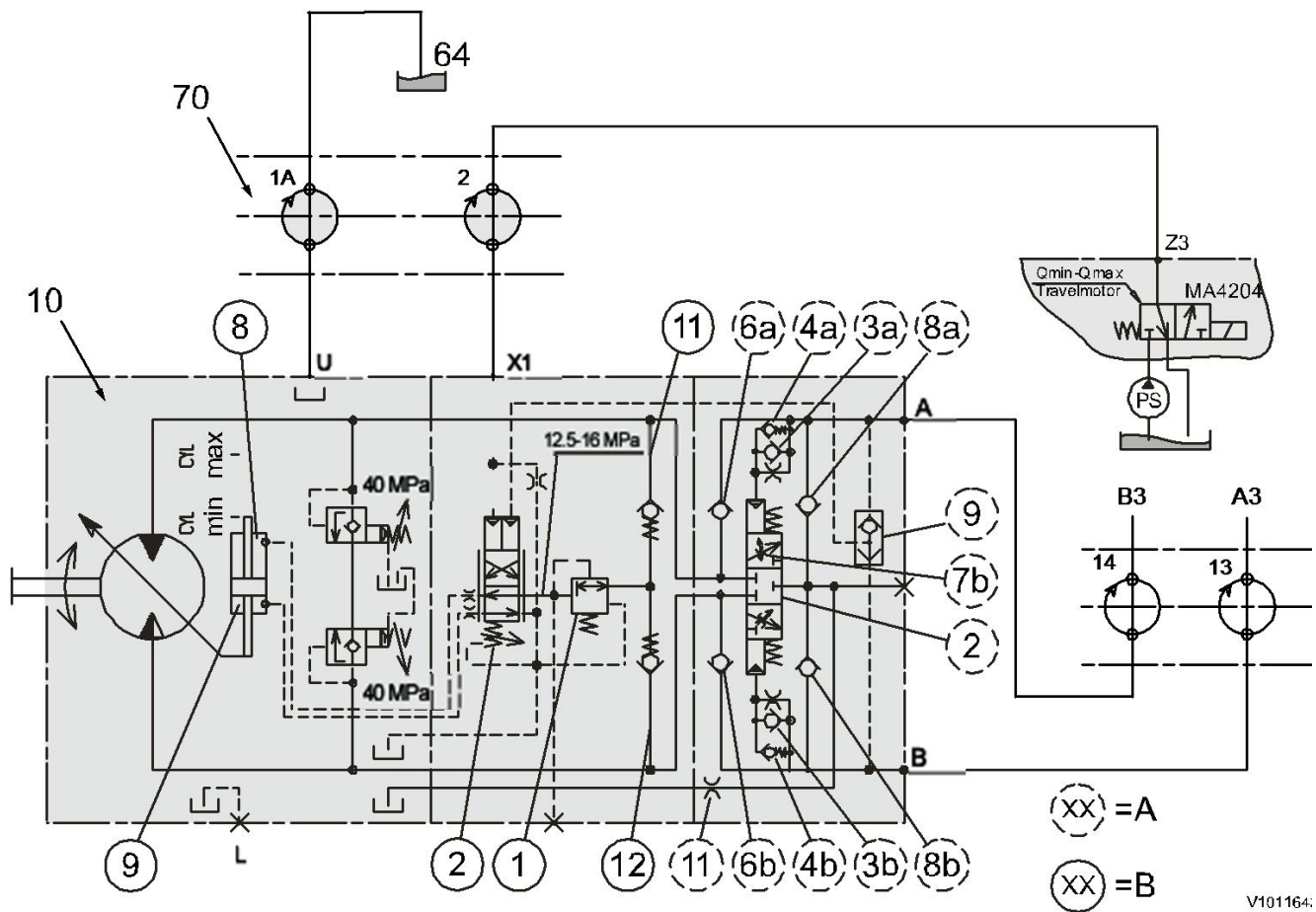
Figure 1
Sub-diagram travel system

01	Restriction in spool	2	Working pump
02	LS line	6	Main valve block MCV
03	Restriction and non-return valve	8	Servo pump
04	Pedal	10	Travel motor
05	Non-return valve in spool	29	Control valve, travelling (operating)
06	Restriction in spool	40	Solenoid valve block
N	Raised return pressure	70	Centre passage
O	Return pressure	MA4202	Solenoid valve, travelling (operating)
P	Servo and control pressure	MA5501	Solenoid valve, parking brake
Q	Pump pressure	SE4201	Position sensor, travel pedal
R	LS pressure	SE5501	Pressure monitor, parking brake

Travel motor with retardation valve

When operating (travelling) a flow enters the **A** port and moves on to shuttle valve **9**, which changes position and directs the flow on to the control spool **2**. The pressure of the flow is still too low to alter the position of the control spool. The flow continues via the non-return valve **3a** and actuates the retardation valve **2** (A) to the upper symbol. The movement is restricted to delay the connection for the return flow to the tank. The oil continues via non-return valve **6a** to the line **11** and to the pressure-control valve **1**. In this the pressure is reduced to 12.5–16 MPa (1810–2320 psi, 125–160 bar) (fixed setting). The reduced pressure continues and pushes the control piston **8** over so that the pump takes up the minimum displacement position. If the machine is not standing on a down hill slope, the pressure will rise until the control spool **2** switches so the cross symbol is engaged. This causes the reduced pressure to change sides and changes the displacement of the motor to maximum with a consequent increase in torque from the motor and the machine can begin to accelerate. As the acceleration progresses the pressure in the system drops reducing the displacement of the motor as the speed increases. The return oil from the motor now passes the open retardation valve. If the operator wants to reduce speed by pressing the pedal in the opposite direction (countering), the oil will return through the non-return valve **8a** to the port **A** and pass via the main valve block to tank via the pressure back-up valves 0.3 MPa and 0.5 MPa (43.5 / 72.5 psi, 3 / 5 bar). During countering the retardation will be reinforced with the aid of the variable restriction **7b**. As the motor has begun to work as a pump, there will be a rapid reduction in speed. If the pedal still is depressed when the machine comes to a standstill, it will begin to move in the opposite direction. Without countering, the retardation spool on its own will provide a slower retardation.

When operating with the snail symbol activated (inching), the solenoid valve **M4204** is supplied with voltage and the right symbol is active. The servo pressure passes out in port **Z3** and on to line **2** and to control spool **2** on the travel motor. Here, the servo pressure **Ps** acts on a circular area on the spool and the upper symbol becomes engaged. The motor is locked in max. displacement (low speed) regardless of how high the system pressure is. This may be practical, for example, when loading on a ramp so that uncontrolled speed increase does not result when the crest of the ramp has been passed.



V101164;

Figure 2
Hydraulic diagram for travel motor 20 km/h

- A Refers to figure. Retardation valve in neutral position and figure. Retardation valve in travelling position
- B Refers to figure. Control for travelling motor 20 km/h
- 10 Travel motor
- 70 Centre passage

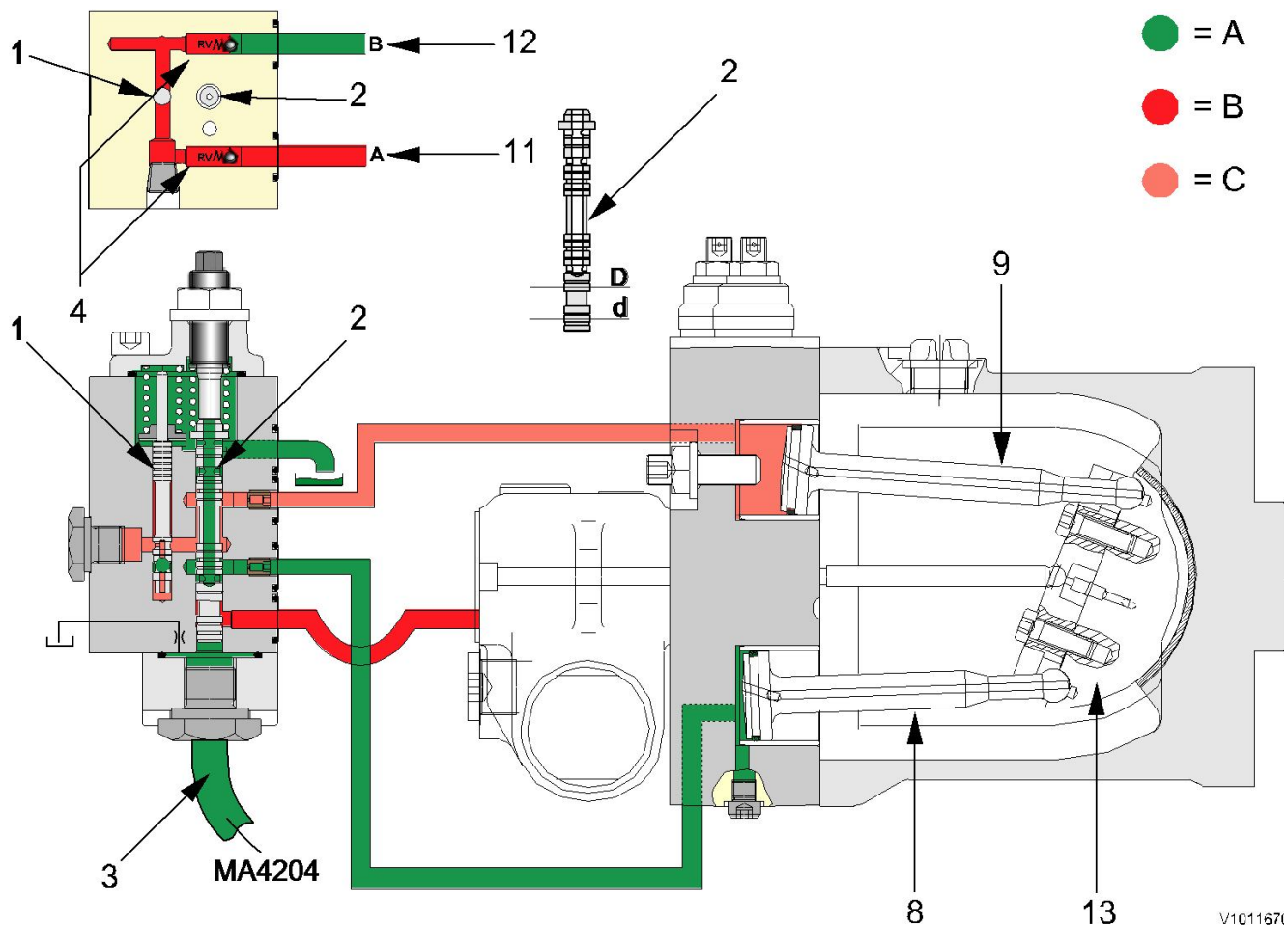
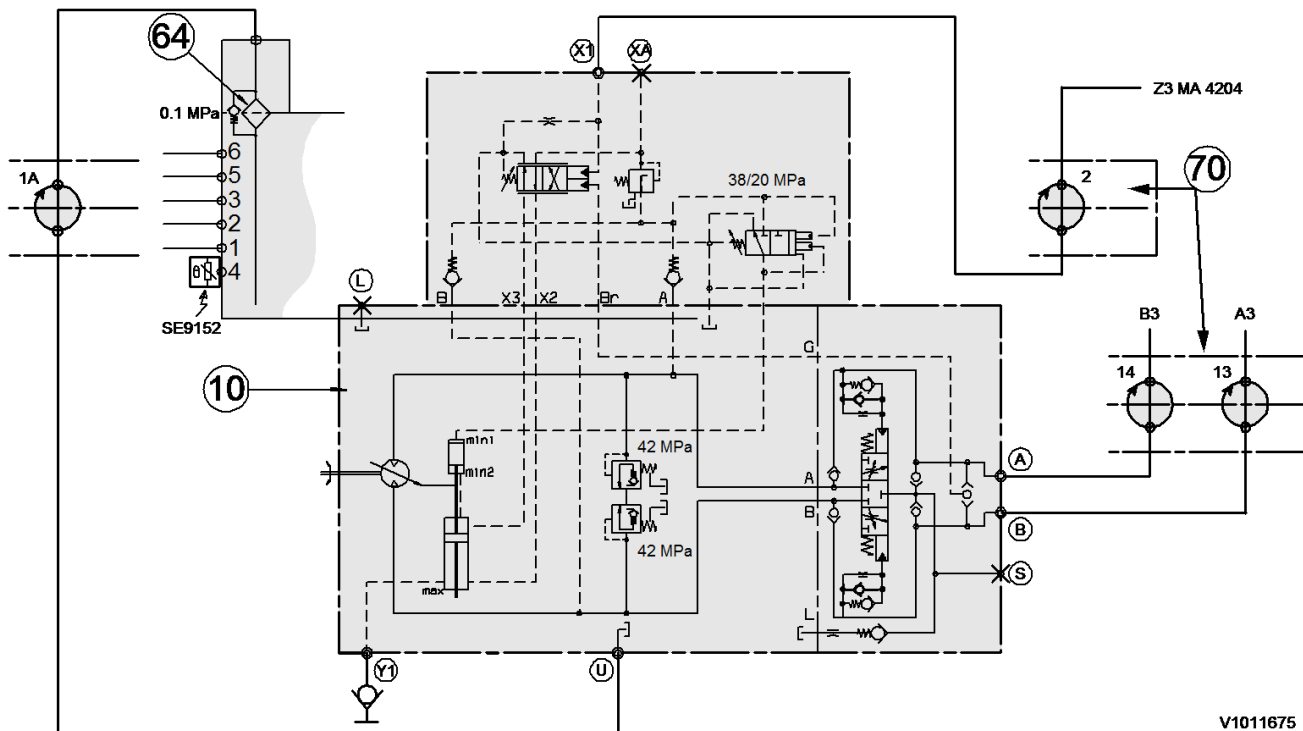


Figure 3
Control for travel motor 20 km/h

- | | | |
|---------------------------|--------------------------------------|-------------------------|
| 1 Pressure-reducing valve | 8 Control piston | 13 Regulator plate |
| 2 2. Control spool | 9 Control piston | A Return pressure |
| 3 Tank/servo line | 11 Line A to pressure-reducing valve | B Pump pressure |
| 4 Pressure-limiting valve | 12 Line B to pressure-reducing valve | C Reduced pump pressure |



V1011675

Figure 4
Hydraulic diagram for travel motor 30 km/h

- 10 Travel motor
- 64 Draining filter
- 70 Centre passage

Control for travel motor 30 km/h with Vmin1-min2

When the transport pedal is activated, the spool opens in the main valve block MCV and pump flow (dark red colour acc. to fig.) passes to **B** port (motor symbol) and into line Br. The pressure increases due to the start resistance. This pressure is designated system pressure in this description.

At low system pressure, the spool **2** is kept in the lower position by spring force. The system pressure reaches the pressure-reducing valve **5** via the non-return valve **3**. The reduced pressure 12.5–16.0 MPa (1810–2320 psi, 125–160 bar) acts in the chamber **G** via line X3. The chambers **D** and **F** are connected to tank. The piston **E** is pressed against the min. screw **C** and the motor is in min. 1 displacement.

Min. displacement gives low torque why the machine remains stationary, but the system pressure increases. When the system pressure in line Br reaches the control point, approx. 29.0 MPa (4210 psi, 290 bar), the spool **2** is lifted and the chamber **G** becomes connected to tank and reduced system pressure acts in the chamber **F**. The motor switches to max. displacement, the torque increases and the machine accelerates.

During acceleration, the system pressure drops and the variable motor is controlled toward min. displacement. When the chambers **F** and **D** have tank pressure, max. speed is determined by the min. screw **C**.

When travelling with pump flow to the travel motor, the system pressure may reach a maximum of 36.0 MPa (5220 psi, 360 bar), which is limited by the DA valve. The control valve **11** has a change-over point at 38.0 MPa (5510 psi, 380 bar).

If the operator at maximum speed takes the foot off the pedal, or the machine is running down hill, the travel motor begins to work as a pump. The pressure rises in the **A** port (motor symbol), when the retardation spool **10** moves towards the centre position with the aid of the centring spring. The pressure passes the non-return valve **4** and acts on an annular area on the spool in the valve **11**. At 38.0 MPa the valve **11** changes over and the pressure passes to chamber **D**, displaces piston **E** to the right (min.2) and increases the displacement. This increase in displacement produces a slight retardation, which makes the operator aware of that it is time to use the brake pedal.

There is a small piston in the bottom end of the spool in valve **11**. This piston forces the pressure to drop to 20.0 MPa (2900 psi, 200 bar) so that the spring can push the spool against the bottom position and chamber **D** becomes connected to tank. When chamber **D** is connected to tank, the motor reverts to min.1 displacement and it is again possible to reach max. speed. There is a port X1 on the control spool which is used when inching (snail). When the operator selects snail, the solenoid valve MA4202 shifts and the servo pressure 3.5 MPa (508 psi, 35 bar) is connected to port X1. 3.5 MPa acts on the bottom end of the spool **2** and lifts it so that the chamber **F** is pressurised and chamber **G** becomes connected to tank. The motor is now locked in max. displacement and inching speed is guaranteed regardless of what the system pressure is. In inching

(snail) mode, the off-road gear is also activated.

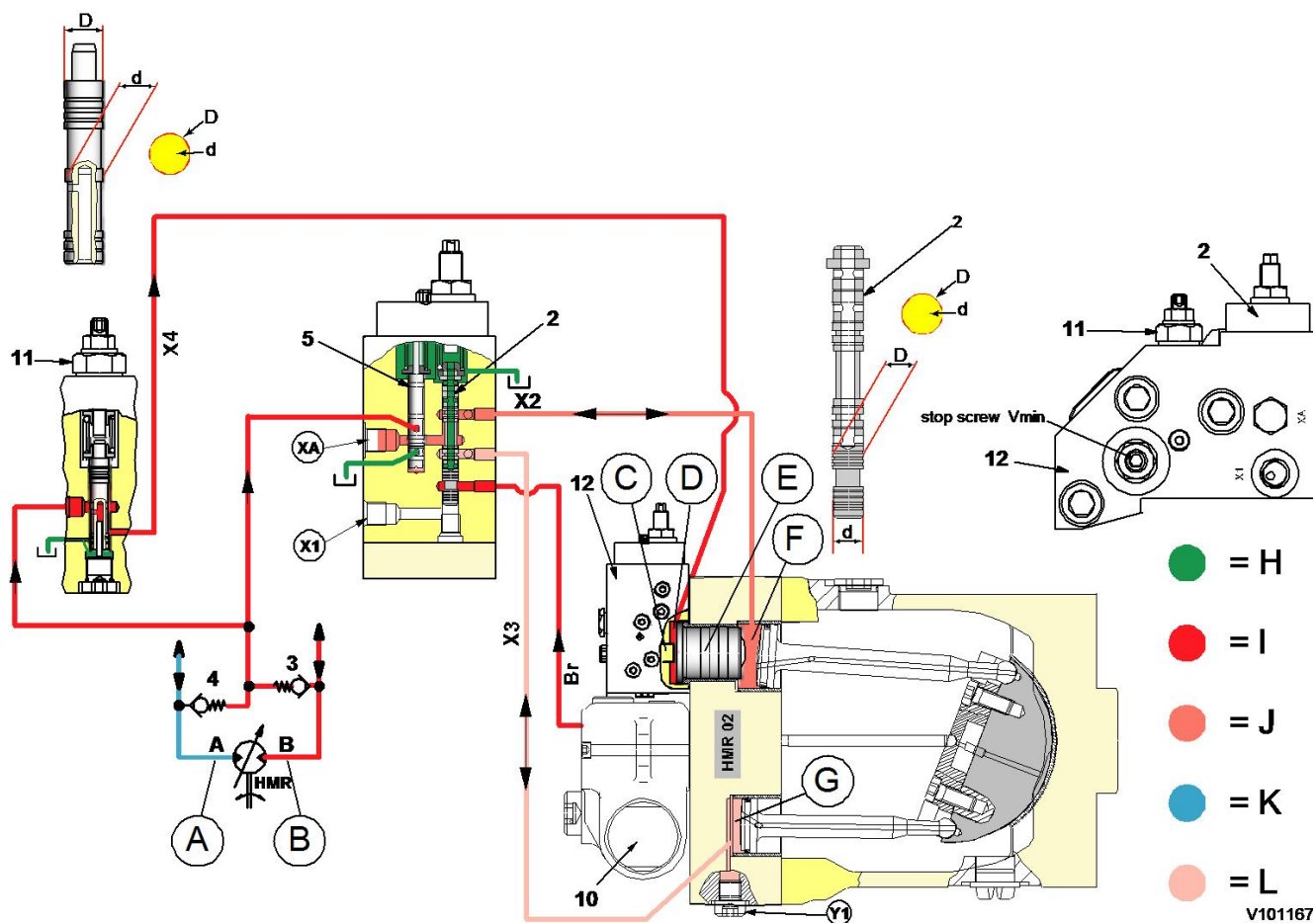


Figure 5
Control for travel motor 30 km/h

2	Spool	Y1	Checking point	G	G. Chamber
3	Non-return valve	A	Port	H	H. Return pressure
4	Non-return valve	B	Port	I	I. Pump pressure
5	Pressure-reducing valve	C	Min. screw	J	Reduced pump pressure
6	Retardation spool	D	Chamber	K	Raised return pressure
11	Control valve	E	Piston	L	Y1 pressure
12	Control block	F	Chamber		

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