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Section F

Transmission

Service Manual - 527-58

Section 1 - General Information

Section 2 - Care and Safety

Section 3 - Routine Maintenance

Section B - Body and Framework

Section C - Electrics

Section E - Hydraulics

Section F - Transmission

Section G - Brakes

Section H - Steering

Section K - Engine

Section M - Electronic Data Systems



Publication No.
9813/0200-2



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Notes:

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Section F - Transmission

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Wheels and Tyres

Introduction

This topic contains information about a machine DEVICE. Make sure you are referring to the correct device. Refer to the applications table.

Descriptions and procedures relate to the device and not related systems. For information about the systems refer to the relevant topics.

This topic is intended to help you understand what the device does and how it works. Where applicable it also includes procedures such as removal and replacement and dismantle and assemble.

⇨ *Related Topics (F1-2)*
⇨ *Specifications (F1-3)*
⇨ *Tyres and Tyre Pressures (F1-3)*
⇨ *Removal and Replacement (F1-4)*
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Related Topics

Table 1. Related Topics in This Publication

The table lists other topics in the manual that contain information related to this topic. Refer to the applicable topics to complete your procedures. Where applicable the text in this section contains cross references to this page to help you find the correct information. Some machines have different systems and devices. Make sure you refer to the correct topic, refer to *Section 1 - Applications*.		
Sections	**Topic Titles**	**Sub Titles**
1	Applications	ALL
2	ALL (Care and Safety)(1)	ALL

(1) You must obey all of the relevant care and safety procedures.

Specifications

Table 2. Tyres and Tyre Pressures

Refer to the relevant ***Operator Handbook*** for tyre and pressure details.

Removal and Replacement

Front Wheels

Important: *The wheel and tyre assembly is heavy. Get the aid of one more person to remove and replace a wheel.*

⚠ WARNING

A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-1-1

Removal (one wheel)

1 Park the machine and make it safe. Fit the boom safety strut. Obey the care and safety procedures. ⇒ *Related Topics (F1-2)*

2 Make sure that the engine cannot be started.

3 Put chocks **A** under the rear wheels.

4 Loosen the five wheel nuts **B** by half a turn.

5 Put a jack **C** under the axle arm. Use the correct jack.

6 Use the jack to lift the machine until the front wheel **D** is off the ground.

7 Put chocks **E** under the axle arm.

8 Hold the wheel **D** and remove the wheel nuts **B**.

9 Remove the wheel.

Replacement

Note: *Make sure that the mating surfaces of the wheel and axle hub are clean.*

⚠ WARNING

If, for whatever reason, a wheel stud is renewed, all the studs for that wheel must be changed as a set, since the remaining studs may have been damaged.

2-3-2-8

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

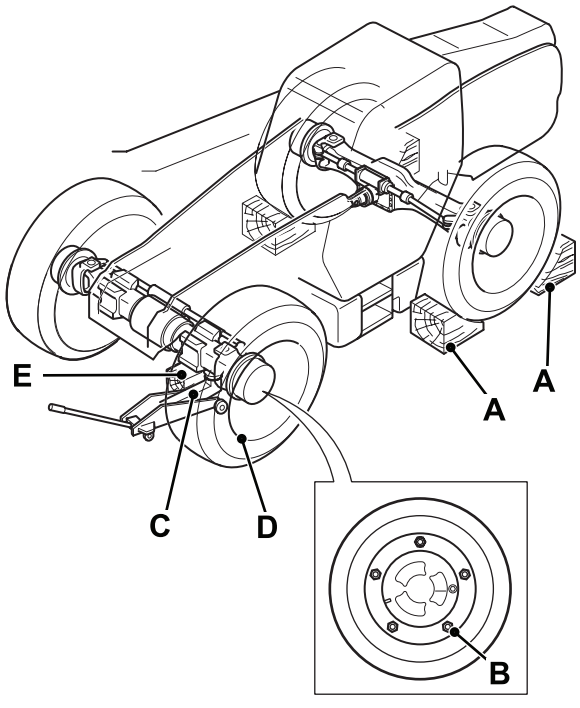
– Torque tighten the nuts **B**.

When the replacement procedure is complete:

– Check the wheel nut torques are correct after every two hours of machine operation until they stay correct.

Table 3. Torque Settings

Item	Nm	kgf m	lbf ft
B	680	69.3	500



C045590

Fig 1.

Rear Wheels

Important: *The wheel and tyre assembly is heavy. Get the aid of one more person to remove and replace a wheel.*

⚠ WARNING

A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-1-1

Removal (one wheel)

1 Park the machine and make it safe. Fit the boom safety strut. Obey the care and safety procedures. ⇨ *Related Topics (F1-2)*

2 Make sure that the engine cannot be started.

3 Put chocks **A** under the front wheels.

4 Loosen the five wheel nuts **B** by half of one turn.

5 Put a jack **C** under the centre of the rear axle. Use the correct jack.

6 Use the jack to lift the machine until both rear wheels are off the ground.

7 Put chocks **E** under each end of the rear axle.

8 Hold the wheel **D** and remove the wheel nuts.

9 Remove the wheel.

Replacement

Note: *Make sure that the mating surfaces of the wheel and axle hub are clean.*

⚠ WARNING

If, for whatever reason, a wheel stud is renewed, all the studs for that wheel must be changed as a set, since the remaining studs may have been damaged.

2-3-2-8

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

– Torque tighten the nuts **B**.

When the replacement procedure is complete:

– Check the wheel nut torques are correct after every two hours of machine operation until they stay correct.

Table 4. Torque Settings

Item	Nm	kgf m	lbf ft
B	680	69.3	500

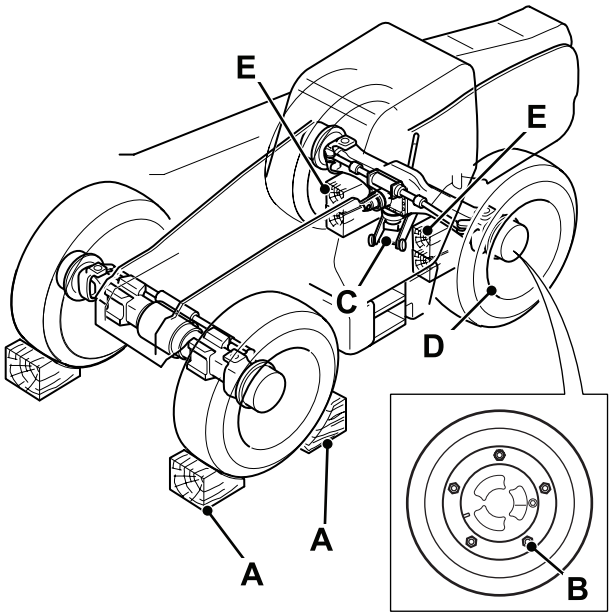


Fig 2.

Wheel Studs

Removal and Replacement

The procedures that follow are for one wheel stud. The procedures are the same for all the wheel studs.

⚠ WARNING

If, for whatever reason, a wheel stud is renewed, all the studs for that wheel must be changed as a set, since the remaining studs may have been damaged.

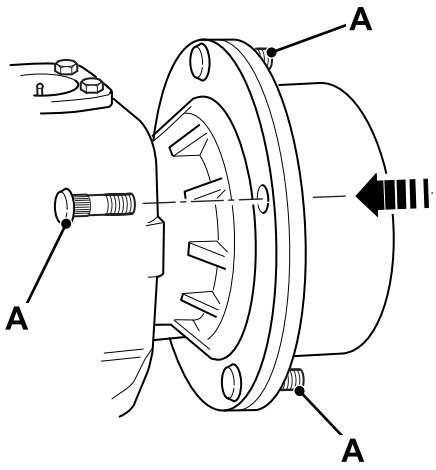
2-3-2-8

Removal

1 Remove the wheel from the hub. ⇨ *Front Wheels (F1-4)* ⇨ *Rear Wheels (F1-5)*

2 Push out the wheel stud **A**.

Important: *Remove all the wheel studs **A** and discard them.*



C045650

Fig 3.

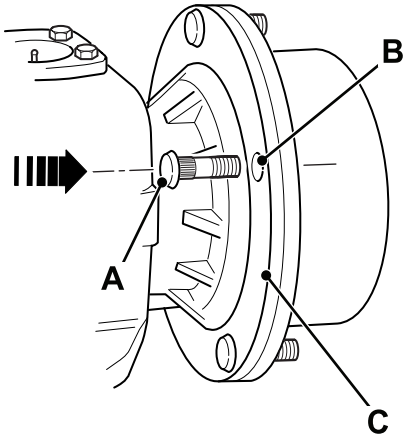
Replacement

Important: *Examine the wheel stud holes **B** in the hub carrier **C**. If the holes are defective do not use the hub carrier. Replace the hub carrier with a new one. Refer to **Applications** for related axle topics.* ⇨ *Related Topics (F1-2)*

1 Put the stud **A** into the hub carrier hole.

2 Use a nut and washer to pull in the stud **A** into the hub carrier **C**.

3 Examine the stud and make sure it is correctly installed. If the stud is loose replace the hub carrier **C**. Refer to ***Applications*** for related axle topics. ⇨ *Related Topics (F1-2)*



C045650-C1

Fig 4.

Front Axles

Introduction

This topic contains information about a machine DEVICE. Make sure you are referring to the correct device. Refer to the applications table.

Descriptions and procedures relate to the device and not related systems. For information about the systems refer to the relevant topics.

This topic is intended to help you understand what the device does and how it works. Where applicable it also includes procedures such as removal and replacement and dismantle and assemble.

⇨ *Related Topics (F2-2)*
⇨ *Specifications (F2-3)*
⇨ *SD55 3 Piece Steer Drive Axle (F2-3)*
⇨ *Component Identification (F2-4)*
⇨ *Removal and Replacement (F2-5)*
⇨ *Dismantle, Inspection and Assembly (F2-7)*

Related Topics

Table 1. Related Topics in This Publication

The table lists other topics in the manual that contain information related to this topic. Refer to the applicable topics to complete your procedures. Where applicable the text in this section contains cross references to this page to help you find the correct information. Some machines have different systems and devices. Make sure you refer to the correct topic, refer to *Section 1 - Applications*.		
Sections	**Topic Titles**	**Sub Titles**
1	***Applications***	ALL
2	ALL (Care and Safety)(1)	ALL
G	***Service Brakes SYSTEM***	***Bleeding***
H	***Steering SYSTEM***	***Bleeding***
H	***Steering SYSTEM***	***Re-Phasing***

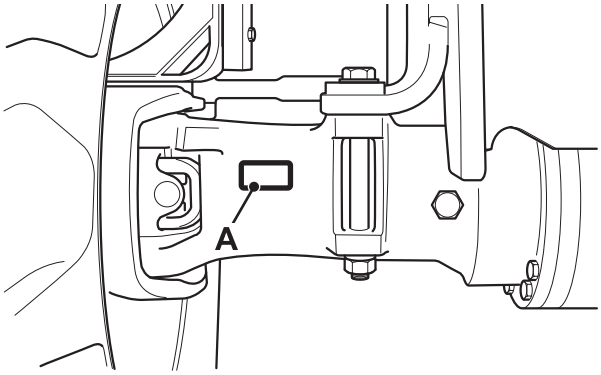
(1) You must obey all of the relevant care and safety procedures.

Table 2. Related Topics in Publication 9803/8610, Transmissions

The table lists topics in another manual that contain information related to this topic. Refer to the applicable topics to complete your procedures. Where applicable the text in this section contains cross references to this page to help you find the correct information. Some machines have different systems and devices. Make sure you refer to the correct topics, refer to *Designations*. ⇨ ***Specifications*** (F2-3)		
Sections	**Section Titles**	**Topic Titles**
A	Axle Hubs	***55 and 70 Series Hubs***
B	Axle Hub Swivels and Driveshafts	***55 Series Hub Swivel and Driveshaft***
C	Axle Integral Brakes	***70 Series Integral Brakes (3 Piece Axles)***
D	Axle Drive Heads	***55 Series Drive Heads (3 Piece Axles)***

Specifications

The axle serial number is stamped on the unit identification plate **1-A** as shown.



A710840-C2

Fig 1.

Note: *It is essential that the correct ratio axle in relationship to the gearbox ratio is fitted to the machine. Do not fit a new axle with a different ratio to the axle being replaced.*

Table 3. SD55 3 Piece Steer Drive Axle

Designations	
Hubs	**D55**
Hub swivels and drive shafts	**D55**
Drive head	**SD55 3 Piece Axle**
Brakes	**70 Series Integral Brakes (3 Piece Axles)**
Mounting	Pad mount
Type	JCB spiral bevel input with epicyclic hub reduction
Brakes	Oil immersed multi-plate discs, located in centre section
Steering	Power Trackrod

Component Identification

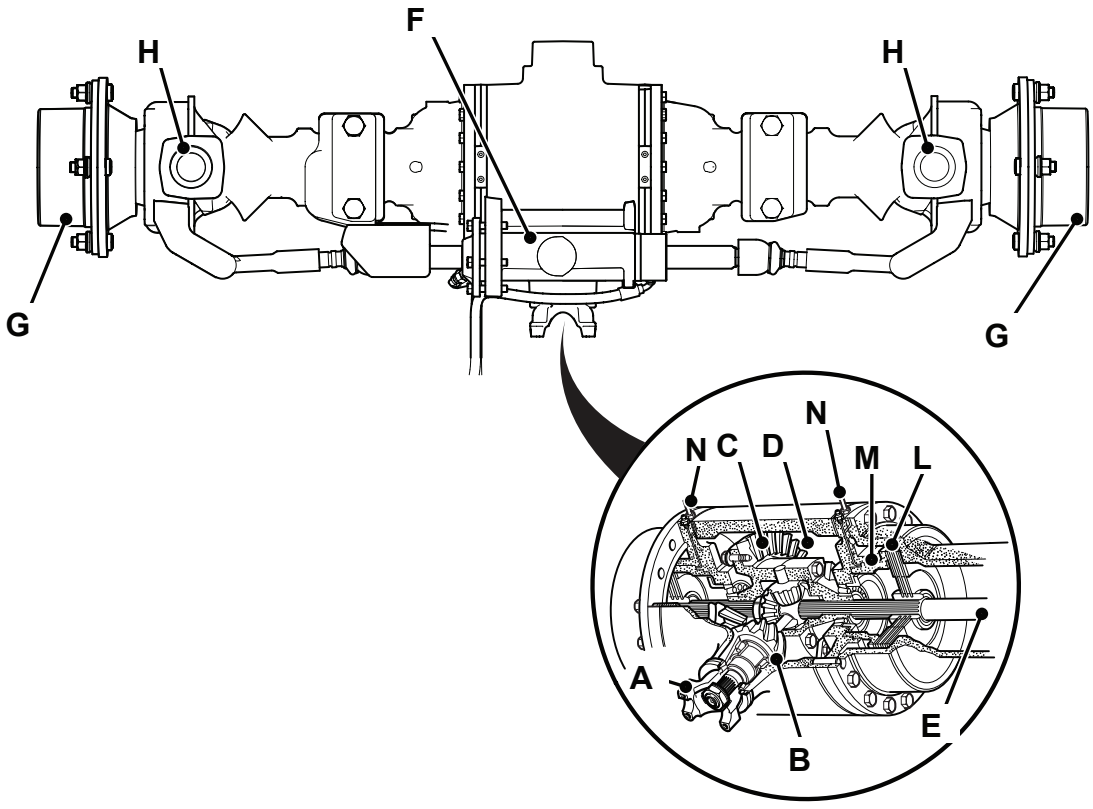
The front axle consists of a centre casing (drivehead) and two axle arms and swivel wheel hubs.

The drivehead houses the differential gearing and two oil-immersed disc brake units.

The axle arms house the driveshafts. Specially shaped spider gears in the differential provide `torque proportioning'. This means that drive power will be kept on one wheel if the other is slipping.

The wheel hubs are connected to the halfshafts through universal joints which drive sun-and-planet gears inside the hubs.

The axle is pad mounted to the chassis.

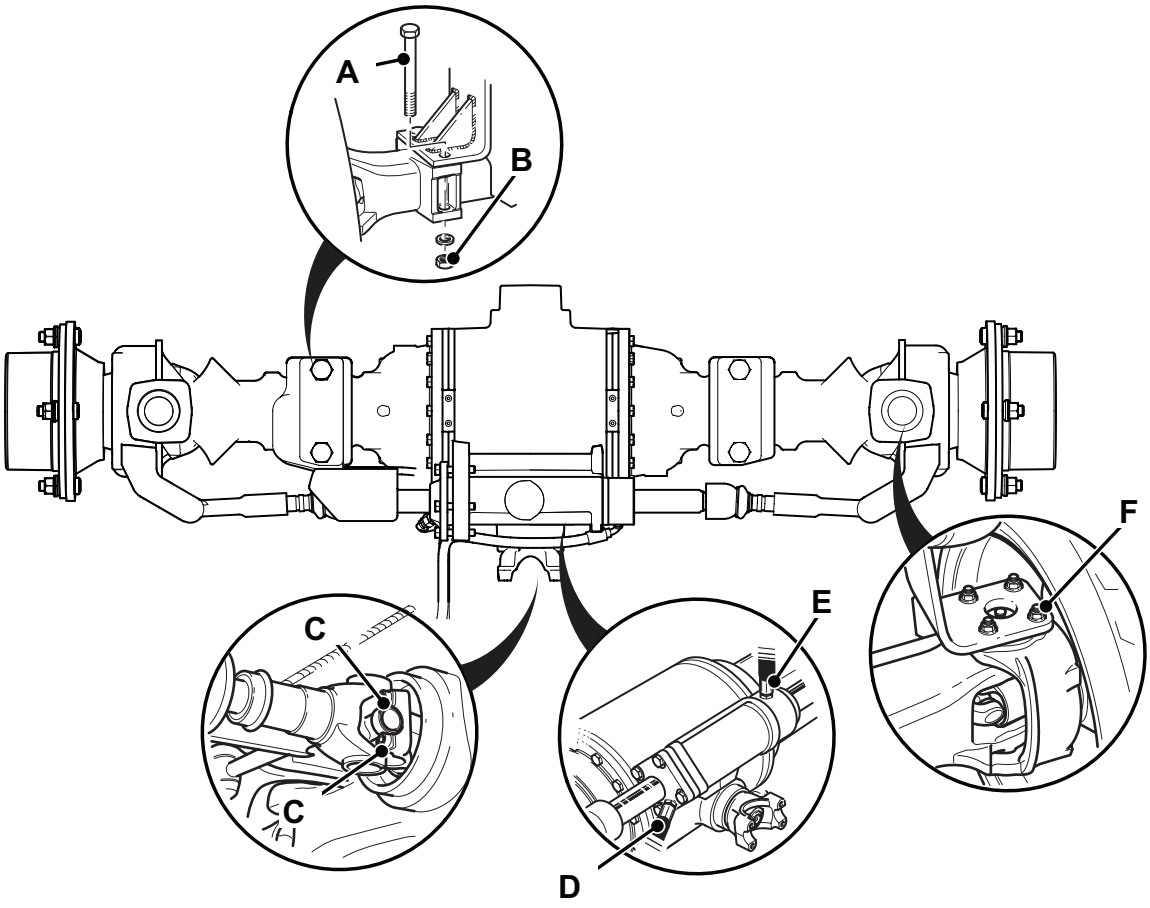


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Fig 2. Front Axle

A	Yoke connection to propshaft
B	Pinion
C	Crownwheel
D	Differential unit
***Note:** Items A, B, C and D form the `drive head' part of the axle.*	
E	Drive shaft
F	Steer track rod
G	Reduction gear hub
H	Steer swivel trunnion bearings
L	Inboard oil-immersed multi-plate disc brakes
M	Brake actuating piston
N	Hydraulic brake lines

Removal and Replacement



C094170-C7

Fig 3.

⚠ WARNING

A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-1-1

If the boom is raised, make sure the maintenance strut is fitted. Obey the care and safety procedures.⇨ *Related Topics (F2-2)*

Removal

1 Disconnect the propshaft coupling from the axle by unscrewing bolts **C**.

2 Disconnect and plug the hydraulic hoses **D** and **E** to the power track rod.

3 Slacken off the roadwheel retaining nuts then raise and support the front end of the machine on axle

stands or blocks positioned under the chassis. Remove the front roadwheels.

4 Remove the front mudguards. Undo the bracket retaining nuts **F** at the steering trunnions.

5 Disconnect the brake hose at the axle. Blank off the exposed connections.

6 Uncouple the steer proximity switch electrical connector (if fitted).

7 Support the axle on a trolley jack.

8 Unscrew axle mounting nuts **B** and remove the bolts **A** and washers.

Note: *Make sure to retain any spacer plates (if fitted).*

9 Lower the axle down from the machine.

10 Remove the axle from the machine.

Replacement

Replacing is the opposite of the removal procedure.

During the replacement procedure do this work also:

– Refit the road wheels and carry out the tightness checks as detailed in ***Section 3 - Routine Maintenance***. ⇨ *Related Topics (F2-2)*

Before driving the machine:

– Bleed the brake system, see ***Section G - Brakes***. ⇨ *Related Topics (F2-2)*
– Bleed the steering system, see ***Section H - Steering***. ⇨ *Related Topics (F2-2)*
– Re-phase the steering system, see ***Section H - Steering***. ⇨ *Related Topics (F2-2)*

Table 4. Torque Settings

Item	Nm	kgf m	lbf ft
A	621	63.3	458
C	70	7.1	51
F	83	8.5	61

Dismantle, Inspection and Assembly

Make sure that you identify the axle sub-assemblies designations correctly. ⇨ *Specifications (F2-3)*

The procedures for dismantling, inspection and assembly are described in the Transmissions Service Manual. ⇨ *Related Topics (F2-2)*

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Rear Axles

Introduction

This topic contains information about a machine DEVICE. Make sure you are referring to the correct device. Refer to the applications table.

Descriptions and procedures relate to the device and not related systems. For information about the systems refer to the relevant topics.

This topic is intended to help you understand what the device does and how it works. Where applicable it also includes procedures such as removal and replacement and dismantle and assemble.

⇨ *Related Topics (F3-2)*

⇨ *Specifications (F3-3)*

⇨ *SD55 1 Piece Steer Drive Axle (F3-3)*

⇨ *Component Identification (F3-4)*

⇨ *Removal and Replacement (F3-6)*

⇨ *Dismantle, Inspection and Assembly (F3-8)*

Related Topics

Table 1. Related Topics in This Publication

The table lists other topics in the manual that contain information related to this topic. Refer to the applicable topics to complete your procedures. Where applicable the text in this section contains cross references to this page to help you find the correct information. Some machines have different systems and devices. Make sure you refer to the correct topic, refer to *Section 1 - Applications*.		
Sections	**Topic Titles**	**Sub Titles**
1	***Applications***	ALL
2	ALL (Care and Safety)(1)	ALL
B	***Load Moment Indicator (LMI) SYSTEM***	***Calibration***
F	***⇒ Propshafts (F8-1)***	***⇒ Removal and Replacement (F8-3)***
G	***Park Brake Disc***	***Removal and Replacement***
G	***Park Brake Calliper***	***Removal and Replacement***
G	***Service Brakes SYSTEM***	***Bleeding***
H	***Steering SYSTEM***	***Bleeding***
H	***Steering SYSTEM***	***Re-Phasing***

(1) You must obey all of the relevant care and safety procedures.

Table 2. Related Topics in Publication 9803/8610, Transmissions

The table lists topics in another manual that contain information related to this topic. Refer to the applicable topics to complete your procedures. Where applicable the text in this section contains cross references to this page to help you find the correct information. Some machines have different systems and devices. Make sure you refer to the correct topics, refer to *Designations*. ⇒ *Specifications (F3-3)*		
Sections	**Section Titles**	**Topic Titles**
A	Axle Hubs	***55 and 70 Series Hubs***
B	Axle Hub Swivels and Driveshafts	***55 Series Hub Swivel and Driveshaft***
D	Axle Drive Heads	***55 and 80 Series Drive Heads (1 Piece Axles)***

Specifications

The axle serial number is stamped on the unit identification plate **1- A** as shown.

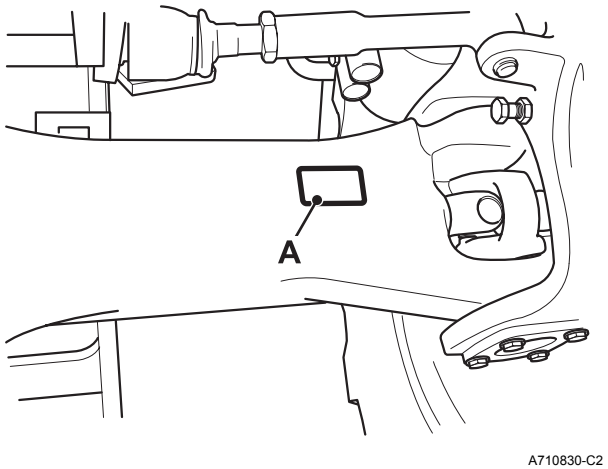


Fig 1.

Note: *It is essential that the correct ratio axle in relationship to the gearbox ratio is fitted to the machine. Do not fit a new axle with a different ratio to the axle being replaced.*

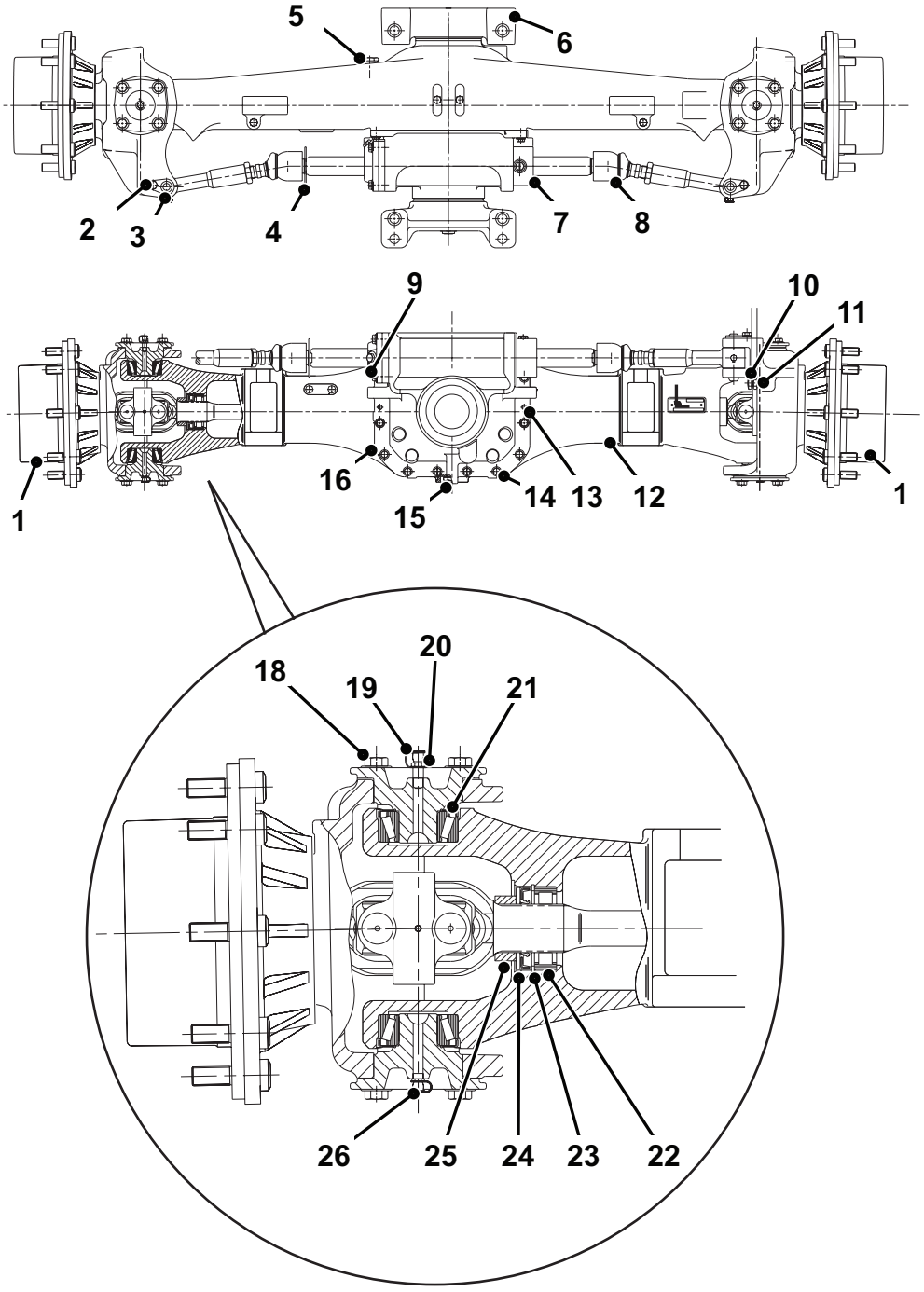
Table 3. SD55 1 Piece Steer Drive Axle

Designations	
Hubs	**D55**
Hub swivels and drive shafts	**D55**
Drive head	**SD55 1 Piece Axle**
Mounting	Trunnion Mount
Type	JCB spiral bevel input with epicyclic hub reduction
Steering	Power Trackrod

Component Identification

⇨ *Fig 2. (F3-5)*.

1 Hub assembly
2 Pivot pin bolt
3 Pivot pin
4 Sensor disc
5 Filler plug and bonded washer
6 Trunnion mount
7 Power track rod
8 Steer link
9 Verbus Ripp bolts M12 x 55
10 Lockstop
11 Lockstop nut M16
12 Centre case
13 Dowel
14 Bolt M10 x 35
15 Drain plug
16 Drivehead
17 Taper roller bearing
18 Setscrew M12 x 35
19 Grease nipple
20 Trunnion
21 Trunnion seal
22 Cylindrical roller bearing
23 Internal circlip
24 Driveshaft seal
25 Masking ring
26 Grease nipple



712840-C3

Fig 2.

Removal and Replacement

⚠ WARNING

A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-1-1

Fully retract the boom. Raise the boom and fit the maintenance strut. Obey the care and safety procedures. ⇨ *Related Topics (F3-2)*

Removal

1 Remove the rear propshaft. ⇨ *Related Topics (F3-2)*

2 Remove the brake disc and calliper. Refer to ***Section G - Parkbrake Disc and Calliper***. ⇨ *Related Topics (F3-2)*

3 Disconnect and plug the hydraulic hoses **E** to the power track rod.

4 Uncouple the steer proximity switch electrical connector.

5 Uncouple the Load Moment Indicator (L.M.I.) transducer **F** electrical connector.

6 Slacken off the roadwheel retaining nuts then raise and support the rear end of the machine on axle stands or blocks positioned under the chassis. Remove the rear roadwheels.

7 Remove the rear mudguards. Undo the bracket retaining nuts **D** at the steering trunnions.

8 Support the axle on a trolley jack.

9 Undo the trunnion nuts and bolts **B** and **C**.

10 Lower the axle down from the machine. Be sure to retrieve dowels **A**. If shims are fitted record their positions. Use some wire to tie the trunnions to the axle.

Replacement

Replacing is the opposite of the removal procedure.

During the replacement procedure do this work also:

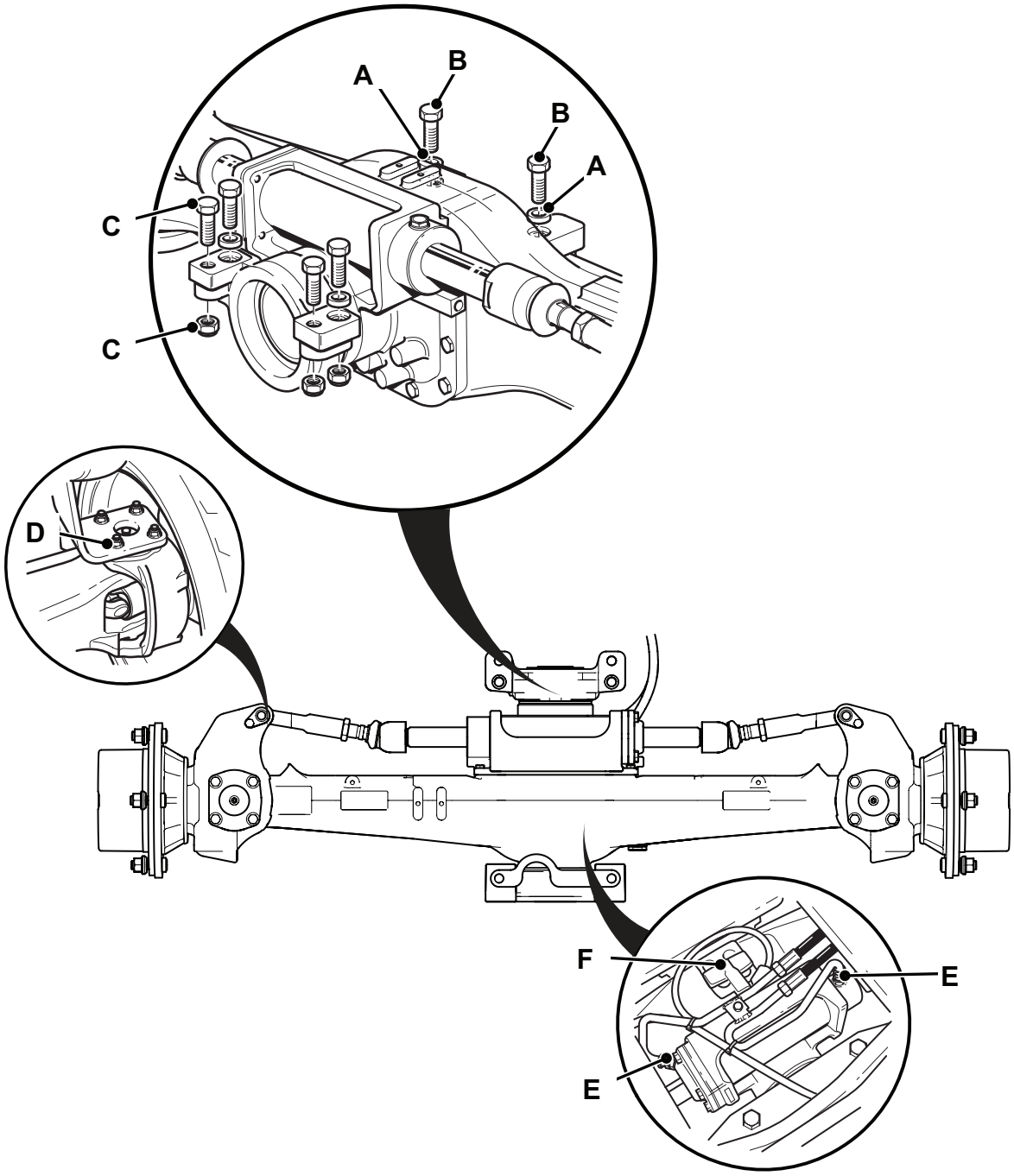
- Make sure you re-fit dowels **A** together with any shims in their original positions.
- Apply JCB Threadlocker to the nuts and bolts **B** and **C**. Torque tighten to the correct torque figure. ⇨ *Table 4. Torque Settings (F3-6)*
- Make sure that the axle oscillates freely before final tightening of the fixing bolts.
- Refit the road wheels and carry out the tightness checks as detailed in ***Section 3 - Routine Maintenance***. ⇨ *Related Topics (F3-2)*

Before driving the machine:

- Bleed the brake system, see ***Section G - Brakes***. ⇨ *Related Topics (F3-2)*
- Bleed the steering system, see ***Section H - Steering***. ⇨ *Related Topics (F3-2)*
- Re-phase the steering system, see ***Section H - Steering***. ⇨ *Related Topics (F3-2)*
- Grease the axle pivot trunnions.
- Carry out L.M.I. calibration, see ***Section B - Body and Framework***. ⇨ *Related Topics (F3-2)*

Table 4. Torque Settings

Item	Nm	kgf m	lbf ft
B and C	360	36.7	265.5



C094170-C6

Fig 3.

Dismantle, Inspection and Assembly

Make sure that you identify the axle sub-assemblies designations correctly. ⇨ *Specifications (F3-3)*

The procedures for dismantling, inspection and assembly are described in the Transmissions Service Manual. ⇨ *Related Topics (F3-2)*

Hydrostatic Transmission SYSTEM

Introduction

This topic contains information about a machine SYSTEM. The system has some devices that connect either mechanically, hydraulically or electrically. Make sure you are referring to the correct system. Refer to the applications table.

Descriptions and procedures relate to the system and not the individual devices. For information about the devices refer to the relevant topics.

This topic is intended to help you understand what the system does and how it works. Where applicable it also includes fault finding, test and service procedures.

⇨ *Specifications (F4-3)*
⇨ *Component Identification (F4-6)*
⇨ *Operation Overview (F4-7)*
⇨ *Hydraulic Operation and Schematics (F4-8)*
⇨ *Electrical Operation and Schematics (F4-28)*
⇨ *Fault Finding (F4-50)*
⇨ *Test Procedures (F4-56)*
⇨ *Priming Procedure (F4-68)*
⇨ *Moving A Disabled Machine (F4-69)*

Related Topics

Table 1. Related Topics in This Publication

The table lists other topics in the manual that contain information related to this topic. Refer to the applicable topics to complete your procedures. Where applicable the text in this section contains cross references to this page to help you find the correct information. Some machines have different systems and devices. Make sure you refer to the correct topic, refer to *Section 1 - Applications*.		
Sections	**Topic Titles**	**Sub Titles**
1	***Applications***	ALL
1	***Machine Hydraulic Schematic Circuits***	ALL
1	***Service Tools***	ALL
1	***Stall Speed Combinations***	ALL
2	ALL (Care and Safety)(1)	ALL
3	***Fluids Lubricants and Capacities***	ALL
3	***Access Panels***	ALL
3	***Electrics***	ALL
C	***Fuses and Relays***	ALL
C	***Electrical Harness SYSTEM***	ALL
M	***Electronic Control Unit Theory***	ALL
M	***Pulse Width Modulation Theory***	ALL
M	***Fault Code SYSTEM***	ALL
M	***Servicemaster SYSTEM***	ALL
M	***Servicemaster Tools***	ALL

(1) You must obey all of the relevant care and safety procedures.

Table 2. Service Tools

The table lists the service tools you will need to do some of the procedures in this topic. Make sure you have the correct service tools BEFORE you start the procedures	
Tool Part Number	**Description**
460/15708(1)	Flow test adaptor
892/00229(1)	Flow meter
892/00253(1)	Hydraulic pressure test kit and relevant adaptors
892/00270(1)	Load valve
998/10650	Pressure gauge kit

(1) Tool available from JCB Service, refer to Section 1 - Service Tools

Specifications

Transmission Pump

20 kph Machines

Model Reference:	AA 4 VG 56
Type:	Axial piston pump - variable displacement (EP- Electronic proportional control)
Mounting:	Engine
Direction of Rotation:	Clockwise
Maximum Displacement:	56 cc/rev (3.41 in^3/rev)
Charge Pump Displacement:	11.6 cc/rev (0.7 in^3/rev)
Relief Valve Settings:	
Charge Pressure - Max	30 bar (30.5 kgf/cm^2, 435.1 lbf/in^2)
Maximum System Pressure	480 bar (489 kgf/cm^2, 6961 lbf/in^2)
Weight:	39 kg (83 lbs)
Corresponding Motor Colour:	Green(1)

(1) The motor is colour coded to aid pump identification

25 kph Machines

Model Reference:	AA 10 VG 63
Type:	Axial piston pump - variable displacement (DA - Speed related control)
Mounting:	Engine
Direction of Rotation:	Clockwise
Maximum Displacement:	63 cc/rev (3.84 in^3/rev)
Charge Pump Displacement:	14.9 cc/rev (0.9 in^3/rev)
Relief Valve Settings:	
Charge Pressure - Max	30 bar (30.5 kgf/cm^2, 435.1 lbf/in^2)
Maximum System Pressure	350 bar (356 kgf/cm^2, 5076 lbf/in^2)
Weight:	39 kg (86 lbs)
Corresponding Motor Colour:	Grey(1)

(1) The motor is colour coded to aid pump identitifcation

34 kph Machines

Model Reference:	AA 4 VG 56
Type:	Axial piston pump - variable displacement (EP- Electronic proportional control)
Mounting:	Engine
Direction of Rotation:	Clockwise
Maximum Displacement:	56 cc/rev (3.41 in^3/rev)
Charge Pump Displacement:	11.6 cc/rev (0.7 in^3/rev)
Relief Valve Settings:	
Charge Pressure - Max	30 bar (30.5 kgf/cm^2, 435.1 lbf/in^2)
Maximum System Pressure	480 bar (489 kgf/cm^2, 6961 lbf/in^2)
Weight:	38 kg (84 lbs)
Corresponding Motor Colour:	Blue(1)

(1) The motor is colour coded to aid pump identitifcation

40 kph Machines

Model Reference:	AA 4 VG 71
Type:	Axial piston pump - variable displacement (EP- Electronic proportional control)
Mounting:	Engine
Direction of Rotation:	Clockwise
Maximum Displacement:	71 cc/rev (4.33 in^3/rev)
Charge Pump Displacement:	19.6 cc/rev (1.2 in^3/rev)
Relief Valve Settings:	
Charge Pressure - Max	30 bar (30.5 kgf/cm^2, 435.1 lbf/in^2)
Maximum System Pressure	480 bar (489 kgf/cm^2, 6961 lbf/in^2)
Weight:	50 kg (110 lbs)
Corresponding Motor Colour:	Black(1)

(1) The motor is colour coded to aid pump identitifcation

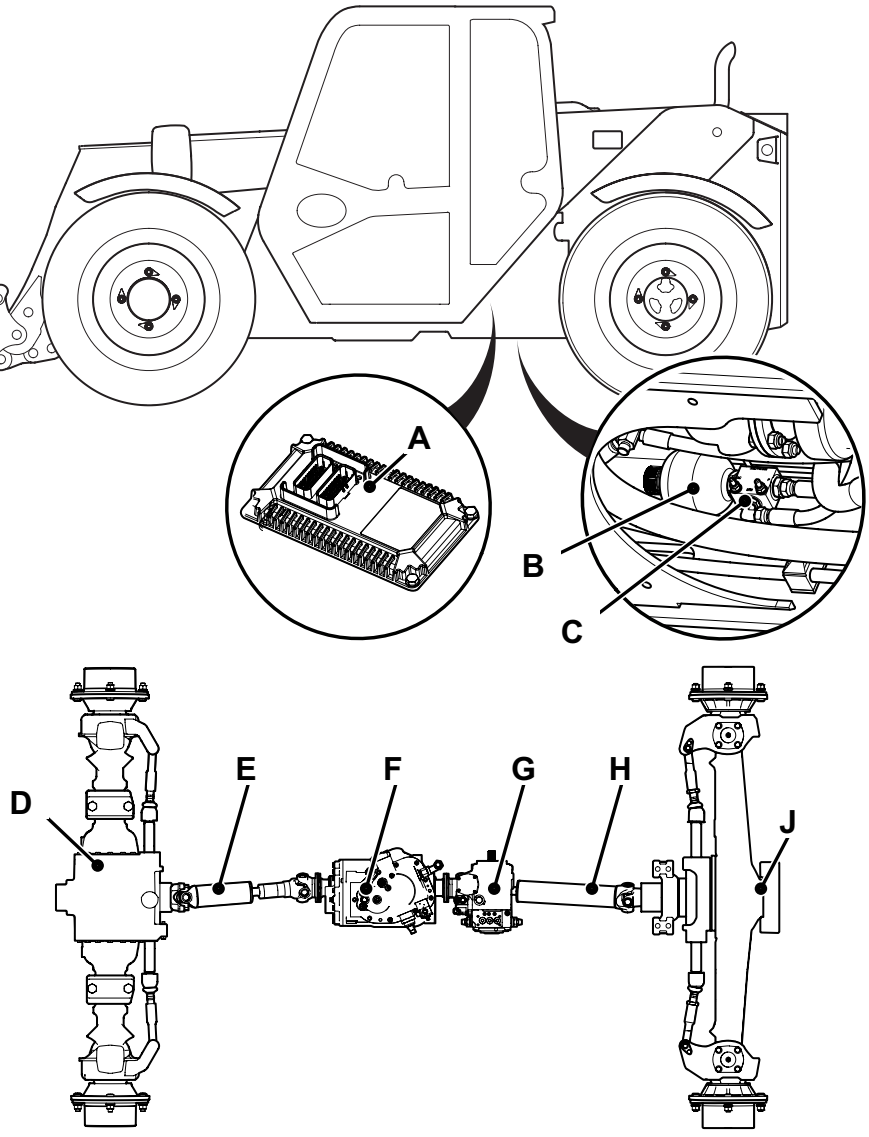
Transmission Motor

Model Reference:	ICVD GT SIN 233V 164
Type:	Variable displacement bent axis piston motor
Mounting:	Chassis
Maximum Displacement:	233 cc/rev (14.2 in^3/rev)
Minimum Displacement:	36 cc/rev (2.2 in^3/rev)
Maximum Flow Rate A-B	400 litres/min (88 UK gal/min, 105 US gal/min)
Maximum Loop Pressure	480 bar (489 kgf/cm^2, 6961 lbf/in^2)
Maximum Case Pressure	5 bar (5.1 kgf/cm^2, 72 lbf/in^2)
Maximum Torque	2560 Nm
Maximum Continuous Speed:	
– At maximum pivot angle	1,800 rpm
– At minimum pivot angle	4,200 rpm
Gear Ratio:	1 : 1.64
Charge pump pressure (approx):	
– min	2.5 bar (2.5 kgf/cm^2, 36.2 lbf/in^2)
– max	30 bar (30.5 kgf/cm^2, 435.1 lbf/in^2)
Weight (Empty) Approx:	140 kg (310 lbs)

Component Identification

Item	Description
A	Transmission ECU
B	Accumulator
C	Manifold
D	Front Axle
E	Propshaft

Item	Description
F	Transmission Motor
G	Transmission Pump
H	Propshaft
J	Rear Axle



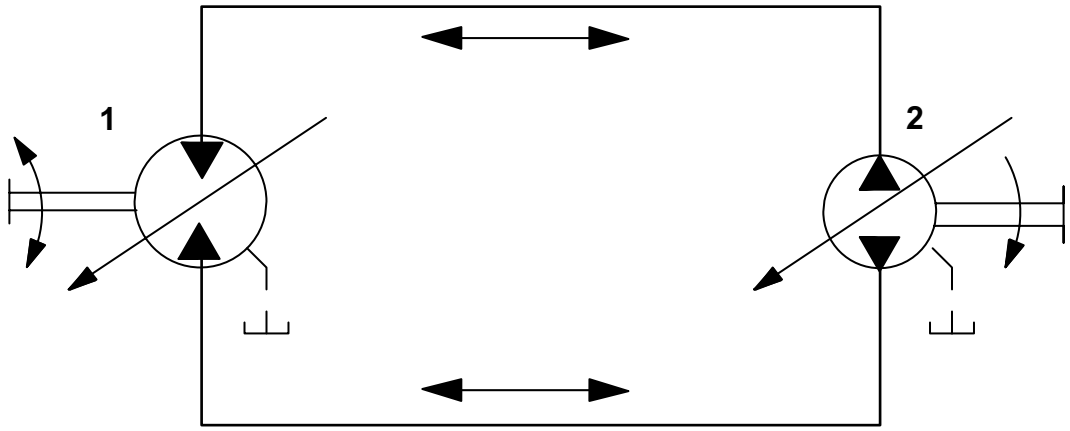
C095250-C2

Fig 1.

Operation Overview

General Description

Hydrostatic Transmission



C094410-C3

Fig 2.

The hydrostatic transmission is an infinitely variable-speed hydraulic drive system which eliminates the need for a conventional gearbox. The system comprises of an engine-driven transmission hydraulic pump **2** which is connected by hoses to a transmission hydraulic motor **1** to drive the wheels. The transmission pump and motor are of a variable displacement axial piston design, and incorporate all the necessary control valves.

The transmission hydraulic circuit is a bi-directional closed loop, which enables the transmission motor to be driven at various speeds in either direction. The motor speed and direction of rotation being determined by the transmission pump output, and the direction of flow around the circuit (loop).

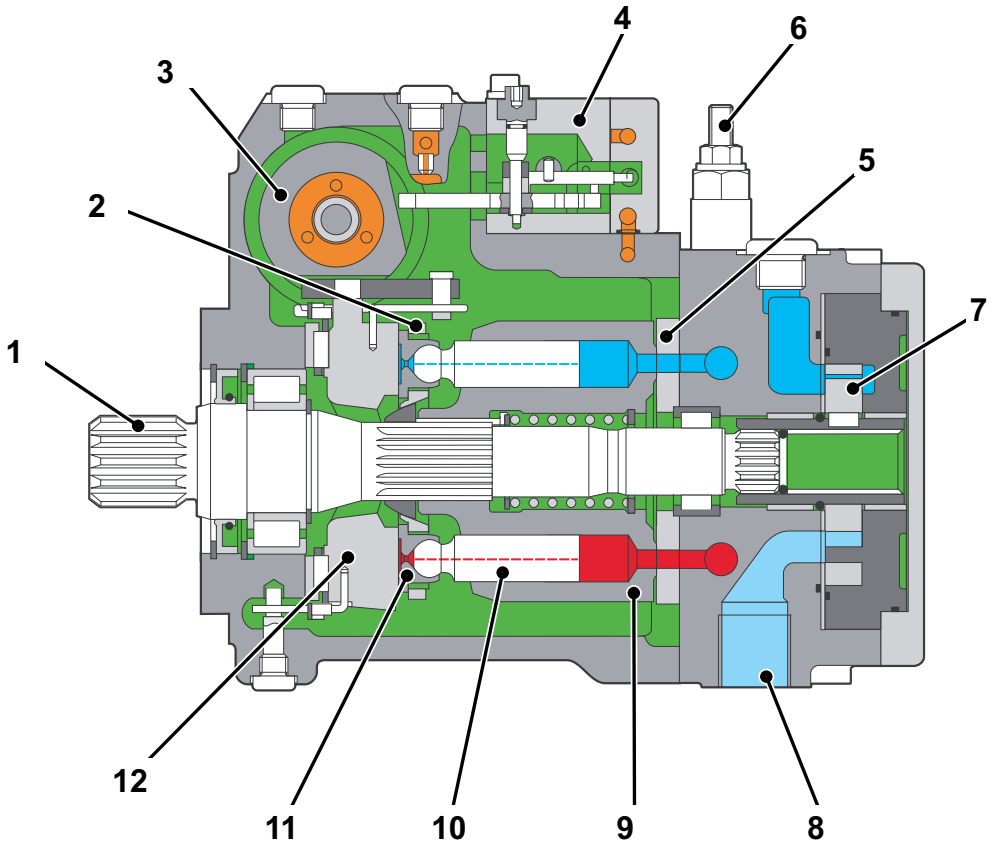
Thus, to drive the machine forwards, one side of the loop feeds the oil to the transmission motor, and this side of the circuit becomes the high pressure side. The other side of the loop returns the oil from the motor, and this becomes the low pressure side. To drive the machine in the opposite direction (i.e. backwards), the direction of flow around the transmission circuit is reversed.

When the machine is stationary, there is no flow around the transmission circuit. The oil pressure on each side of the circuit is equal, therefore the transmission motor is prevented from turning by the effect of a hydraulic lock in the system.

A detailed description of the transmission pump and motor operation is given in the following pages:

Hydraulic Operation and Schematics

Transmission Pump



C095280

Fig 3. Sectioned View - typical pump

Item	Description
1	Drive Shaft
2	Retaining Plate
3	Swash Control Piston
4	Controller
5	Control Plate
6	Pressure Cut Off Valve
7	Charge Pump
8	Suction Port
9	Cylinder
10	Piston

Item	Description
11	Slipper Pad
12	Swashplate

The transmission hydraulic pump is a variable displacement axial piston pump, which uses the swashplate design principle.

Rotation of the input drive shaft **1** produces linear movement of the axial pistons **10**. The pump output is controlled via the swash control piston **3**. The piston varies the angle of the tilting swashplate **12**, which alters the displacement (stroke) of the pistons.

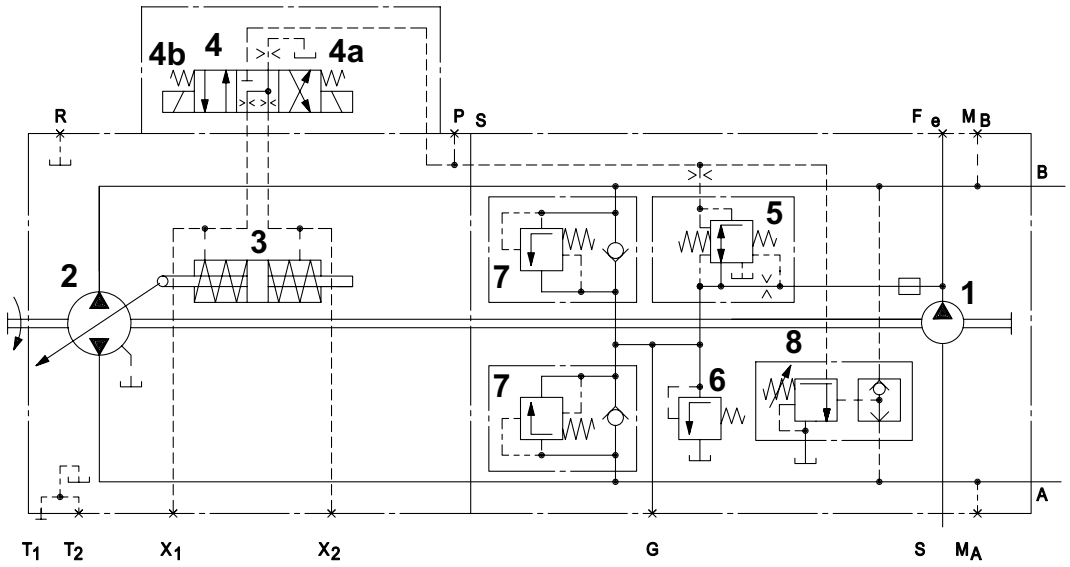
Integral with the transmission pump is the charge pump **7**, which generates the control pressure for the pump control circuits.

An accumulator is incorporated into the transmission circuit to prevent any sharp pressure increases or decreases which would cause uncomfortable operation.

There are two types of pump control make sure to refer to the correct control unit for the machine.

- ***⇨ Speed Related (DA) Control Unit - 25 kph Machines (F4-10)***
- ***⇨ Proportional (EP) Control Unit - 20, 34 and 40 kph Machines (F4-12)***

Speed Related (DA) Control Unit - 25 kph Machines



C094410

Fig 4. Schematic Diagram

Item	Description
1	Charge Pump
2	Main Pump
3	Swash Control Piston
4	Direction Control Valve
5	Displacement Angle Control Valve
6	Charge Pressure Relief Valve
7	High Pressure Relief and Make-up Valves
8	Pressure Cut Off Valve

This system uses an internal hydraulic circuit to control the pump output.

The pump is part of a closed loop which supplies high pressure to the motor. The pump ports **A** and **B** are the pressure supply and return lines to the motor. The direction of drive required by the operator dictates which port supplies high pressure and which is the return.

Charge Pump and Pilot Operation

The charge pump **1** provides charge pressure and flow to the main pump **2** and motor. Oil from the tank is drawn through the suction filter and enters the charge pump at port **S**. Some of the oil is pushed into the low pressure side of the high pressure loop to make up for leakage losses, some is used to provide a flow for pump control and the remainder is dumped across the charge pressure relief valve into the pump case for cooling and lubrication purposes.

The pressure from the charge pump **1** varies with engine speed giving the control system an indication of engine RPM. As the engine RPM increases the charge pump output increases.

The charge pressure is directed through internal drillings to the swash control piston **3** via the solenoid operated direction control valve **4**. Selection of `Forward' or `Reverse' on the forward/neutral/reverse lever (column switch), energises the relevant solenoid **4a** or **4b**. The valve spool moves across to direct the charge pressure to the corresponding end of the swash control piston. The charge pressure moves the swash control piston **3** proportionally against the force of the centring springs, and in turn moves the pump swashplate. Thus changes in the charge pressure will therefore cause corresponding changes to the pump swashplate angle.

Increasing the pump drive speed (i.e. increasing engine rpm) generates a higher charge pressure at the swash control piston, which in turn increases the pump swashplate angle and therefore the output flow.

High pressures in the transmission circuit, and/or simultaneous operation of the machine hydraulic services will load the engine, causing the engine rpm to decrease slightly (i.e. decreasing the pump drive speed). Decreasing the pump drive speed generates a lower charge pressure at the swash control piston, which in turn decreases the pump swashplate angle and output flow. In this way, there is full utilisation of the engine power available, and automatic power division between the transmission and hydraulic services.

The maximum charge pressure that can be achieved is set by the charge pressure relief valve **6**.

Two high pressure relief and make-up valves **7** set the maximum pressure in the transmission circuit, and protect the transmission pump and transmission motor from over pressurisation. The valves also function as make-up valves, allowing some of the flow from the charge pump **1** to enter the low pressure side of the transmission circuit to make-up for oil losses due to normal internal leakage.

Note: *The high pressure relief valves **7** also provide a bypass facility to enable towing of a disabled machine, see **Moving a Disabled Machine**.*

When the pressure cut-off valve **8** reaches its pressure setting, it operates and vents some of the charge pressure back to tank via the case drain, thereby decreasing the pump swashplate angle proportionally. The action of the pressure cut-off valve prevents the high pressure relief valves **7** from operating during normal accelerating or decelerating of the transmission, when large pressure peaks may occur in the transmission circuit as the pump swashplate angle changes rapidly.

Proportional (EP) Control Unit - 20, 34 and 40 kph Machines

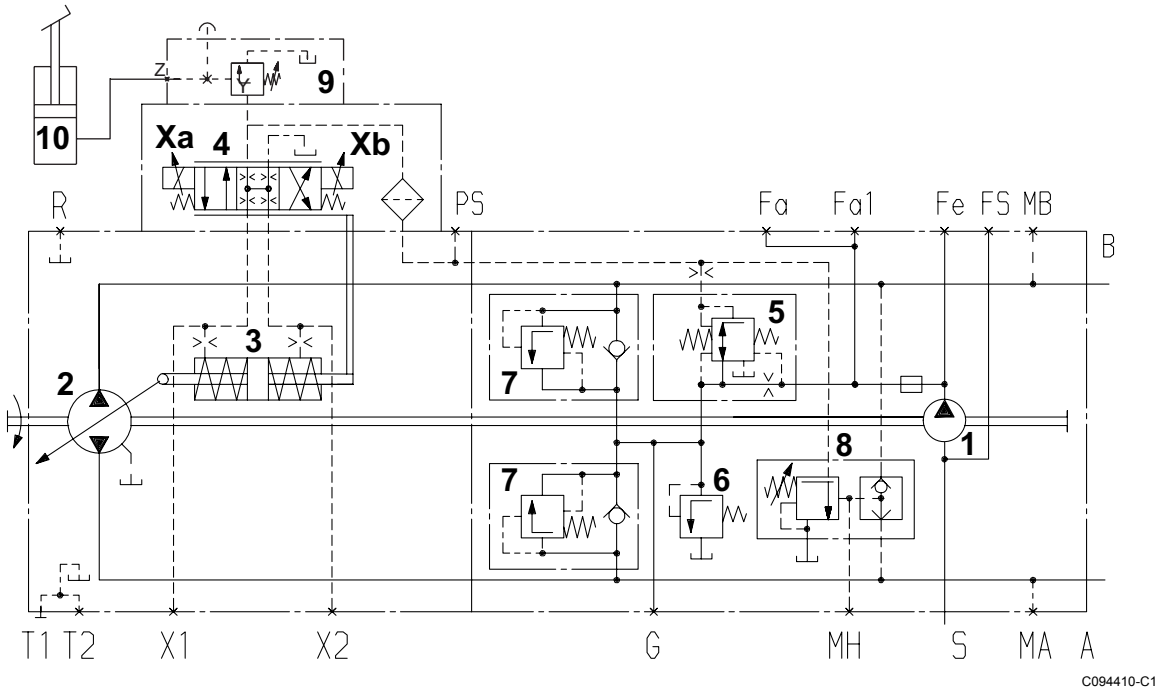


Fig 5. Schematic Diagram

Item	Description
1	Charge Pump
2	Main Pump
3	Swash Control Piston
4	Direction Control Valve
5	Displacement Angle Control Valve
6	Charge Pressure Relief Valve
7	High Pressure Relief and Make-up Valves
8	Pressure Cut Off Valve
9	Hydraulic Inching Valve
10	Brake Master Cylinder
Xa/Xb	Proportional Direction Control Solenoids

This system uses an Electronic Control Unit (ECU) to control the pump output.

The pump is part of a closed loop which supplies high pressure to the motor. The pump ports **A** and **B** are the pressure supply and return lines for the motor. The direction of drive required by the operator dictates which port supplies high pressure and which is the return.

The proportional solenoid valves **Xa/Xb** alter the pump output (power curve characteristic). The solenoid valves are controlled by a current signal from the transmission electronic control unit (ECU). The solenoid valves work as a separate pressure regulating valve and vary the charge pressure acting on the swash control piston **3** by a set amount, according to the valve current signal.

In this way, the hydraulic power curve of the pump can be altered electrically by the current signal from the Transmission ECU. The current signal from the transmission ECU is a PWM signal. Refer to ***Section M - PWM Theory***.

Charge Pump and Pilot Operation

The charge pump **1** provides charge pressure and flow to the main pump **2** and motor. Oil from the tank is drawn through the suction filter and enters the charge pump at port **S**. Some of the oil is pushed into the low pressure side of the high pressure loop to make up for leakage losses, some is used to provide a flow for pump control and the remainder is dumped across the charge pressure relief valve into the pump case for cooling and lubrication purposes.

The charge pressure is directed through internal drillings to the swash control piston **3** via the proportional solenoid operated direction control valve **4**. Selection of `Forward' or `Reverse' on the forward/neutral/reverse lever (column switch), sends a signal to the transmission ECU. The ECU energises the relevant proportional solenoid **Xa** or **Xb**. The proportional solenoid directs charge pressure to the corresponding end of the swash control piston. The charge pressure moves the swash control piston **3** proportionally against the force of the centring springs, and in turn moves the pump swashplate. A feedback lever on the pump control piston keeps the transmission ECU informed of the piston position.

High pressures in the transmission circuit, and/or simultaneous operation of the machine hydraulic services will load the engine, causing the engine rpm to decrease slightly (i.e. decreasing the pump drive speed). Decreasing the pump drive speed generates a lower charge pressure at the swash control piston, which in turn decreases the pump swashplate angle and output flow. In this way, there is full utilisation of the engine power available, and automatic power division between the transmission and hydraulic services.

The maximum charge pressure that can be achieved is set by the charge pressure relief valve **6**.

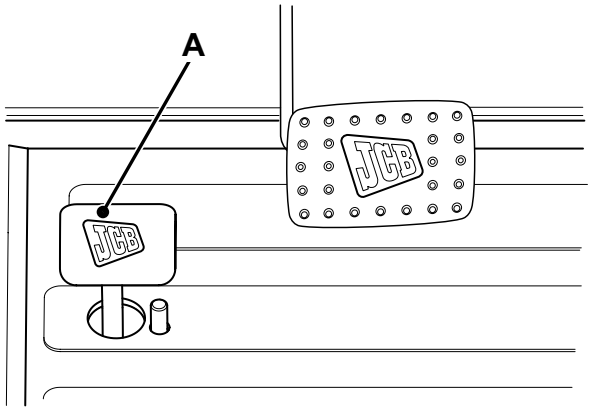
Two high pressure relief and make-up valves **7** set the maximum pressure in the transmission circuit, and protect the transmission pump and transmission motor from over pressurisation. The valves also function as make-up valves, allowing some of the flow from the charge pump **1** to enter the low pressure side of the transmission circuit to make-up for oil losses due to normal internal leakage.

Note: *The high pressure relief valves* ***7*** *also provide a bypass facility to enable towing of a disabled machine, see* ***Moving a Disabled Machine****.*

When the pressure cut-off valve **8** reaches its pressure setting, it operates and vents some of the charge pressure back to tank via the case drain, thereby decreasing the pump swashplate angle proportionally. The action of the pressure cut-off valve prevents the high pressure relief valves **7** from operating during normal accelerating or decelerating of the transmission, when large pressure peaks may occur in the transmission circuit as the pump swashplate angle changes rapidly.

Inching Control

Electronic - Inching Pedal



C095580-C2

Fig 6.

The inching pedal **A** (if fitted) can be used to proportionally control the maximum speed of the machine, whilst maintaining a high engine speed. As the pedal is depressed a braking effect from the transmission will slow the machine.

The inching pedal contains a dual output potentiometer which supplies a signal to the transmission ECU. The transmission ECU reduces the current to the pump displacement proportional solenoids to reduce the machine speed.

Electronic - Varispeed

Refer to the schematic in this section.

⇨ *Speed Limit (F4-38)*

Hydraulic - Brake Pedal

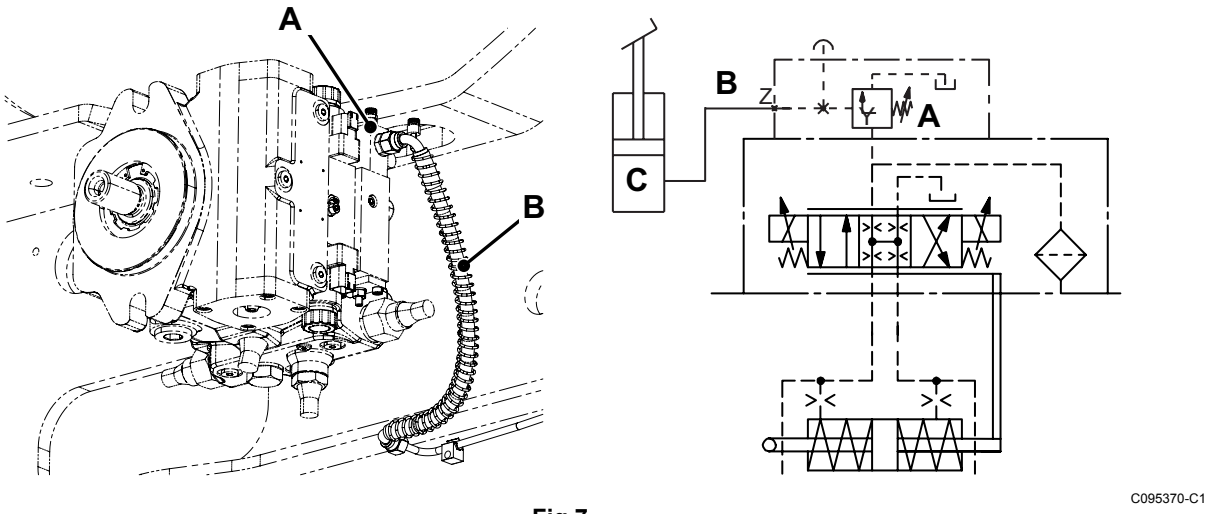


Fig 7.

The inching valve enables the transmission pump control pressure to be reduced independently of the pump drive speed.

The inching valve **A** uses a pressure signal from the master brake cylinder **C** to limit the machine speed by reducing the pump control pressure. As the brake pedal is pushed down the machine speed reduces.

When the brakes are applied, the increased pressure in the brake line **B** pushes the inching valve spool **A**, and creates a connection to case drain.

Transmission Motor

The transmission motor consists of three sections:

- Motor control valves **A**. ⇨ ***Motor Control Valves (F4-17)***
- The hydraulic motor section **B**. ⇨ ***Hydraulic Motor Section (F4-22)***
- The gear train **C**. ⇨ ***Gear Train (F4-23)***

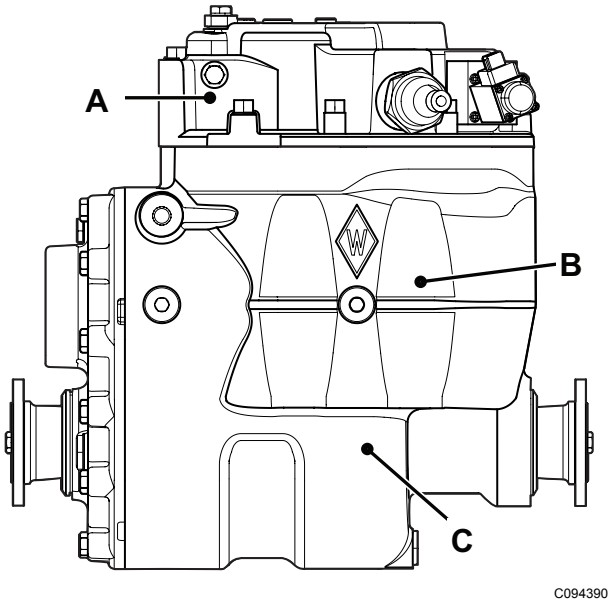


Fig 8.

Motor Control Valves

Component Location

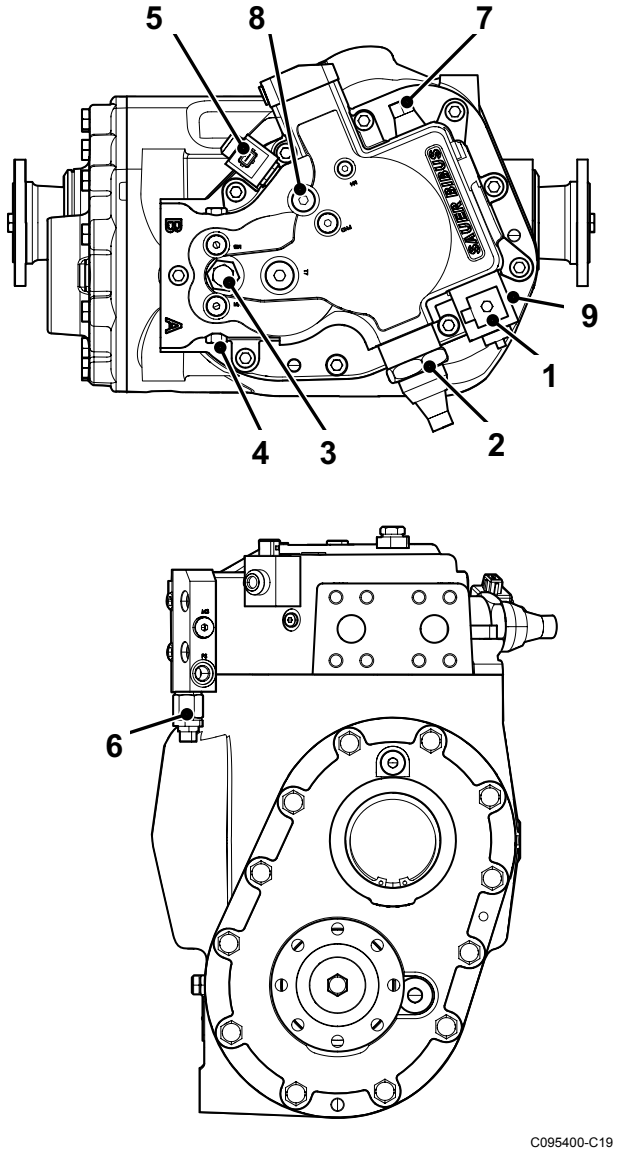
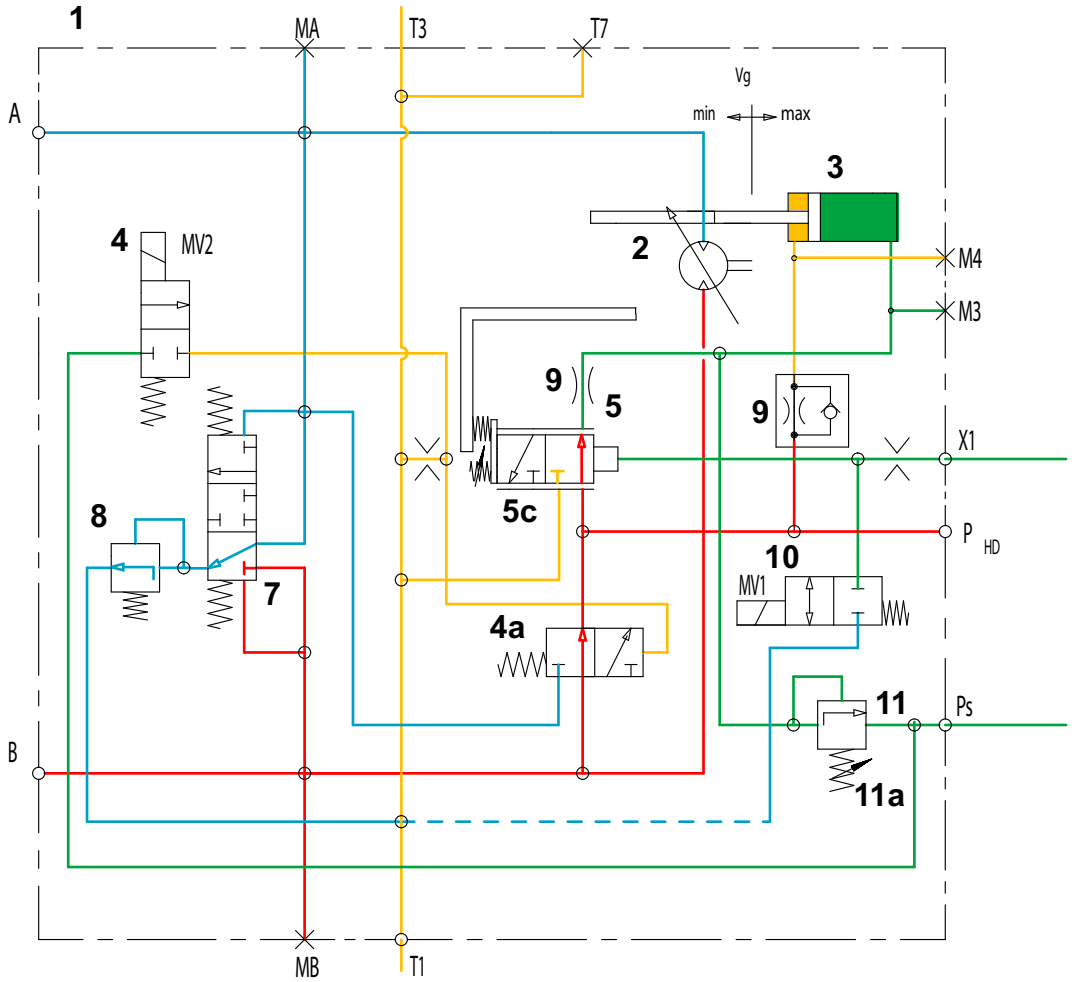


Fig 9.

Item	Description
1	Low Speed Solenoid Valve
2	Minimum Displacement Limiter
3	Flushing Valve
4	Shuttle Valve
5	Reverse Direction Solenoid Valve
6	PCOR (Pressure Limiter Valve)
7	Controller Start Screw
8	Break Pressure Defeat Spool
9	Displacement Valve

Operation



C095410-C1

Fig 10. High speed range motor operation in forward

Item	Description
1	Transmission Motor Assembly
2	Motor Rotating Group
3	Swash Control Piston
4	Reverse Direction Solenoid
4a	Direction Pilot Valve
5	Displacement Valve
7	Shuttle Valve
8	Flushing Pressure Maintaining Valve
9	Restrictor Orifice

Item	Description
10	Low Speed Solenoid Valve
11	PCOR (Pressure Limiter Valve)

Table 3. Colour Codes

	Red	**High Pressure**
	Blue	**Low Pressure**

	Green	**Control Pressure**
	Yellow	**Case Drain/Lubrication Pressure**

⇨ *Fig 10. (F4-18)*

Integral within the transmission motor are the control valves which make up the motor control circuit.

The two main loop connections from the transmission pump to the transmission motor are shown as **A** and **B**. It may be assumed that connection **B** is pressurised when forward drive is selected and **A** is pressurised when reverse drive is selected.

In the unregulated condition, the motor operates at minimum displacement. As the system pressure builds the control unit moves the swash plate to maximum displacement.

The control pressure from the pump is directed through internal drillings to the swash control piston **3**. The control pressure also acts on the spool of the displacement valve **5**. The valve spool moves proportionally against the force of the spring **5c**, directing the control pressure to the other end of the swash control piston via restrictor orifice **9**. The orifice dampens the action of the swivel control to prevent fierce operation.The control pressure moves the swash control piston **3**, and in turn changes the angle of the swashplate. Thus changes in the control pressure acting on the displacement valve spool **5** will cause corresponding changes to the motor swashplate angle.

The control pressure and hence motor swashplate angle is largely determined by the load on the transmission. As the machine is driven, the angle varies constantly with changes in the load. Light loads on the transmission generate lower control pressures, which in turn decreases the angle and therefore increase the output speed. High loads in the transmission generate higher control pressures, which in turn increase the angle and therefore increase the output torque. When the control pressure reaches the maximum setting of the spring **5c** the motor swashplate will be at the maximum angle (low speed and high torque).

The start of regulation is determined by the pressure setting of the starter screw. This adjusts the spool of the displacement valve **5** and this value is the point where the motor begins to swing to maximum displacement.

The shuttle valve **7** senses which side of the transmission circuit is high pressure. The valve spool moves across to connect the low pressure side of the transmission circuit to the flushing pressure maintaining valve **8**.

The flushing pressure maintaining valve **8** is operating constantly, thereby allowing some of the oil in the low pressure side of the transmission circuit to continually vent back to tank via the motor case drain port.

The oil losses from the low pressure side of the transmission circuit are made up by flow from the charge pump via the high pressure relief and make-up valves in the transmission pump. In this way, the hot oil in the transmission circuit is continually being replenished, and prevents the hydrostatic transmission overheating.

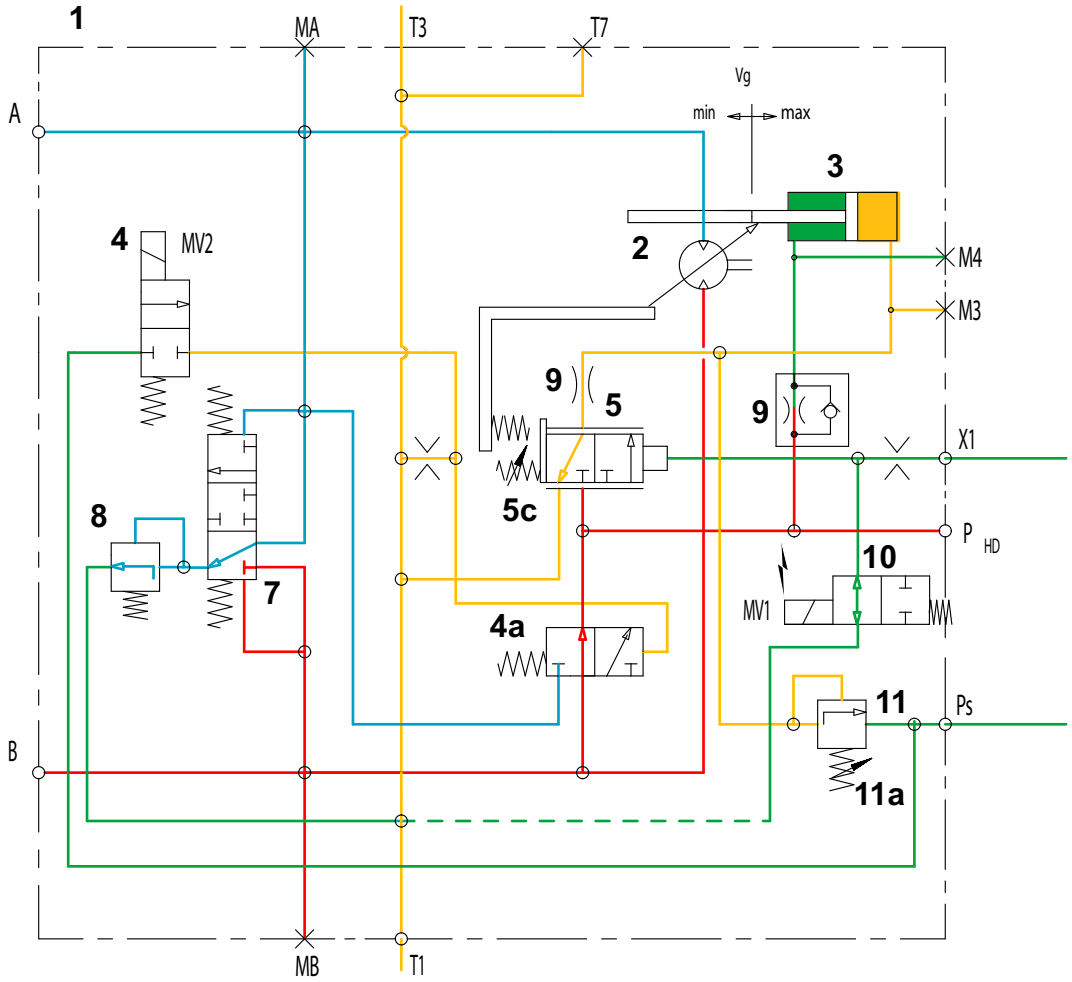
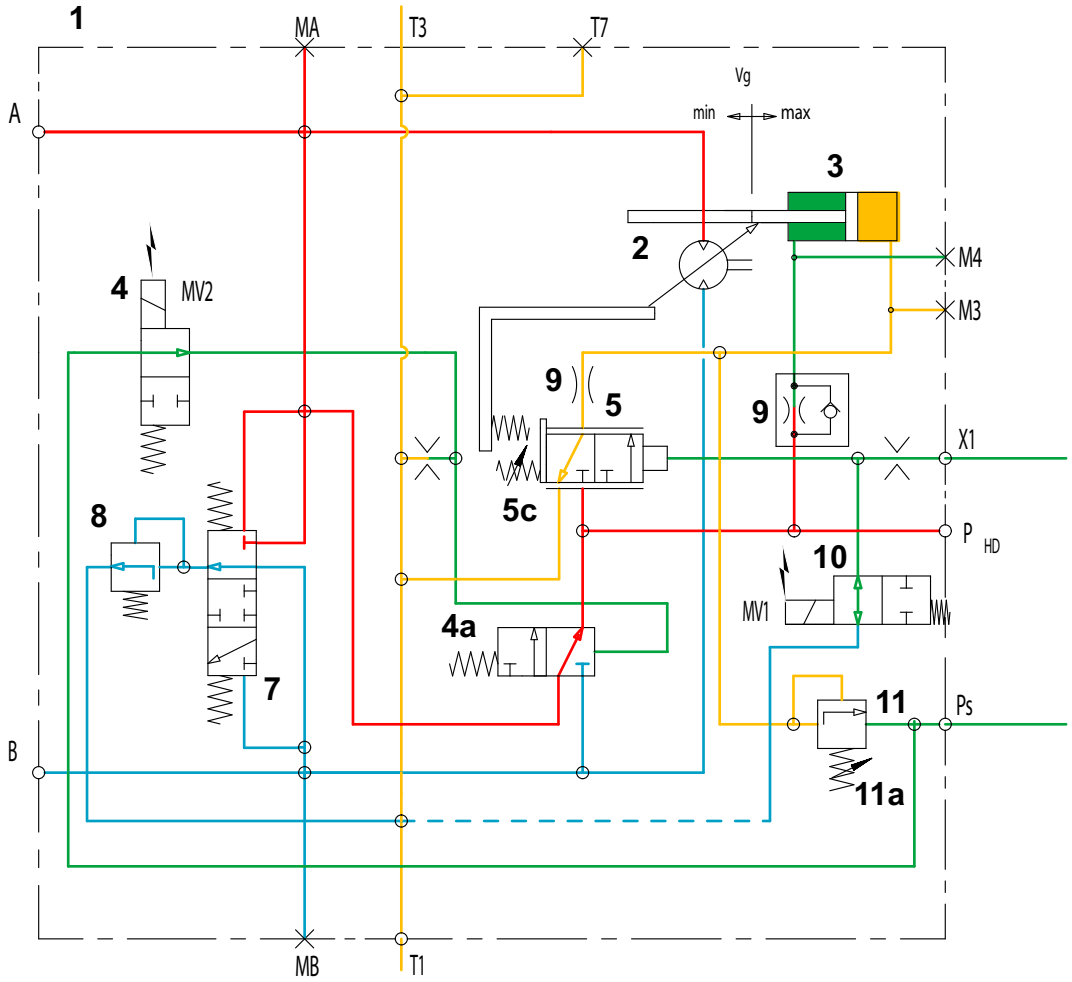


Fig 11. Low speed range motor operation in forward

Low Speed Solenoid: Selection of `Low Speed' from a switch in the cab, sends a signal to the transmission ECU. The ECU energises the Low speed solenoid **10** (as shown).The low speed solenoid allows some of the control pressure to escape into the low pressure line. The reduced control pressure allows the displacement valve spool **5** to stop the supply of pressure to the minimum displacement side of the swash control piston. The control pressure is directed to the large area end of the swash control piston **3**. The force of the control pressure acting on the larger area causes the piston to move the swashplate to the maximum angle (low speed and high torque). While the solenoid remains energised, the swashplate is held at the maximum angle (maximum displacement) for driving the machine at slow speed.



C095410-C2

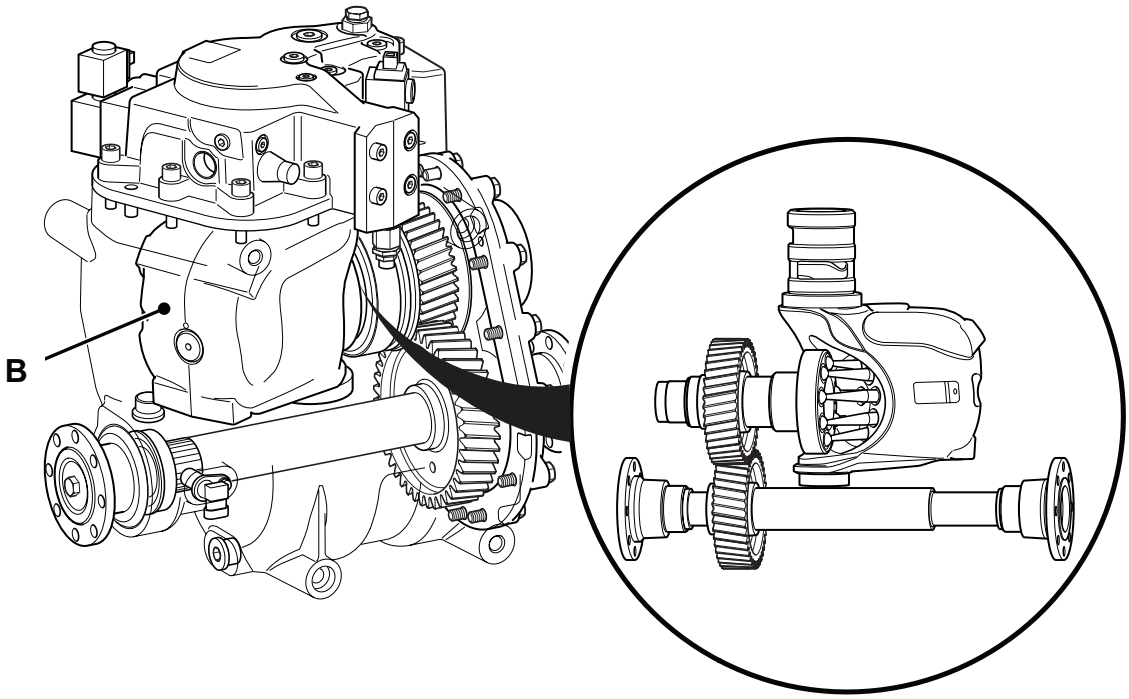
Fig 12. Low speed range motor operation in reverse

Reverse Direction Solenoid: Selection of `Reverse' on the forward/neutral/reverse lever (column switch) in the cab, sends a signal to the transmission ECU. The ECU energises the reverse direction solenoid **4** (as shown). This allows pilot pressure to the valve spool on the direction pilot valve **4a**. The valve spool moves across so that the control pressure is derived from the reverse side of the transmission circuit when reverse direction is selected.

Break Pressure Defeat Circuit

The system incorporates a circuit for preventing the motor displacement increasing when the machine is travelling downhill. This circuit uses pressure signals from the pump control solenoid valves to operate a brake pressure defeat valve in the motor.

Hydraulic Motor Section



C095630

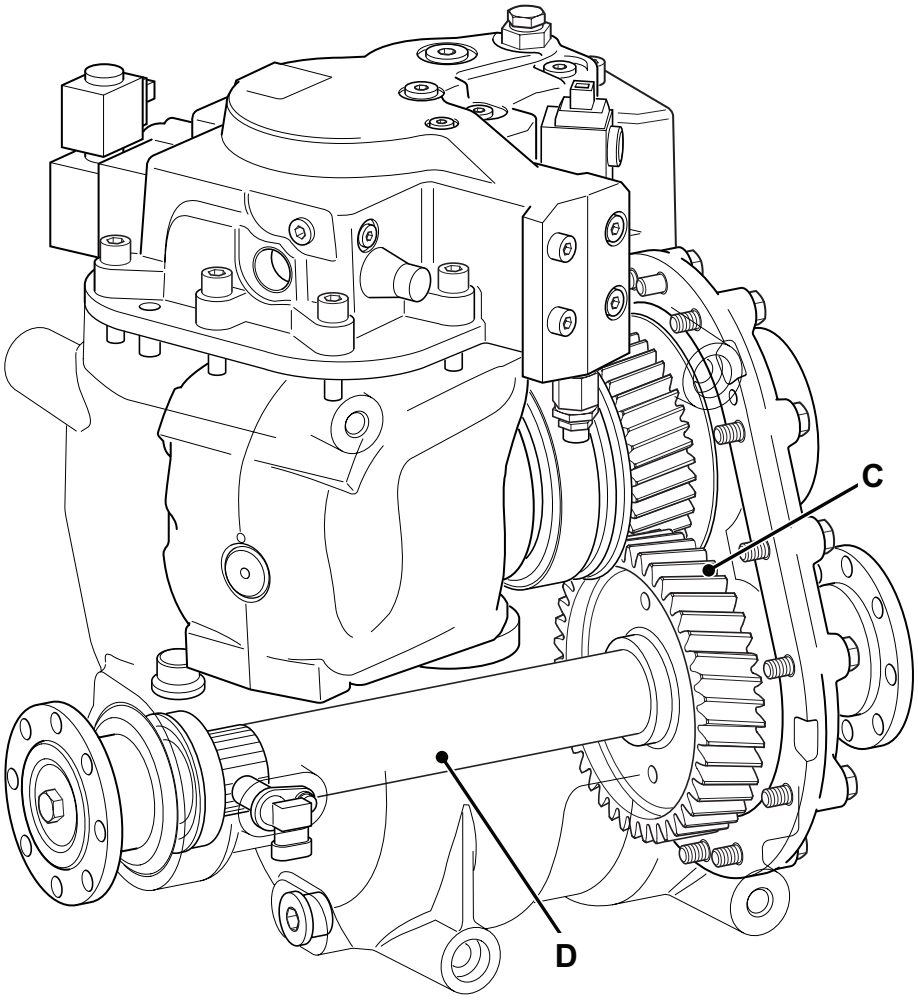
Fig 13.

The transmission hydraulic motor **B** is a bi-directional, variable displacement axial piston motor, which uses the bent axis design principle.

Linear movement of the axial pistons produces rotation of the output drive shaft. The motor output is controlled via the swash control piston. The piston varies the angle of the swashplate, which alters the displacement (stroke) of the pistons.

The angle of the swashplate swivel is regulated automatically by hydraulic pressure in the transmission circuit. During normal operation, the motor displacement varies constantly with changes in transmission load. ⇨ *Motor Control Valves (F4-17)*.

Gear Train



C095630-C1

Fig 14.

The transmission hydraulic motor engages with the gear train **C**, to drive the main output shaft **D**.

The output shaft has a coupling yoke at one end, which drives the rear propshaft. At the other end, another coupling yoke is attached to the brake disc which drives the front propshaft.

Hose and Pipework

Component Key:⇨ *Fig 15. (F4-25)*, ⇨ *Fig 16. (F4-26)* and ⇨ *Fig 17. (F4-27)*	
1	Transmission Pump
2	Transmission Motor
3	Hydraulic Tank Connector Plate
4	Check Valve
5	Hydraulic Filter
6	Cooling Pack
7	Accumulator and Manifold

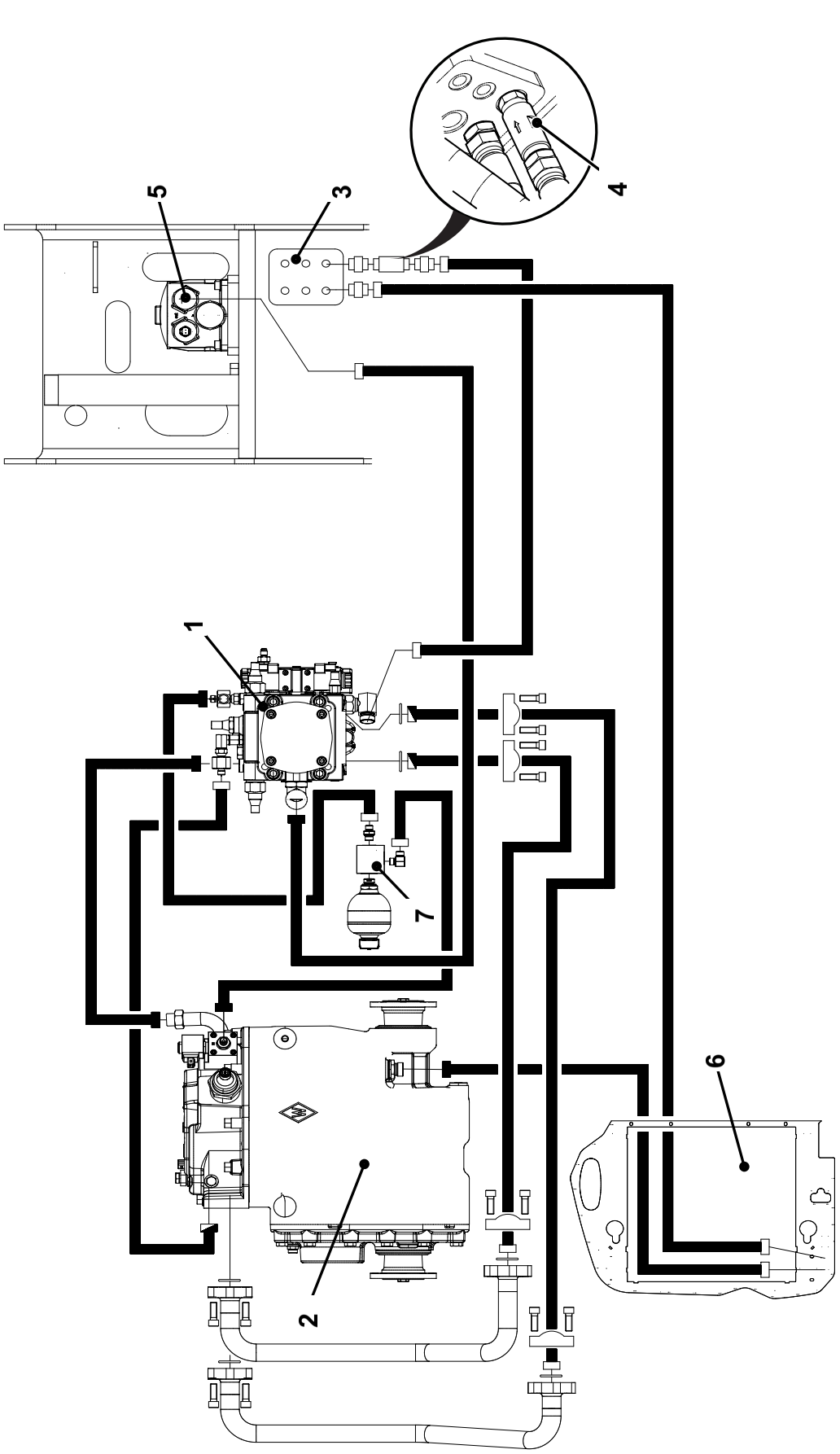


Fig 15. 25 Kph Machines

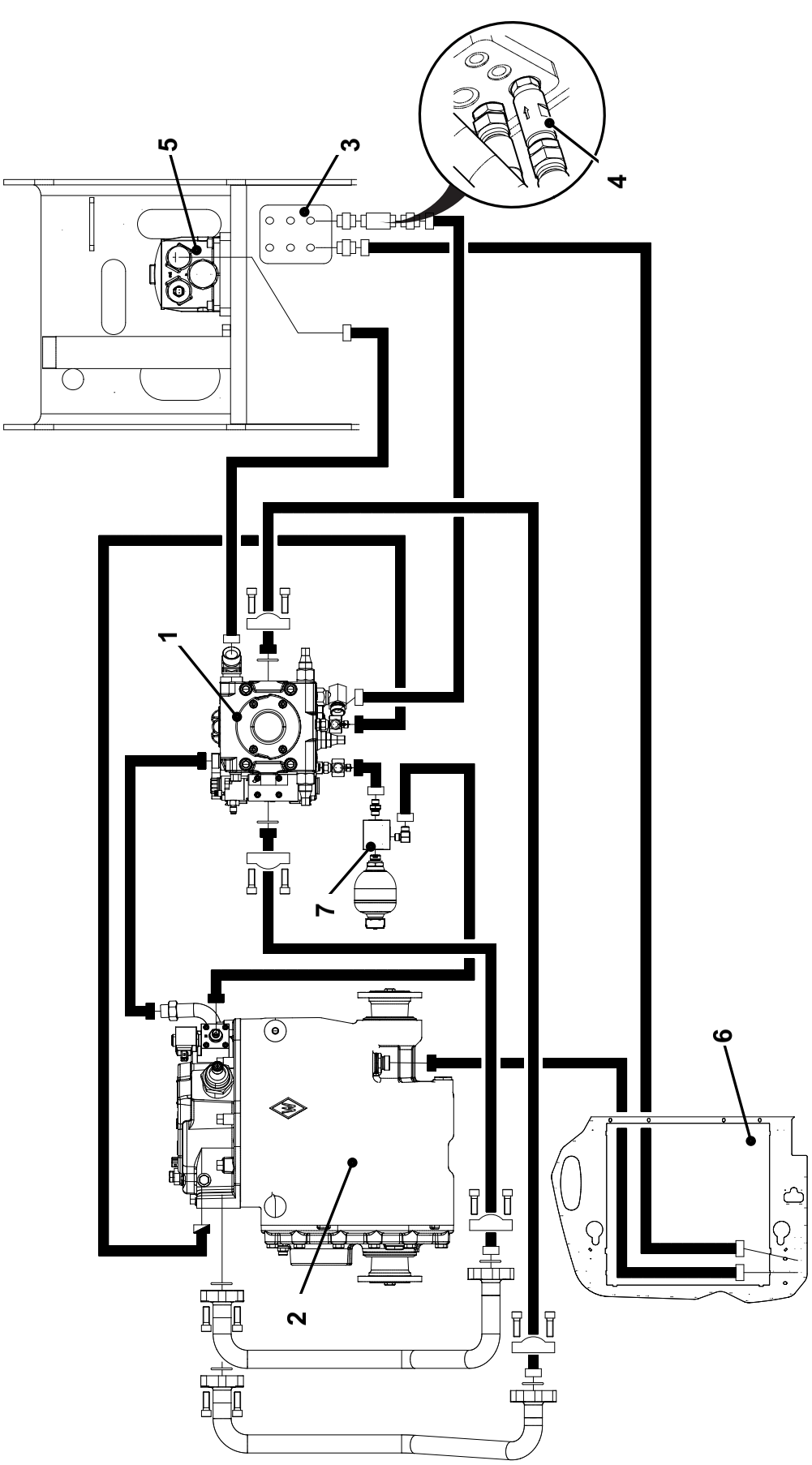


Fig 16. 20/34 Kph Machines

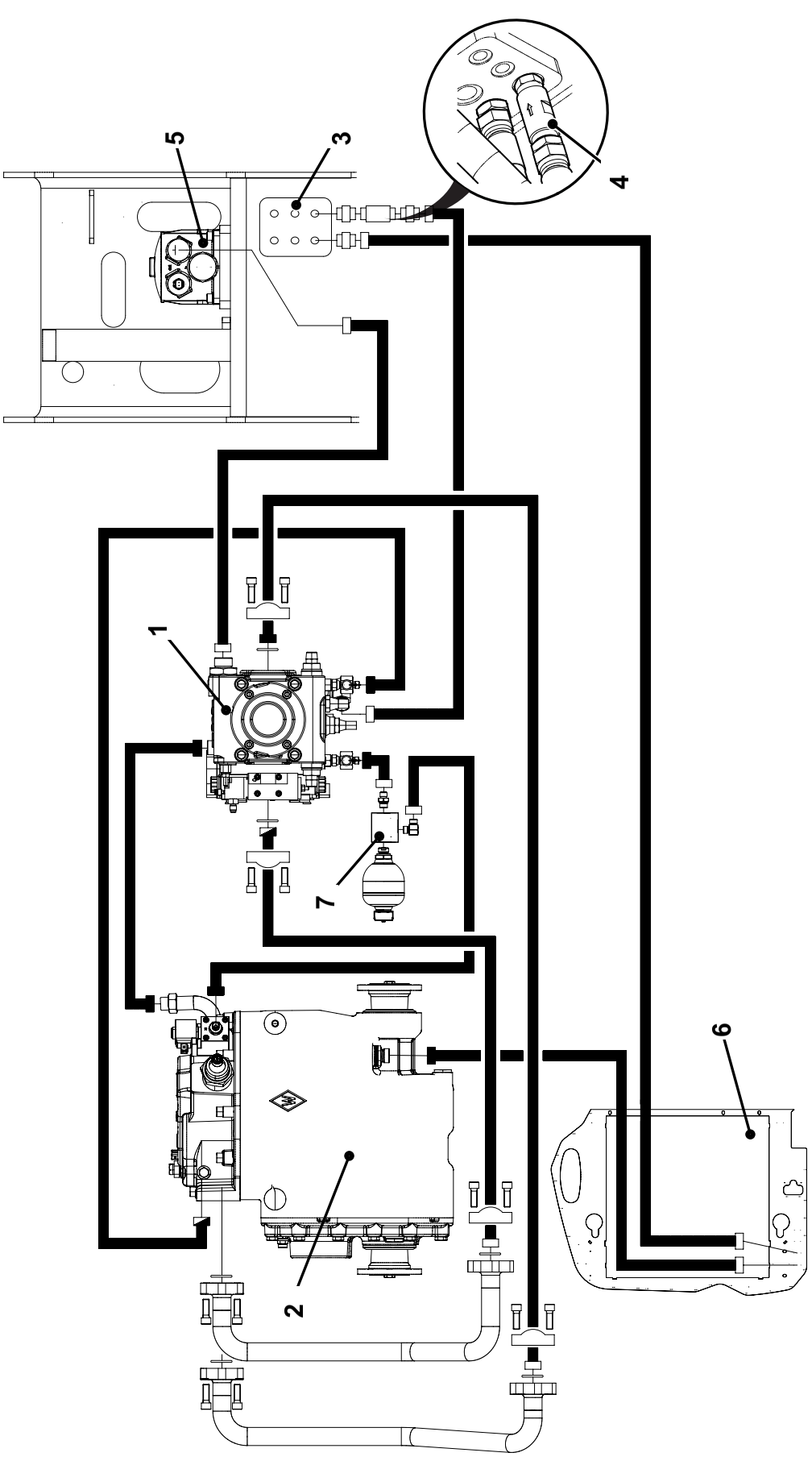


Fig 17. 40 Kph Machine

Electrical Operation and Schematics

Transmission ECU

Power Supply and Earths

Component Key:	
C042	Transmission ECU Supply
C046 - J1	Transmission ECU connector J1
C047 - J2	Transmission ECU connector J2
C050	Earth Point
C056	Auxiliary Fuse Supply
P02	Secondary Fusebox A
P41/C041	Chassis Harness to Panel Harness connector 2

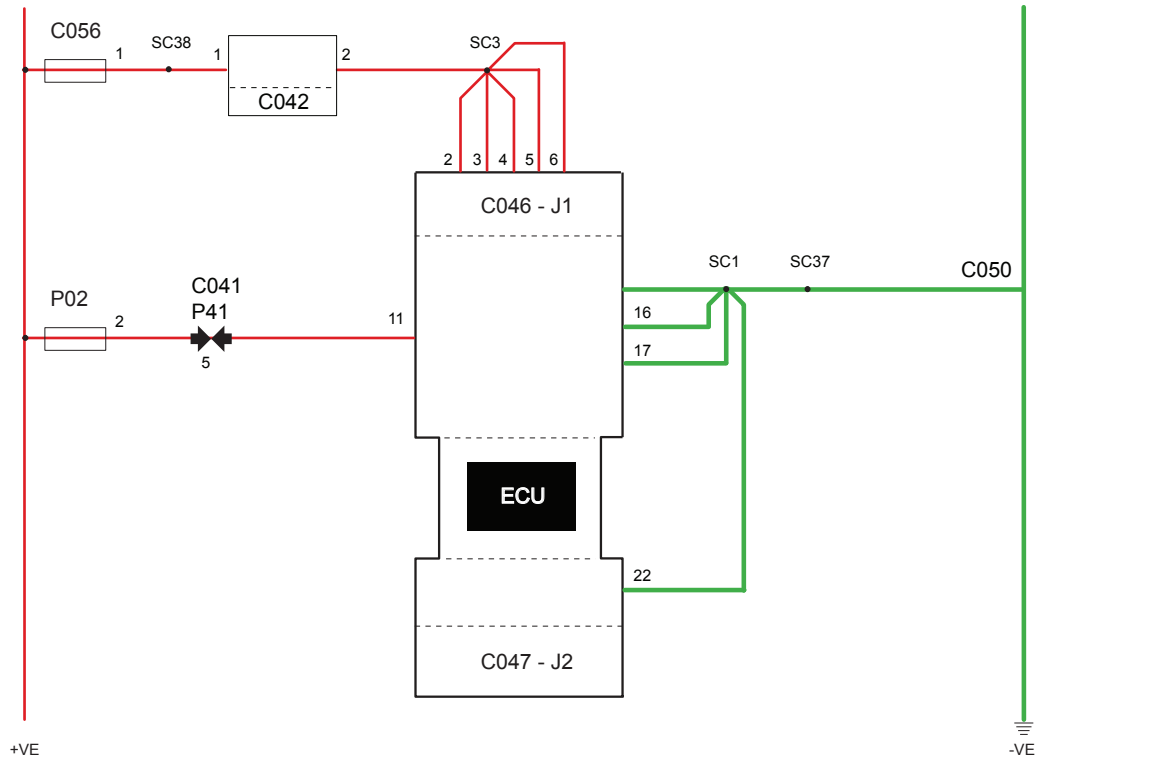


Fig 18.

Forward/Reverse Drive Control

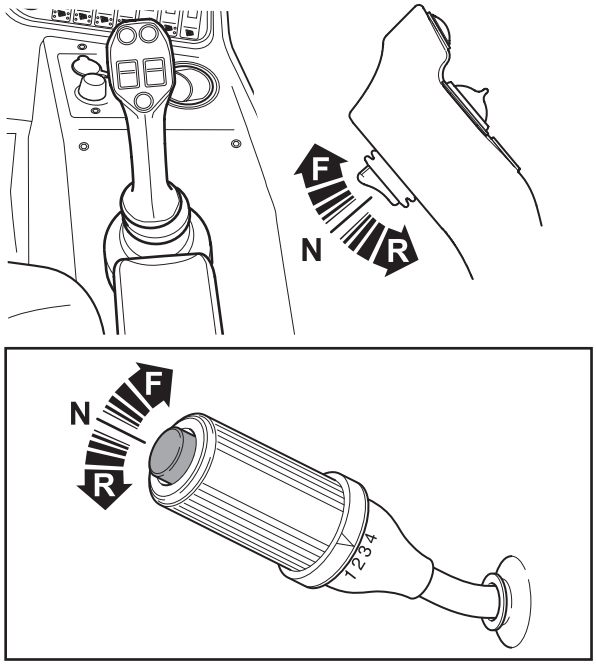


Fig 19.

The machine operator selects the machine travel direction with the Forward/Neutral/Reverse switch (**F/N/R**).

The neutral position in the centre of the switch must be selected to start the engine.

For more information on switch operation refer to the Dual Control System topic in this section. ⇨ ***Dual Control SYSTEM (F5-1)***

Solenoid Operation

The Transmission ECU uses the F/N/R switch signals to operate the transmission pump control solenoid. The control solenoid acts in two directions and the centre position is neutral. The movement of the control solenoid allows pilot oil to flow to the relevant side of the pump swash control piston. This swaps the high pressure and low pressure circuits to operate the motor in the opposite direction.

In neutral both of the solenoids are de-energised and no pilot flow is sent to the swash control piston therefore the pump stays at the minimum setting.

25 kph machines: The pilot flow is determined by the charge pressure generated by the charge pump. This increases and decreases with engine speed. The pilot pressure acts on the swash control piston and increases and decreases the swash angle as required.

20, 34 and 40 kph machines: The pilot flow is controlled by the pump control solenoid. These are proportional solenoids which are controlled by the transmission ECU. Therefore the movement of the swash control piston depends upon the flow of pilot oil supplied by the control solenoid.

Component Key:	
C006/ T001	Chassis harness to Transmission harness connector
C021	Reverse Alarm
C046	Transmission ECU Connector J1
C047	Transmission ECU Connector J2
E002	Starter solenoid
P01/C001	Panel harness to Chassis harness connector 1
P03	Fusebox B
P04	Fusebox C
P06	Neutral start relay
P08	Reverse relay
P12/P13	Ignition Switch
P16	L/H Column Switch
P20	Warning Light Cluster
P24/RC01	Panel harness to Rear Cab harness connector
P41/C041	Panel harness to Chassis harness connector 2
RC02	Parkbrake Switch
T002	Forward solenoid
T003	Reverse solenoid
T004	Motor Reverse Solenoid

Neutral Operation

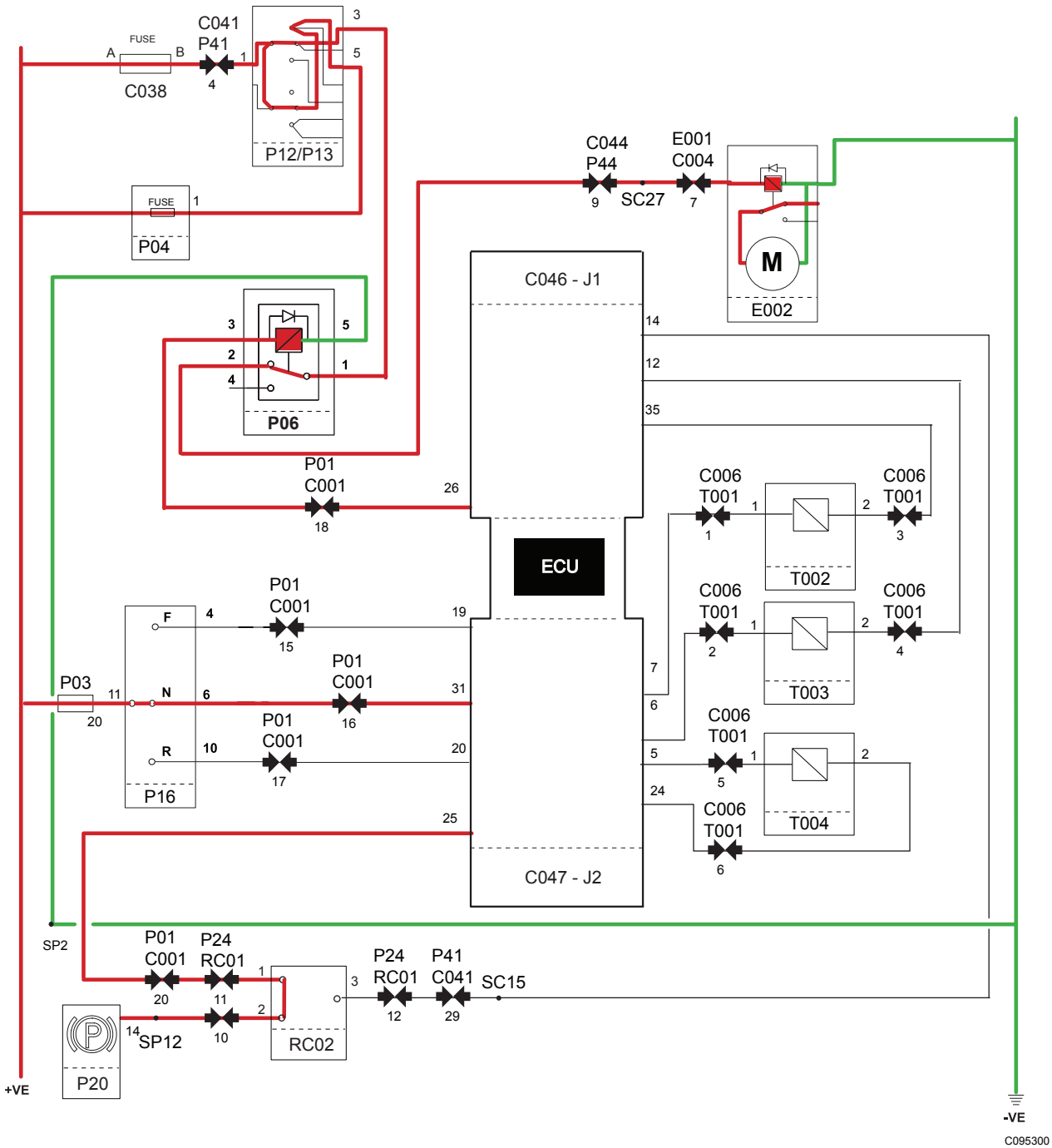


Fig 20. Neutral Switch Position

With the F/N/R switch in the neutral position power is supplied to the transmission ECU. The transmission ECU supplies power to the engine starter motor solenoid **E002** to start the engine. If the F/N/R switch **P16** is in the forward or reverse position the neutral start relay **P06** and the starter motor solenoid **E002** are not energised.

Power is also supplied to the neutral position relay **P06**. Power is supplied to the park brake switch **RC02**. With the park brake applied the switch **RC02** closes and power is supplied to the parkbrake warning light **P20**.

Forward Operation

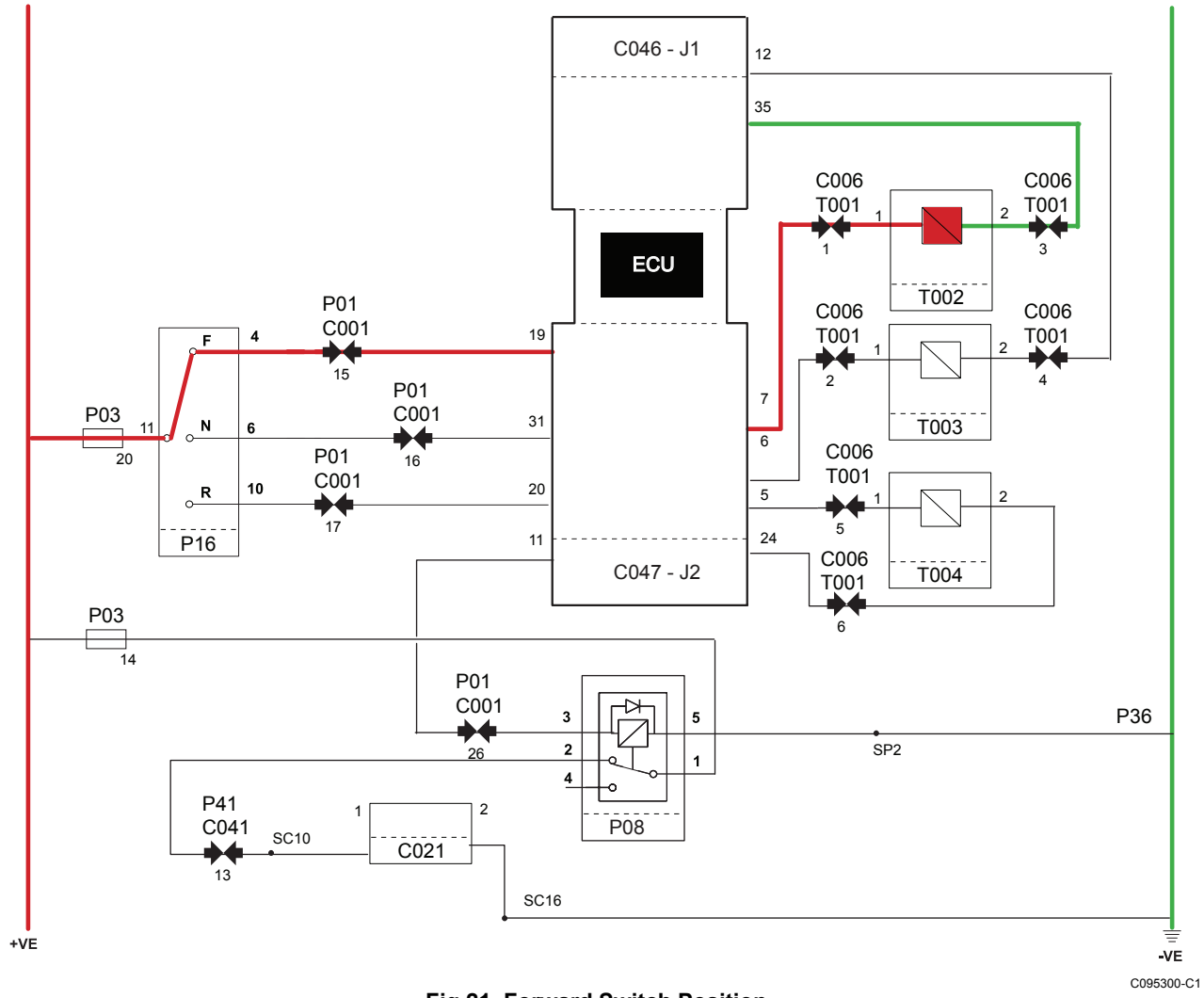


Fig 21. Forward Switch Position

When the F/N/R switch **P16** is moved to the forward position power is supplied to the ECU **C047**. The ECU supplies power to the forward solenoid **T002** on the transmission pump and hydraulic fluid is supplied via the forward drive port to the motor.

The direction solenoid **T004** on the motor is in the forward position (not energised).

Reverse Operation

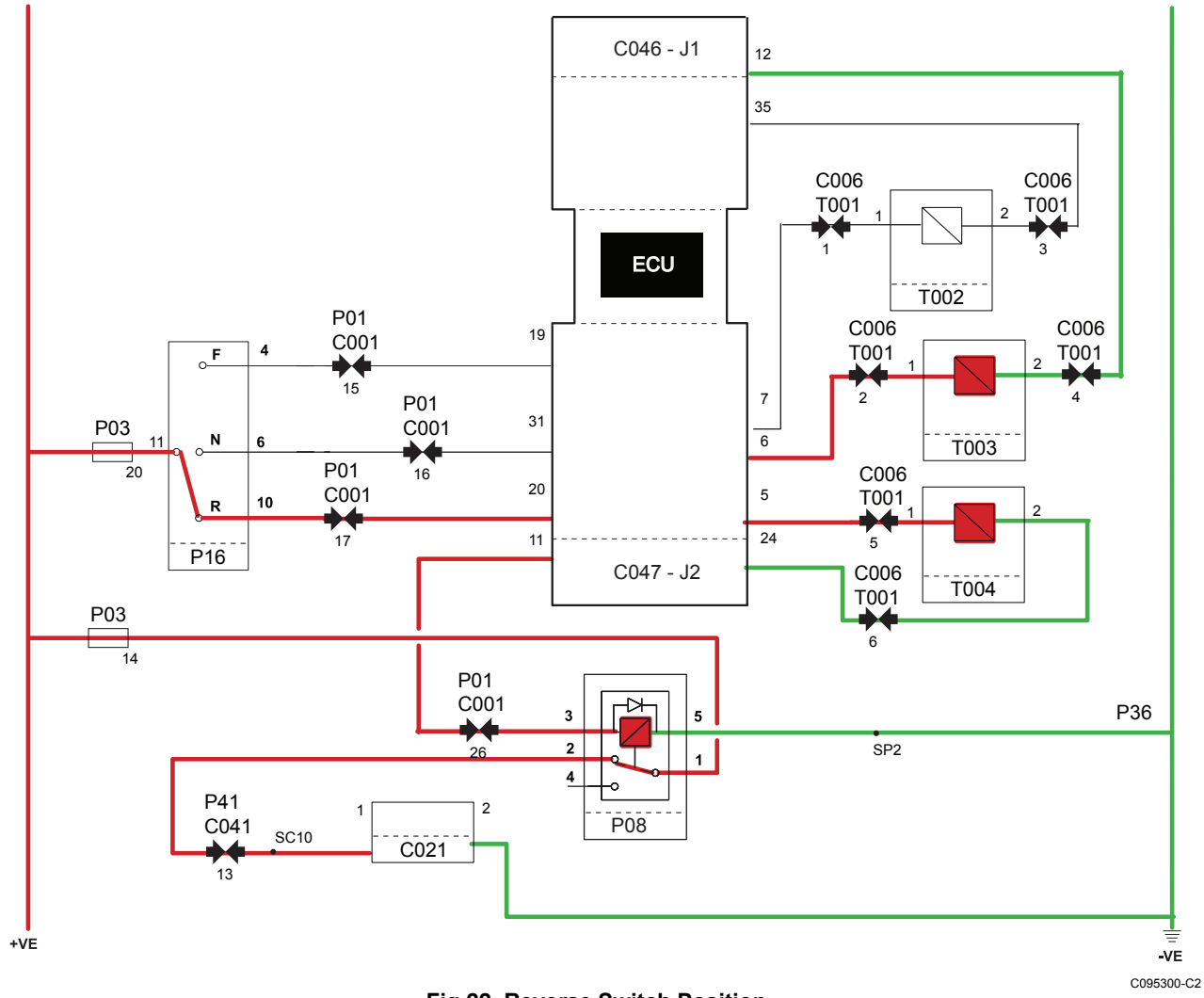


Fig 22. Reverse Switch Position

When the F/N/R switch **P16** is moved to the reverse position power is supplied to the ECU **C047**. The ECU supplies power to the reverse relay **P08**. The relay supplies power to the reverse solenoid **T003** on the transmission pump and hydraulic fluid is supplied via the reverse drive port to the motor.

The direction solenoid **T004** on the motor is in the reverse position (energised).

High/Low Speed Range

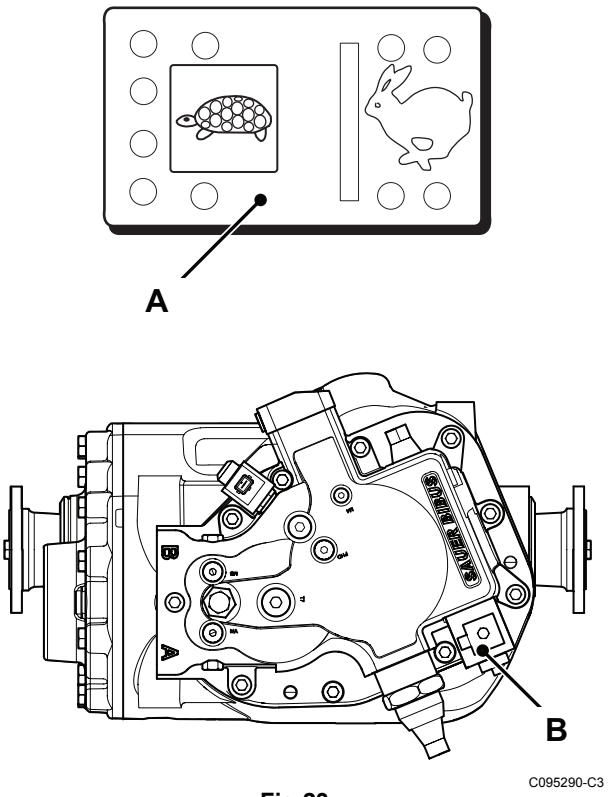


Fig 23.

The machine operator selects the machine travel speed with the High/Low speed switch **A**.

The tortoise symbol represents the lower machine speed range and the hare symbol represents the higher machine speed range.

Solenoid Operation

The Transmission ECU uses the switch signals to operate the transmission motor low speed solenoid **B**.

When the slow speed range is selected the transmission ECU energises the low speed solenoid **B** to allow the some of the control pressure of the motor to escape to the charge pressure line. This prevents a high control pressure which limits the speed of the motor.

When the high speed range is selected the transmission ECU de-energises the low speed solenoid. Therefore all of the motor control pressure is available to operate the motor throughout the speed range.

If the low speed range is selected when the machine speed exceeds 20 kph an audible warning will be emitted until the machine speed is below 20 kph.

Component Key:	
C006/ T001	Chassis harness to Transmission harness connector
C046	Transmission ECU Connector J1
C047	Transmission ECU Connector J2
P01/C001	Panel harness to Chassis harness connector 1
P55	High/Low Speed Switch
T005	Motor Low Speed Solenoid
T006	Transmission Speed Sensor

Low Speed Range Operation

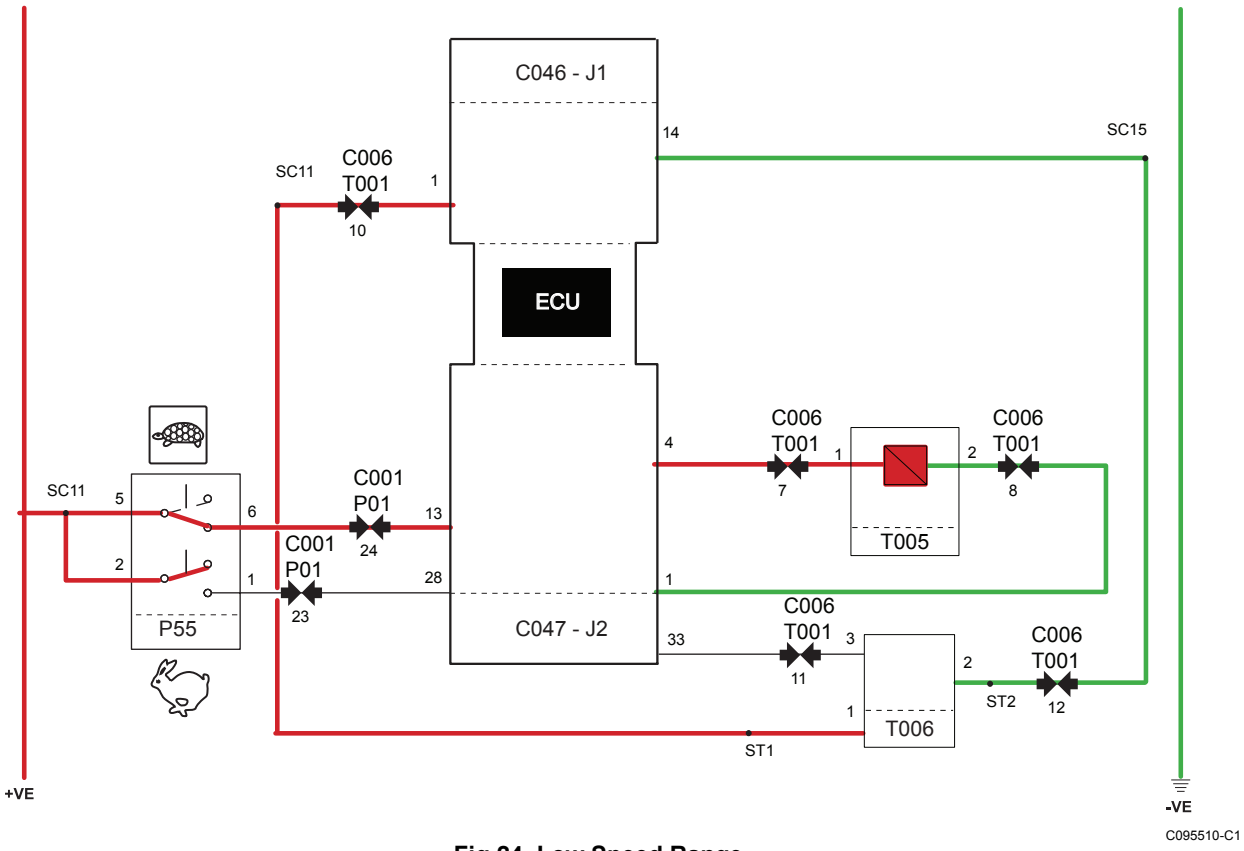


Fig 24. Low Speed Range

With the speed range switch **P55** operated in the low speed range position, power is supplied to the transmission ECU **C047**. The transmission ECU supplies power to the transmission motor low speed solenoid **T005** which energises to allow control pressure to escape to the charge pressure line.

The ECU also monitors the machine speed through the signal from the transmission speed sensor **T006**.

High Speed Range Operation

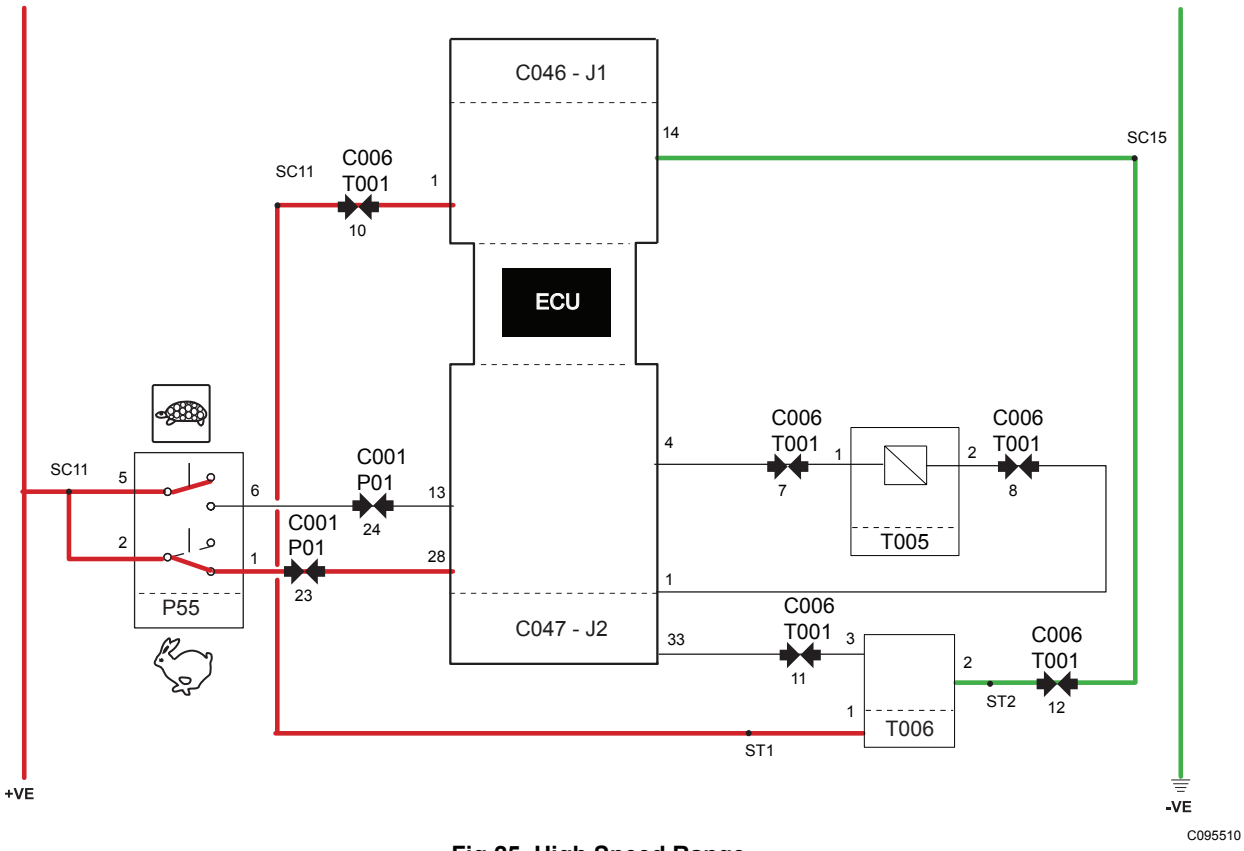


Fig 25. High Speed Range

With the speed range switch **P55** operated in the high speed range position, power is supplied to the transmission ECU **C047**. The transmission ECU stops the power to the transmission motor low speed solenoid **T005** which de-energises to provide the full control pressure range for motor operation.

The ECU also monitors the machine speed through the signal from the transmission speed sensor **T006**. If the machine speed is above 20 kph the transmission ECU will not allow the low speed range operation to be selected by not allowing power to energise the solenoid **T005**. An audible warning is emitted to warn the machine operator.

Ground Speed

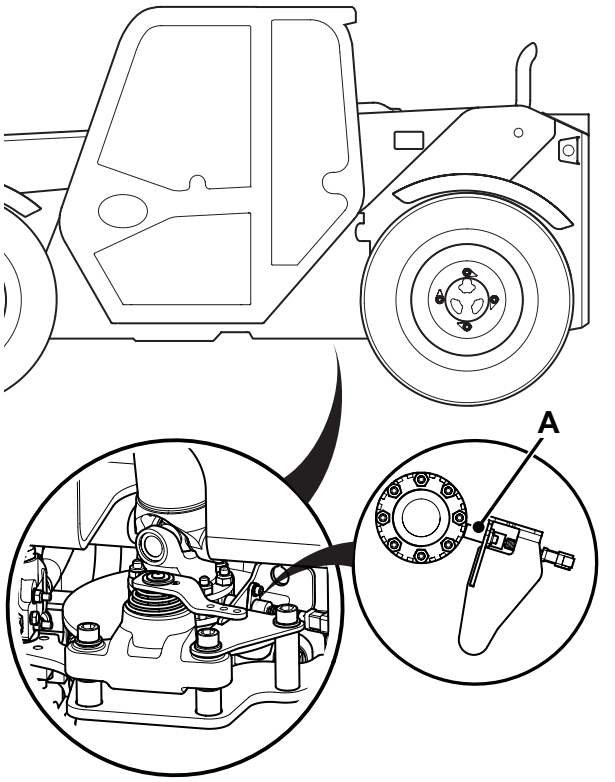


Fig 26.

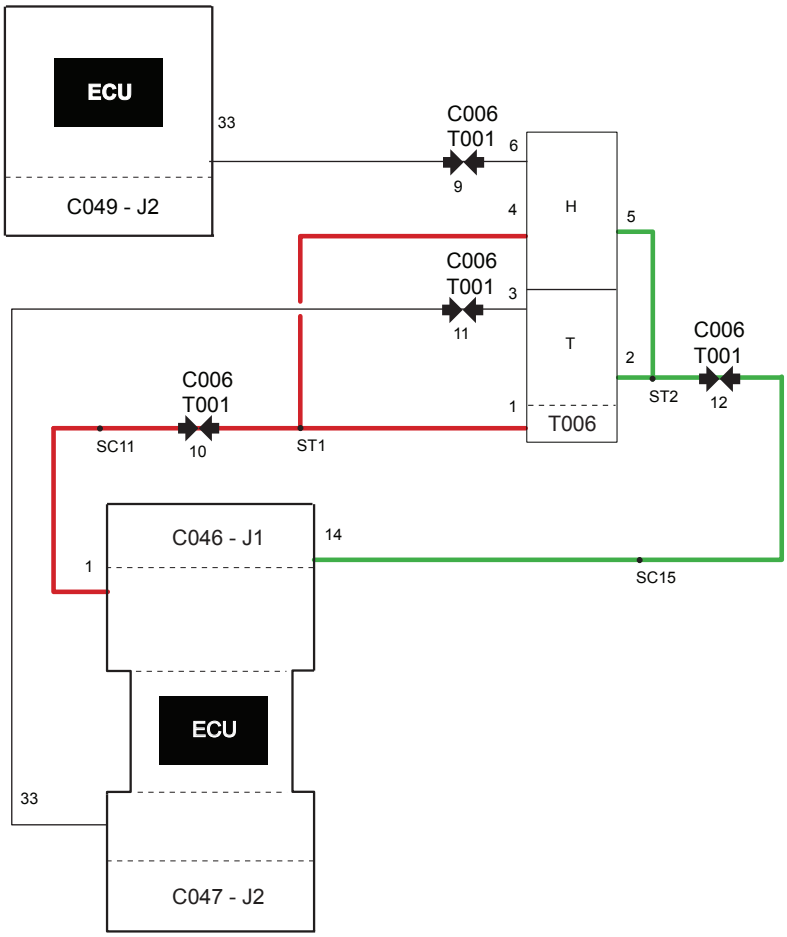
A speed sensor **A** outputs two separate signals - one to the transmission ECU and the other to the hydraulic control ECU.

The two signals are compared over the machine CANbus system. If the values differ the machine will enter Limp Mode. ⇨ *Transmission `Limp Modes' (F4-50)*

The CANbus values are also used to display ground speed on the LMS display.

The hydraulic control ECU uses the speed data for the MC system operation.

The transmission ECU uses the speed data to control the pump solenoid current to limit ground speed or allow varispeed operation and to prevent changing speed range when the machine is travelling too fast.



C095510-C2

Fig 27. Ground Speed

Component Key:	
C006/ T001	Chassis harness to Transmission harness connector
C049	Hydraulic Control ECU Connector J2
C047	Transmission ECU Connector J2
P01/C001	Panel harness to Chassis harness connector 1
T006 - T	Transmission Speed Sensor - Transmission ECU Signal
T006 - H	Transmission Speed Sensor - Hydraulic Control ECU Signal

Speed Limit

The transmission ECU monitors the machine ground speed. ⇨ *Ground Speed (F4-36)*

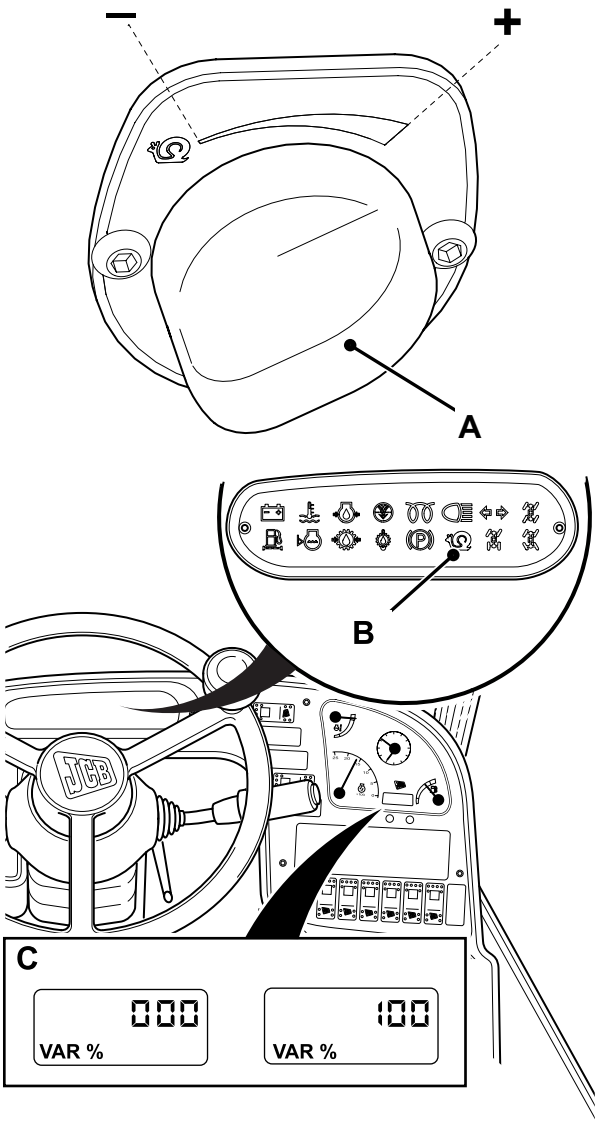
40 Kph Machines

When the machine ground speed reaches 40 kph the transmission ECU controls the current to the pump displacement proportional solenoids. This limits the machine ground speed to 40 kph.

All Machines

When the transmission ECU is in Limp Mode the ECU will reduce the current to the pump proportional solenoids to limit machine speed.

Varispeed



C094700-C4

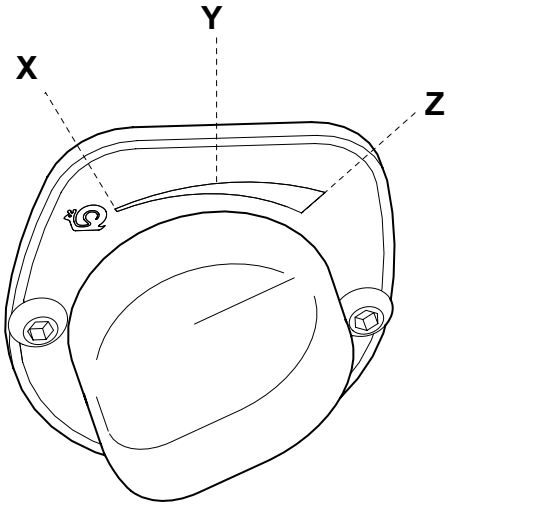
Fig 28.

The Varispeed control **A** (if fitted) is used to limit the machine speed. The varispeed control is a dual output potentiometer which supplies a signal to the transmission ECU. When the varispeed control is in the maximum position the machine speed is not controlled.

When the Varispeed control is moved out of the maximum position the transmission ECU reduces the current to the pump displacement proportional solenoids to reduce the machine speed. The LMS displays the percentage of ground speed available in the selected varispeed position **C**. An icon **B** is also displayed on the warning cluster.

The varispeed sensors convert the movement of the control into an electrical signal for interpretation by the transmission ECU. The transmission ECU uses this signal to limit the machine speed via the transmission pump proportional control solenoids.

Two signals are output from the unit, an output 1 signal and an output 2 signal. One signal varies the voltage by the angle to the left of the dial. The other signal varies the voltage by the angle to the right of the dial. Both signals will always add up to 5v, for example ⇨ *Table 4. Sensor Output (F4-39)*



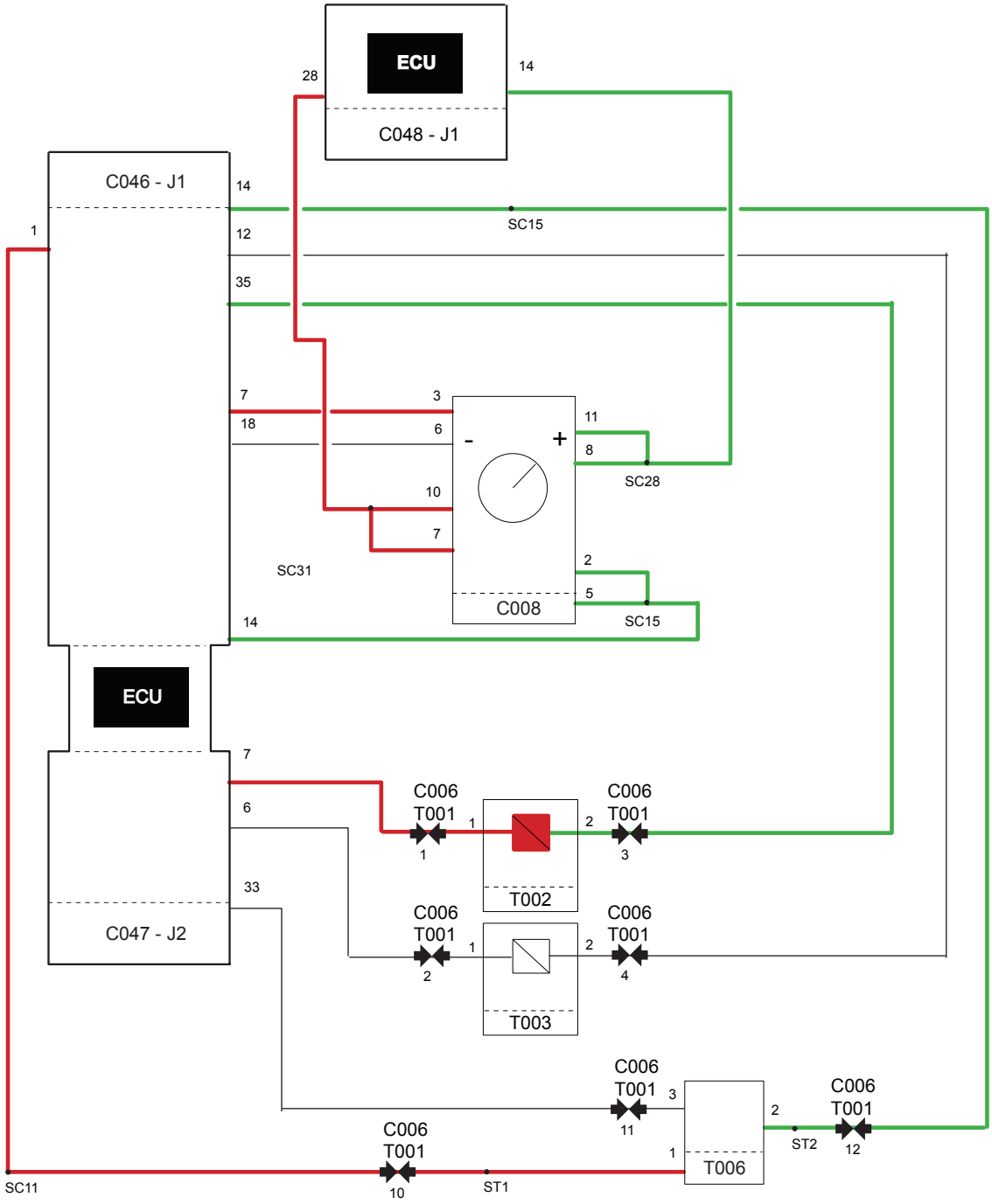
C093800-C4

Table 4. Sensor Output

Dial Position	Voltage output
X - Minimum Speed	Signal 1 = 0.5V Signal 2 = 4.5V
Y - Centre Position	Signal 1 = 2.5V Signal 2 = 2.5V
Z - Maximum Speed	Signal 1 = 4.5V Signal 2 = 0.5V

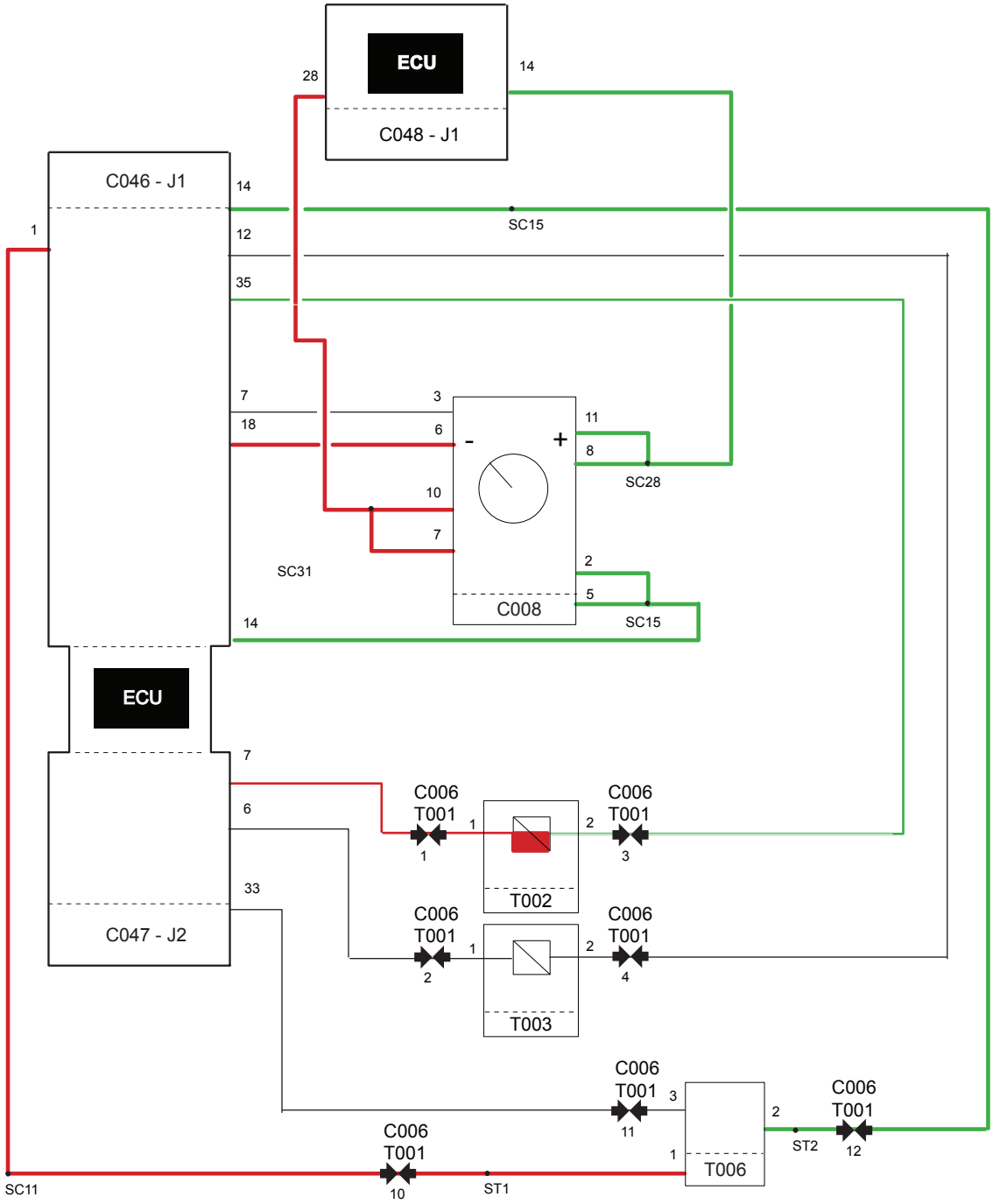
Component Key: ⇨ *Fig 29. (F4-40)* and ⇨ *Fig 30. (F4-41)*	
C006/ T001	Chassis harness to Transmission harness connector

C046	Transmission ECU Connector J1
C047	Transmission ECU Connector J2
C048	Hydraulic Control ECU Connector J2
T006	Transmission Speed Sensor
T002	Forward solenoid
C008	Varispeed/Hand Throttle Connector
T003	Reverse solenoid



C095510-C3

Fig 29. Varispeed in maximum position



C095510-C4

Fig 30. Varispeed in minimum position

Inching Pedal

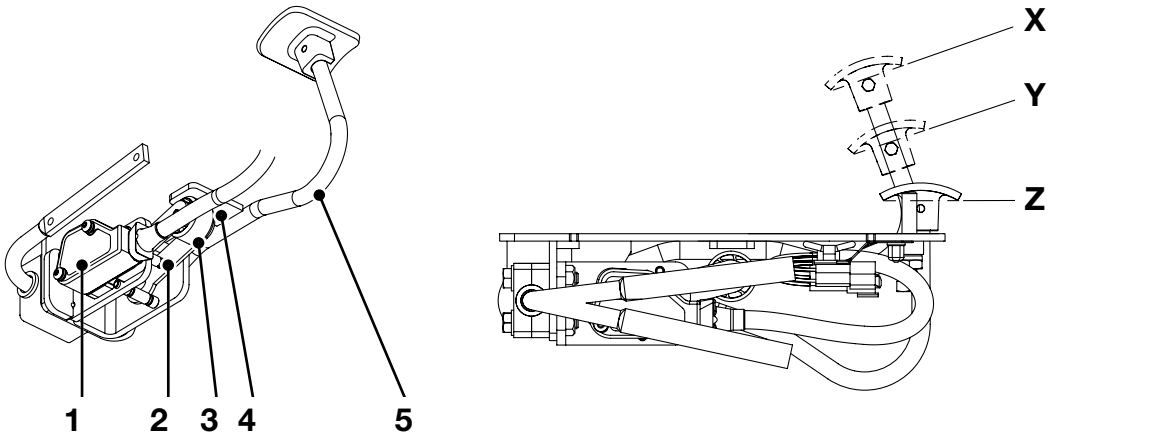


Fig 31.

The inching pedal sensor converts the movement of the pedal into an electrical signal for interpretation by the transmission ECU. The transmission ECU uses this signal to limit the machine speed via the transmission pump proportional control solenoids. As the pedal is pushed down the machine speed reduces.

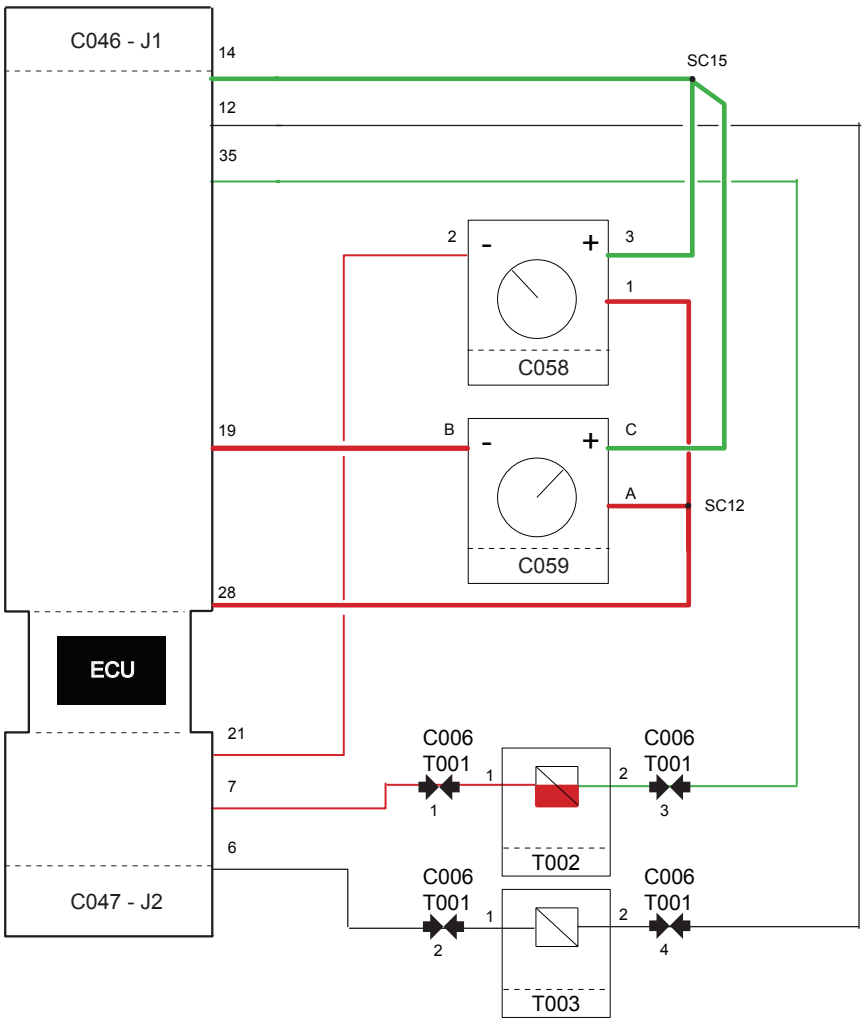
Movement of the pedal operates a lever **5**. Attached to the lever is a plate **4**. The pedal movement is transmitted from the plate to a roller **3** and swing arm **2** on the Sensor unit **1**. A variable resistor within the sensor unit **1** changes the voltage output in relation to the position of the pedal.

Two signals are output from the unit, a track 1 signal and a track 2 signal. One signal varies the voltage by the angle below the foot pedal pad. The other signal varies the voltage by the angle above the foot pedal pad. Both signals will always add up to 5v, for example ⇨ *Table 5. Pedal Sensor Output (F4-42)*

Table 5. Pedal Sensor Output

Pedal Position	Voltage output
X	Signal 1 = 0V Signal 2 = 5V
Y	Signal 1 = 2.0V Signal 2 = 3.0V
Z	Signal 1 = 5.0V Signal 2 = 0V

Component Key: ⇨ *Fig 32. (F4-43)*	
C006/ T001	Chassis harness to Transmission harness connector
C046	Transmission ECU Connector J1
C047	Transmission ECU Connector J2
C058	Inching Pedal Connector A
C059	Inching Pedal Connector B
T002	Forward solenoid
T003	Reverse solenoid



C095510-C9

Fig 32. Inching Pedal Pressed

Overheat

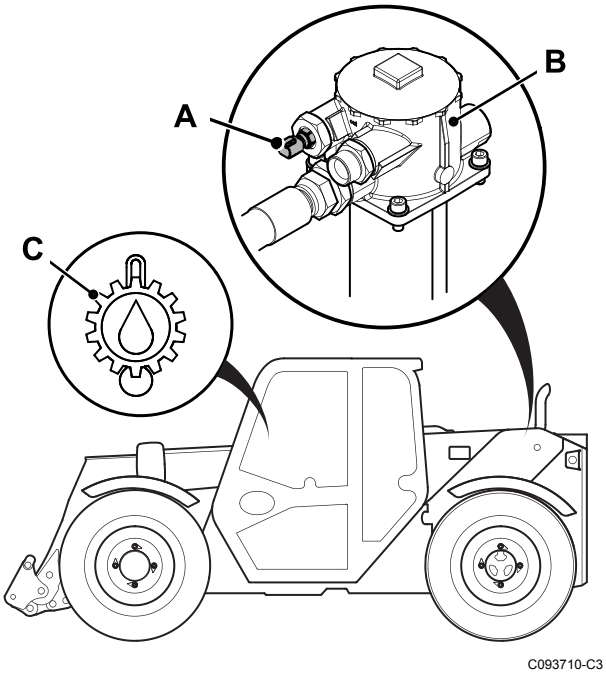


Fig 33.

A temperature sender **A** mounted on the hydraulic filter head **B** monitors the transmission oil temperature. If the temperature exceeds 95 ºC the transmission ECU will enter Limp Mode. ⇨ *Transmission `Limp Modes' (F4-50)*

The transmission ECU sends a CANbus signal to the LMS display to illuminate the hydraulic warning icon **C**.

Component Key:	
C006/ T001	Chassis harness to Transmission harness connector
C046	Transmission ECU Connector J1
C047	Transmission ECU Connector J2
C033	Hydraulic Temperature Sensor
T002	Forward solenoid
T003	Reverse solenoid

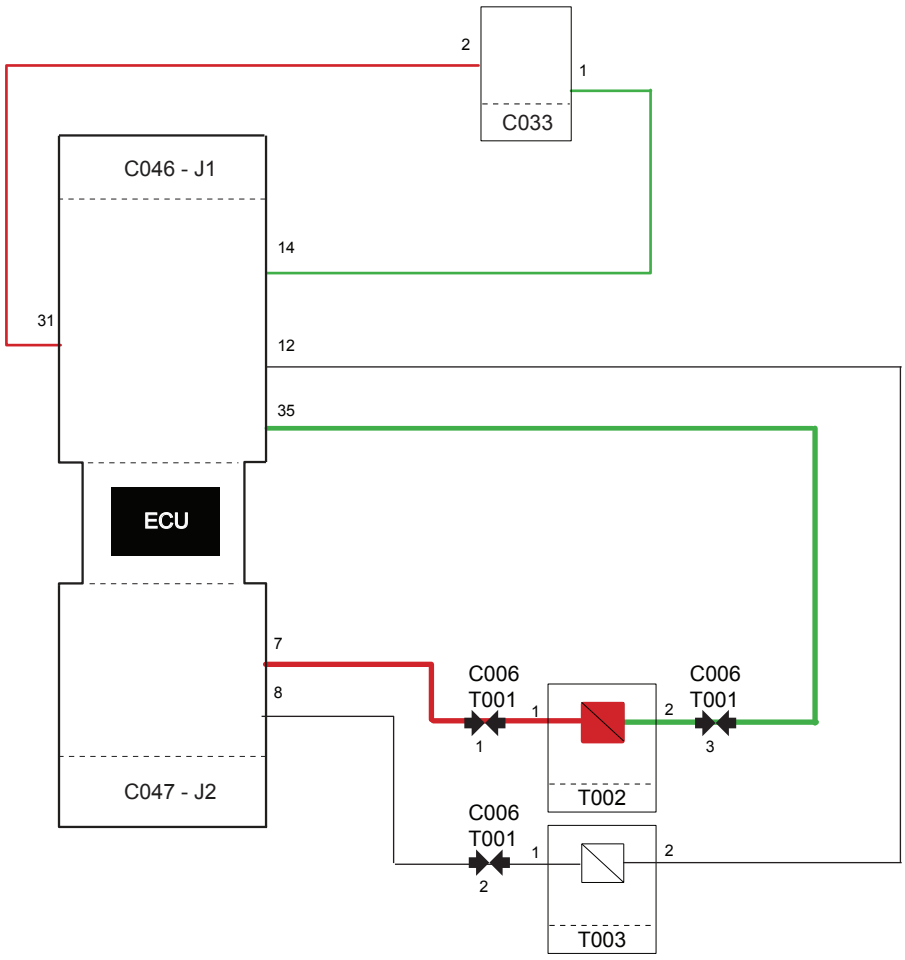
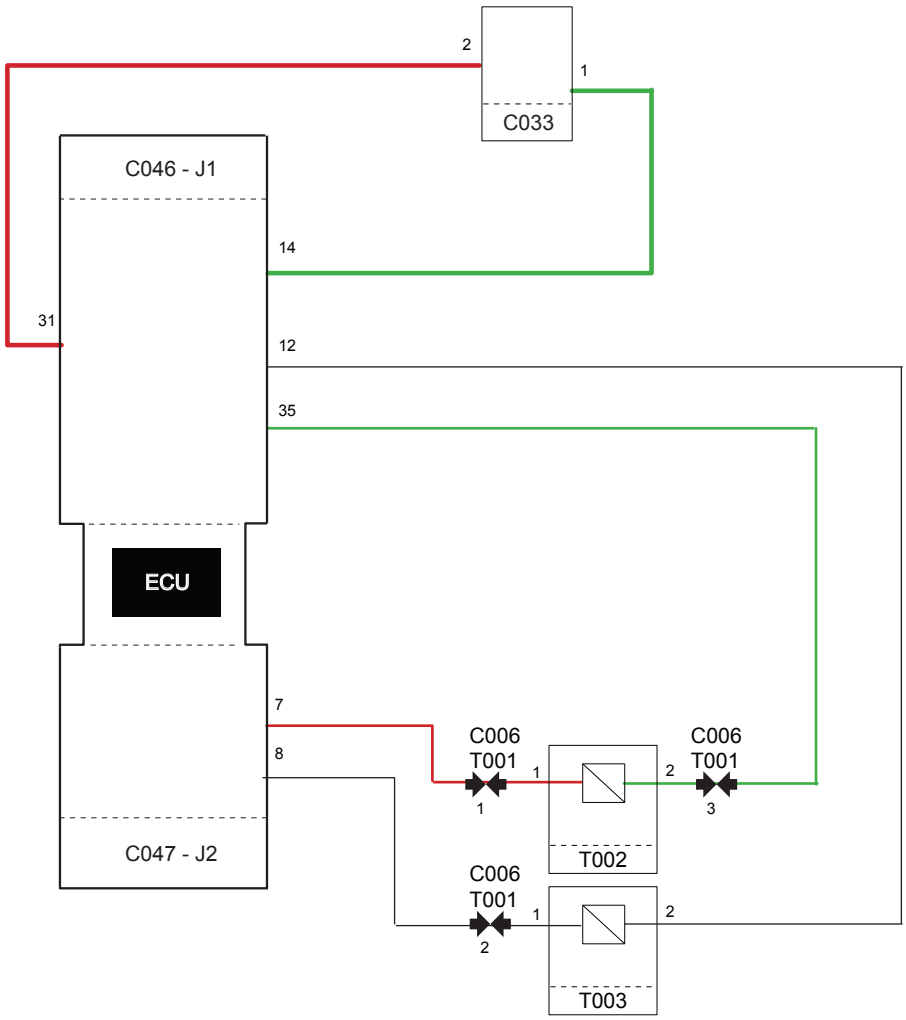


Fig 34. Transmission Oil Temperature Normal

When the transmission oil temperature is normal the resistance of the earth of the temperature sensor **C033** is high. The transmission ECU **C046/C047**allows normal operation of the pump proportional control solenoids **T002** and **T003**.



C095510-C5

Fig 35. Transmission Oil Overheat

When the transmission oil temperature is high the resistance of the earth of the temperature sensor **C033** is low. The transmission ECU **C046/C047** restricts the current to the pump proportional control solenoids **T002** and **T003**.

The transmission ECU sends a message over the CANbus to the LMS ECU to display the transmission warning light on the warning cluster.

Trailer Present

A trailer detection wire in the trailer connector **B** sends a signal to the transmission ECU when a trailer is connected to the machine.

The transmission ECU sends a CANbus signal to the LMS display to illuminate the trailer present icon **A**.

The transmission ECU controls the direction indicator light, brake light and hazard warning light circuits.

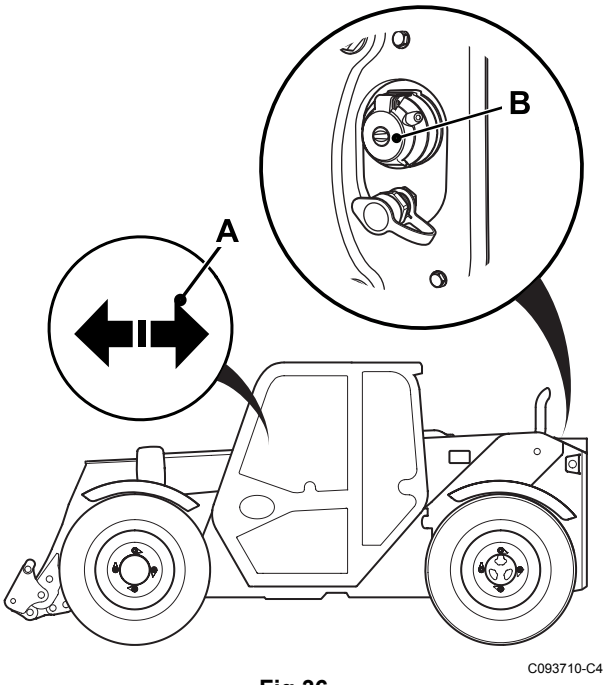


Fig 36.

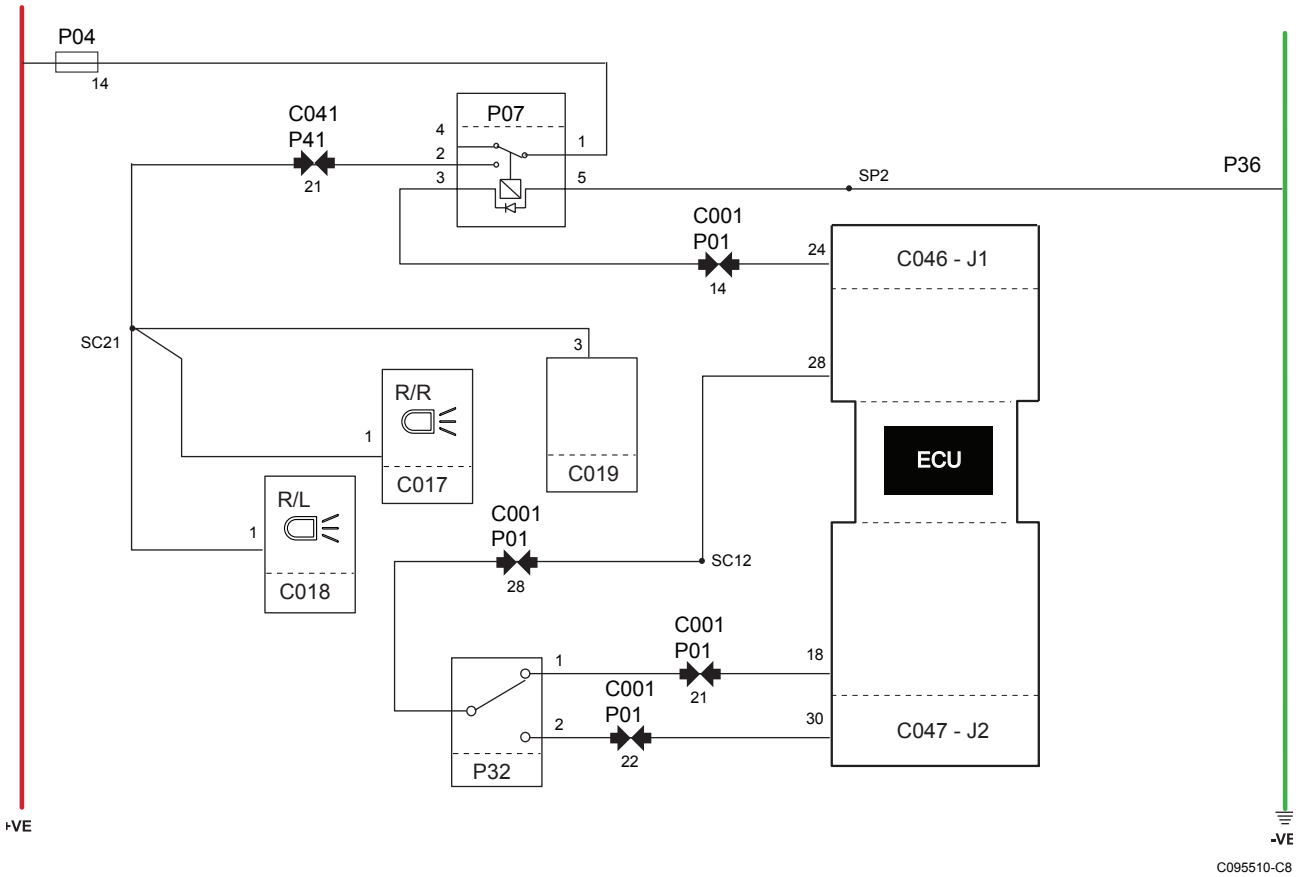


Fig 37. Brake light controls

Component Key: ⇒ *Fig 37. (F4-48)* and ⇒ *Fig 38. (F4-49)*	
C001/P01	Chassis harness to Panel harness connector 1
C002	Left Headlamp Connector
C005	Right Headlamp Connector
C017	Right Rear Lamp Connector
C018	Left Rear Lamp Connector
C019	Trailer Harness Connector
C041/P41	Chassis harness to Panel harness connector 2
C046	Transmission ECU Connector J1
C047	Transmission ECU Connector J2
P03	Fusebox B
P04	Fusebox C
P05	Fusebox D

P07	Brake Lights Relay
P10	Indicator Relays
P17	R/H Column Switch
P30	Turn Signal Diode 2
P31	Turn Signal Diode
P32	Foot Brake Pedal Switch
P35	Right Indicator Diode
P36	Earth Point

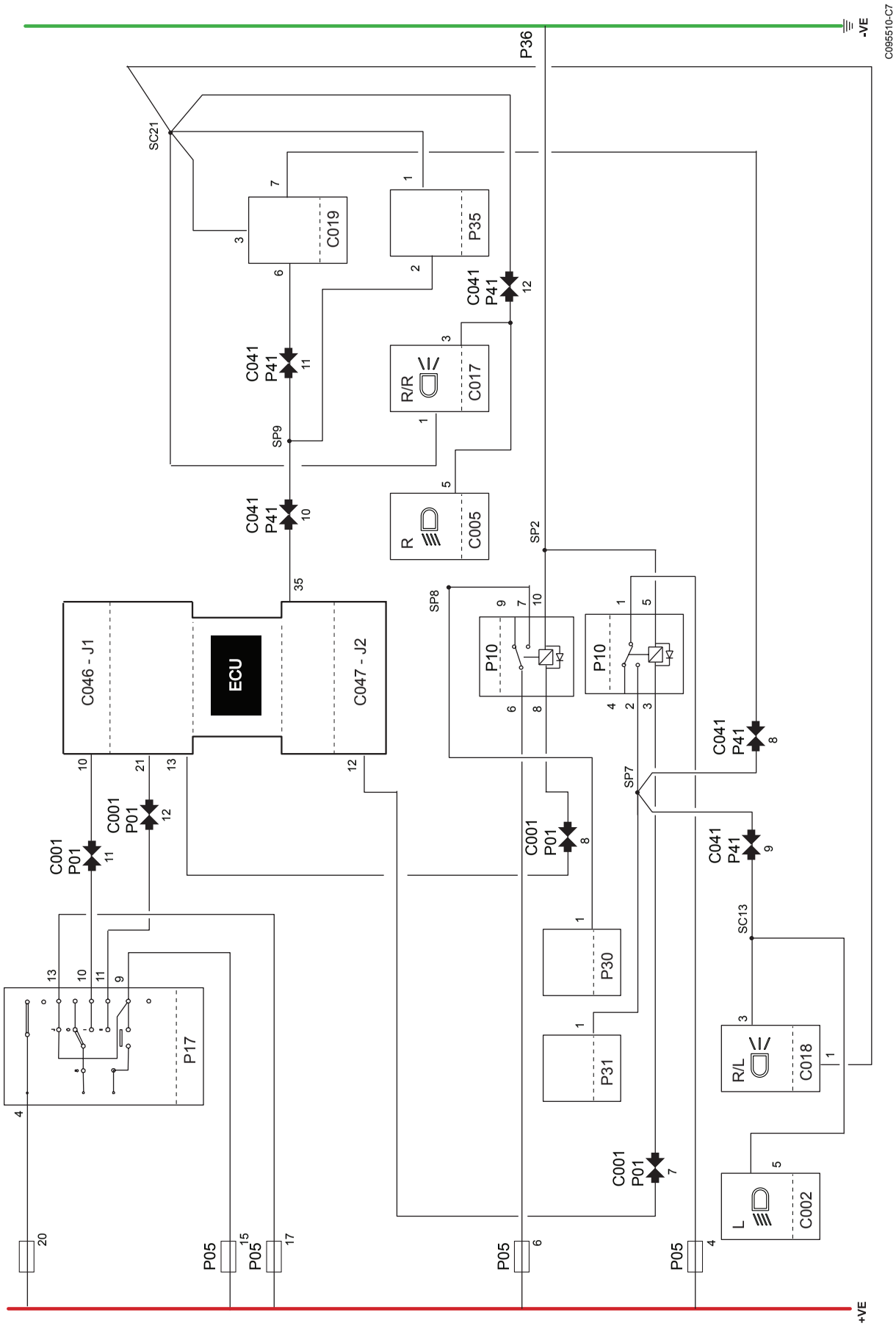


Fig 38. Trailer socket and Direction Indicator controls

Fault Finding

The purpose of this section is to help you trace a particular fault. The tables identify possible causes and give a suggested action with specific tests where applicable.

To help identify the hydraulic components mentioned in the fault finding tables, refer also to the hydraulic schematic diagram (near the beginning of this section).

1 Before you begin fault finding, read the safety information at the beginning of this manual.

2 Make any relevant electrical checks before moving on to the hydraulics.

3 Make simple checks before say, stripping a major hydraulic component.

4 Make sure that the hydraulic fluid is at the correct working temperature (50 °C, 122 °F).

5 If hydraulic contamination is found be sure to remove ALL debris, and if possible identify its origin. It may be part of a component from elsewhere in the hydraulic circuit.

6 What ever the fault, check the condition of the hydraulic fluid. Drain and replace if necessary.

7 Renew any seals such as 'O' rings when re-assembling hydraulic components.

The transmission ECU incorporates `Limp Modes'. These modes can operate in response to other faults. Make sure you understand the characteristics of the `Limp Modes'. ⇨ *Transmission `Limp Modes' (F4-50)*

Transmission `Limp Modes'

When applicable the transmission ECU provides restricted or modified transmission operation if faults are detected by the ECU. Typical `Limp Mode' forms of operation are:

Mode	Possible Reason
Limp Mode Speed limit reduced	Speed sensor error
	Transmission temperature above 95 ° C

Electronic Fault Codes

The machine will log some system faults as an error code. These error codes can be accessed with the correct diagnostics software tool, using a laptop computer connected to the machine CAN system.

For the fault code descriptions refer to ***Section M - Fault Code SYSTEM***. ⇨ *Related Topics (F4-2)*

To access the fault codes and diagnostic software use the Servicemaster program. Refer to ***Section M - Servicemaster System*** and ***Section M - Servicemaster tools***. ⇨ *Related Topics (F4-2)*

Fault Finding Tables

Connect pressure gauges into the hydraulic test ports at the transmission pump and transmission motor as specified in the fault finding tables. For the locations of the hydraulic test ports ⇨ *Flow and Pressure Tests (F4-56)*.

⇨ *Table 6. Lack of Pulling Power in High Range (F4-51)*

⇨ *Table 7. No Reverse Drive (F4-51)*

⇨ *Table 8. No Forward or Reverse Drive (F4-52)*

⇨ *Table 9. Machine Creeping (F4-53)*

⇨ *Table 10. Machine Pulls Away Prematurely (F4-53)*

⇨ *Table 11. Machine Movement Slow To Reach Top Speed (F4-53)*

⇨ *Table 12. Machine Does Not Achieve Maximum Road Speed (F4-53)*

⇨ *Table 13. Machine Will Not Travel Uphill (F4-54)*

⇨ *Table 14. Hydraulic oil temperature high. (F4-55)*

Table 6. Lack of Pulling Power in High Range

Action		Yes	No
1	Check engine - Complete stall test on machine. OK?	Go to 2	Attend to fault on machine. ***See Section K - Engine***.
2	Check tyre pressures and hydraulic oil temperature and grade is correct. Ok?	Go to 3	Attend to fault on machine.
3	Check parking brake and service brake pads are not binding or ceased on to the disc. OK?	Go to 4	Attend fault. ***See Section G - Brakes.***
4	Check charge pressure. Ok?	Go to 5	Check filter for contamination - check charge pressure relief valve, remove clean and replace if required
5	Check control pressure X1 and X2 OK?	Go to 6	Remove DA control valve, clean and replace. Check inching operation.
6	Check Ma and Mb high pressure loop. OK?	Go to 7	If low, remove clean and replace pressure cut off valve.
7	Check M3 pressure. OK?	Go to 8	PCOR set too high, adjust.
8	Check reverse direction valves		Either solenoid or pilot operated reverse direction valves at fault, check solenoid and spools. If still not OK, change motor.

Table 7. No Reverse Drive

Action		Yes	No
1	Is error code T028 displayed on the LMS?	Check continuity on reverse solenoid coil.	Go to 2
2	Ensure handbrake is released and handbrake sensor works. Also ensure calipers on hand brake and service brake are free from the disc. OK?.	Go to 3	Attend fault. ***See Section G - Brakes.***

Action		Yes	No
3	Check charge pressure. OK?	Go to 4	Check filter for contamination - check charge pressure relief valve, remove clean and replace. If charge pressure still low, replace drive coupling.
4	Check control pressure X1 and X2. OK?	Go to 5	If X1 and X2 are low check DA valve or check inching valve operation. If both OK pump servo piston is worn - change pump.
5	Check electrical solenoids on pump and check continuity and switch in cab. OK?	Go to 6	If electrics are OK, check DA valve or check inching valve operation. If both OK pump servo piston is worn - change pump.
6	Check Ma and Mb high pressure loop. OK?		Remove and clean Pressure Cut Off Valve and Relief Valve.
Does machine move slowly? If yes continue to step 7			
7	Check pressure at M3.		Either solenoid or pilot operated reverse direction valves at fault, check solenoid and spools. If still not OK, change motor.

Table 8. No Forward or Reverse Drive

Action		Yes	No
1	Ensure handbrake is released and handbrake sensor works. Also ensure calipers on hand brake and service brake are free from the disc. OK?.	Go to 2	Attend fault. ***See Section G - Brakes.***
2	Check charge pressure. OK?	Go to 3	Check filter for contamination - check charge pressure relief valve, remove clean and replace. If charge pressure still low, replace drive coupling.
3	Check control pressure X1 and X2. OK?	Go to 4	If X1 and X2 are low check DA valve or check inching valve operation. If both OK pump servo piston is worn - change pump.
4	Check electrical solenoids on pump and check continuity and switch in cab. OK?	Go to 5	If electrics are OK, check DA valve or check inching valve operation. If both OK pump servo piston is worn - change pump.
5	Check Ma and Mb high pressure loop. OK?		Remove and clean Pressure Cut Off Valve and Relief Valve.
Does machine move slowly? If yes continue to step 6			
6	Check pressure at M3.		Either solenoid or pilot operated reverse direction valves at fault, check solenoid and spools. If still not OK, change motor.

Table 9. Machine Creeping

Action		Yes	No
1	Does machine drive at idle speed with the drive switch in neutral?	Go to 2	
2	Check control pressure X1 and X2 OK?	Go to 3	Remove DA control valve, clean and replace. Check inching operation.
3	Check the neutral swash angle adjuster OK?		Adjust as necessary.

Table 10. Machine Pulls Away Prematurely

Action		Yes	No
1	Does the machine drive at idle speed with the drive selected?	Go to 2	Machine OK
2	Check engine idle speed refer to section K of service manual. OK?	Go to 3	Adjust as necessary
3	Check DA valve setting		Make sure that between 1000rpm & 1100rpm the machine begins to move.

Table 11. Machine Movement Slow To Reach Top Speed

Action		Yes	No
1	Is machine on level ground?	Go to 2	Reposition machine.
2	Check Hydraulic oil temperature. OK?	Go to 3	***⇨ Hydraulic oil temperature high. (F4-55)***
3	Check parking brake and service brake pads are not binding or ceased on to the disc. OK?	Go to 4	Attend fault. ***See Section G - Brakes.***
4	Check charge pressure. OK?	Go to 5	Check filter for contamination - check charge pressure relief valve, remove clean and replace.
5	Check control pressure X1 and X2. Ok?	Go to 6	Remove DA control valve, clean and replace. Check inching valve operation.
6	Check DA valve setting. Ok?	Go to 7	Make sure that between 1000rpm & 1100rpm the machine begins to move.
7	Check M3 Pressure. Ok?	Go to 8	Adjust PCOR valve (set too high)
8	Check X1 motor orifice. Ok?		Check for contamination

Table 12. Machine Does Not Achieve Maximum Road Speed

Action		Yes	No
1	Check engine - Complete stall test on machine. OK	Go to 2	Attend fault on machine. ***See Section K - Engine***.
2	Check tyre pressures and hydraulic oil temperature and grade is correct. OK?	Go to 3	Attend fault on machine.

Action		Yes	No
3	Check charge pressure. OK?	Go to 4	Check filter for contamination - check charge pressure relief valve, remove clean and replace. If charge pressure still low, replace drive coupling.
4	Check control pressure X1 and X2. OK?	Go to 5	Remove DA control valve, clean and replace. Check inching valve operation.
5	Check Ma and Mb high pressure loop. Ok?	Go to 6	If low, remove clean and replace pressure cut off valve.
6	Check M3 Pressure. Ok?	Go to 7	Adjust PCOR valve (set too high)
7	Check X1 pressure (motor). Ok?	Go to 8	Remove and clean displacement valve. If still not OK go to step 8.
8	Check flushing pressure maintaining valve operation.		Replace if necessary

Table 13. Machine Will Not Travel Uphill

Action		Yes	No
1	Check engine - Complete stall test on machine. OK	Go to 2	Attend fault on machine. ***See Section K - Engine***.
2	Check tyre pressures and hydraulic oil temperature and grade is correct. OK?	Go to 3	Attend fault on machine.
3	Check parking brake and service brake pads are not binding or seized on to the disc. OK?	Go to 4	Attend fault. ***See Section G - Brakes.***
4	Check charge pressure. OK?	Go to 5	Check filter for contamination - check charge pressure relief valve, remove clean and replace.
5	Check control pressure X1 and X2. Ok?	Go to 6	Remove DA control valve, clean and replace. Check inching valve operation.
6	Check Ma and Mb high pressure loop. OK?	Go to 7	If low, remove clean and replace pressure cut off valve.
7	Check M3 Pressure. Ok?	Go to 8	Adjust PCOR valve (set too high)
8	Check reverse direction valves.		Either solenoid or pilot operated reverse direction valves at fault, check solenoid and spools. If still not OK, change motor.

Table 14. Hydraulic oil temperature high.

Possible Cause	Action
Tank	– Hydraulic oil level too low. – Hydraulic oil wrong viscosity.
Cooler/radiator	– Cooling fan defective. – Oil contamination. – By-pass valve defective.
Transmission pump	– Incorrect valve settings. – Defective flushing valve. – Pump mechanical wear.
Drive motor	– Insufficient cooling. – Defective purge valve. – Motor mechanical wear.

Test Procedures

Flow and Pressure Tests

Pump Port Identification

25 kph Machines

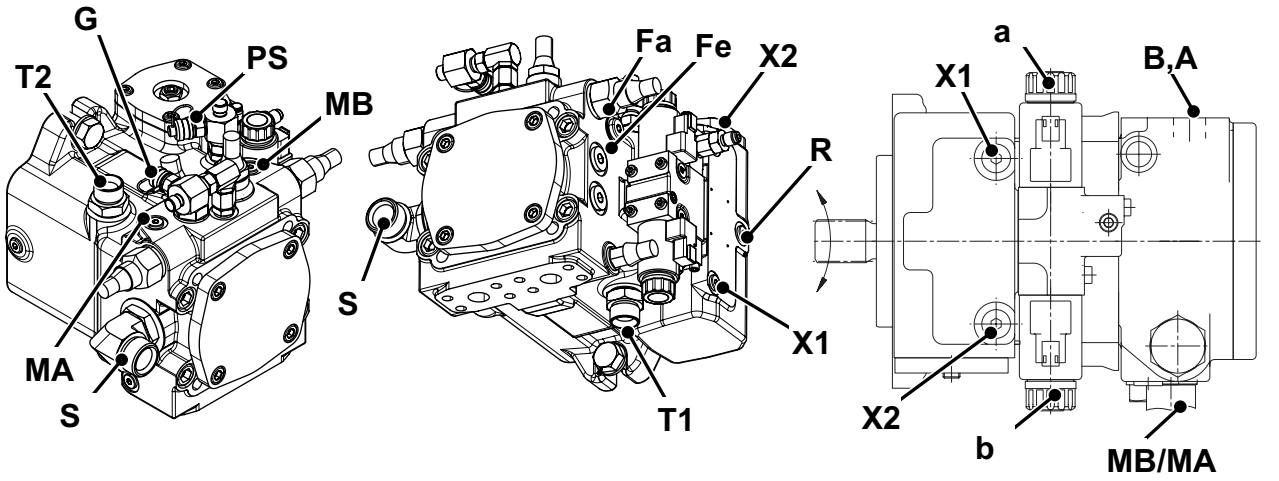


Fig 39. Pump

Table 15. Ports

Port	Service	Adaptor		Expected Reading		Pressure Gauge
		Size	Part Number	Forward (Solenoid B)	Reverse (Solenoid A)	
MA	High pressure	7/16 in - 20 UNF 2B	TBA	NA	350 bar (356 kgf/cm^2, 5076 lbf/in^2) at stall	0-600 bar (0-611 kgf/cm^2, 0-9000 lbf/in^2)
MB	High pressure	7/16 in - 20 UNF 2B	TBA	350 bar (356 kgf/cm^2, 5076 lbf/in^2) at stall	NA	0-600 bar (0-611 kgf/cm^2, 0-9000 lbf/in^2)
X1	Actuating pressure	7/16 in - 20 UNF 2B	TBA	2.5 bar (2.5 kgf/cm^2, 36.2 lbf/in^2)	30 bar (30.5 kgf/cm^2, 435.1 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
X2	Actuating pressure	7/16 in - 20 UNF 2B	TBA	30 bar (30.5 kgf/cm^2, 435.1 lbf/in^2)	2.5 bar (2.5 kgf/cm^2, 36.2 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)

Table 16. Ports

Port	Service	Adaptor		Expected Reading		Pressure Gauge
		Size	Part Number	Idle (900 rpm)	Flight (2300 rpm)	
G	Charge Pressure Supply to Transmission Motor Test Point	HSP	TBA	25 +/- 2 bar (25.4 +/- 2 kgf/cm², 362 +/- 29 lbf/in²)	30 +/- 2 bar (30.5 +/- 2 kgf/cm², 435.1 +/- 29 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)
PS	Control/Pilot Pressure	HSP	TBA	5 +/- 2 bar (5.09 +/- 2 kgf/cm², 72+/- 29 lbf/in²)	30 +/- 2 bar (30.5 +/- 2 kgf/cm², 435.1 +/- 29 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)

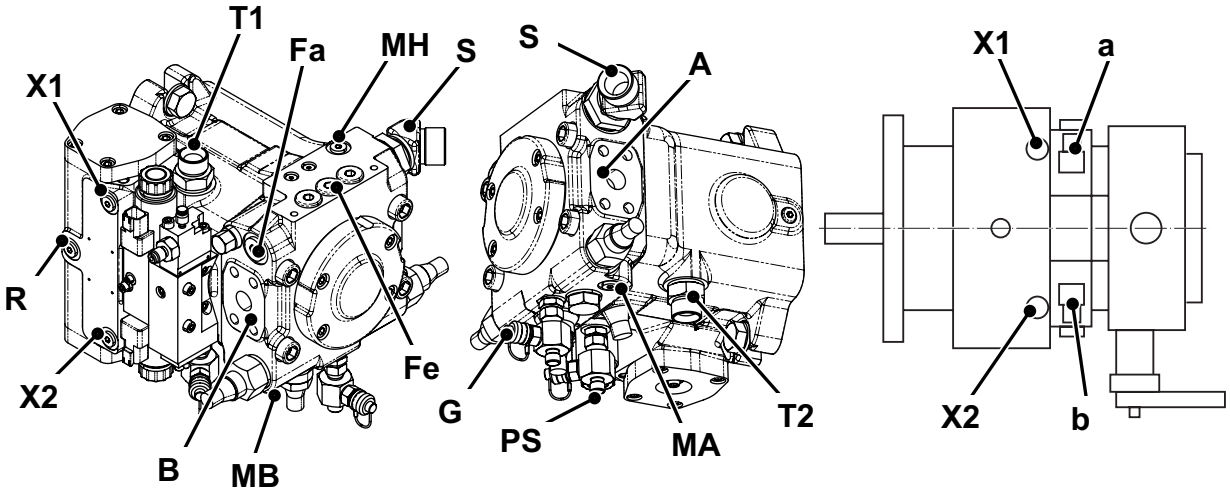
Table 17. Ports

Port	Service	Adaptor		Maximum Reading	Pressure Gauge
		Size	Part Number		
G	Charge Pressure	3/4 in 16 UNF 2B	TBA	40 bar (40.7 kgf/cm², 580 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)
Fa	Boost Pressure Outlet	3/4 in - 16 UNF 2B	TBA	40 bar (40.7 kgf/cm², 580 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)
Fe	Boost Pressure Outlet	M18 x 1.5	TBA	40 bar (40.7 kgf/cm², 580 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)
MH	Measuring High Pressure Test Point	7/16 in - 20 UNF 2B	TBA	450 bar (458 kgf/cm², 6526 lbf/in²)	0-600 bar (0-611 kgf/cm², 0-9000 lbf/in²)
R	Air Bleed	7/16 in - 20 UNF 2B	TBA	3 bar (3.05 kgf/cm², 43.5 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)
S	Suction Port	1 5/16 in - 12 UN 2B	TBA	5 bar (5.09 kgf/cm², 72.5 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)
T1/T2	Leakage Fluid and Filling/Drain Ports	7/8 in - 14 UNF 2B	TBA	3 bar (3.05 kgf/cm², 43.5 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)
T3	Hydraulic Return Line via Oil Cooler	3/4 BSP	TBA	3 bar (3.05 kgf/cm², 43.5 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)

Table 18.

Solenoid Actuated	Test Point for Control Pressure	Test Point for Operating Pressure
a (Forward)	X2	MB
b (Reverse)	X1	MA

20/34 kph Machines



C095390-C1

Fig 40. Pump

Table 19. Ports

Port	Service	Adaptor		Expected Reading		Pressure Gauge
		Size	Part Number	Forward (Solenoid B)	Reverse (Solenoid A)	
MA	High pressure	7/16 in - 20 UNF 2B	TBA	450 bar (458 kgf/cm², 6526 lbf/in²) at stall	NA	0-600 bar (0-611 kgf/cm², 0-9000 lbf/in²)
MB	High pressure	7/16 in - 20 UNF 2B	TBA	NA	450 bar (458 kgf/cm², 6526 lbf/in²) at stall	0-600 bar (0-611 kgf/cm², 0-9000 lbf/in²)
X1	Actuating pressure	7/16 in - 20 UNF 2B	TBA	2.5 bar (2.5 kgf/cm², 36.2 lbf/in²)	30 bar (30.5 kgf/cm², 435.1 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)
X2	Actuating pressure	7/16 in - 20 UNF 2B	TBA	30 bar (30.5 kgf/cm², 435.1 lbf/in²)	2.5 bar (2.5 kgf/cm², 36.2 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)

Table 20. Ports

Port	Service	Adaptor		Expected Reading		Pressure Gauge
		Size	Part Number	Idle (900 rpm)	Flight (2300 rpm)	
G	Charge Pressure Supply to Transmission Motor Test Point	HSP	TBA	25 +/- 2 bar (25.4 +/- 2 kgf/cm², 362 +/- 29 lbf/in²)	30 +/- 2 bar (30.5 +/- 2 kgf/cm², 435.1 +/- 29 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)
PS	Control/Pilot Pressure	HSP	TBA	5 +/- 2 bar (5.09 +/- 2 kgf/cm², 72+/- 29 lbf/in²)	30 +/- 2 bar (30.5 +/- 2 kgf/cm², 435.1 +/- 29 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)

Table 21. Ports

Port	Service	Adaptor		Maximum Reading	Pressure Gauge
		Size	Part Number		
G	Charge Pressure	9/16 in - 18 UNF 2B	TBA	40 bar (40.7 kgf/cm^2, 580 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
Fa	Boost Pressure Outlet	3/4 in - 16 UNF 2B	TBA	40 bar (40.7 kgf/cm^2, 580 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
Fe	Boost Pressure Outlet	M18 x 1.5	TBA	40 bar (40.7 kgf/cm^2, 580 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
MH	Measuring High Pressure Test Point	7/16 in - 20 UNF 2B	TBA	450 bar (458 kgf/cm^2, 6526 lbf/in^2)	0-600 bar (0-611 kgf/cm^2, 0-9000 lbf/in^2)
R	Air Bleed	7/16 in - 20 UNF 2B	TBA	3 bar (3.05 kgf/cm^2, 43.5 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
S	Suction Port	1 5/16 in - 12 UN 2B	TBA	5 bar (5.09 kgf/cm^2, 72.5 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
T1/T2	Leakage Fluid and Filling/Drain Ports	1 1/16 in - 12 UN 2B	TBA	3 bar (3.05 kgf/cm^2, 43.5 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
T3	Hydraulic Return Line via Oil Cooler	3/4 BSP	TBA	3 bar (3.05 kgf/cm^2, 43.5 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)

Table 22.

Solenoid Actuated	Test Point for Control Pressure	Test Point for Operating Pressure
a (Reverse)	X1	MB
b (Forward)	X2	MA

40 kph Machines

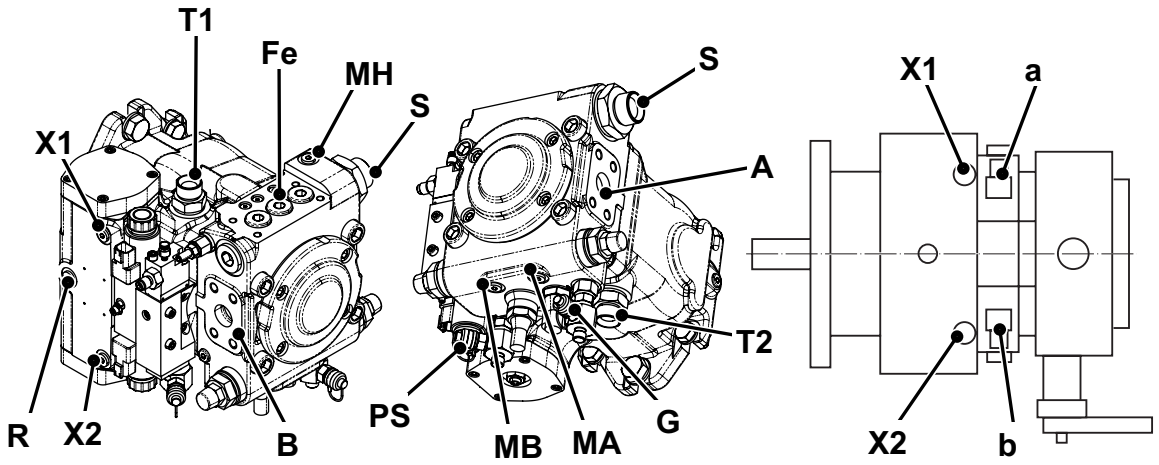


Fig 41. Pump

Table 23. Ports

Port	Service	Adaptor		Expected Reading		Pressure Gauge
		Size	Part Number	Forward (Solenoid B)	Reverse (Solenoid A)	
MA	High pressure	7/16 in - 20 UNF 2B	TBA	450 bar (458 kgf/cm², 6526 lbf/in²) at stall	NA	0-600 bar (0-611 kgf/cm², 0-9000 lbf/in²)
MB	High pressure	7/16 in - 20 UNF 2B	TBA	NA	450 bar (458 kgf/cm², 6526 lbf/in²) at stall	0-600 bar (0-611 kgf/cm², 0-9000 lbf/in²)
X1	Actuating pressure	7/16 in - 20 UNF 2B	TBA	2.5 bar (2.5 kgf/cm², 36.2 lbf/in²)	30 bar (30.5 kgf/cm², 435.1 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)
X2	Actuating pressure	7/16 in - 20 UNF 2B	TBA	30 bar (30.5 kgf/cm², 435.1 lbf/in²)	2.5 bar (2.5 kgf/cm², 36.2 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)

Table 24. Ports

Port	Service	Adaptor		Expected Reading		Pressure Gauge
		Size	Part Number	Idle (900 rpm)	Flight (2300 rpm)	
G	Charge Pressure Supply to Transmission Motor Test Point	HSP	TBA	25 +/- 2 bar (25.4 +/- 2 kgf/cm², 362 +/- 29 lbf/in²)	30 +/- 2 bar (30.5 +/- 2 kgf/cm², 435.1 +/- 29 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)
PS	Control/Pilot Pressure	HSP	TBA	5 +/- 2 bar (5.09 +/- 2 kgf/cm², 72+/- 29 lbf/in²)	30 +/- 2 bar (30.5 +/- 2 kgf/cm², 435.1 +/- 29 lbf/in²)	0-70 bar (0-71 kgf/cm², 0-1000 lbf/in²)

Table 25. Ports

Port	Service	Adaptor		Maximum Reading	Pressure Gauge
		Size	Part Number		
G	Charge Pressure	3/4 in - 16 UNF 2B	TBA	40 bar (40.7 kgf/cm^2, 580 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
Fa	Boost Pressure Outlet	1 1/16 in - 12 UNF 2B	TBA	40 bar (40.7 kgf/cm^2, 580 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
Fe	Boost Pressure Outlet	M22 x 1.5	TBA	40 bar (40.7 kgf/cm^2, 580 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
MH	Measuring High Pressure Test Point	7/16 in - 20 UNF 2B	TBA	450 bar (458 kgf/cm^2, 6526 lbf/in^2)	0-600 bar (0-611 kgf/cm^2, 0-9000 lbf/in^2)
R	Air Bleed	7/16 in - 20 UNF 2B	TBA	3 bar (3.05 kgf/cm^2, 43.5 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
S	Suction Port	1 5/8 in - 12 UN 2B	TBA	5 bar (5.09 kgf/cm^2, 72.5 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
T1/T2	Leakage Fluid and Filling/Drain Ports	1 1/16 in - 12 UN 2B	TBA	3 bar (3.05 kgf/cm^2, 43.5 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
T3	Hydraulic Return Line via Oil Cooler	3/4 BSP	TBA	3 bar (3.05 kgf/cm^2, 43.5 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)

Table 26.

Solenoid Actuated	Test Point for Control Pressure	Test Point for Operating Pressure
a (Forward)	X1	MA
b (Reverse)	X2	MB

Motor Port Identification

The pressures stated below are the expected pressures with all machine wheels off the ground, hydraulic oil temperature above 50 ºC and at maximum machine speed.

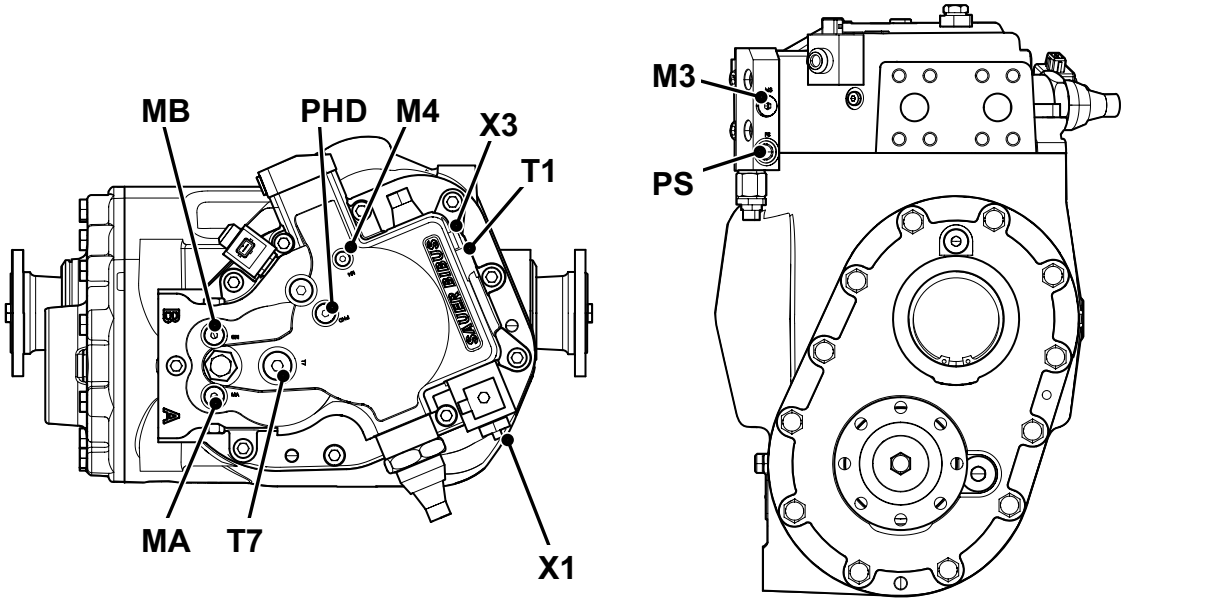


Fig 42. Motor

Port	Service	Size	Expected Reading	Pressure Gauge
M3	System Pressure Test Point (minimum angle)	M14 x 1.5	120 bar (122 kgf/cm^2, 1740 lbf/in^2) at stall (At low speed range setting - tortoise)	0-600 bar (0-611 kgf/cm^2, 0-9000 lbf/in^2)
M4	System Pressure Test Point (maximum angle)	M10 x 1	130 bar (132 kgf/cm^2, 1885 lbf/in^2)	0-600 bar (0-611 kgf/cm^2, 0-9000 lbf/in^2)
MA (Reverse High Pressure)	High pressure Test Point	M14 x 1.5	130 bar (132 kgf/cm^2, 1885 lbf/in^2)	0-600 bar (0-611 kgf/cm^2, 0-9000 lbf/in^2)
MB (Forward High Pressure)	High pressure Test Point	M14 x 1.5	25 bar (25.5 kgf/cm^2, 362 lbf/in^2)	0-600 bar (0-611 kgf/cm^2, 0-9000 lbf/in^2)
PS	Charge Pressure Supply from Transmission Pump	Use in-line T piece	25 to 27 bar (25.5 to 27.5 kgf/cm^2, 362 to 391 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
T1	Leakage/Case Lubrication from Transmission Pump	M26 x 1.5	2 bar (2 kgf/cm^2, 29 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
T3	Hydraulic Return Line via Oil Cooler	M26 x 1.5	1.8 bar (1.83 kgf/cm^2, 26 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
T7	Hydraulic Return Line with Oil Cooler Test Point	M20 x 1.5	1.8 bar (1.83 kgf/cm^2, 26 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)
X1	Control/Pilot Pressure Supply from Transmission Pump	Use in-line T piece	27 to 30 bar (27.5 to 30.5 kgf/cm^2, 391 to 435.1 lbf/in^2)	0-70 bar (0-71 kgf/cm^2, 0-1000 lbf/in^2)

General Precautions

⚠ WARNING

When working close to the machine with the engine running, protective clothing must be worn, ie. Safety glasses, ear protection, gloves etc.

GEN-4-3

⚠ WARNING

If a 4 wheel drive machine is to be raised and the engine/transmission run, make sure all four wheels are off the ground and supported by axle stands. If only one pair of wheels is raised, the machine could still drive through the other axle.

TRANS-2-2_2

Make sure that the hydraulic fluid is at correct working temperature (50 °C, 122 °F).

Charge Pressure

⇨ *General Precautions (F4-63)*

Note: *Refer to the pump port identification pages for test port locations.* ⇨ *Pump Port Identification (F4-56)*

1 Stop the engine.

2 Connect a 0 - 70 bar (0 - 1000 lb/in^2) pressure gauge to the test point **G**.

3 Run engine at maximum speed with transmission in neutral and check pressure is as specified. ⇨ *Specifications (F4-3)*

Pump Actuating Pressure

⇨ *General Precautions (F4-63)*

Note: *Refer to the pump port identification pages for test port locations.* ⇨ *Pump Port Identification (F4-56)*

1 Stop engine.

2 Make sure the machine will not move in forward or reverse as this test requires the transmission to be in drive. Block the machine against a wall or other sturdy obstacle.

3 Raise the boom and fit the safety strut. Refer to ***Section 2 - General Procedures***. ⇨ *Related Topics (F4-2)*

4 Remove the deck plate. Refer to ***Section 3 - Access Panels***. ⇨ *Related Topics (F4-2)*

Note: *If you need to test the pressure for one travel direction only, connect one gauge and blank one port.*

5 Using a 3/16 allen key remove the blanking plugs in the X1 and X2 pump ports.

6 Connect two 0-70 bar (0-1000 lbf/in^2) pressure gauges into the pump ports X1 and X1 (the port direction depends on machine model.

7 Select drive direction using column switch.

⚠ CAUTION

Do not hold the transmission in drive for more than 10 seconds or serious overheating will occur.

0086

8 Run engine at full r.p.m., release handbrake and make sure that there is no wheel slip.

9 Check that the pressure is as specified. ⇨ *Specifications (F4-3)*

10 If the pressure is not as specified, check or renew the relief valves then re-test.

Pump High Pressure

⇨ *General Precautions (F4-63)*

Note: *Refer to the pump port identification pages for test port locations.* ⇨ *Pump Port Identification (F4-56)*

1 Stop engine.

2 Make sure the machine will not move in forward or reverse as this test requires the transmission to be in drive. Block the machine against a wall or other sturdy obstacle.

3 Raise the boom and fit the safety strut. Refer to ***Section 2 - General Procedures***. ⇨ *Related Topics (F4-2)*

4 Remove the deck plate. Refer to ***Section 3 - Access Panels***. ⇨ *Related Topics (F4-2)*

5 Using a 3/16 allen key remove the blanking plugs in the Ma and Mb pump ports.

6 Connect two 0-600 bar (0-9000 lbf/in^2) pressure gauges into the pump ports Ma and Mb.

7 Select drive direction using column switch.

⚠ CAUTION

Do not hold the transmission in drive for more than 10 seconds or serious overheating will occur.

0086

8 Run engine at full r.p.m., release handbrake and make sure that there is no wheel slip.

9 Check the pressure at test points Ma and Mb. The direction of flow through these ports varies depending on machine model. Make sure to check the flow direction. ⇨ *Pump Port Identification (F4-56)*

10 Check that the pressure is as specified. ⇨ *Specifications (F4-3)*

11 If the pressure is not as specified, check or renew the relief valves then re-test.

Displacement Angle Control Valve (DA)

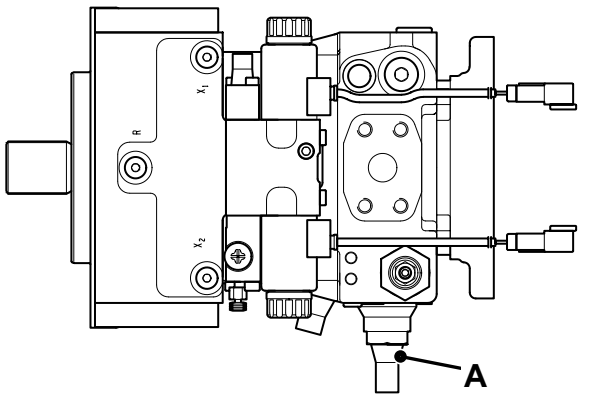


Fig 43.

This procedure is to test that the displacement angle control valve **A** is working correctly.

⇨ *General Precautions (F4-63)*

⚠ WARNING

If a 4 wheel drive machine is to be raised and the engine/transmission run, make sure all four wheels are off the ground and supported by axle stands. If only one pair of wheels is raised, the machine could still drive through the other axle.

TRANS-2-2_2

1 Raise all four wheels off the ground and support the machine with axle stands.

2 Raise the boom and fit the safety strut. Refer to ***Section 2 - General Procedures***. ⇨ *Related Topics (F4-2)*

3 Remove the deck plate. Refer to ***Section 3 - Access Panels***. ⇨ *Related Topics (F4-2)*

4 Apply the throttle gradually. The road wheels should start to turn at around 1000 to 1100 r.p.m.

Directional Control Valve (DCA)

⇒ *General Precautions (F4-63)*

1 Make sure the machine will not move in forward or reverse as this test requires the transmission to be in drive. Block the machine against a wall or other sturdy obstacle.

2 Raise the boom and fit the safety strut. Refer to ***Section 2 - General Procedures***. ⇒ *Related Topics (F4-2)*

3 Remove the deck plate. Refer to ***Section 3 - Access Panels***. ⇒ *Related Topics (F4-2)*

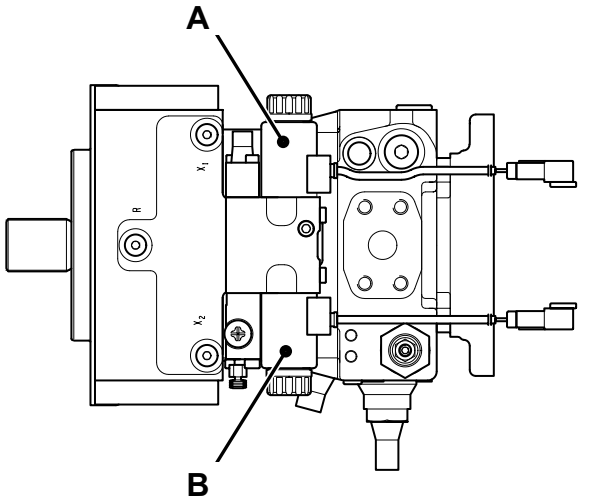


Fig 44.

4 Select the drive direction using the column switch.

5 Check the solenoids operate correctly according to the direction selected. ⇒ *Pump Port Identification (F4-56)*

Motor Solenoid Testing

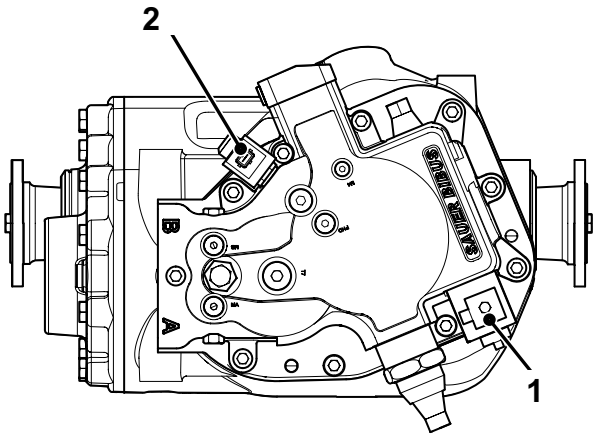


Fig 45.

Reverse Solenoid

1 Make sure the machine will not move in forward or reverse as this test requires the transmission to be in drive. Block the machine against a wall or other sturdy obstacle.

2 Raise the boom and fit the safety strut. Refer to ***Section 2 - General Procedures***. ⇨ *Related Topics (F4-2)*

3 Remove the deck plate. Refer to ***Section 3 - Access Panels***. ⇨ *Related Topics (F4-2)*

4 Select the drive direction using the column switch.

5 Check that the solenoid **2** operates correctly according to the direction selected.

Table 27. Reverse Solenoid Operation

Solenoid	Operation
Forward	Coil De-energised (0V / 6-6.5 Ohms)
Reverse	Coil Energised (12V)

Low Speed Solenoid

1 Make sure the machine will not move in forward or reverse as this test requires the transmission to be in drive. Block the machine against a wall or other sturdy obstacle.

2 Raise the boom and fit the safety strut. Refer to ***Section 2 - General Procedures***. ⇨ *Related Topics (F4-2)*

3 Remove the deck plate. Refer to ***Section 3 - Access Panels***. ⇨ *Related Topics (F4-2)*

4 Select the drive direction using the column switch.

5 Select high or low speed operation using the switch as required.

6 Check that the solenoid **1** operates correctly according to the speed range selected.

Table 28. Low Speed Solenoid Operation

Solenoid	Operation
Low	Coil De-energised (0V)
High	Coil Energised (12V / 5 Ohms +/- 2)

Priming Procedure

Note: *Refer to the pump port identification pages for test port locations.* ⇨ ***Pump Port Identification (F4-56)***

Important: *If a new or rebuilt pump is being fitted always refill the pump with filtered oil prior to start up. Disconnect the hose from the T1 port and pour 2 litres of oil into the pump. Use the correct fluid (see* ***Section 3 - Lubricants and Capacities****).*

The following start-up procedure should always be followed when starting up a new installation or when restarting an installation in which either a pump or motor has been removed from the system.

⚠ WARNING

The following procedure requires the machine to be disabled (wheels raised off the ground, attachment disconnected etc.) while the work is carried out.

HYD-8-1_2

1 Place the machine safely onto blocks, so that all four wheels are clear of the ground. Ensure that the machine is stable.

⚠ WARNING

It is not possible to vent all residual pressure. Loosen the connection one full turn and allow the pressure to dissipate. Keep face and hands well clear of pressurised hydraulic oil and wear protective glasses.

HYD-4-3

⚠ WARNING

Fluid Under Pressure

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear protective glasses and gloves. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

INT-3-1-10_3

2 Fill the hydraulic tank with the correct fluid (see ***Lubricants and Capacities,*** Section 3) via a 10 micron filter (no by-pass).

3 Raise the boom and fit the safety strut. Refer to ***Section 2 - General Procedures***. ⇨ ***Related Topics (F4-2)***

4 Remove the deck plate. Refer to ***Section 3 - Access Panels***. ⇨ ***Related Topics (F4-2)***

5 Check that the pump inlet line from the hydraulic filter to the pump unit is filled with fluid, by slackening the hose connection at the loader pump.

6 Bleed air from the pump casing by slackening the case drain hose connections **T1** and **T2** until oil flows freely, then retighten the connections.

7 Install a 0 - 40 bar (0 - 600 lbf/in^2, 0 - 42 kgf/cm^2) pressure gauge in the charge pressure test point **G**.

8 Remove the ESOS fuse to prevent the engine from starting. With the Forward/Reverse switch (in the cab) at Neutral, 'jog' the engine using the starter. The pressure gauge should show a small rise in pressure as the engine turns. If so, replace the ESOS fuse and operate the starter whilst slowly increasing the throttle lever setting until the engine starts and runs at the lowest possible speed. For fuse details refer to ***Section 3 - Electrics***.⇨ ***Related Topics (F4-2)***

9 As air leaves the system, the charge pressure (as indicated on the gauge) should rise to a minimum of 2.5 bar (2.5 kgf/cm^2, 36.2 lbf/in^2). If charge pressure is not registered on the gauge, shut-down and determine the cause.

10 Once charge pressure has been established, operate the drive system 10 times in all directions with the engine at idle then slowly increase the engine speed whilst continuing to operate the system. Finally operate the system in all directions several times with the engine running at maximum speed.

11 Check the charge pressure at maximum engine speed which should be as specified. ⇨ ***Specifications (F4-3)***

12 Stop the engine and remove the gauge. Check the system for leaks and top up the fluid as necessary.

Moving A Disabled Machine

Towing

Important: *Towing a machine too far or too fast can damage the transmission. When towing prepare the machine as described below. Failure to comply will result in lack of lubrication and seizure of the transmission motor and pump.*

Note: *Machine can be towed for 25 metres at a maximum speed of 1 kph, without removing the propshafts.*

Important: *Use a rigid drawbar. If a towing chain must be used, then use two towing vehicles. One towing vehicle should be coupled to the front of the disabled machine. The other towing vehicle should be coupled to the rear of the disabled machine, to provide braking power. The towing vehicle must have enough pulling and braking power to move and stop the machine.*

1 Using suitable lifting equipment, remove any payload from the machine.

2 Place chocks both sides of each wheel.

3 Attach a rigid tow bar between a suitable connection point on the machine and the towing vehicle.

4 Remove the propshafts. ⇒ ***Propshafts (F8-1)***

Important: *When the propshafts are disconnected, the park brake will become ineffective.*

Important: *Make sure to replace the parkbrake disc retaining nuts after the removal of the rear propshaft.*

5 Remove the wheel chocks from each wheel and tow the machine to a place of repair. When towing is complete, place chocks both sides of each wheel.

6 Remove the tow bar and wheel chocks.

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Dual Control SYSTEM

Introduction

This topic contains information about a machine SYSTEM. The system has some devices that connect either mechanically, hydraulically or electrically. Make sure you are referring to the correct system. Refer to the applications table.

Descriptions and procedures relate to the system and not the individual devices. For information about the devices refer to the relevant topics.

This topic is intended to help you understand what the system does and how it works. Where applicable it also includes fault finding, test and service procedures.

⇨ *Related Topics (F5-2)*
⇨ *Component Identification (F5-3)*
⇨ *Operation Overview (F5-4)*
⇨ *Electrical Operation and Schematics (F5-5)*

Related Topics

Table 1. Related Topics in This Publication

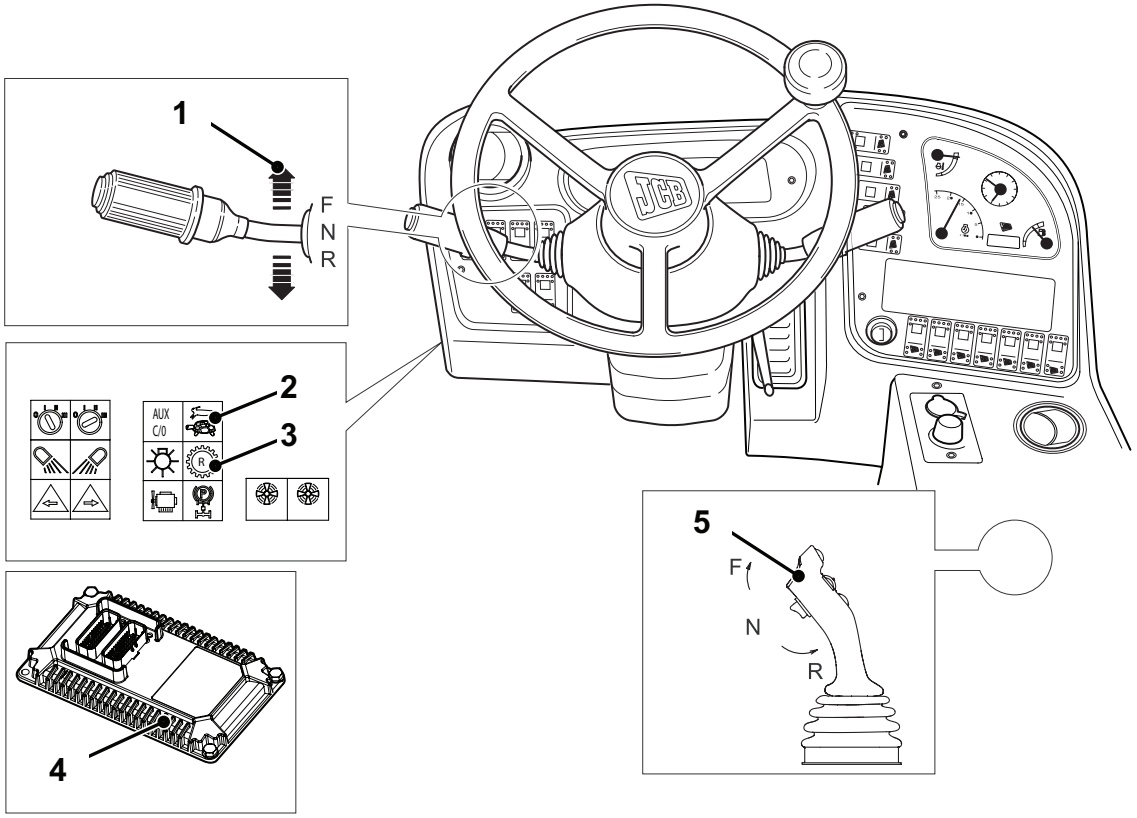
The table lists other topics in the manual that contain information related to this topic. Refer to the applicable topics to complete your procedures. Where applicable the text in this section contains cross references to this page to help you find the correct information. Some machines have different systems and devices. Make sure you refer to the correct topic, refer to *Section 1 - Applications*.		
Sections	**Topic Titles**	**Sub Titles**
1	Applications	ALL
2	ALL (Care and Safety)(1)	ALL
C	***Fuses and Relays***	ALL
C	***Electrical Harness SYSTEM***	ALL
F	***⇨ Hydrostatic Transmission SYSTEM (F4-1)***	***⇨ Electrical Operation and Schematics (F5-5)***

(1) You must obey all of the relevant care and safety procedures.

Component Identification

ECU Input Devices	
1	Column Forward / Neutral / Reverse selection switch
2	High/Low Drive Relay
3	Reverse Drive Relay

ECU Input Devices	
4	Transmission Control ECU
5	Joystick Forward / Neutral / Reverse selection switch



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Fig 1. Components

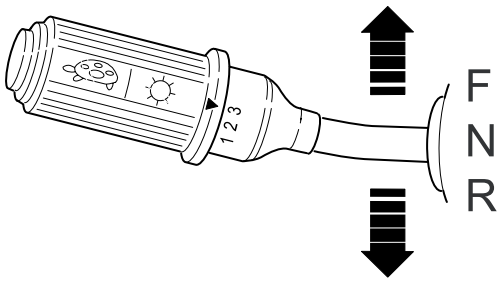
Operation Overview

There are two methods of selecting the drive direction.

- The column F/N/R switch ⇒ *Fig 2. (F5-4)*
- The joystick F/N/R switch ⇒ *Fig 3. (F5-4)*

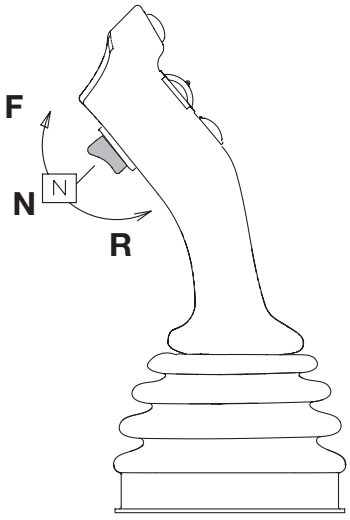
The transmission ECU is used to control the drive direction selection. It co-ordinates the direction selection between the Joystick F/N/R switch and the column F/N/R switch.

There is a logic control to the direction selection. Selection of F or R with the column switch disables the joystick F/N/R switch. Both the joystick and column switch must first be set to N before the joystick switch is enabled.



C053880

Fig 2. Column F/N/R Switch



C053890

Fig 3. Joystick F/N/R Switch

Electrical Operation and Schematics

Electrical Schematics

⇨ Fig 4. (F5-5), ⇨ Fig 5. (F5-6), ⇨ Fig 6. (F5-7)	
C014	Joystick/control lever connector 2
C016	Joystick/control lever connector 4
C047	Transmission ECU Connector J2
C050	Controller Earth Point
P01/C001	Panel Harness connector to Chassis Harness connector 1
P3	Fusebox B
P16	Column switch LH

Note: *For ECU power supply and earths refer to* ***Section F - Hydrostatic Transmission SYSTEM*** *topic.* ⇨ ***Related Topics (F5-2)***

⇨ ***Fig 4. (F5-5)***

When the column F/N/R switch **P16** is in neutral it sends an input to pin 31 of the ECU **C047**. When the ECU receives this input it allows a power supply to the joystick F/N/R switch **C014** to allow the drive direction to be selected.

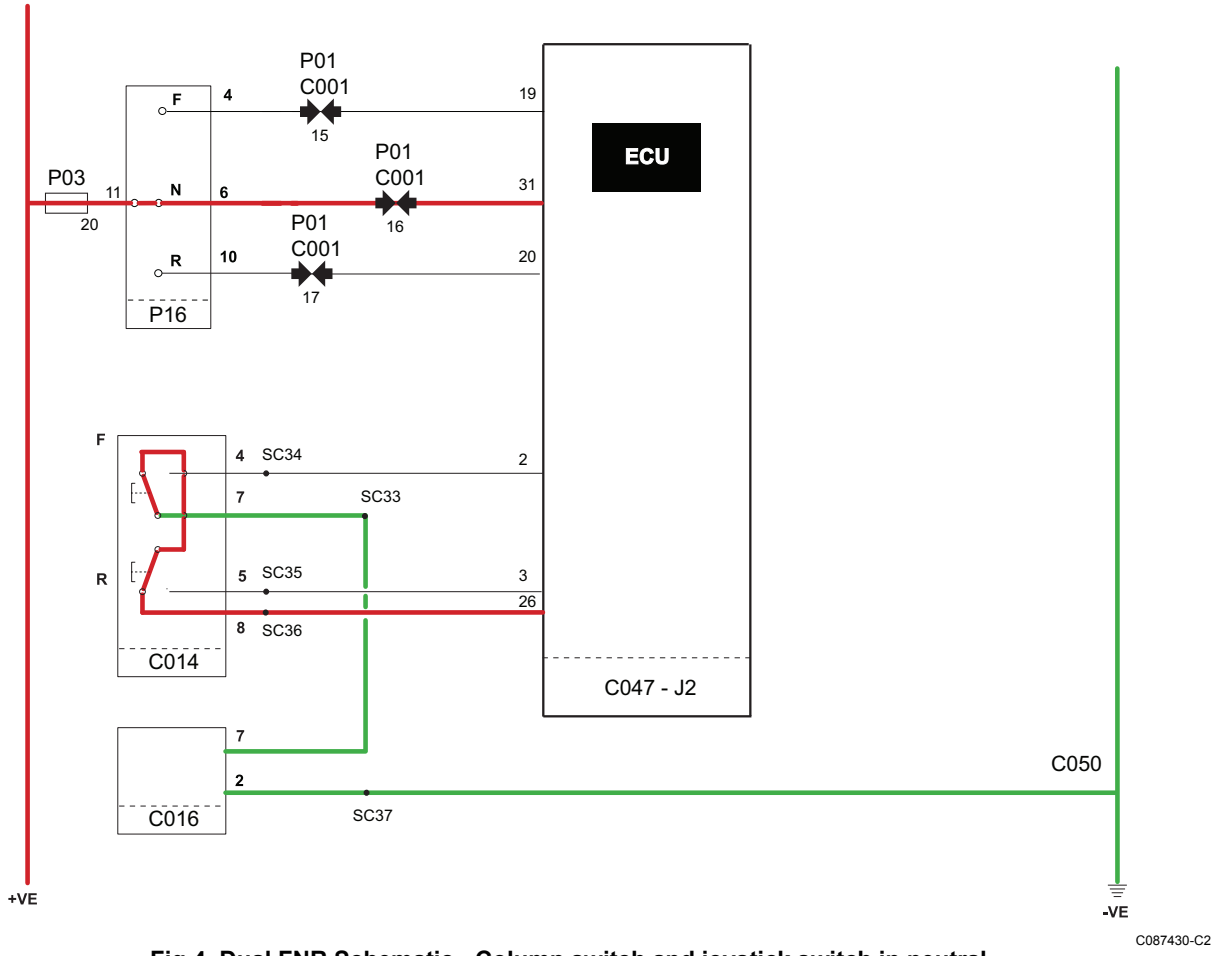


Fig 4. Dual FNR Schematic - Column switch and joystick switch in neutral

⇒ *Fig 5. (F5-6)*

If the column F/N/R switch **P16** is in forward or reverse the ECU **C047** will receive an input on pin 19 (forward) or pin 20 (reverse). When this input is present the ECU will not supply the joystick FNR switch **C014** with power. This prevents the column switch and joystick switch being operated at the same time. The joystick forward **F** and reverse **R** switches will only operate with the column switch **P16** in neutral.

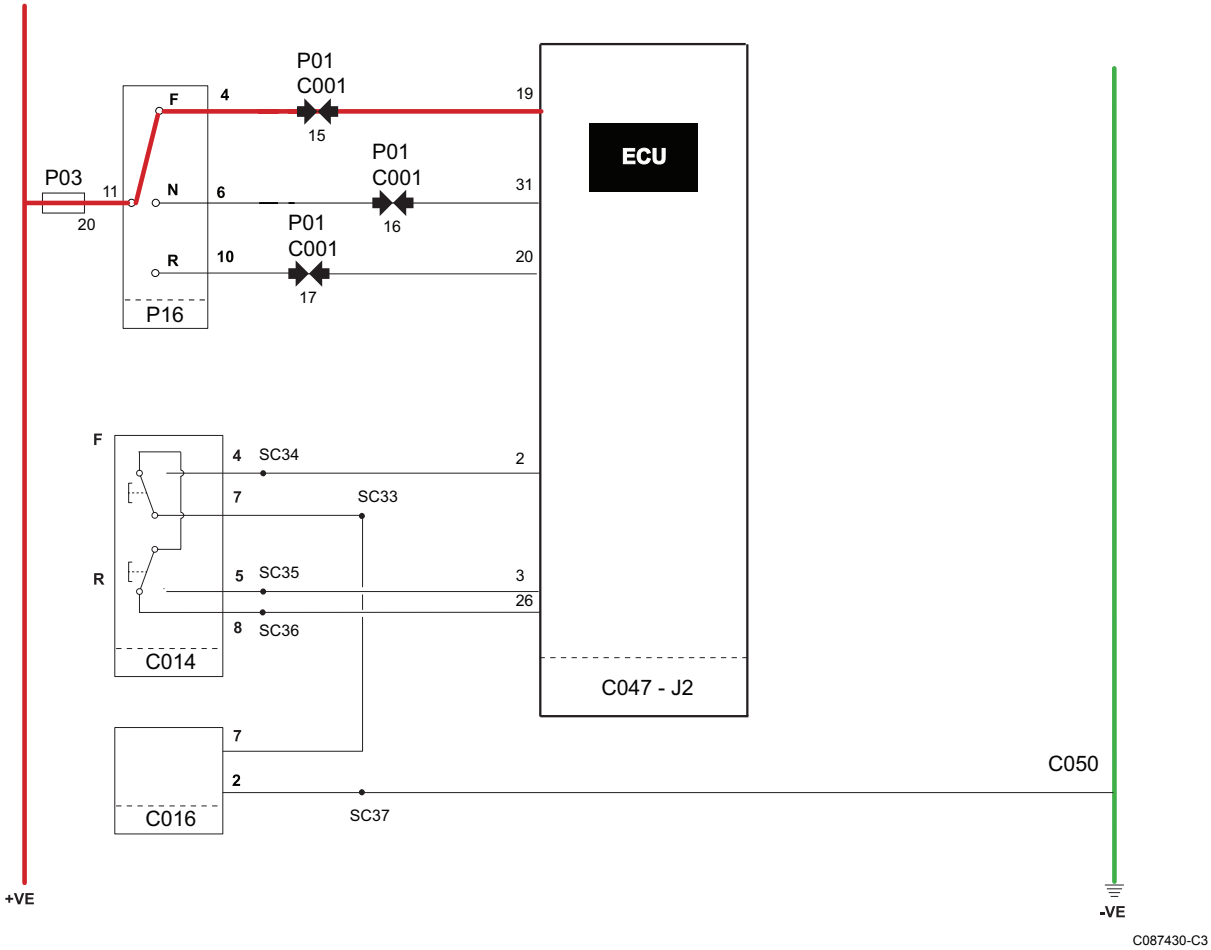


Fig 5. Dual FNR Schematic - Column switch in forward

⇒ *Fig 6. (F5-7)*

When the column F/N/R switch **P16** is in neutral it sends an input to pin 31 of the ECU **C047**. When this input is present the ECU supplies the joystick FNR switch **C014** with power. When the joystick switch is in forward or reverse the ECU **C047** will receive an input on pin 2 (forward) or pin 3 (reverse)

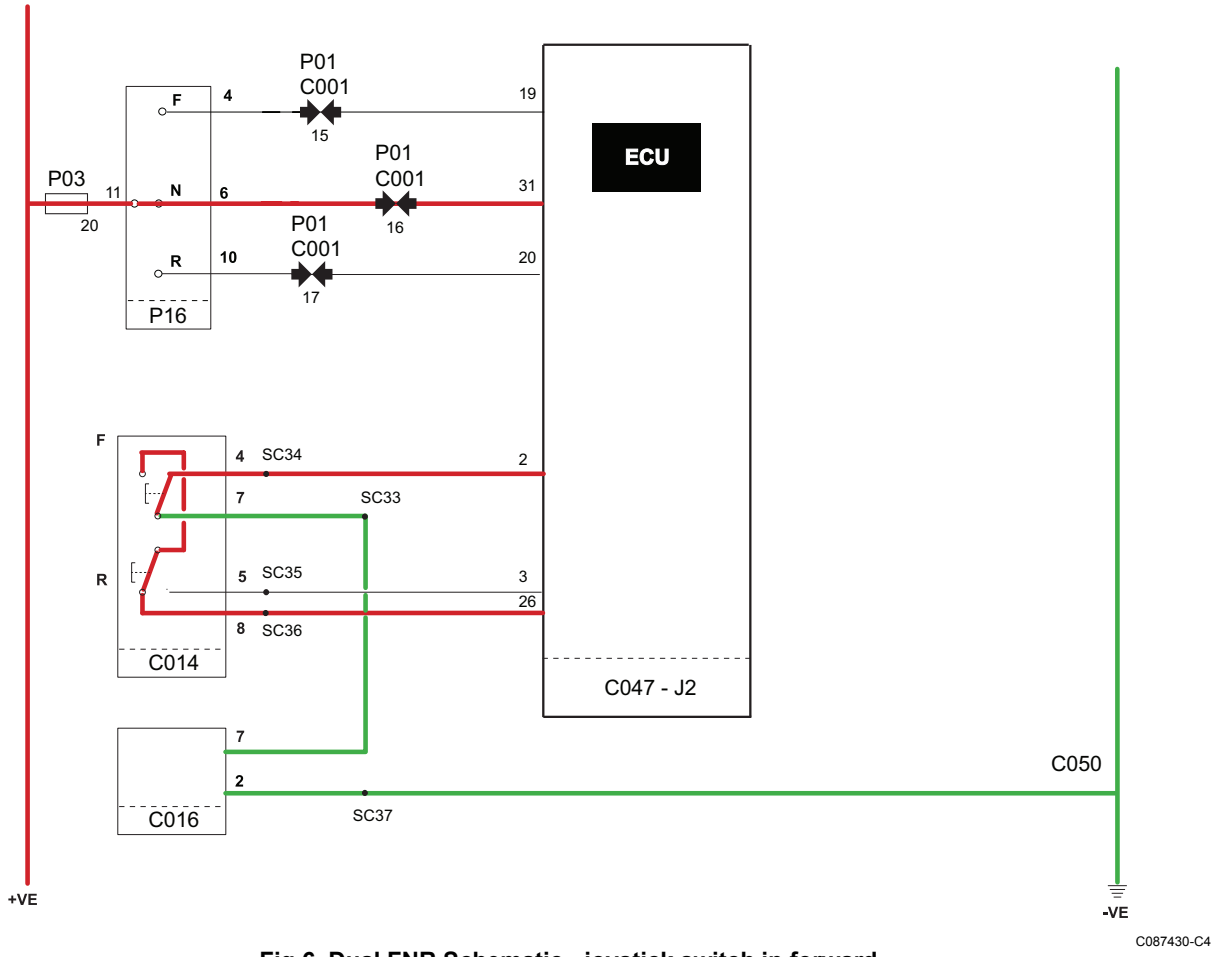


Fig 6. Dual FNR Schematic - joystick switch in forward

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Hydrostatic Drive Motor

Introduction

This topic contains information about a machine DEVICE. Make sure you are referring to the correct device. Refer to the applications table.

Descriptions and procedures relate to the device and not related systems. For information about the systems refer to the relevant topics.

This topic is intended to help you understand what the device does and how it works. Where applicable it also includes procedures such as removal and replacement and dismantle and assemble.

⇨ *Related Topics (F6-2)*
⇨ *Removal and Replacement (F6-3)*
⇨ *Component Replacement (F6-7)*
⇨ *High/Low Speed Solenoid (F6-8)*
⇨ *Direction Valve Solenoid (F6-9)*
⇨ *Displacement Valve Block (F6-10)*
⇨ *Break Pressure Defeat Valve (F6-11)*
⇨ *Flushing Relief Valve (F6-11)*
⇨ *Flushing Valve Spool (F6-12)*
⇨ *PCOR Cartridge (F6-13)*

Related Topics

Table 1. Related Topics in This Publication

The table lists other topics in the manual that contain information related to this topic. Refer to the applicable topics to complete your procedures. Where applicable the text in this section contains cross references to this page to help you find the correct information. Some machines have different systems and devices. Make sure you refer to the correct topic, refer to *Section 1 - Applications*.		
Sections	**Topic Titles**	**Sub Titles**
1	***Applications***	ALL
1	***Service Tools***	ALL
2	ALL (Care and Safety)(1)	ALL
3	***Routine Maintenance***	***Transmission***
3	***Routine Maintenance***	***Access Panels***
B	***Chassis Panels***	ALL
F	***⇨ Hydrostatic Transmission SYSTEM (F4-1)***	ALL

(1) You must obey all of the relevant care and safety procedures.

Removal and Replacement

Important: *After replacing the transmission motor do not start the engine until the correct start-up procedure has been carried out. Failure to carry out the procedure may cause the transmission pump and motor to be damaged.* ⇨ ***Priming Procedure (F4-68)***

Park the machine and make it safe with the boom raised. Obey the care and safety procedures. See ***Section 2 - General Procedures***. ⇨ ***Related Topics (F6-2)***

⚠ WARNING

Make the machine safe before working underneath it. Park the machine on level ground, lower the attachments to the ground. Apply the park brake, put the transmission in neutral and stop the engine. Block both sides of all four wheels.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-4-1_1

When disconnecting hydraulic pipework ensure that sufficient receptacles are in place to catch any leakages of hydraulic fluid.

Removal

1 Release the hydraulic pressure. See ***Section 2 - General Procedures***. ⇨ ***Related Topics (F6-2)***

Important: *If the machine has the trailer brake option, make sure to release the accumulator pressure. To do this turn the starter key to off and apply the brake pedal repeatedly until there is no resistance at the pedal.*

2 Remove the deck plate and undershields. Refer to ***Section 3 - Access Panels***. ⇨ ***Related Topics (F6-2)***

3 Raise the machine until the axles are at a minimum height of 660 mm (2ft 2 inches).

4 Remove the propshafts. ⇨ ***Propshafts (F8-1)***

5 Remove the engine cover and engine pod. Refer to ***Section B - Chassis Panels***. ⇨ ***Related Topics (F6-2)***

6 Support the cooling pack.

7 Remove the bolts **A** and hoses **B** from the cooling pack.

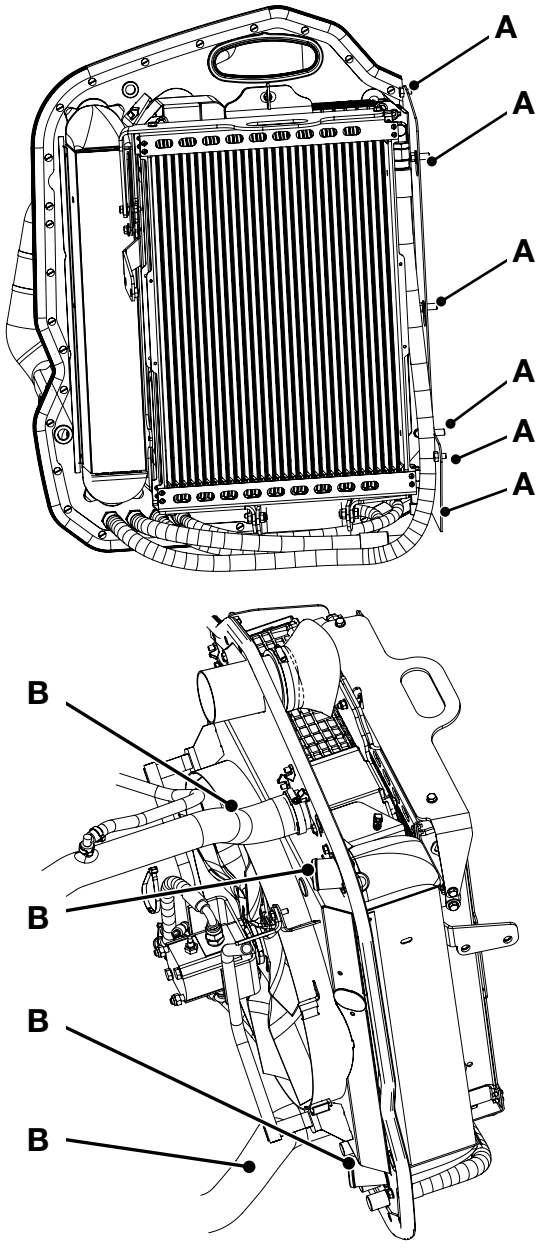
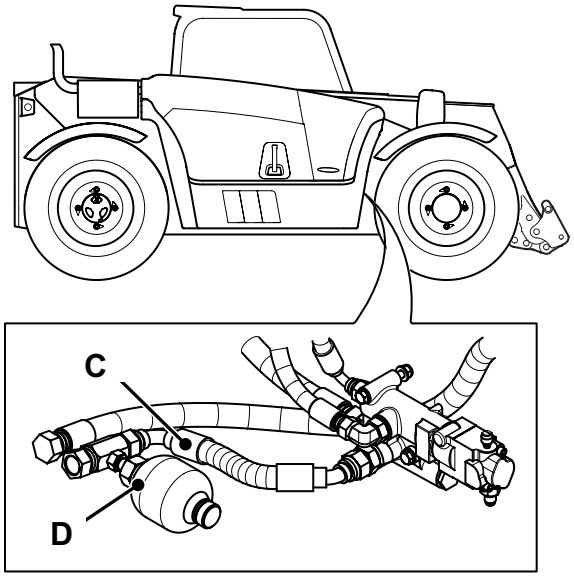


Fig 1.

8 Disconnect the trailer brake hose **C** from the accumulator **D** (if fitted).

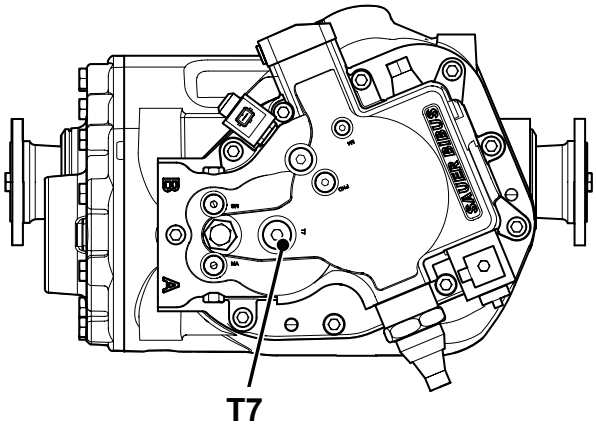


C096500

Fig 2.

9 Move the lower part of the cooling pack towards the front axle and secure.

10 Remove blanking plug and install lifting eye to port **T7**. For lifting eye details refer to ***Section 1 - Service Tool***s. ⇨ *Related Topics (F6-2)*



C095400-C13

Fig 3.

11 Put a label on the motor hydraulic hoses to aid replacement.

12 Disconnect and plug the motor hydraulic hoses **F**,**G** and **L** to prevent fluid loss and contamination.

Note: *A modified spanner will be required to disconnect hose L from the transmission motor. Refer to* ***Section 1 - Service Tools***. ⇨ *Related Topics (F6-2)*

13 Remove bolts **N** to disconnect the loop hoses **P** from the pipes **M**.

14 Disconnect the electrical connections to the solenoid valves **E** and **H**.

15 Attach lifting equipment to the lifting eye and support the weight of the motor.

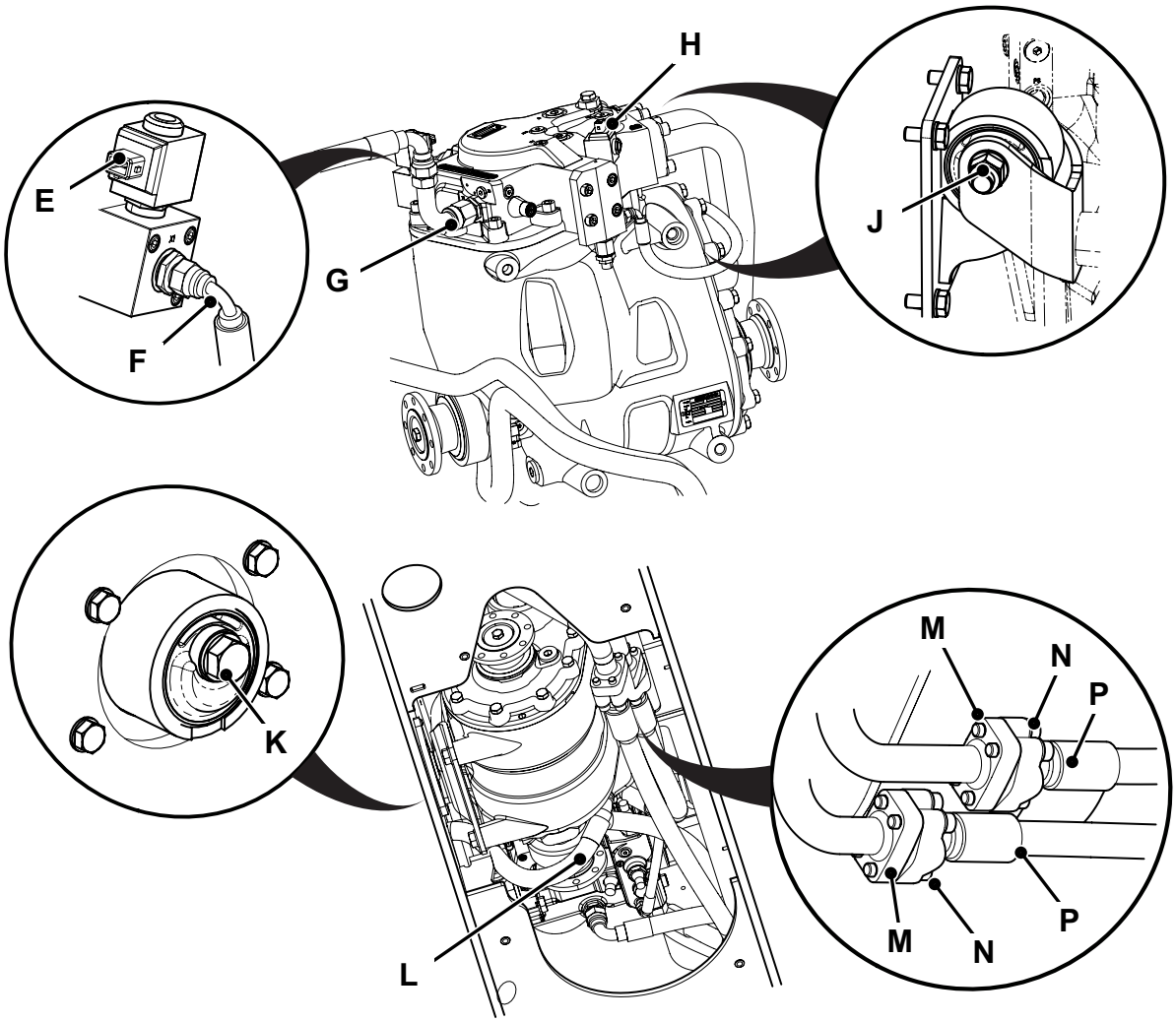
16 Place a suitable trolley below the motor.

17 Remove the motor mounting bolts **K** and **J**.

18 Lower the motor out of the chassis and onto the trolley.

19 Wheel the motor clear of the machine.

Replacement



C096510

Fig 4.

Important: *After replacing the transmission motor do not start the engine until the correct start-up/priming procedure has been carried out.* ⇨ ***Priming Procedure (F4-68)***. *Failure to carry out the procedure may cause the transmission pump and drive motor to be damaged.*

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

– Apply JCB Threadlocker and Sealant and torque tighten all bolts. ⇨ ***Table 2. Torque Settings (F6-6)***
– Check the hydraulic fluid level, refer to ***Section 3 - Routine Maintenance***. ⇨ ***Related Topics (F6-2)***
– Torque tighten the **T7** blanking plug and the loop hose clamp bolts **N**. ⇨ ***Table 2. Torque Settings (F6-6)***

Table 2. Torque Settings

Item	Nm	kgf m	lbf ft
T7	80	8.1	59
N(1)	65	6.6	48
N(2)	42	4.3	31

(1) 40 Kph machines only
(2) 20,25 and 34 Kph machines

Component Replacement

The motor assembly is a non serviceable part. Some of the external components may be replaced.

For the procedures that follow, the motor must be removed from the machine: ⇨ ***Removal and Replacement (F6-3)***

- ⇨ ***Displacement Valve Block (F6-10)***
- ⇨ ***PCOR Cartridge (F6-13)***

The procedures that follow can be carried out with the motor in place on the machine:

Note: *Make sure to park the machine and make it safe. Refer to* ***Section 2 - General Procedures****. Remove the chassis deck plates, refer to* ***Section 3 - Access Panels****.*

- ⇨ ***Direction Valve Solenoid (F6-9)***
- ⇨ ***Break Pressure Defeat Valve (F6-11)***
- ⇨ ***High/Low Speed Solenoid (F6-8)***
- ⇨ ***Flushing Relief Valve (F6-11)***

High/Low Speed Solenoid

Removal

1 Disconnect the electrical connector at the solenoid coil **C**.

2 Unscrew the knurled nut **A** and remove 'O' ring **B**.

3 Remove the solenoid coil **C** from the valve.

4 Remove the valve **D** from the motor.

Replacement

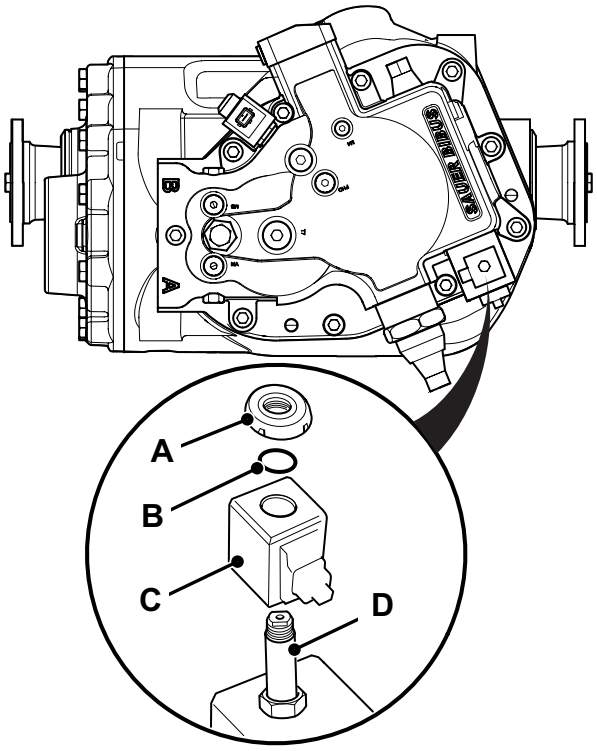
Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

– Replace `O' ring **B** and make sure it is located correctly.
– Make sure that the needle valve in the solenoid valve **D** is free to move. If it is seized renew the valve.

Table 3. Torque Settings

Item	Nm	kgf m	lbf ft
D	35	3.57	25.8



C095400-C14

Fig 5.

Direction Valve Solenoid

Removal

1 Disconnect the electrical connector at the solenoid coil **C**.

2 Unscrew the knurled nut **A** and remove 'O' ring **B**.

3 Remove the solenoid coil **C** from the valve.

4 Remove the valve **D** from the motor.

Replacement

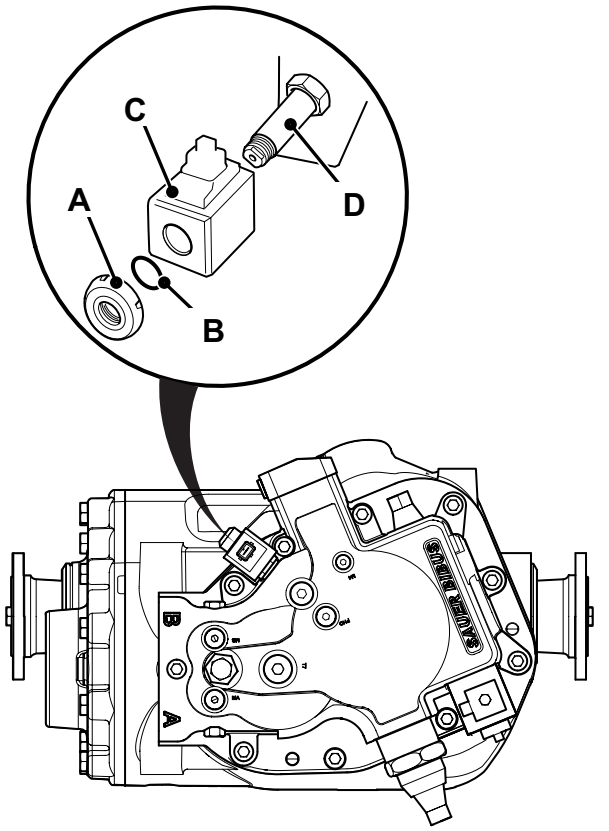
Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

- Replace `O' ring **B** and make sure it is located correctly.
- Make sure that the needle valve in the solenoid valve **D** is free to move. If it is seized renew the valve.

Table 4. Torque Settings

Item	Nm	kgf m	lbf ft
D	35	3.57	25.8



C095400-C15

Fig 6.

Displacement Valve Block

Removal

Note: *Make sure to have new 'O' rings available before doing this procedure.*

Note: *Note the position of the valve block, spool, orifice and sleeve before dismantling to aid replacement.*

This component is not serviceable. If the spool or orifice are not serviceable the block must be replaced.

1 Disconnect the electrical connector from the solenoid **D**.

2 Use a 4mm allen key to remove the valve block securing screws **C**.

3 Remove the valve block **B** from the motor.

Replacement

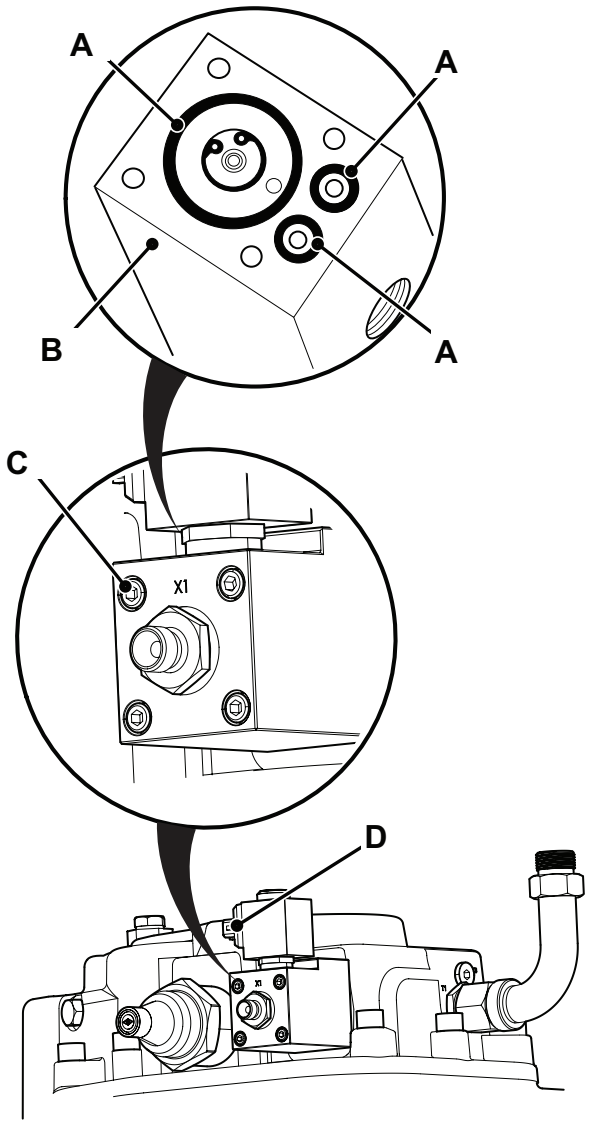
Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

– Replace the `O' rings **A** and make sure that they are located correctly.

Table 5. Torque Settings

Item	Nm	kgf m	lbf ft
C	10	1	7.4



C094390-C2

Fig 7.

Break Pressure Defeat Valve

Removal

Note: *Note the position of the valve spool as it is removed from the motor to aid replacement.*

1 Remove the blanking plug **A**.

2 Using a magnet remove the break pressure defeat valve spool **B** out through the top of the motor.

Replacement

Replacement is the opposite of the removal procedure.

Table 6. Torque Settings

Item	Nm	kgf m	lbf ft
A	30	3.05	22.1

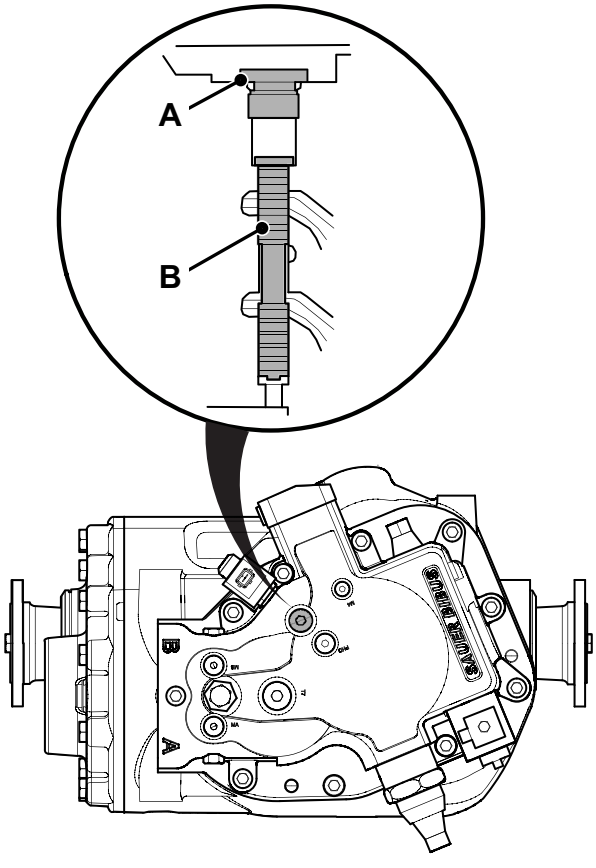


Fig 8.

Flushing Relief Valve

Removal

Note: *Make sure to have new 'O' rings available before doing this procedure.*

1 Use a spanner to remove the flushing valve **A** from the motor.

Replacement

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

– Replace the `O' rings **B** and make sure that they are located correctly.

Table 7. Torque Settings

Item	Nm	kgf m	lbf ft
A	30	3.05	22.1

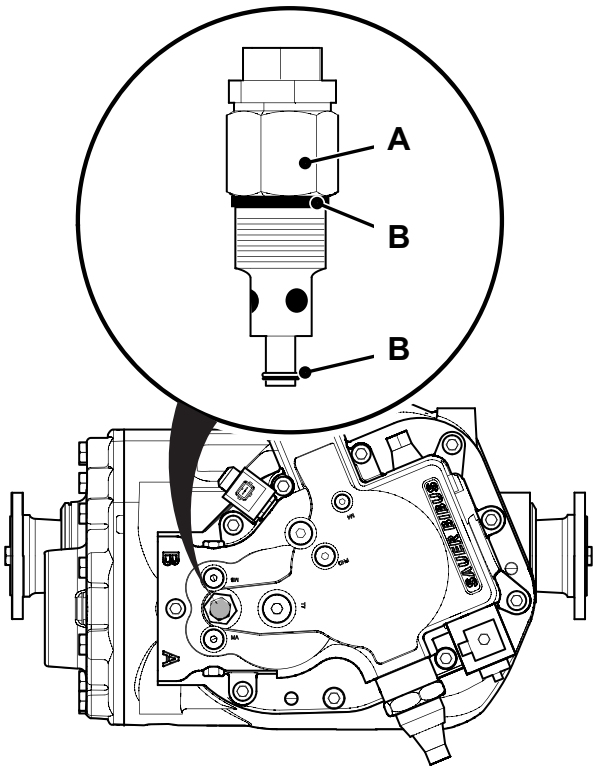


Fig 9.

Flushing Valve Spool

Removal

Note: *Make sure to have new 'O' rings available before doing this procedure.*

Note: *Note the position of the valve spool before dismantling to aid replacement.*

1 Remove the flushing valve. ⇨ *Flushing Relief Valve (F6-11)*

2 Use a spanner to remove the flushing valve spool end caps **A**.

3 Remove the springs **C** from each end of the flushing valve.

4 Use a magnet to remove the spring seats **D** from each end of the flushing valve.

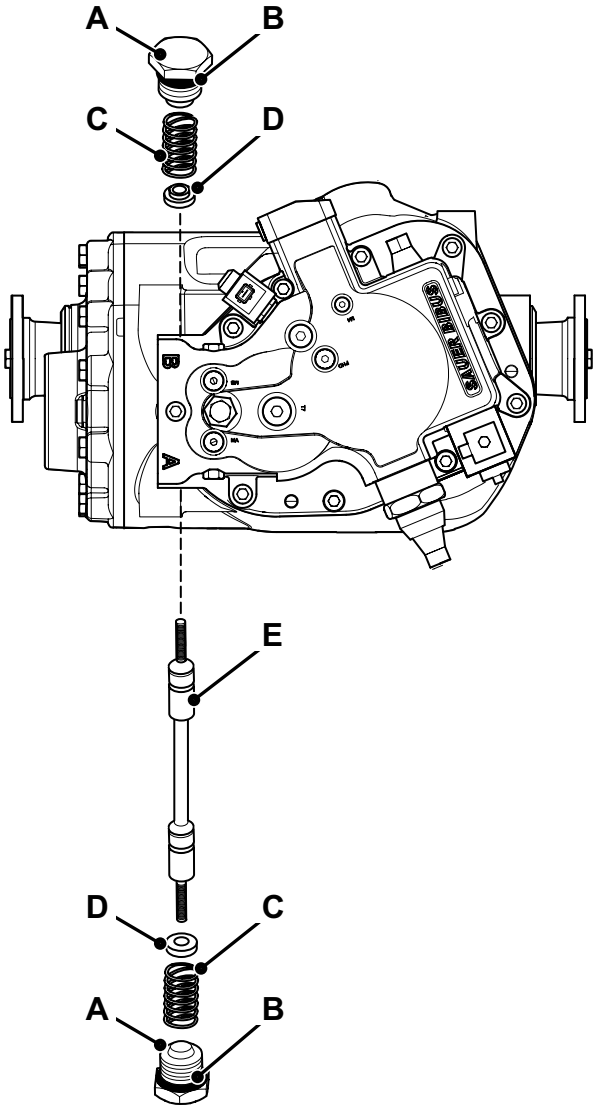
5 Pull the valve spool **E** out from the motor.

Replacement

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

– Replace the `O' rings **B** and make sure that they are located correctly.



C095400-C18

Fig 10.

Table 8. Torque Settings

Item	Nm	kgf m	lbf ft
A	30	3.05	22.1

PCOR Cartridge

Removal

Note: *Make sure to have new 'O' rings available before doing this procedure.*

1 Use a 24mm spanner to remove the PCOR valve **A** from the motor.

2 Using a long 6mm allen key, remove the orifice **C** from inside the motor.

Replacement

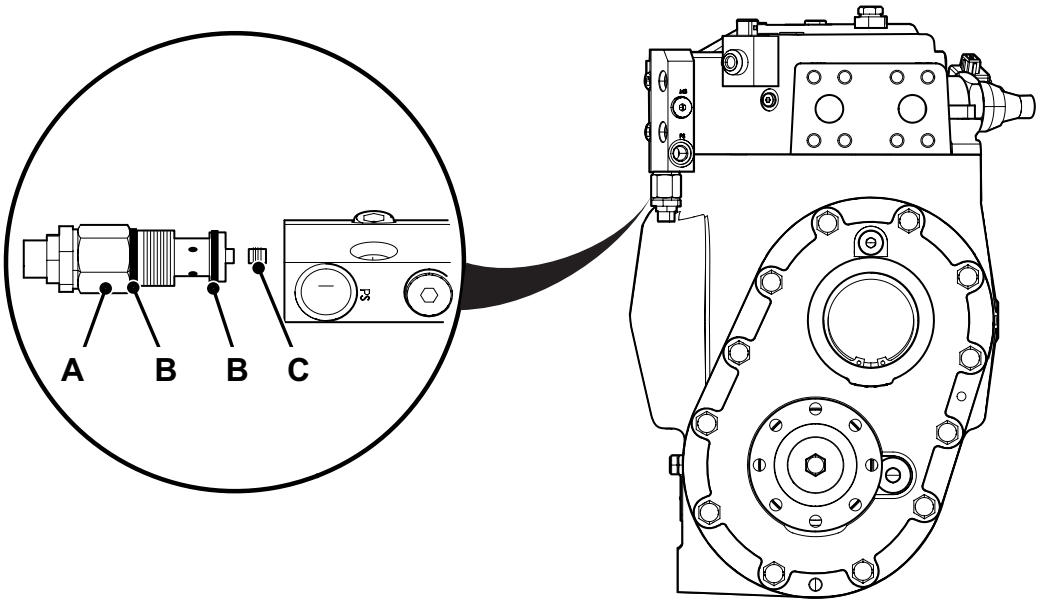
Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

– Make sure to renew the 'O' rings **B**.

Table 9. Torque Settings

Item	Nm	kgf m	lbf ft
A	25	2.5	18.4
C	12	1.2	8.85



C095400-C7

Fig 11.

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Hydrostatic Drive Pump

Introduction

This topic contains information about a machine DEVICE. Make sure you are referring to the correct device. Refer to the applications table.

Descriptions and procedures relate to the device and not related systems. For information about the systems refer to the relevant topics.

This topic is intended to help you understand what the device does and how it works. Where applicable it also includes procedures such as removal and replacement and dismantle and assemble.

⇨ *Related Topics (F7-2)*
⇨ *Removal and Replacement (F7-3)*
⇨ *Component Replacement (F7-5)*
⇨ *Shaft Seal (F7-6)*
⇨ *High Pressure Relief Valves (F7-6)*
⇨ *DA/EP Control Valve (F7-7)*
⇨ *DA/EP Control Valve Solenoid (F7-8)*
⇨ *Pressure Cut Off Valve (F7-8)*
⇨ *Charge Pump (F7-9)*

Related Topics

Table 1. Related Topics in This Publication

The table lists other topics in the manual that contain information related to this topic. Refer to the applicable topics to complete your procedures. Where applicable the text in this section contains cross references to this page to help you find the correct information. Some machines have different systems and devices. Make sure you refer to the correct topic, refer to *Section 1 - Applications*.		
Sections	**Topic Titles**	**Sub Titles**
1	***Applications***	ALL
2	ALL (Care and Safety)(1)	ALL
3	***Routine Maintenance***	***Transmission***
3	***Routine Maintenance***	***Access Panels***
F	⇨ *Hydrostatic Transmission SYSTEM (F4-1)*	ALL
K	***Engine***	***Removal and Replacement***

(1) You must obey all of the relevant care and safety procedures.

Removal and Replacement

When disconnecting hydraulic pipework make sure that sufficient receptacles are in place to catch any leakages of hydraulic fluid.

Removal

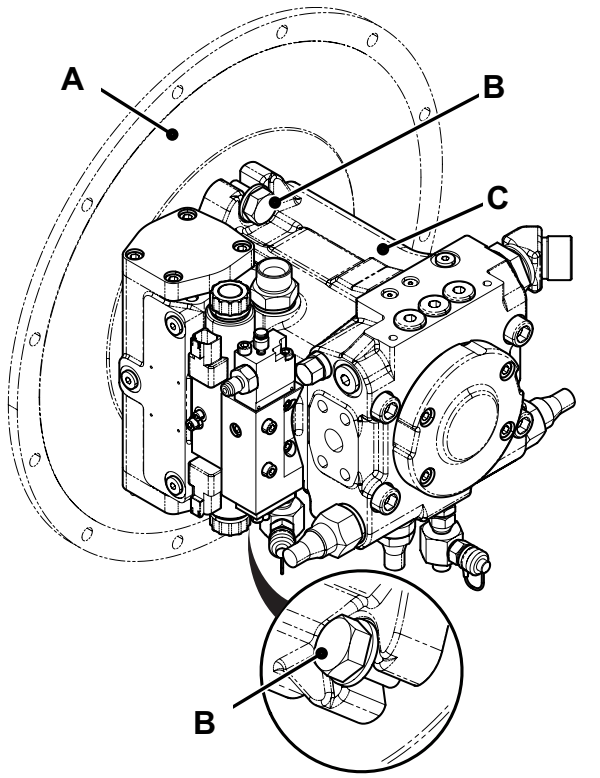


Fig 1.

Note: *The illustration shows the 20/34 kph pump, the procedure is the same for other machines.*

1 Park the machine and make it safe. Lower the boom. Obey the General Safety procedures, see ***Section 2 - General Procedures***. ⇒ *Related Topics (F7-2)*

2 Vent the hydraulic pressure, see ***Section 2 - General Procedures***. ⇒ *Related Topics (F7-2)*

3 Remove the engine from the machine. Refer to ***Section K - Engine***. ⇒ *Related Topics (F7-2)*

4 Attach suitable lifting equipment to the pump **C**.

5 Remove the 2 bolts **B** securing the pump to the engine coupling **A**.

6 Withdraw the pump assembly **C** horizontally until the inner coupling is clear before lifting out.

Replacement

Important: *After replacing the transmission pump do not start the engine until the correct start-up/priming procedure has been carried out.* ⇒ *Priming Procedure (F4-68)*. *Failure to carry out the procedure may cause the transmission pump and drive motor to be damaged.*

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

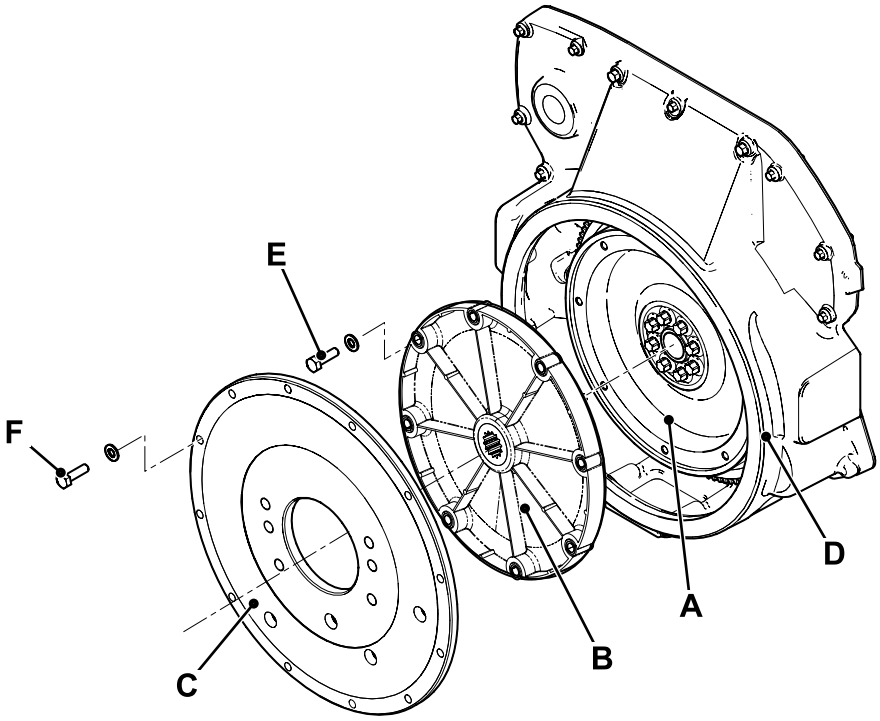
– Apply JCB Threadlocker and Sealant and torque tighten all bolts. ⇒ *Table 2. Torque Settings (F7-3)*
– Check the hydraulic fluid level, refer to ***Section 3 - Routine Maintenance***. ⇒ *Related Topics (F7-2)*

Table 2. Torque Settings

Item	Nm	kgf m	lbf ft
B	184	18.8	135.7

Pump and Engine Coupling

Removal



T003320-1-C1

Fig 2.

1 Remove the transmission pump. ⇨ *Removal and Replacement (F7-3)*

2 Make sure that the engine is securely supported.

3 Support the adaptor plate **C** and remove the securing bolts and washers **F**.

4 Remove the adaptor plate **C** from the engine bell housing **D**.

5 Support the coupling plate **B** and remove the securing bolts and washers **E**.

6 Remove the coupling plate **B** from the engine flywheel **A**.

Replacement

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

– Apply JCB Threadlocker and Sealant to bolts **F** and torque tighten. ⇨ *Table 3. Torque Settings (F7-4)*
– Torque tighten bolts **E**. ⇨ *Table 3. Torque Settings (F7-4)*

Table 3. Torque Settings

Item	Nm	kgf m	lbf ft
E	47	4.8	34.6
F	TBA	TBA	TBA

Component Replacement

The pump assembly is a non serviceable part. Some of the external components may be replaced.

For the procedures that follow, the pump must be removed from the machine: ⇨ ***Removal and Replacement (F7-3)***

- ⇨ ***Shaft Seal (F7-6)***
- ⇨ ***High Pressure Relief Valves (F7-6)***
- ⇨ ***Charge Pump (F7-9)***

The procedures that follow can be carried out with the pump in place on the machine:

Note: *Make sure to park the machine and make it safe with the boom raised. Refer to* ***Section 2 - General Procedures****.* ⇨ ***Related Topics (F7-2)***

Note: *Remove the chassis deck plates, refer to* ***Section 3 - Access Panels****.* ⇨ ***Related Topics (F7-2)***

- ⇨ ***Pressure Cut Off Valve (F7-8)***
- ⇨ ***DA/EP Control Valve (F7-7)***
- ⇨ ***DA/EP Control Valve Solenoid (F7-8)***

Shaft Seal

Removal

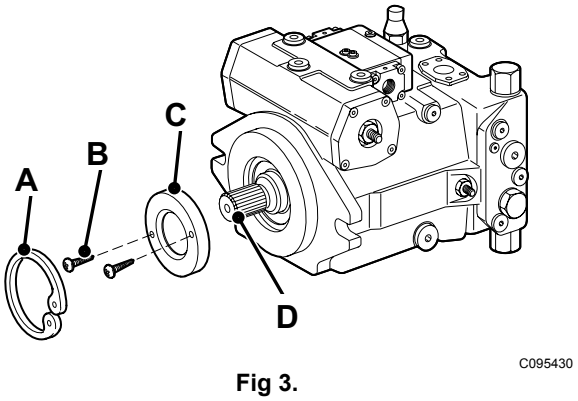


Fig 3.

1 Using circlip pliers remove the circlip **A** from the shaft **D**.

2 Screw two self tapping screws **B** into the holes in the seal **C**.

3 Use the screws **B** to pull the seal **C** from the pump.

Replacement

1 Grease the shaft seal **C** between the seal and dust lip.

2 Cover the shaft splines **D** with adhesive tape to prevent damage to the new seal **C**.

3 Use a sleeve to press the seal into the correct position.

4 Remove the tape from the drive shaft.

High Pressure Relief Valves

Removal

1 Remove the tamper proof caps if fitted.

2 Unscrew the valve **A** from the pump.

3 Repeat steps 1 and 2 for the opposite relief valve.

Replacement

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

– Replace `O' ring **B** and make sure it is located correctly.
– Replace ‘O’ ring and back up ring **C** and make sure it is located correctly.

Table 4. Torque Settings

Item	Nm	kgf m	lbf ft
A	150	15.2	110

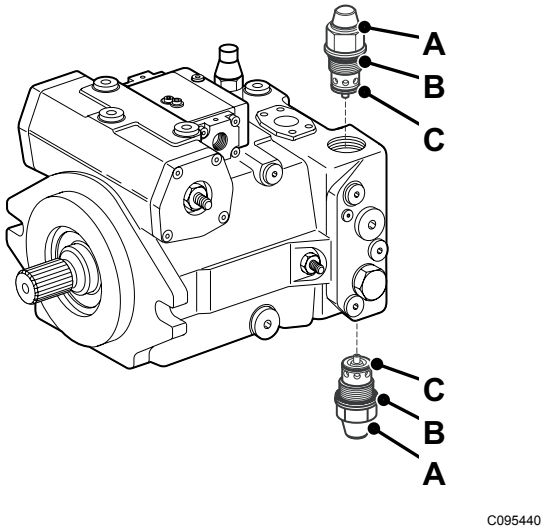


Fig 4.

DA/EP Control Valve

Removal

1 Disconnect the solenoid electrical connectors.

2 Using a 5mm allen key, remove the fastening screws **A** and **B**.

3 Prise the control unit **D** from the pump making sure not to damage the seal face.

Replacement

1 Replace the `O' ring **E** and the gasket **C** and make sure they are located correctly.

2 Position the control valve **D** on the pump.

3 Screw the fastening screws **B** in hand tight only.

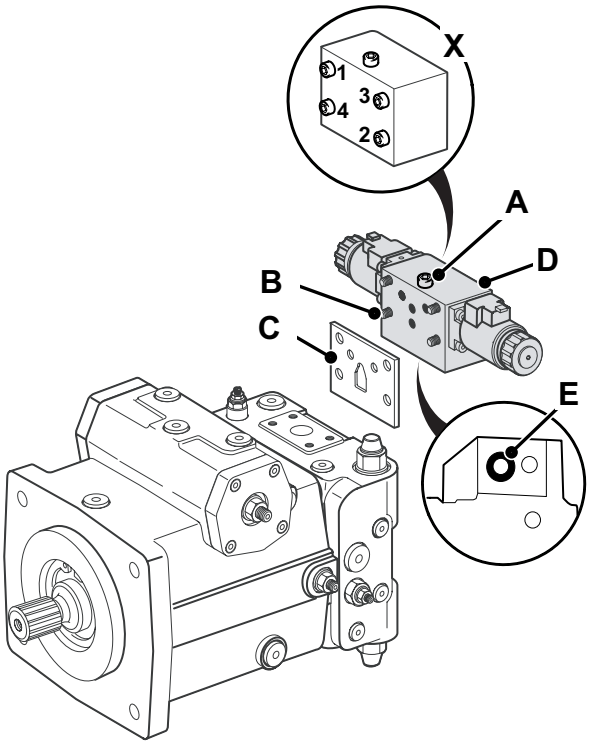
4 Install the screw **A**.

5 Tighten the screws **B** to a torque of 5 Nm (0.5 kgf m, 3.6 lbf ft).

6 Tighten the screw **A** to a torque of 10.4 Nm (1 kgf, 7.6 lbf ft).

7 Tighten the screws **B** in the order shown at **X** to 11 Nm (1.1 kgf m, 8.1 lbf ft).

8 Connect the solenoid electrical connectors.



C095500

Fig 5.

DA/EP Control Valve Solenoid

Removal

1 Disconnect the solenoid electrical connectors.

2 Using a 3 mm allen key, remove the fastening screws **B**.

3 Prise the solenoid assembly **C** from the control valve **A** making sure not to cause any damage.

Replacement

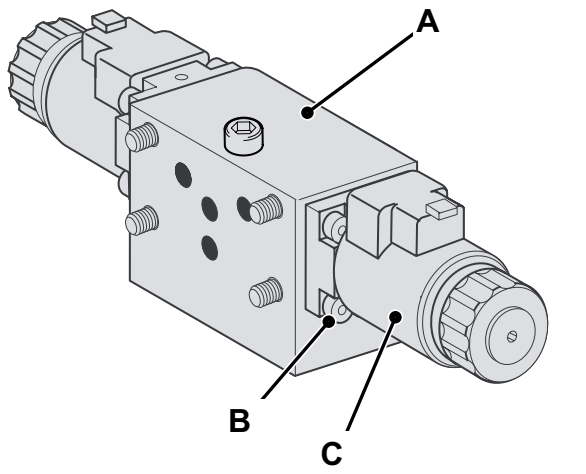
Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

– Torque tighten the screws **B**.

Table 5. Torque Settings

Item	Nm	kgf m	lbf ft
B	5	0.5	3.7



C095500-C1

Fig 6.

Pressure Cut Off Valve

Removal

1 Make a note of the measurement **X** to aid assembly.

2 Unscrew the locking nut **A** from the valve.

3 Unscrew the valve **B** from the pump.

Replacement

1 Replace the `O' ring **C** and make sure it is located correctly.

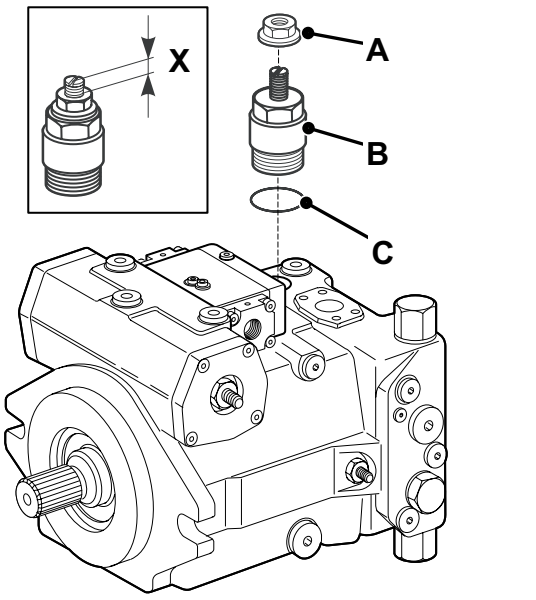
2 Replace valve **B** and torque tighten. ⇨ *Torque Settings (F7-8)*

3 Install the locking nut **A** to the dimension **X** as noted.

4 Torque tighten the nut **A**.

Table 6. Torque Settings

Item	Nm	kgf m	lbf ft
A	25	2.5	18.4
B	35	3.5	25.8



C095450

Fig 7.

Charge Pump

The charge pump is not a serviceable item. If it is faulty it must be replaced.

Removal

1 Make a mark on the housing and charge pump cover plate as shown at **C** to aid replacement.

2 Remove the four retaining screws **B**.

3 Using screwdrivers as shown remove the cover plate **A**.

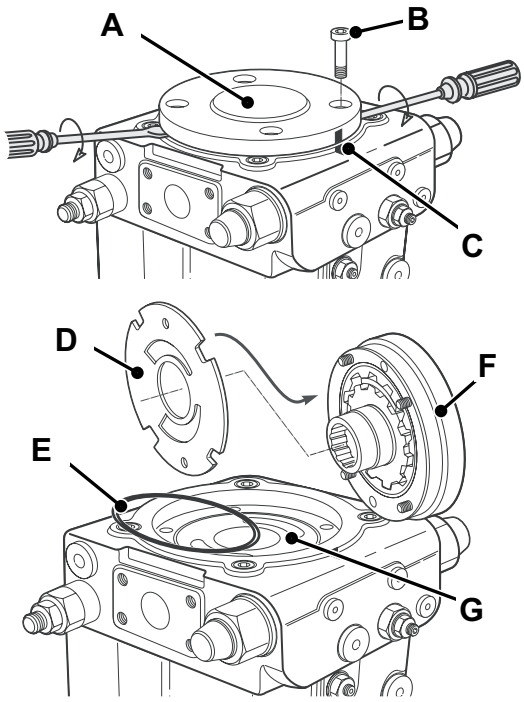
4 Remove the pump **F**, port plate **D** and 'O' ring **E**.

Replacement

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

– Replace `O' ring **E** and make sure it is located correctly.
– Make sure there is no contamination in the charge pump area of the transmission pump **G**.
– Use the marks **C** made in step **1** to align the charge pump cover plate **A** to the housing.



C095460

Fig 8.

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Propshafts

Introduction

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This topic is intended to help you understand what the device does and how it works. Where applicable it also includes procedures such as removal and replacement and dismantle and assemble.

⇨ *Related Topics (F8-2)*

⇨ *Removal and Replacement (F8-3)*

Related Topics

Table 1. Related Topics in This Publication

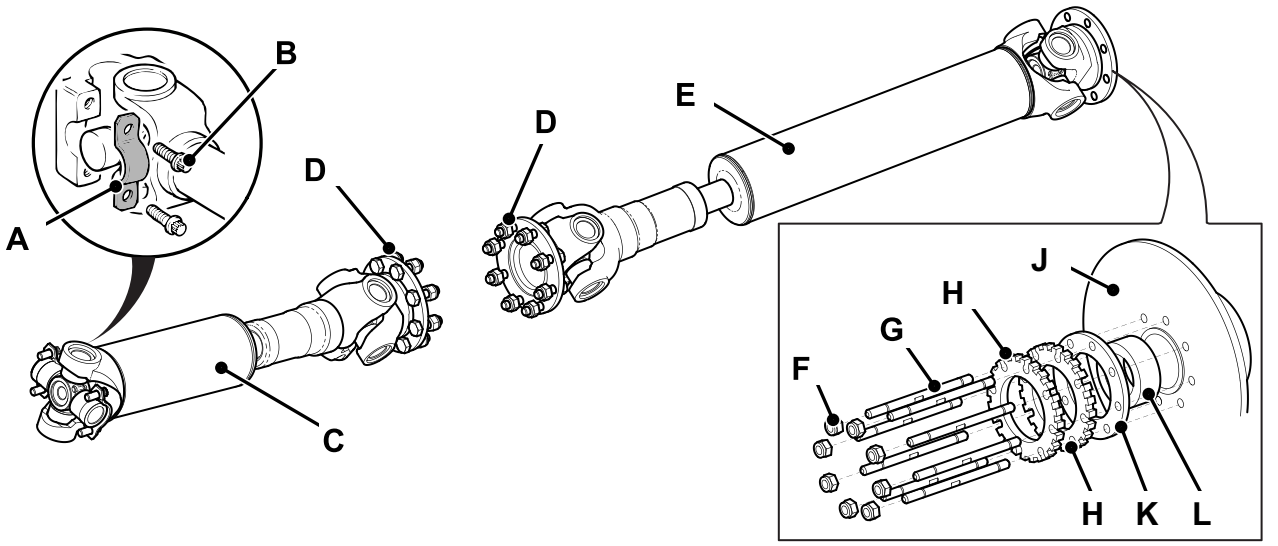
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Sections	**Topic Titles**	**Sub Titles**
2	ALL (Care and Safety)(1)	ALL
3	***Routine Maintenance***	***Access Panels***
F	***⇒ Speed Sensors (F9-1)***	***⇒ Adjustment (F9-5)***

(1) You must obey all of the relevant care and safety procedures.

Removal and Replacement

Propshaft Removal and Replacement

Removal



C094790-C3

Fig 1.

DANGER

Ensure that the blocks and towing vehicle will prevent the machine from moving because when the driveshafts have been disconnected the park brake cannot prevent the machine from moving. It is necessary to work under the machine to remove the driveshafts. This job should be done by a qualified mechanic. Anyone working underneath, or near the machine, could be killed or seriously injured if the machine moved.

13-2-4-3_2

Important: *This procedure should only be carried out by a qualified engineer. If you have any queries concerning this procedure, consult your local JCB dealer.*

Important: *When disconnecting propshafts the park brake will become ineffective. Before disconnecting any propshaft chock all 4 wheels.*

1 Park the machine and make it safe. Obey the care and safety procedures. ⇨ ***Related Topics (F8-2)***

2 Before removing propshafts always mark both companion flanges and also mark the sliding joints prior to removal.

3 Working below the machine remove the front, centre and rear undershields. Refer to ***Section 3 - Access Panels***.

4 Support the front propshaft **C** and remove the strap retaining bolts **B** and the straps **A** from the axle yoke.

5 Use a crows foot ring spanner to remove the nuts **D**.

6 Support the rear propshaft **E**.

7 Use a crows foot ring spanner to remove the nuts **D**.

8 Remove the nuts **F** and slide the propshaft off the securing studs **G**.

9 Replace the nuts **F** to secure the parkbrake disc.

Replacement

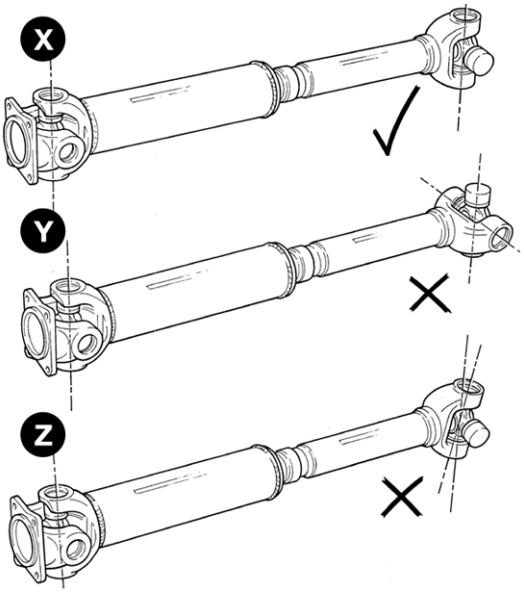
Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

- On replacement, after lubricating sliding joints with JCB HP or MPL Grease, align the shafts against identification marks previously made or, in the case of a shaft being renewed, use the manufacturer's alignment markings. Apply JCB Threadlocker and Sealer to threads of all flange bolts.
- The front propshaft retaining straps **A** stretch with use, therefore these straps must always be replaced with new ones.
- The propshaft must have both ends exactly on the same plane as shown at **X**. The yokes must not be at right angles as at **Y** or at an intermediate angle as at **Z**.
- Torque tighten the bolts and nuts. ⇨ *Torque Settings (F8-4)*
- If the studs **F** are damaged replace with new studs. Apply JCB Threadlocker and Sealer to the stud threads.
- Degrease the mating faces of the speed sensor rings **H**, spacer **K**, propshaft **E** and parkbrake disc **J**.
- Apply JCB Locking Fluid High Strength to the mating faces of the two speed sensor rings**H** and spacer **K** to bond them together.
- Adjust the speed sensor. ⇨ *Adjustment (F9-5)*

Table 2. Torque Settings

Item	Nm	kgf m	lbf ft
B	70	7.1	51.6
D	60	6.1	44.2
F	72	7.3	53.1



S189610-C1

Fig 2.

Speed Sensors

Introduction

This topic contains information about a machine DEVICE. Make sure you are referring to the correct device. Refer to the applications table.

Descriptions and procedures relate to the device and not related systems. For information about the systems refer to the relevant topics.

This topic is intended to help you understand what the device does and how it works. Where applicable it also includes procedures such as removal and replacement and dismantle and assemble.

⇨ *Related Topics (F9-2)*
⇨ *Transmission Speed Sensor (F9-3)*
⇨ *Component Location (F9-3)*
⇨ *Operation Overview (F9-3)*
⇨ *Testing (F9-4)*
⇨ *Removal and Replacement (F9-5)*
⇨ *Engine Speed Sensor (F9-6)*
⇨ *Testing (F9-6)*
⇨ *Removal and Replacement (F9-7)*

Related Topics

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Sections	Topic Titles	Sub Titles
1	***Applications***	ALL
2	ALL (Care and Safety)(1)	ALL
2	Routine Maintenance	***Access Panels***
F	***⇨ Hydrostatic Transmission SYSTEM (F4-1)***	***⇨ Component Identification (F4-6)***
G	***External Parkbrake System***	ALL
M	***Fault Code SYSTEM***	ALL
M	***Servicemaster SYSTEM***	ALL
M	***Servicemaster Tools***	ALL

(1) You must obey all of the relevant care and safety procedures.

Transmission Speed Sensor

Component Location

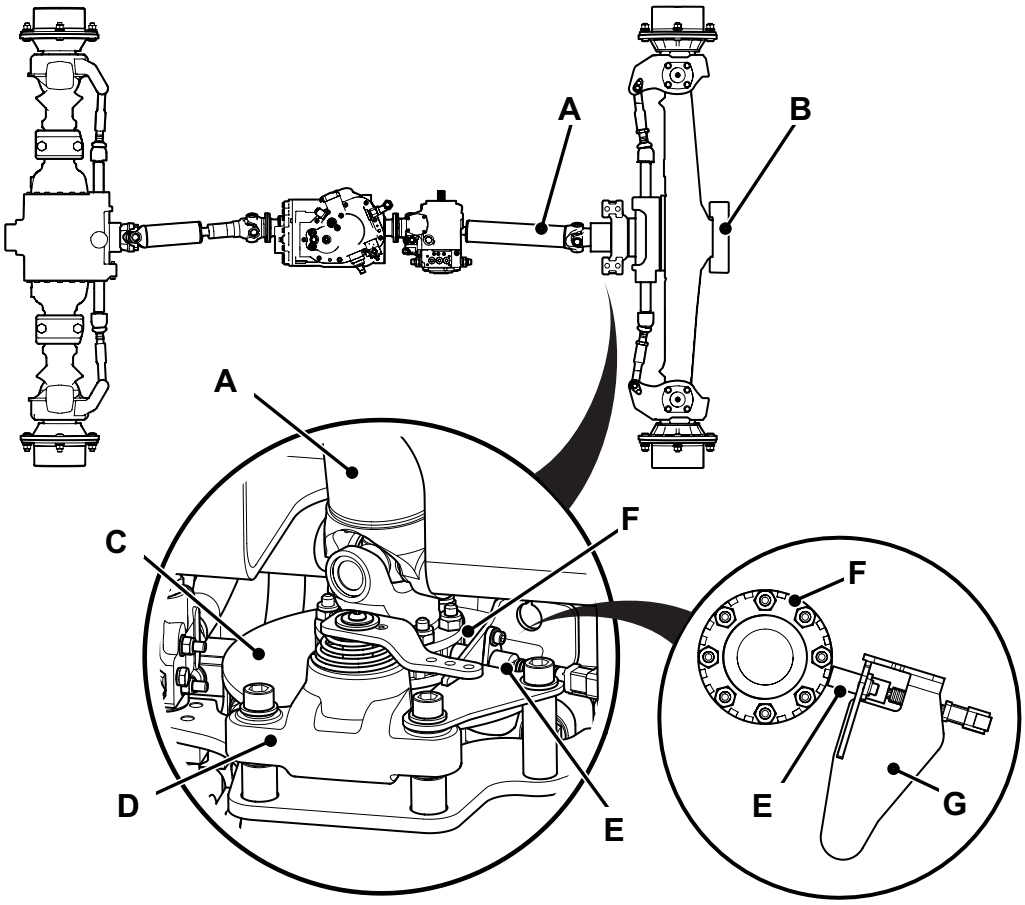


Fig 1.

Table 2. Key to components

Item	
A	Rear Propshaft
B	Rear Axle
C	Parkbrake Disc
D	Parkbrake Caliper
E	Speed Sensor
F	Sensor Plate
G	Parkbrake Reaction Bracket

Operation Overview

⇨ *Fig 1. (F9-3)*

The transmission speed sensor **E** is located on the parkbrake reaction bracket **G** at the drive connection to the rear axle **B**.

Drive from the transmission motor is transmitted to the rear axle **B** through the rear propshaft **A** and parkbrake disc **C**. For more information on the Parkbrake System - refer to ***Section G - External Parkbrake System***.

The transmission speed sensor **E** detects the speed of rotation of the transmission propshaft/brake disc and relays this information to a machine ECU.

The sensor plate **F** turns with the rear propshaft **A**. The speed sensor **E** detects the gear teeth on the sensor plate **F** as they move past the sensor tip. When adjacent to the top of a gear tooth the sensor electrical output turns ON, when adjacent to a gap between the teeth the sensor output turns OFF. In this way the frequency of the electrical signal changes according to the speed of rotation.

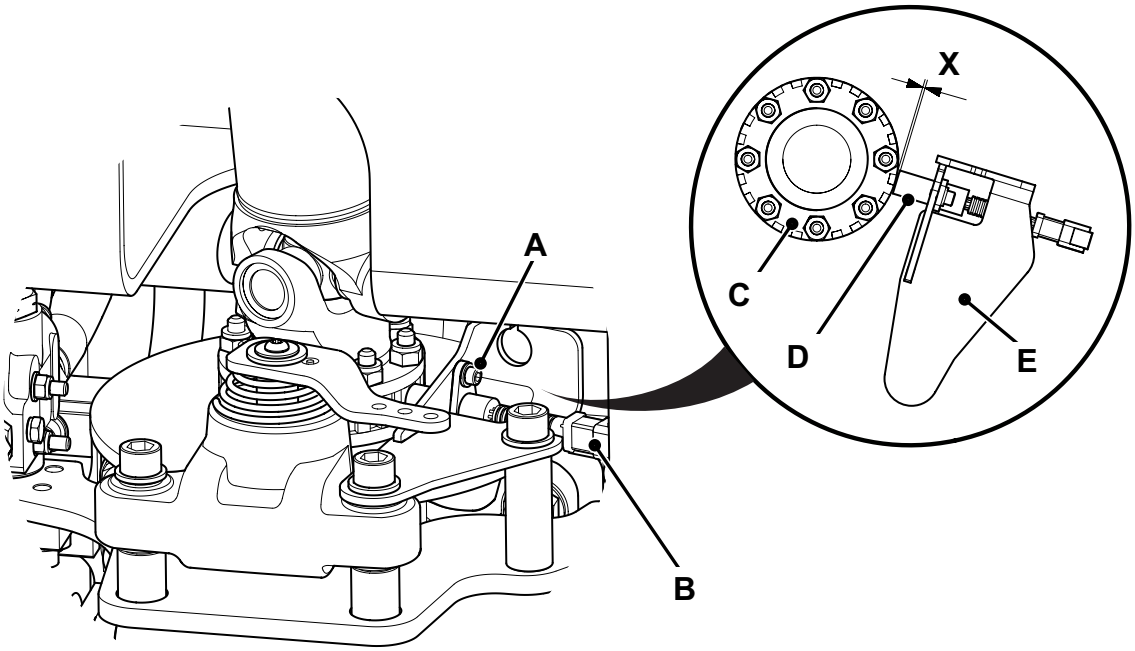
Testing

To test the transmission speed sensor operation use the Servicemaster program. Refer to ***Section M - Servicemaster System*** and ***Section M - Servicemaster tools***. ⇨ *Related Topics (F9-2)*

If the transmission speed sensor is not functioning correctly the machine will log the fault as an error code. These error codes can be accessed with the correct diagnostics software tool, using a laptop computer connected to the machine CAN system.

For the fault code descriptions refer to ***Section M - Fault Code SYSTEM***. ⇨ *Related Topics (F9-2)*

Removal and Replacement



C107080-C1

Fig 2.

Removal

1 Park the machine and make it safe. Obey the care and safety procedures. ⇨ *Related Topics (F9-2)*

2 Remove the chassis undershield. Refer to ***Section 3 - Routine Maintenance***. ⇨ *Related Topics (F9-2)*

3 Disconnect the speed sensor electrical connector **B**.

4 Remove the sensor securing screw **A**.

5 Remove the speed sensor **D** from the parkbrake reaction bracket **E** together with shims or spacers (if fitted).

Replacement

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

- Check the condition of the sealing 'O' ring. If the 'O' ring is damaged replace it with a new one.
- If spacers or shims were removed replace them correctly. Check the sensor adjustment. ⇨ *Adjustment (F9-5)*
- Torque tighten the sensor securing screw. ⇨ *Table 3. Torque Settings (F9-5)*

Table 3. Torque Settings

Item	Nm	kgf m	lbf ft
A	10	1.01	7.37

Adjustment

1 Rotate the propshaft and sensor plate **C** and measure the gap **X** between the tip of the sensor **D** and the sensor plate C. This gap must be a maximum of 1.0 mm and a minimum of 0.5 mm throughout the rotation.

2 To adjust the gap:

a Remove the speed sensor. ⇨ *Removal (F9-5)*

b Install a shim between the speed sensor D and the reaction bracket E.

c Replace the speed sensor. ⇨ *Replacement (F9-5)*

d Check the gap, refer to step 1.

Engine Speed Sensor

The engine speed sensor (if fitted) detects the speed of rotation of the engine crank shaft and relays this information to a machine ECU.

The sensor detects the passing of gear teeth on the engine flywheel starter ring. When adjacent to a tooth the sensor electrical output turns ON, when adjacent to a gap between the teeth the sensor output turns OFF. In this way the frequency of the electrical signal changes according to the speed of rotation and therefore engine speed.

Testing

The speed sensor can be tested in situ without removing it by means of service test harness 892/01096.

1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Raise the engine cover and identify the engine speed sensor **D**.

2 Connect the test harness **E** as shown. Tie back and secure the wires clear of the cooling fan and other moving components. Make sure that the light emitting diode (LED) **F** can be seen.

3 Start the engine. If the sensor is operating correctly the LED will illuminate as the flywheel teeth pass the sensor, when the speed increases the LED will flash at a greater frequency until becoming continuously illuminated at higher speeds.

4 If the LED fails to illuminate correctly carefully check the relevant wires and connectors for damage.

Note: *It should be noted that the speed sensor is normally a reliable component and a fault is more likely attributed to factors such as damaged wires or electrical connectors.*

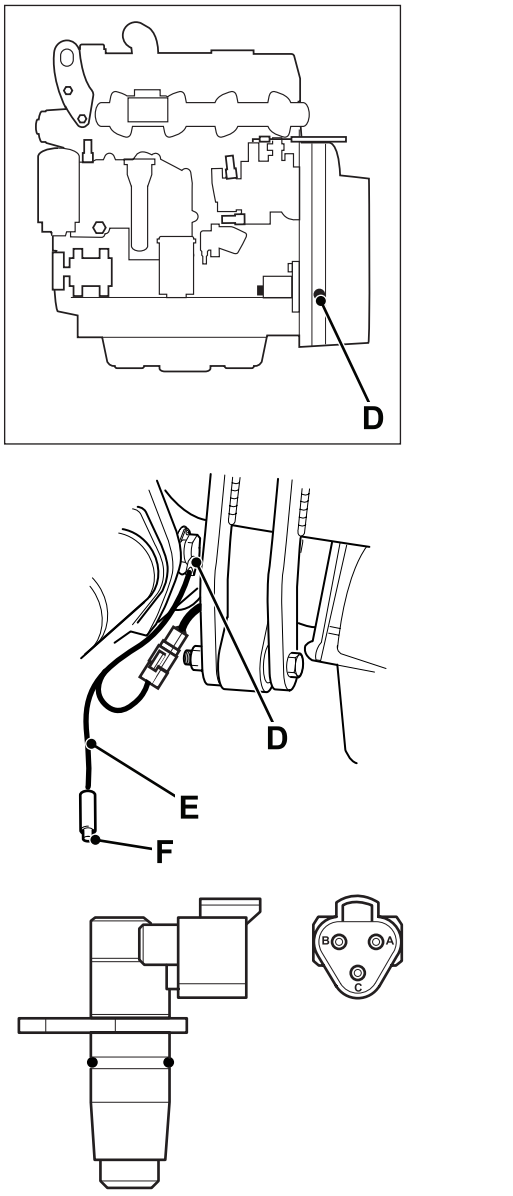


Fig 3.

Key:

A	Ground
B	+V
C	Output

Removal and Replacement

Removal

1 Park the machine and make it safe. Obey the care and safety procedures. ⇨ *Related Topics (F9-2)*

2 Disconnect the speed sensor electrical connector.

3 Remove the sensor securing screw.

4 Remove the speed sensor from the housing together with shims or spacers (if fitted).

Replacement

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

- Check the condition of the sealing ‘O’ ring. If the ‘O’ ring is damaged replace it with a new one.
- If spacers or shims were removed replace them correctly. The speed sensor may be damaged or fail to operate if it is not at the correct distance inside the housing.

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Transmission ECU

Introduction

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This topic is intended to help you understand what the device does and how it works. Where applicable it also includes procedures such as removal and replacement and dismantle and assemble.

⇒ *Related Topics (F10-2)*
⇒ *Removal and Replacement (F10-3)*

Related Topics

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3	***Routine Maintenance***	***Access Panels***
F	***⇨ Hydrostatic Transmission SYSTEM (F4-1)***	ALL
M	***Servicemaster Tools***	ALL

(1) You must obey all of the relevant care and safety procedures.

Removal and Replacement

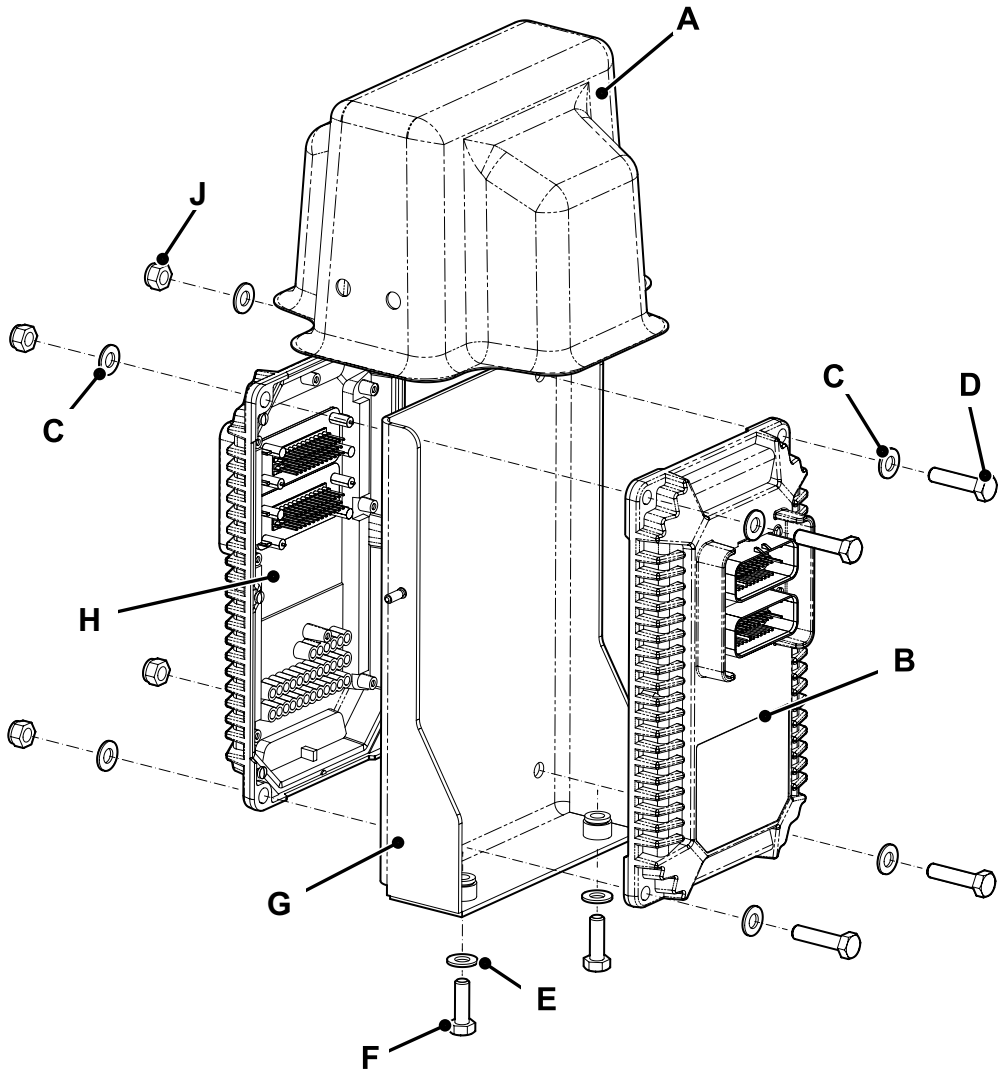


Fig 1.

Removal

1 Park the machine and make it safe. Obey the general safety procedures, see ***Section 2 - General Procedures.*** ⇨ *Related Topics (F10-2)*

2 Remove the battery covers. Refer to ***Section 3 - Access Panels***. ⇨ *Related Topics (F10-2)*

3 Remove the ECU cover **A**.

4 Put a label on the ECU electrical connectors to aid replacement.

5 Disconnect the ECU electrical connectors.

6 Remove the bracket securing bolts **F** and washers **E**.

7 Remove the ECUs **B** and **H** and bracket **G** from the machine.

8 Support the transmission ECU **H**.

9 Remove the nuts **J**, bolts **D** and washers **C** and remove the transmission ECU **H** from the bracket.

Replacement

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

– If a new ECU is installed make sure to set the software up correctly. Refer to ***Section M - Servicemaster Tools***. ⇨ *Related Topics (F10-2)*

Transmission Manifold

Introduction

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⇨ *Related Topics (F11-2)*

⇨ *Removal and Replacement (F11-3)*

Related Topics

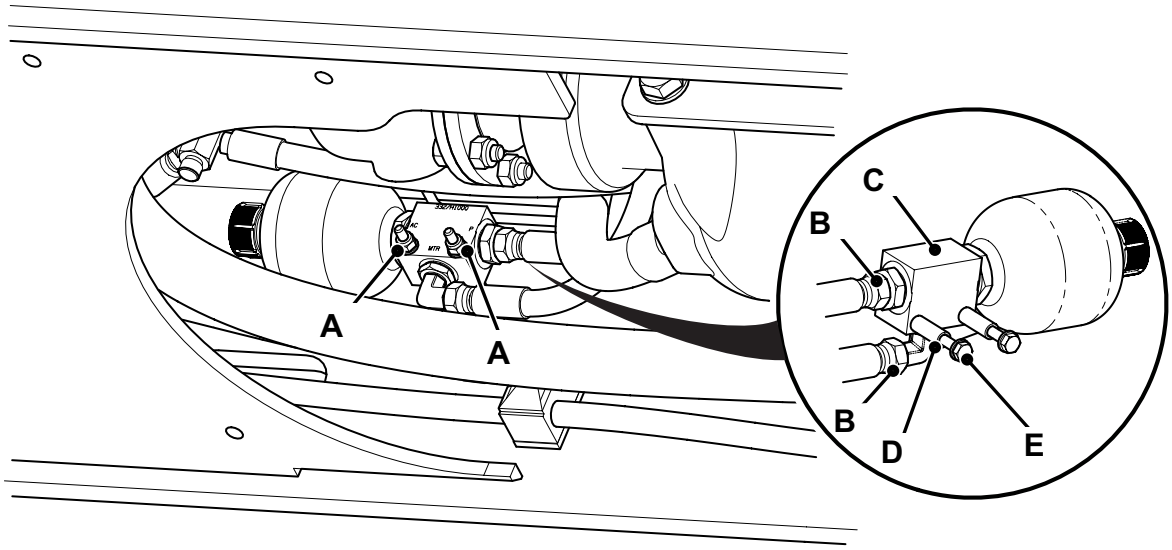
Table 1. Related Topics in This Publication

The table lists other topics in the manual that contain information related to this topic. Refer to the applicable topics to complete your procedures. Where applicable the text in this section contains cross references to this page to help you find the correct information. Some machines have different systems and devices. Make sure you refer to the correct topic, refer to *Section 1 - Applications*.		
Sections	**Topic Titles**	**Sub Titles**
2	ALL (Care and Safety)(1)	ALL
3	***Routine Maintenance***	***Access Panels***

(1) You must obey all of the relevant care and safety procedures.

Removal and Replacement

Removal



C105910

Fig 1.

⚠ WARNING

Make the machine safe before working underneath it. Park the machine on level ground, lower the attachments to the ground. Apply the park brake, put the transmission in neutral and stop the engine. Block both sides of all four wheels.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-4-1_1

1 Park the machine and make it safe. Obey the care and safety procedures. ⇨ *Related Topics (F11-2)*

2 Switch off the engine.

3 Working below the machine remove the centre undershield. Refer to ***Section 3 - Access Panels***.

4 Put a label on the hydraulic hoses to aid identification when replacing.

5 Disconnect the hydraulic hose connectors **B** from the manifold **C**.

6 Remove the nuts **A**, spacers **D**, bolts **E** and manifold **C**.

Replacement

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

- Make sure to install the spacers **D** on each bolt **E** between the manifold **C** and chassis.
- Make sure to phase the hoses as shown.
- Torque tighten the securing nuts **A**. ⇨ *Table 2. Torque Settings (F11-3)*

Table 2. Torque Settings

Item	Nm	kgf m	lbf ft
A	10	1.0	7.3

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