Doosan Infracore

DL200

Serial Number 5001 and UP

Shop Manual

K1024538CHE Chicago Bid

Safety

Safety precautions are described in SAFETY from page -10 on.

DOOSAN cannot predict every circumstance that might involve a potential hazard in operation and maintenance. Therefore the safety messages in this manual and on the machine may not include all possible safety precautions. If any procedures or actions not specifically recommended or allowed in this manual are used, you must be sure that you and others can do such procedures and actions safely and without damaging the machine. If you are unsure about the safety of any procedures, contact a *DOOSAN* distributor.

BEFORE STARTING ENGINE

Work Site Precautions

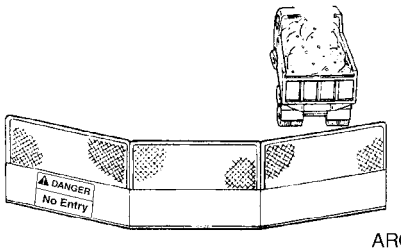
Before starting operations, thoroughly check the area for any unusual conditions that could be dangerous.

Check the terrain and condition of the ground at the work site, and determine the best and safest method of operation.

Make sure the ground surface is as hard and horizontal as possible before carrying out operations. If there is a lot of dust and sand on the work site, spray water before starting operations.

If you need to operate on a street, protect pedestrians and cars by designating a person for work site traffic duty or by erecting fences and posting "No Entry" signs around the work site.

Erect fences, post "No Entry" signs, and take other steps to prevent people from coming close to or entering the work site. If people come close to a moving machine, they may be hit or caught by the machine, and this may lead to serious personal injury or death.



ARO1251L

Figure 12

Waterlines, gas lines, phone lines and high-voltage electrical lines may be buried under the work site. Contact each utility and identify their locations. Be careful not to damage or cut any of these lines.

NEVER work in water that is more than the permissible water depth. Refer to "Operation Manual."

Any object in vicinity of boom could represent a potential hazard, or cause the operator to react suddenly and cause an accident. Use a spotter or signal person when working near bridges, phone lines, work site scaffolds, or other obstructions.

Minimum levels of insurance coverage, work permits or certification, physical barriers around the work site or restricted hours of operation may be mandated by governing authorities. There may also be regulations, guidelines, standards or restrictions on equipment that may have to be followed for local requirements. There may also be regulations related to performing certain kinds of work. If there is any question about whether your machine and work site complies with the applicable standards and regulations, contact your local authorities and agencies.

Avoid entering soft ground. It will be difficult for the machine to escape.

Avoid operating your machine to close to the edge of cliffs, overhangs, and deep ditches. The ground may be weak in such areas. If the ground collapses, the machine could fall or tip over resulting in serious injury or death.

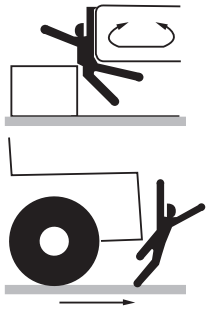
Remember that soil after heavy rain, blasting or after earthquakes, is weakened in these areas.

Keep "Pinch Point" Areas Clear - Use Caution in Reverse

Use a signal person in high traffic areas and whenever operator's view is not clear, such as when traveling in reverse.

Anyone standing near wheels, or working assemblies of the attachment, is at risk of being caught between moving parts of machine.

Never allow anyone to ride on any part of machine or attachment, including any part of operator's cabin.



HAOA191L

Figure 20

Operate Carefully on Snow and Ice and in Very Cold Temperatures

In icy cold weather avoid sudden travel movements and stay away from even very slight slopes. Machine could skid off to one side very easily.

Snow accumulation could hide or obscure potential hazards. Use care while operating or while using machine to clear snow.

Warming up engine for a short period may be necessary, to avoid operating with sluggish or reduced working capacity. Jolting shocks and impact loads caused by bumping or bottoming boom or attachment are more likely to cause severe stress in very cold temperatures. Reducing work cycle rate and workload may be necessary.

When the temperature rises, frozen road surfaces become soft, and machine travel becomes unstable.

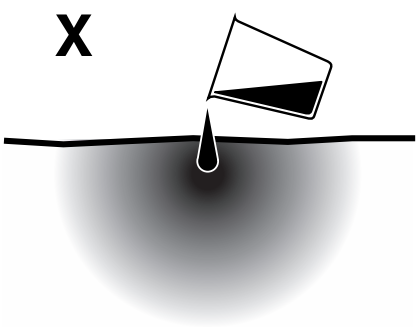
In cold weather, do not touch metal surfaces with your bare hands. If you touch a metal surface in extremely cold weather, your skin may freeze to the metal surface.

Dispose of All Petroleum Based Oils and Fluids Properly

Physical contact with used motor oil may pose a health risk. Wipe oil from your hands promptly and wash off any remaining residue.

Used motor oil is an environmental contaminant and may only be disposed of at approved collection facilities. To prevent pollution of the environment, always do the following:

- Never dump waste oil in a sewer system, rivers, etc.
- Always put oil drained from your machine in containers. Never drain oil directly onto the ground.
- Obey appropriate laws and regulations when disposing of harmful materials such as oil, fuel, solvent, filters, and batteries.



HAOA470L

Figure 32

Check Tire Pressure and Condition

Maintain tire pressure but do not overinflate. Inspect tires and wheels daily. When inflating tires, follow procedures in Maintenance Section, which include using an extension to allow you to avoid standing in front of or over a tire. Do not change a tire unless you have both experience and proper equipment.

Table of Contents

Specification for DL200

CATEGORY		DL200		
Tires		20.5x25-16PLY (L5)		
Working Range	Dump Height at 45° (w/BOC) -1)	mm (ft-in)	A	2,891 (9' 5")
	Dump Reach at 45° (w/BOC) -1)	mm (ft-in)	B	1,065 (3' 6")
	Max Dump Angle (fully raised)	deg	C	47
	Max Tilt Angle (on ground)	deg	D	41
	Max Tilt Angle (fully raised)	deg	E	66
	Max Tilt Angle (at carry)	deg	F	47
	Bucket Hinge Height	mm (ft-in)	G	3,982 (13' 1")
	Digging Depth (0° level)	mm (in)	H	165 (6.5")
Travel Dimension	Overall Length (w/BOC)	mm (ft-in)	J	7,312 (23' 11")
	Overall Width	mm (ft-in)	K	2,590 (8' 6"")
	Overall Height	mm (ft-in)	L	3,300 (10' 10")
	Ground Clearance	mm (ft-in)	M	500 (1' 8")
	Wheel Base	mm (ft-in)	N	2,900 (9' 6")
	Tread	mm (ft-in)	O	1,930 (6' 4")
Max Steering Angle		deg	P	40
Turning Radius (Tire center)		mm (ft-in)	Q	4,949 (16' 3"")

SAFETY PRECAUTIONS

CAUTION

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that are in good working order.

Use lifting and hoisting equipment capable of safely handling the load.

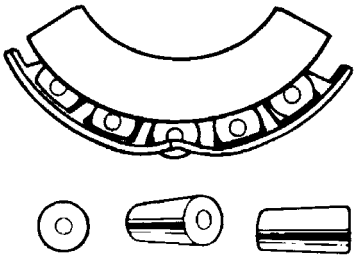
Remember, that ultimately safety is your own responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
ALL MODELS	ALL RANGES

Replace bearing.



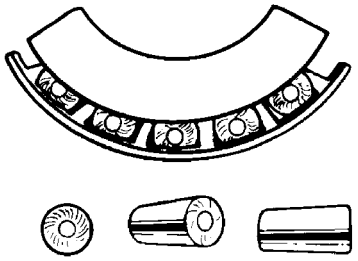
HASA470S

Figure 4

Galling

Metal smears on roller ends because of overheating, lubricant failure or overload.

Replace bearing - check seals and check for proper lubrication.



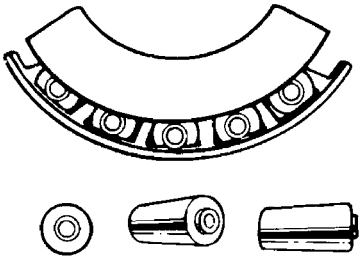
HASA480S

Figure 5

Abrasive Step Wear

Pattern on roller ends caused by fine abrasives.

Clean all parts and housings, check all parts and housings, check seals and bearings and replace if leaking, rough or noisy.



HASA490S

Figure 6

SAFETY PRECAUTIONS

CAUTION

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that are in good working order.

Use lifting and hoisting equipment capable of safely handling the load.

Remember, that ultimately safety is your own responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
ALL MODELS	ALL RANGES

I. "Loctite" Fastener Adhesives

Product	Application	Color	Removal	Breakaway Cure Strength (in lb) of Sealer Alone
222	Low strength for 6 mm (1/4") or smaller fasteners.	Purple	Hand tools	45
242 or 243	Medium strength for 6 mm (1/4") and larger fasteners.	Blue	Hand tools	80
262	High strength for high-grade fasteners subject to shock, stress and vibration.	Red	Heat/260°C (500°F) Remove HOT (NO solvent)	160
271	Extra high strength for fine thread fasteners up to 25 mm (1") diameter.	Red	Heat/260°C (500°F) Remove HOT	160
272	High temperature/high strength for hostile environments to 232°C (450°F).	Red	Heat/316°C (600°F) Remove HOT	180
277	Extra high strength for coarse thread fasteners 25 mm (1") diameter and larger.	Red	Heat/260°C (500°F) Remove HOT	210

II. "Loctite" Pipe Thread Sealant

Product	Application	Color	Removal	Required Setup
545	"No-filler/nonclog" formula for high-pressure hydraulic systems. Over application will not restrict or foul system components.	Purple	Hand tools	4 Hours (or 1/2 hour with Locquic "T" Primer)
656	Solvent resistant, higher viscosity tapered thread sealer.	White	Hand tools	4 Hours (or 1/2 hour with Locquic "T" Primer)

III. "Loctite" gasket/flange sealer

Product	Application	Color	Notes
518	Gasket eliminator specifically made for aluminum flanges/surfaces. For hydraulic systems to 34,475 kPa (5,000 psi).	Red	Use Locquic "N" primer for fast (1/2 - 4 hours) setup. Unprimed setup 4 - 24 hours.
504	Low-pressure/wide-gap gasket eliminator compound. Fills gaps to 0.0012 mm (0.030"), cures to rigid seal.	Orange	Use Locquic "N" primer for faster (1/2 - 4 hours) setup. Unprimed setup 4 - 24 hours.
515	General purpose, fast setup, flexible-cure gasket eliminator. For nonrigid assemblies subject to shock, vibration or deflection.	Purple	Use Locquic "N" primer for faster (1/4 - 2 hours) setup. Unprimed setup 1 - 12 hours.

SAFETY PRECAUTIONS

CAUTION

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that are in good working order.

Use lifting and hoisting equipment capable of safely handling the load.

Remember, that ultimately safety is your own responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DL200	5001 and Up

TRANSMISSION FAULTS CODES

The transmission has a monitoring system that indicates when a malfunction is occurring.

Fault Display

If a fault is detected, the display shows a wrench symbol (g) for a fault. The display shows the fault code, if the gear selector is in neutral.

If more than one fault is detected, each fault code is shown for about 1 second.

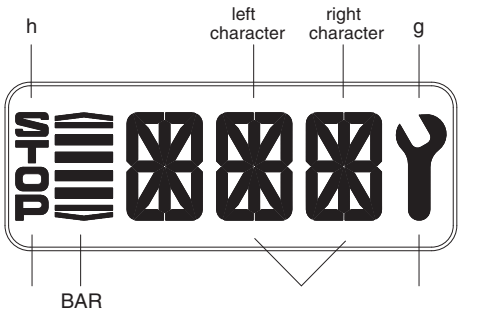


Figure 23

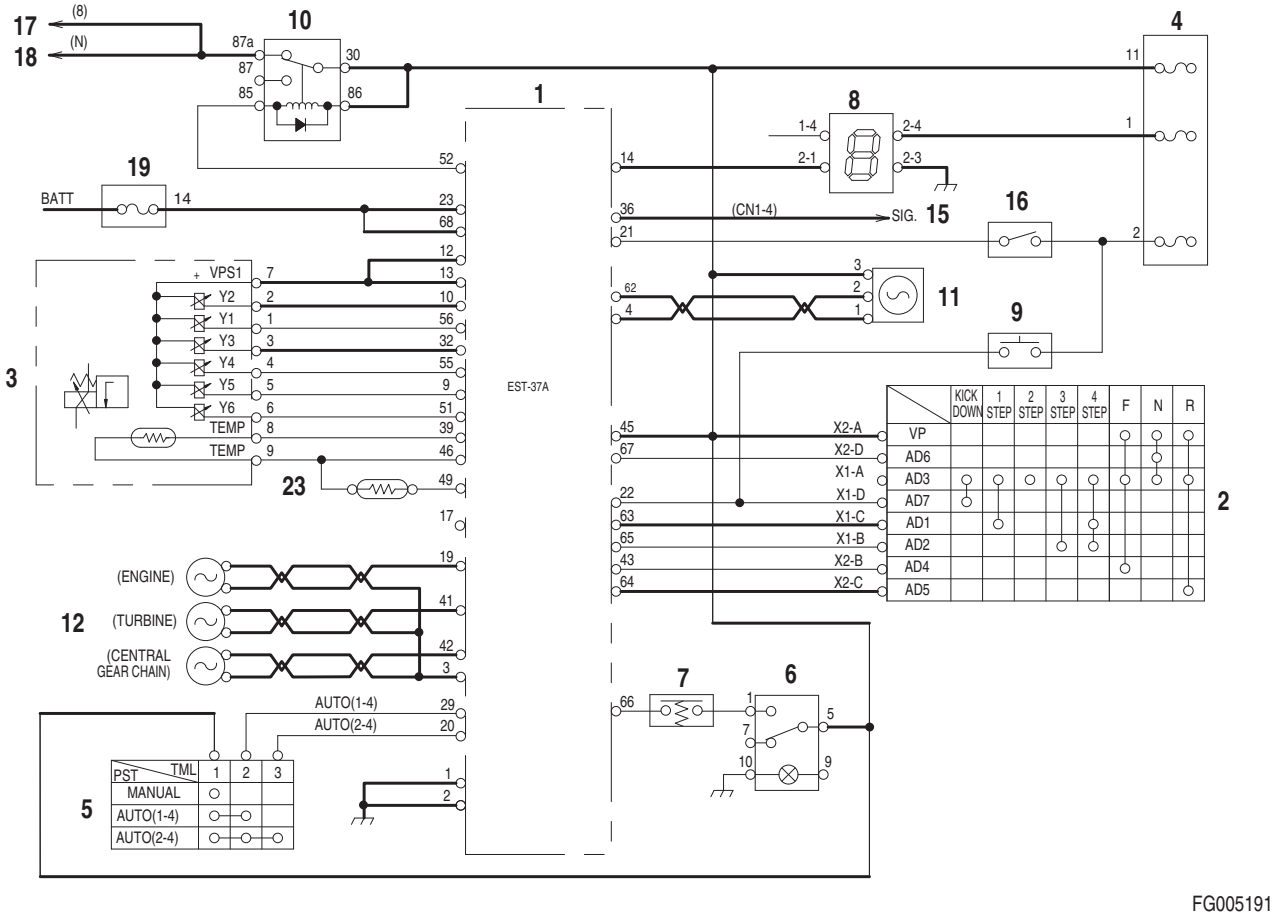
CAN - Message

The TCU sends the fault code of a detected fault in the specified CAN - message, while the fault is active.

If more than one fault is detected, the fault code scrolls.

Description of Fault Codes

First Number	Meaning of Number
1 Hex	Digital Input Signal
2 Hex	Analog Input Signal
3 Hex	Speed Signal
4 Hex	Can Signal Error
5 Hex	Can Signal Error
6 Hex	Can Signal Error
7 Hex	Analog Current Output Signal
8 Hex	Analog Current Output Signal
9 Hex	Digital Output Signal
A Hex	Digital Output Signal
B Hex	Transmission Fault, Clutch Error
C Hex	Logical Fault
D Hex	Power Supply
E Hex	High-speed Signal
F Hex	General Fault



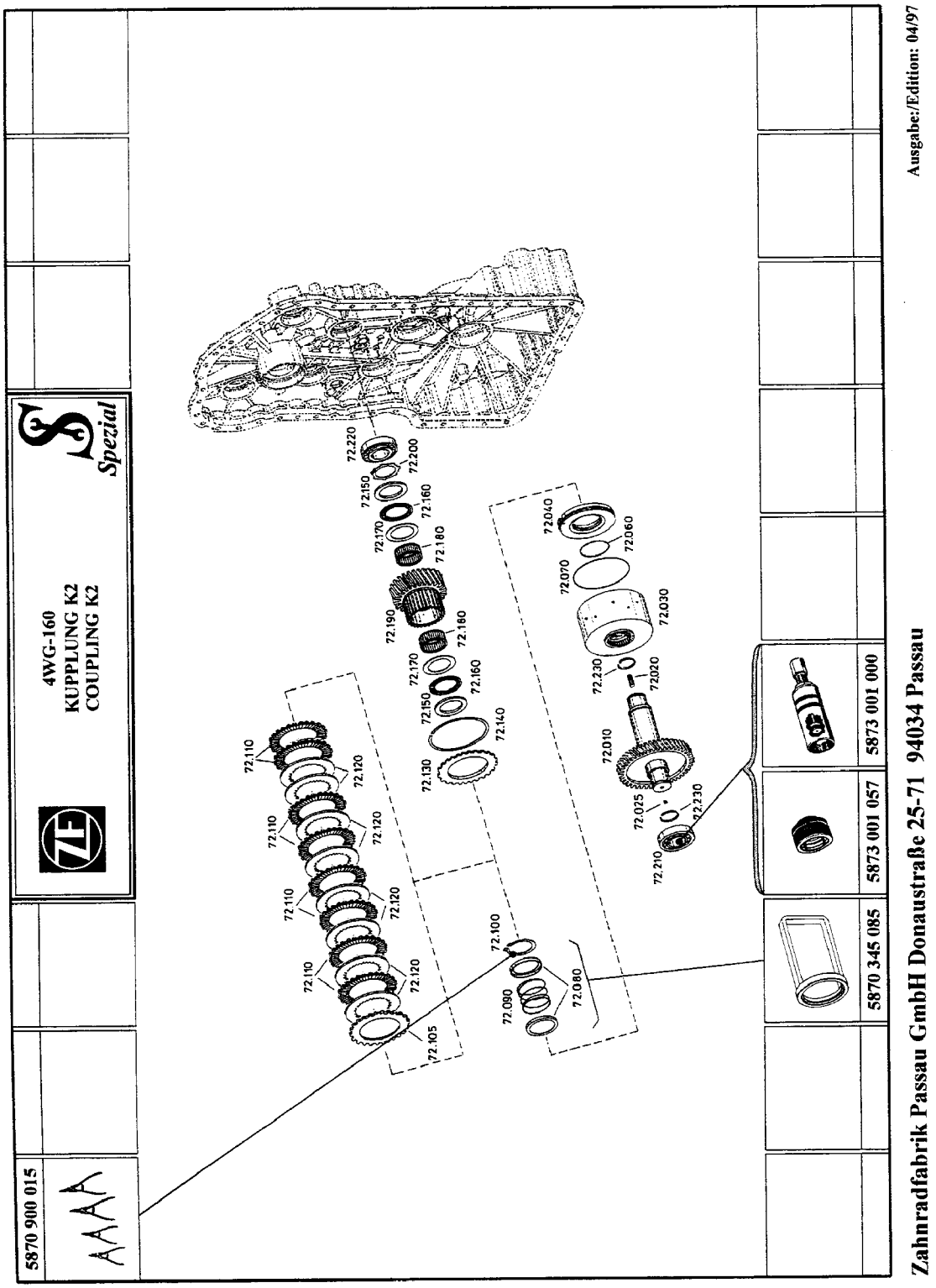
FG005191

Figure 32

Transmission solenoid valves (Y1 and Y3, Figure 32) are energized when in reverse first gear.

Symbol	Meaning	Remarks
 + E	Engine speed too low, →raise engine speed	
 + E	Engine speed too high, →lower engine speed	
 + T	Transmission oil temperature too low → heat up transmission	
 + T	Transmission oil temperature too high →cool down transmission	
FT	Transmission temperature not in defined range during calibration	Transmissions stays in neutral, you have to restart the TCU (starter switch off/on)
FB	Operating mode not NORMAL or transmission temperature sensor defective or storing of calibrated values to EEPROM-has failed.	Transmissions stays in neutral, you have to restart the TCU (starter switch off/on)
FO	Output speed_not_zero	Transmissions stays in neutral, you have to restart the TCU (starter switch off/on)
FN	Shift lever not in Neutral position	Transmissions stays in neutral, you have to restart the TCU (starter switch off/on)
FP	Parking brake_not_applied	Transmissions stays in neutral, you have to restart the TCU (starter switch off/on)
STOP	AEB - Starter was used incorrect or is defective	Transmissions stays in neutral, you have to restart the TCU (starter switch off/on)

NOTE: *To prevent the transmission oil temperature from falling down while AEB operating, keep the transmission oil temperature about 80°C before starting AEB. (Temperature Range: 60°C - 90°C)*



APS0050S

Figure 54

Filter

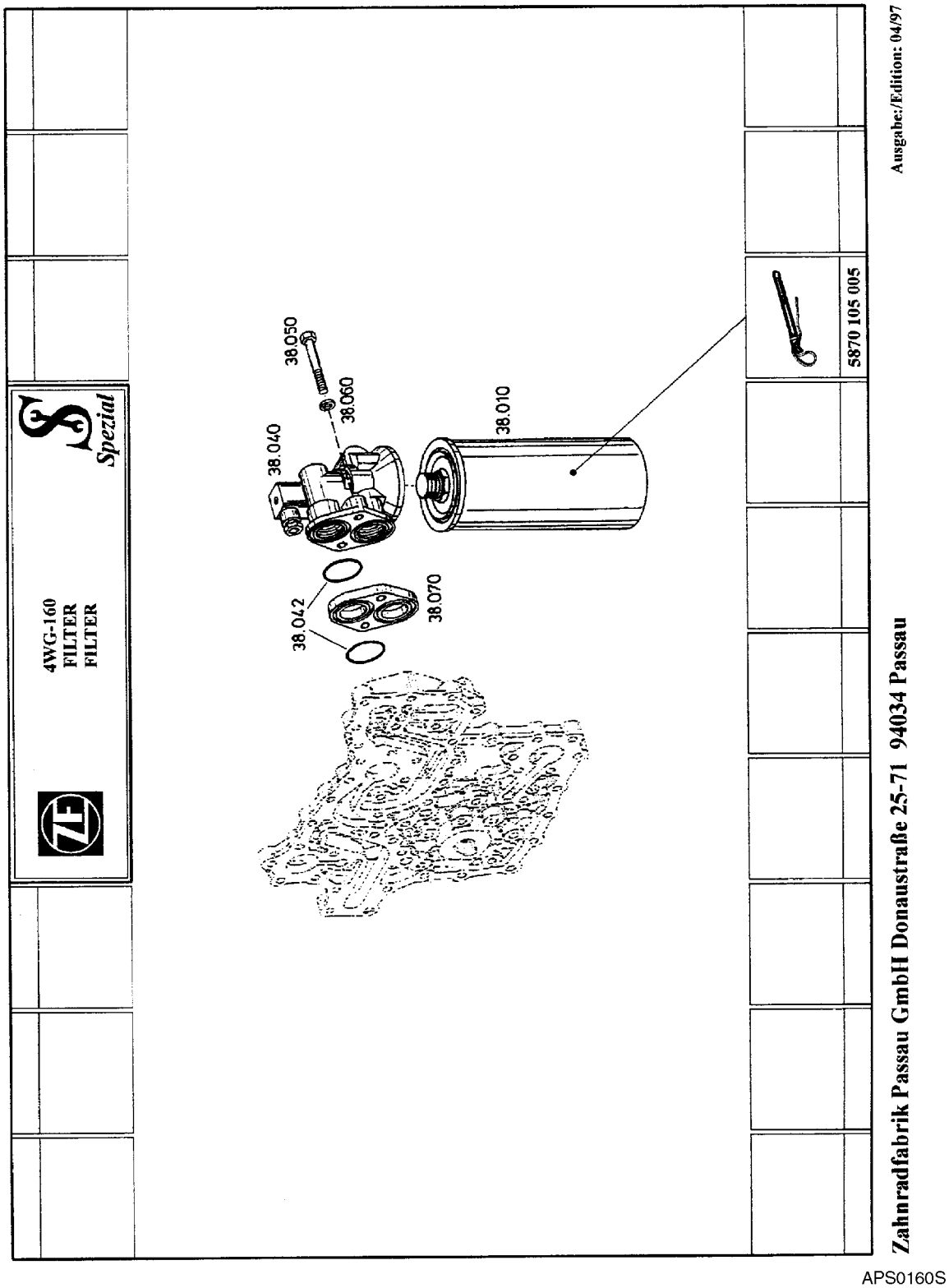


Figure 64

K. Install female connector against shoulder, with groove facing guide nose of cover.

L. Install gaskets (Figure 90) and fasten cover using socket head screws.

NOTE: *Torque limit 0.56 kg•m (4 ft lb).*

(S) Box wrench (Torx TX-27) - 5873 042 002

Figure 90

M. Install female connector using retaining clamp, see Figure 91.

N. Install opposite cover.

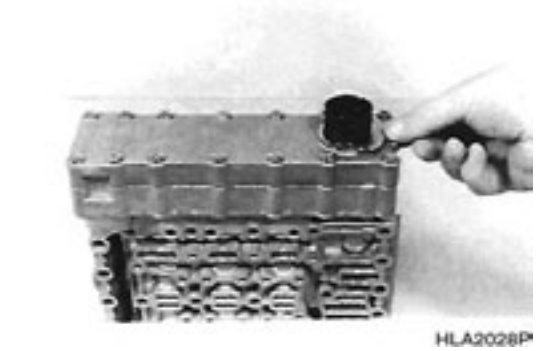


Figure 91

O. Install two adjusting screws and mount gasket I.

NOTE: *Pay attention to different gaskets, see Figure 92 and Figure 95.*

(S) Adjusting screws - 5870 204 063

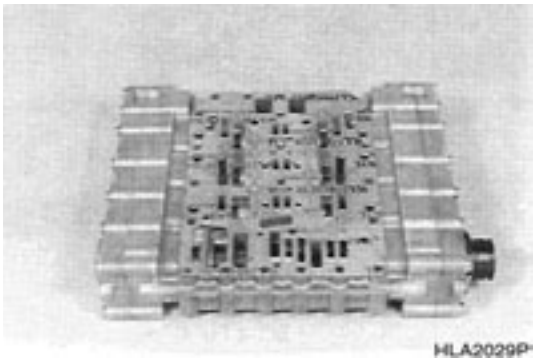


Figure 92

9. Intermediate plate-version with screens:

A. Insert screens (6x) flash -mounted into bore of intermediate plate, see Figure 93.

NOTE: *Pay attention to installation position screens are facing up (facing duct plate).*

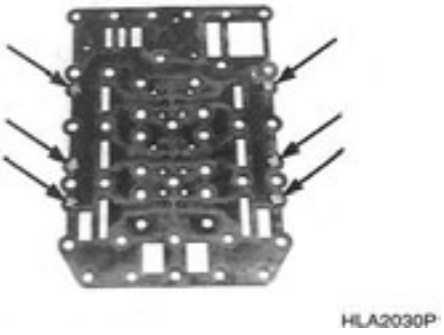


Figure 93

Remove Output, Input and Clutches

1. Remove lock plate, hex head screws, and pry converter side output flange from shaft.
2. Pry shaft seal out of housing bore.
3. Tilt gearbox 180° and remove rear output flange.

   (S) Pry bar - 5870 345 065

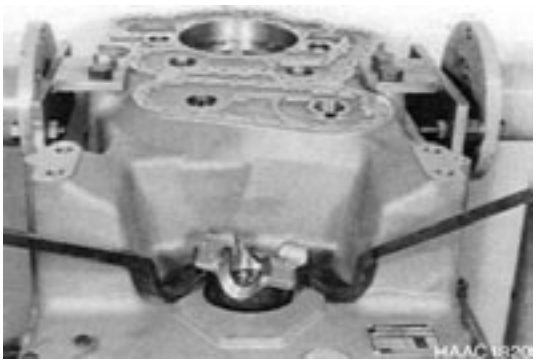


Figure 125

4. Remove speed sensor and both inductive transmitters (Arrows).

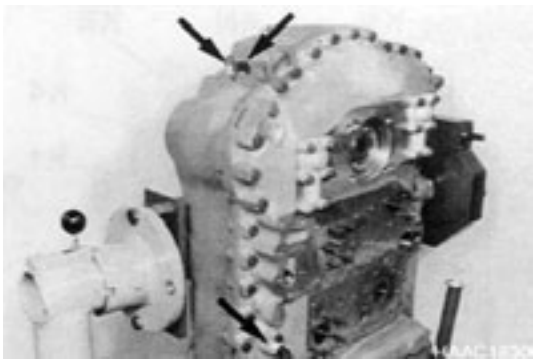


Figure 126

5. Loosen hex nuts and remove two covers (Figure 127).
6. Loosen screw connection.

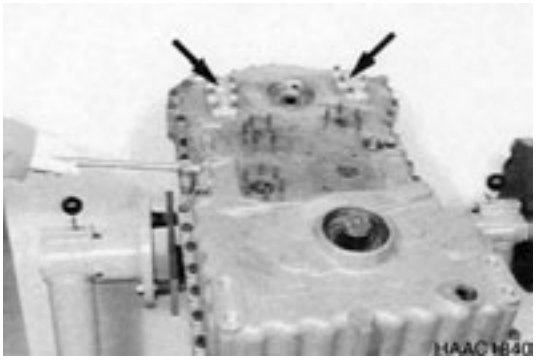


Figure 127

7. Drive both cylindrical pins (Figure 128) out.

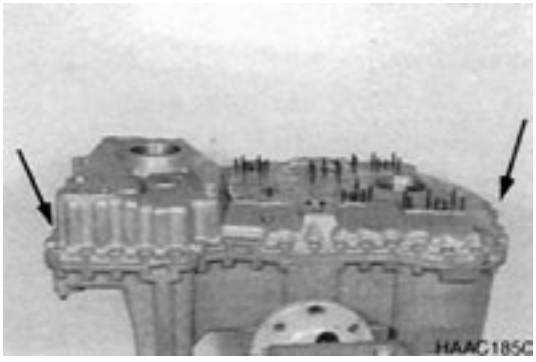


Figure 128

10. Pry plate carrier from the shaft.

    (S) Pry bar - 5870 345 065

Figure 162

Disassemble Clutch - K4

1. Squeeze rectangular ring out and pull tapered roller bearing from the shaft.
2. Remove opposite tapered roller bearing.

    (S) Grab sleeve - 5873 001 057

    (S) Basic set - 5873 001 000

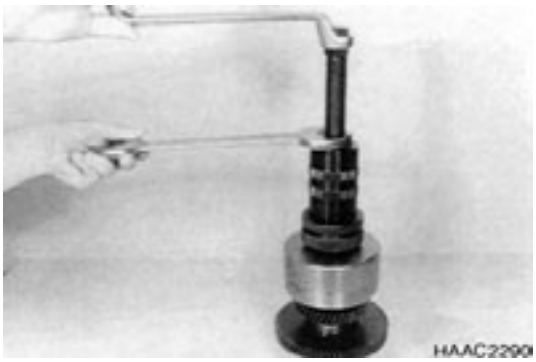


Figure 163

3. Squeeze retaining ring out and remove plate carrier from the shaft.

    (S) Assembly aid - 5870 345 085

    (S) Set of external pliers - 5870 900 015

Figure 164

4. Squeeze retaining ring out and remove plate pack.

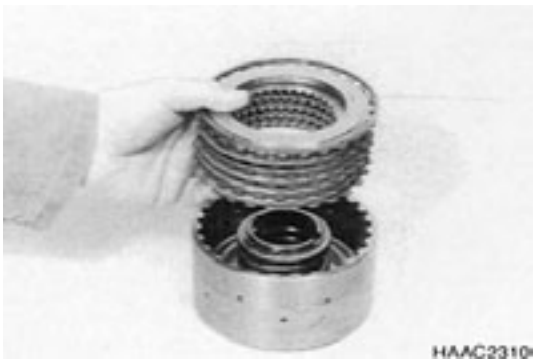


Figure 165

11. Insert ball bearing until contact is obtained and attach it using retaining ring.

Figure 191

12. Assemble needle bearing.

Figure 192

13. Press idler gear against shoulder.

    NOTE: *Support it on the inner bearing race.*

Figure 193

14. Attach idler gear axially using retaining ring.

    NOTE: *At clutch KR there is no recess in the shaft - assemble retaining ring until contact on the inner bearing race is obtained.*

    (S) Set of internal pliers - 5870 900 013

Figure 194

8. Adjust plate clearance = $1.20^{+0.20}$ mm ($0.0472^{+0.0079}$ in).

   NOTE: *For the plate clearance adjustment there are retaining rings of different thickness available. To ensure a faultless measuring result, install the plates for the moment without oil.*

9. Install plate pack according to Figure 223.

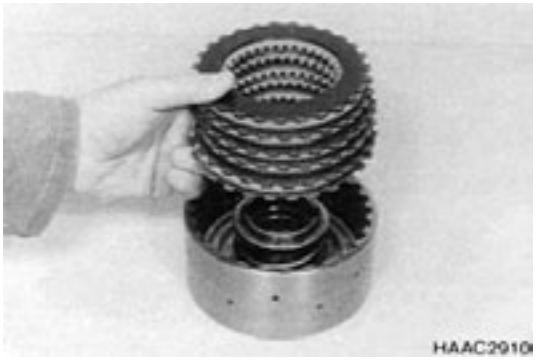


Figure 224

10. Fit end shim and squeeze retaining ring (e.g. s = 3.0 mm (0.1181 in)).

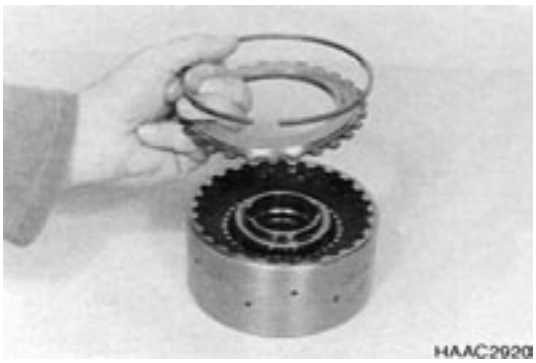


Figure 225

11. Press end shim on with about 10 kg (22 lb)) and measure Dimension I from the end face/plate carrier to the end shim.

    Dimension I e.g. 7.20 mm (0.2835 in)

    (S) Digital depth gauge - 5870 200 072

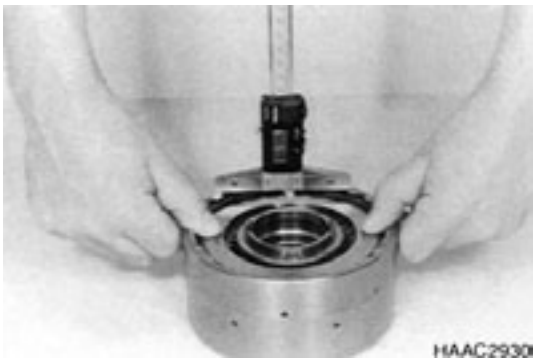


Figure 226

Install Output Flanges

1. Assemble sheet and press both inner bearing races against shoulder until contact is obtained.

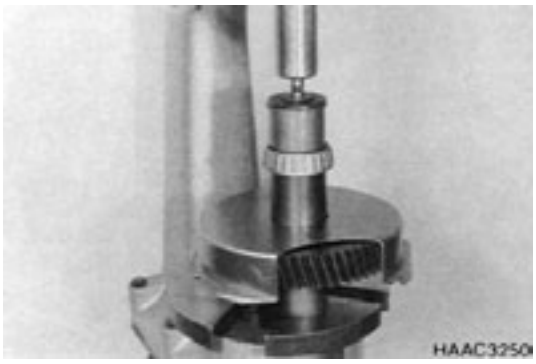


Figure 257

2. Insert outer bearing race (Figure 258) into the housing bore until contact is obtained.

Figure 258

3. Position screening plate.

Figure 259

4. Insert output shaft.

Figure 260

Filter

1. Figure 291, shows the components of the filter unit.

   NOTE: *Install new O-rings (Figure 291).*

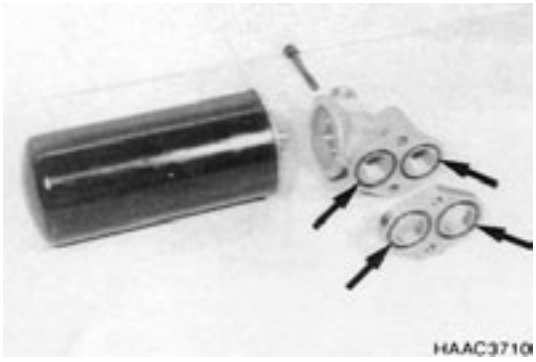


Figure 291

2. Fasten intermediate plate and filter head using hex head screws (mount flat washers).

   NOTE: *Torque limit 2.55 kg•m (18 ft lb).*

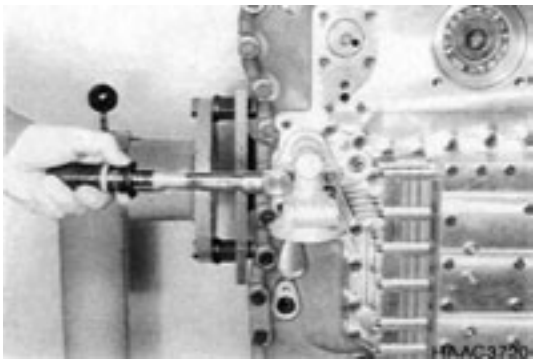


Figure 292

3. Oil gasket and tighten exchange filter handtight.

Figure 293

4. If necessary, install warning switch (according to the version).

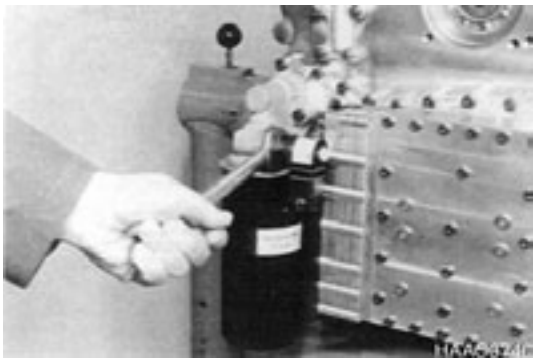


Figure 294

DISPLAY

If a fault is detected, the display shows a wrench symbol (g) for a fault. The display shows the fault code, if the gear selector is in neutral position.

If more than one fault is detected, each fault code is shown for about 1 second.

Reference Letter	Description
a, f	Automatic Range (Upshifting and Downshifting)
b, c, d, e	Preselected Gear
g	EST-37 has detected an error and is flashing.
h	This character will not be used at the EST-37.

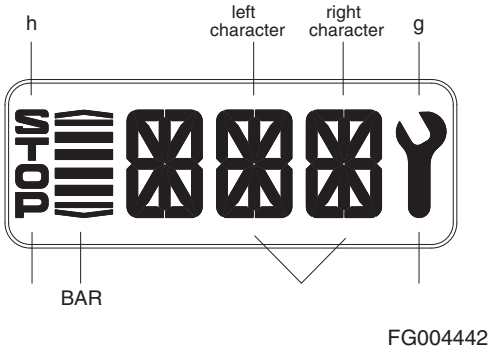


Figure 1

Description of Fault Codes

The first number of the error code is the category that it is grouped into. They are as follows for the first number.

First Number	Meaning of Number
1 Hex	Digital Input Signal
2 Hex	Analog Input Signal
3 Hex	Speed Signal
4 Hex	CAN Signal Error
5 Hex	CAN Signal Error
6 Hex	CAN Signal Error
7 Hex	Analog Current Output Signal
8 Hex	Analog Current Output Signal
9 Hex	Digital Output Signal
A Hex	Digital Output Signal
B Hex	Transmission Fault, Clutch Error
C Hex	Logical Fault
D Hex	Power Supply
E Hex	High-speed Signal
F Hex	General Fault

Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
22	S.C. to ground or O.C. at clutch cutoff input. The measured voltage is too low: • Cable is defective and is contacted to vehicle ground. • Clutch cutoff sensor has an internal defect. • Connector pin is contacted to vehicle ground or is broken.	Clutch cutoff function is disabled OP-Mode: normal	Check the cable from TCU to the sensor. Check the connectors. Check the clutch cutoff sensor.	----------
23	S.C. to battery voltage at load sensor input. The measured voltage is too high • Cable is defective and is contacted to battery voltage. • Load sensor has an internal defect. • Connector pin is contacted to battery voltage.	Retarder function is affected TCU uses default load OP-Mode: normal	Check the cable from TCU to the sensor. Check the connectors. Check the load sensor Check the assembly tolerances of load sensor.	Availability of retarder depends on default load.
24	S.C. to ground or O.C. at load sensor input. The measured voltage is too low: Cable is defective and is contacted to vehicle ground. Cable has no connection to TCU. Load sensor has an internal defect. Connector pin is contacted to vehicle ground or is broken.	Retarder function is affected TCU uses default load. OP-Mode: normal	Check the cable from TCU to the sensor. Check the connectors. Check the load sensor. Check the assembly tolerances of load sensor.	Availability of retarder depends on default load.
25	S.C. to battery voltage or O.C. at transmission sump temperature sensor input. The measured voltage is too high: • Cable is defective and is contacted to battery voltage. • Cable has no connection to TCU. • Temperature sensor has an internal defect. • Connector pin is contacted to battery voltage or is broken.	No reaction. TCU uses default temperature. OP-Mode: normal.	Check cable from TCU to sensor. Check connectors. Check temperature sensor.	----------
26	S.C. to ground at transmission sump temperature sensor input. The measured voltage is too low: • Cable is defective and is contacted to vehicle ground. • Temperature sensor has an internal defect. • Connector pin is contacted to vehicle ground.	No reaction. TCU uses default temperature. OP-Mode: normal.	Check cable from TCU to sensor. Check connectors. Check temperature sensor.	----------

Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
5F	CAN message 'Front wheel drive status (V IDENT FWD)' contains invalid data.	TCU shifts to neutral	Check FWD controller.	----------
60	Additional brake status signal CAN signal for additional park brake status is defective. • I/O controller is defective. • Interference on CAN-Bus.	No reaction. OP-Mode: normal	Check I/O controller. Check wire of CAN-Bus. Check cable to I/O controller	----------
61	AEB request signal CAN signal for AEB request is defective • I/O controller is defective. • Interference on CAN-Bus.	No reaction. OP-Mode: normal Last selection is kept	Check I/O controller. Check wire of CAN-Bus. Check cable to I/O controller	----------
62	PTO torque signal CAN signal for PTO torque is defective • I/O controller is defective. • Interference on CAN-Bus.	No reaction. TCU uses default PTO torque signal OP-Mode: normal	Check I/O controller. Check wire of CAN-Bus. Check cable to I/O controller	----------
63	Driving mode signal CAN signal for driving mode is defective. • I/O controller is defective. • Interference on CAN-Bus.	No reaction. TCU uses default driving mode signal OP-Mode: normal	Check I/O controller. Check wire of CAN-Bus. Check cable to I/O controller	----------
64	Starting gear signal CAN signal for starting gear is defective. • I/O controller is defective. • Interference on CAN-Bus.	No reaction. TCU uses default starting gear OP-Mode: normal	Check I/O controller. Check wire of CAN-Bus. Check cable to I/O controller	----------
65	Engine torque signal CAN signal for engine torque is defective • Engine controller is defective. • Interference on CAN-Bus.	OP-Mode: substitute clutch control	Check engine controller Check wire of CAN-Bus. Check cable to engine controller	----------
69	Reference engine torque signal CAN signal for reference of engine torque id defective • Engine controller is defective. • Interference on CAN-Bus.	OP-Mode: substitute clutch control	Check engine controller Check wire of CAN-Bus. Check cable to engine controller	----------
6A	Actual engine torque signal CAN signal for actual engine torque is defective • Engine controller is defective. • Interference on CAN-Bus.	OP-Mode: substitute clutch control	Check engine controller Check wire of CAN-Bus. Check cable to engine controller	----------

Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
9D	S.C. to ground at retarder solenoid. TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground. • Cable is defective and is contacted to vehicle ground. • Retarder solenoid has an internal defect. • Connector pin is contacted to vehicle ground.	No reaction. OP-Mode: normal.	Check cable from TCU to the retarder solenoid. Check connectors from retarder solenoid to TCU. Check resistance [1] of retarder solenoid.	[1] See “Measurement of Resistance at Actuator/Sensors and Cable” on page 55.
9E	O.C. at retarder solenoid. TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin. • Cable is defective and has no connection to TCU. • Retarder solenoid has an internal defect. • Connector has no connection to TCU.	No reaction. OP-Mode: normal.	Check cable from TCU to the retarder solenoid. Check connectors from retarder solenoid to TCU. Check resistance [1] of retarder solenoid.	[1] See “Measurement of Resistance at Actuator/Sensors and Cable” on page 55.
9F	S.C. to battery voltage at retarder solenoid. TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage. • Cable is defective and is contacted to battery voltage • Retarder solenoid has an internal defect. • Connector pin is contacted to battery voltage	No reaction. OP-Mode: normal.	Check cable from TCU to the retarder solenoid. Check connectors from retarder solenoid to TCU. Check resistance [1] of retarder solenoid.	[1] See “Measurement of Resistance at Actuator/Sensors and Cable” on page 55.
A1	S.C. to ground at difflock or axle connection solenoid. TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground. • Cable is defective and is contacted to vehicle ground • Difflock solenoid has an internal defect. • Connector pin is contacted to vehicle ground	No reaction. OP-Mode: normal.	Check cable from TCU to the difflock solenoid. Check connectors from difflock solenoid to TCU. Check resistance [1] of difflock solenoid.	[1] See “Measurement of Resistance at Actuator/Sensors and Cable” on page 55.

Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
C8	S.C. to battery voltage at over temperature neutral indicator. TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage. • Cable is defective and is contacted to battery voltage. • Over temperature status indicator has an internal defect. • Connector pin is contacted to battery voltage.	No reaction. OP-Mode: normal.	Check cable from TCU to over temperature neutral indicator. Check connectors from over temperature neutral indicator to TCU. Check resistance [1] of over temperature neutral indicator.	[1] See “Measurement of Resistance at Actuator/Sensors and Cable” on page 55.
C9	O.C. at over temperature neutral indicator TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin. • Cable is defective and has no connection to TCU. • Over temperature status indicator has an internal defect. • Connector has no connection to TCU.	No reaction. OP-Mode: normal.	Check cable from TCU to the over temperature neutral indicator. Check connectors from over temperature neutral indicator to TCU. Check resistance [1] of over temperature neutral indicator.	----------
CA	Engine retarder configuration time out Time out of CAN-message Engine retarder configuration from EEC controller. • Interference on CAN-Bus • CAN wire/ connector is broken. • CAN wire/ connector is defective an has contact to vehicle ground or battery voltage.	OP-Mode: substitute clutch control.	Check EEC controller. Check wire of CAN-Bus. Check cable to EEC controller.	----------
CB	ERC1 time out. Time out of CAN-message ERC1 from EEC controller. • Interference on CAN-Bus • CAN wire/ connector is broken. • CAN wire/ connector is defective an has contact to vehicle ground or battery voltage.	OP-Mode: substitute clutch control.	Check EEC controller. Check wire of CAN-Bus. Check cable to EEC controller.	----------
D1	S.C. to battery voltage at power supply for sensors. TCU measures more than 6V at the pin AU1 (5V sensor supply).	See fault codes No. 21 - 2C.	Check cables and connectors to sensors, which are supplied from AU1. Check the power supply at the pin AU1 (should be approximately 5V).	Fault codes No. 21 to No. 2C may be a reaction of this fault.

Driveshaft

Edition 1

Table of Contents

Service Brake

Brake Supply Valve

Edition 1

Table of Contents

Parking Brake

Table of Contents

Brake Pedal Valve

SAFETY PRECAUTIONS

CAUTION

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that are in good working order.

Use lifting and hoisting equipment capable of safely handling the load.

Remember, that ultimately safety is your own responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DL200	5001 and Up

SAFETY PRECAUTIONS

CAUTION

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that are in good working order.

Use lifting and hoisting equipment capable of safely handling the load.

Remember, that ultimately safety is your own responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DL200	5001 and Up

Special Tool T21

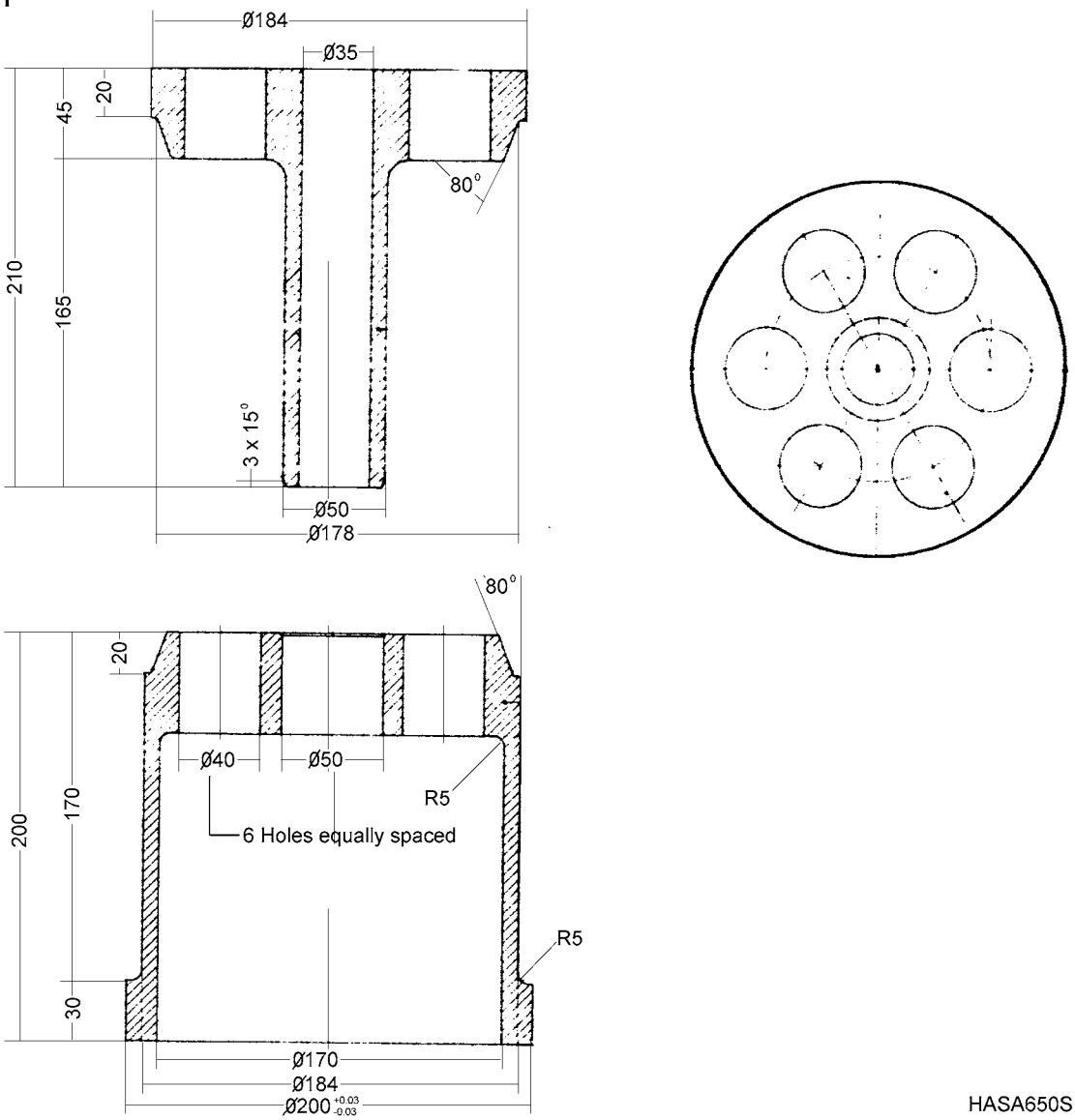


Figure 5 DIFFERENTIAL GEAR OPERATION

Adjustment of Safety Brake

1. Apply 25 - 35 bar (360 - 510 psi) of pressure in hydraulic circuit, then remove bolt and locking plate.

Figure 30

2. Turn the pinion with 8 Nm (6 ft lb) torque counterclockwise till it stops. Adjust gap between brake disks by turning three complete revolutions clockwise.

Figure 31

3. Set adjusting studs to unlock safety brake at 47 mm (1.85 in), and lock counter nut

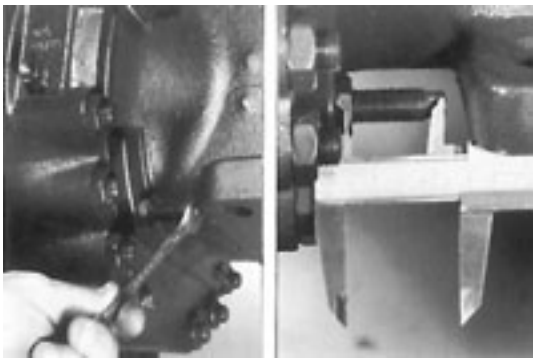


Figure 32

5. Determination of shim pack S1 for preload of taper roller bearings.

   NOTE: *S1 = B - C + X*

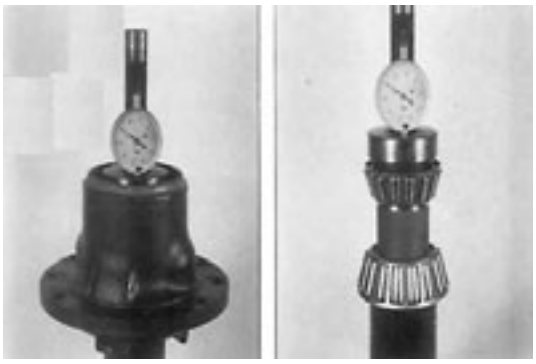


Figure 64

6. Value X = 0,09 - 0,11 mm (0.003 - 0.004 in) (Rear Axle)

   NOTE: *Value X = 0,11 - 0,14 mm (0.004 - 0.006 in) (Front Axle)*

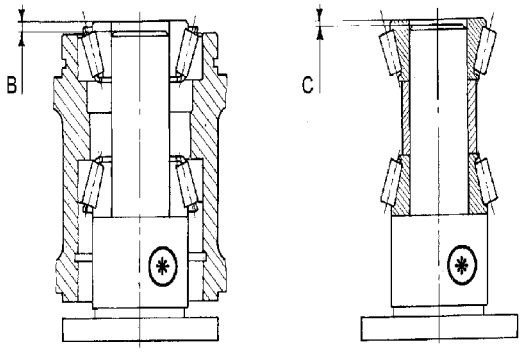


Figure 65

7. Press fit bearing cone onto pinion gear, then assemble spacer and shim.

   NOTE: *There must be no clearance at contact faces of any parts.*

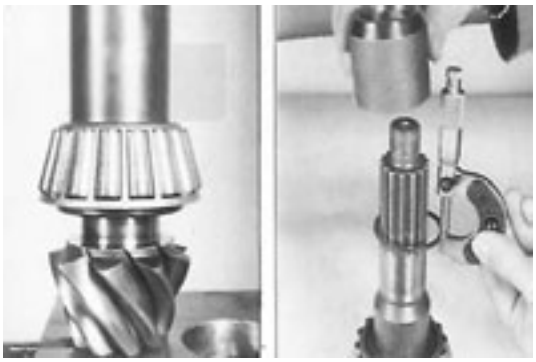


Figure 66

8. Press fit bearing cups in cage. Assemble pinion gear in cage, then press fit bearing cone. Apply pressure to bearing at specified load, and rotate the case to settle bearing. A special tool T22 is required (refer to "Special Tools" in back of this section).

   NOTE: *Specified load = 49 Kn (5 ton)*

   NOTE: *When rotating the case at the specified load, rotate lightly by hand. If the rotation is not smooth, replace the bearing and spacer, and again rotate lightly by hand.*

Figure 67

Table of Contents

Steering

7. Hold pressure relief valve with a pliers and use a 5 mm allen wrench to remove set screw. See Figure 13.

Figure 13

8. The pressure relief valve is composed of a valve housing, valve needle, spring and set screw. See Figure 14.

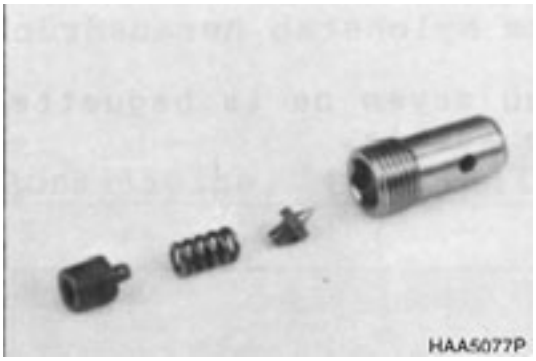


Figure 14

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

For general cleaning and inspection procedures, refer to "General Maintenance Procedures" section.

Clean all parts with a nonflammable, nontoxic solvent.

Carefully inspect all parts. Replace all worn or broken parts. Use only new O-rings to assemble the valve.

Cost all parts with oil before assembling them.

TROUBLESHOOTING, TESTING AND ADJUSTMENT

Problem	Cause	Remedy
Steering wheel does not operate smoothly	Broken or damaged oil pump.	Replace pump.
	Stuck or damaged relief valve.	Repair or replace.
	Stuck, damaged or worn out steering valve.	Clean, repair or replace.
	Restricted hose or pipe. Leaking or restricted hose, pipe, or connection.	Clean, repair or replace.
	Mechanical defect in steering gear.	Repair or replace.
Steering wheel has a heavy feel.	Oil level low in reservoir.	Add oil.
	Low oil pressure because of broken or damaged oil pump.	Replace pump.
	Steering valve stuck.	Clean, repair or replace.
	Low oil level in steering gearbox.	Inspect oil level, fill to proper level.
	Damaged bolt and nut in steering gearbox.	Replace damaged parts.
Difficult to drive in a straight line	Defective spool in steering valve.	Tighten locknut.
	Stuck or damaged steering valve or damaged or defective spring.	Repair or replace.
	Improper fit of track line.	Repair or replace.
Noise during steering	Low oil level in reservoir.	Add oil.
	Restricted inlet pipe or filter.	Clean or replace
Steering system leaking oil	Worn or damaged O-ring and oil seal of pipe and steering valve.	Replace worn or damaged parts.

10. Insert assembly tool down into bore of steering unit. See Figure 60.

Figure 60

11. Use assembly tool to install O-ring and backup ring into bore. See Figure 61.

Figure 61

12. Unbolt housing from stabilizing base. Hold housing in a horizontal position. See Figure 62. Insert sleeve and spool into bore.

Figure 62

Specifications

Item		Specification
Maximum Rated Pressure		210 bar (3,050 psi)
Rated Flow Ports to P1		110 lpm (29.06 U.S. gpm)
Rated Flow Ports to P3		210 lpm (55.48 U.S. gpm)
Rated Flow Ports to C		100 lpm (26.42 U.S. gpm)
Rated Flow Ports to R1, R2		300 lpm (79.25 U.S. gpm)
Setting Pressure	C1	3.5 ±0.2 Bar Cracking Pressure
Port Size	R1, R2, R3	1-1/4" SAE Flange Port
	P1	1" SAE Flange Port
	HT, EF	3/4" PF O-ring
	TPM	1/4" PF O-ring
	C	1" PF O-ring

Emergency Steering

Edition 1

Frame

Counterweight

Edition 1

Hydraulic Oil Tank

Edition 1

Table of Contents

Fuel Tank

Table of Contents

Cylinders

Reference Number	Description
1	Tube Assembly
2	Steel Bushing
3	Rod Assembly
4	Steel Bushing
5	Rod Cover
6	DU-bushing
7	U-packing
8	Backup Ring
9	Dust wiper
10	O-ring
11	Backup Ring
12	O-ring
13	Washer
14	Piston

Reference Number	Description
15	Glyd Ring
16	Wear Ring
17	Dust Ring
18	O-ring
19	Piston Nut
20	Lock Ring
21	Cushion Plunger
22	Stop Ring
23	Check Valve
24	Spring
25	Plug
26	O-ring
27	Grease Fitting Seal Kit

12. Insert one end of backup ring into its groove. See Figure 27. Use your hand to slide other end of ring into groove.

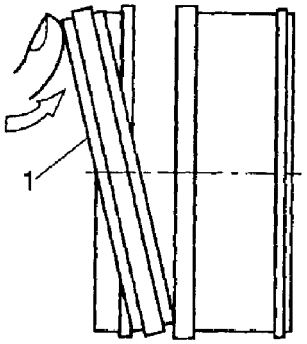


Figure 27

13. Use warm water to expand slipper seal. See Figure 28. This will make seal easier to install. Set slipper seal in 60 -100° C (140 - 212° F) water for 5 minutes or longer.

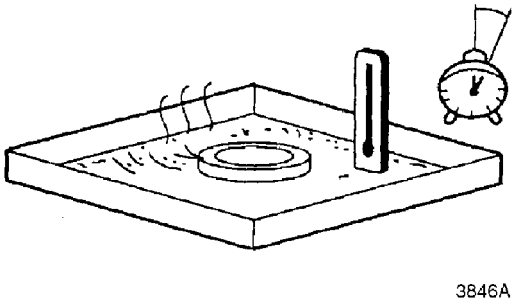


Figure 28

14. Insert one end of slipper seal, (1, Figure 29) into its groove. Use your hand to slide other end of slipper seal into groove.

⚠ WARNING

Before piston is inserted into cylinder tube, make sure that slipper seal is no longer expanded. If seal is still expanded, it could catch on threaded portion of cylinder tube. An expanded seal could also jam inside cylinder tube.

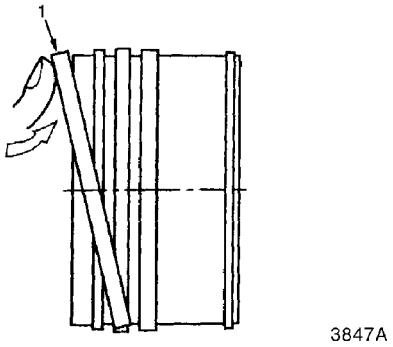


Figure 29

GENERAL DESCRIPTION

Theory Of Operation

The hydraulic pump is a triple gear pump which contains three pumping sections. The first pumping section supplies oil for the front attachment. The second pumping section supplies oil for the steering cylinders. Surplus oil which is not necessary for the steering function is directed into control valve to join the first pump's oil by the priority valve. The third pump section, is the pilot pump, used for brakes and pilot line operation.

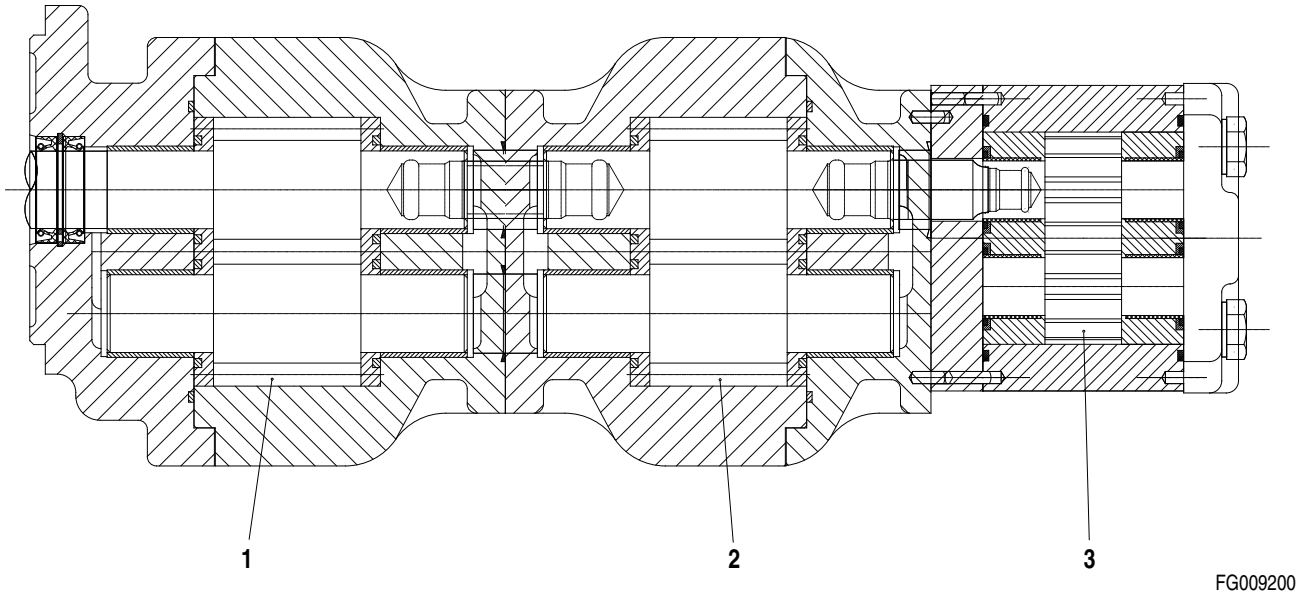


Figure 1

1. First pumping section (Figure 1).

   Pumping displacement: 44.0 cc/rev. (2.69 in^3/rev)

   Front attachment.

2. Second pumping section (Figure 1).

   Pumping volume: 44.0 cc/rev. (2.69 in^3/rev)

   Steering and front attachment.

3. Pilot pumping section (Figure 1).

   Pumping volume: 16 cc/rev. (0.98 in^3/rev)

   Fan, Brakes and pilot line operation.

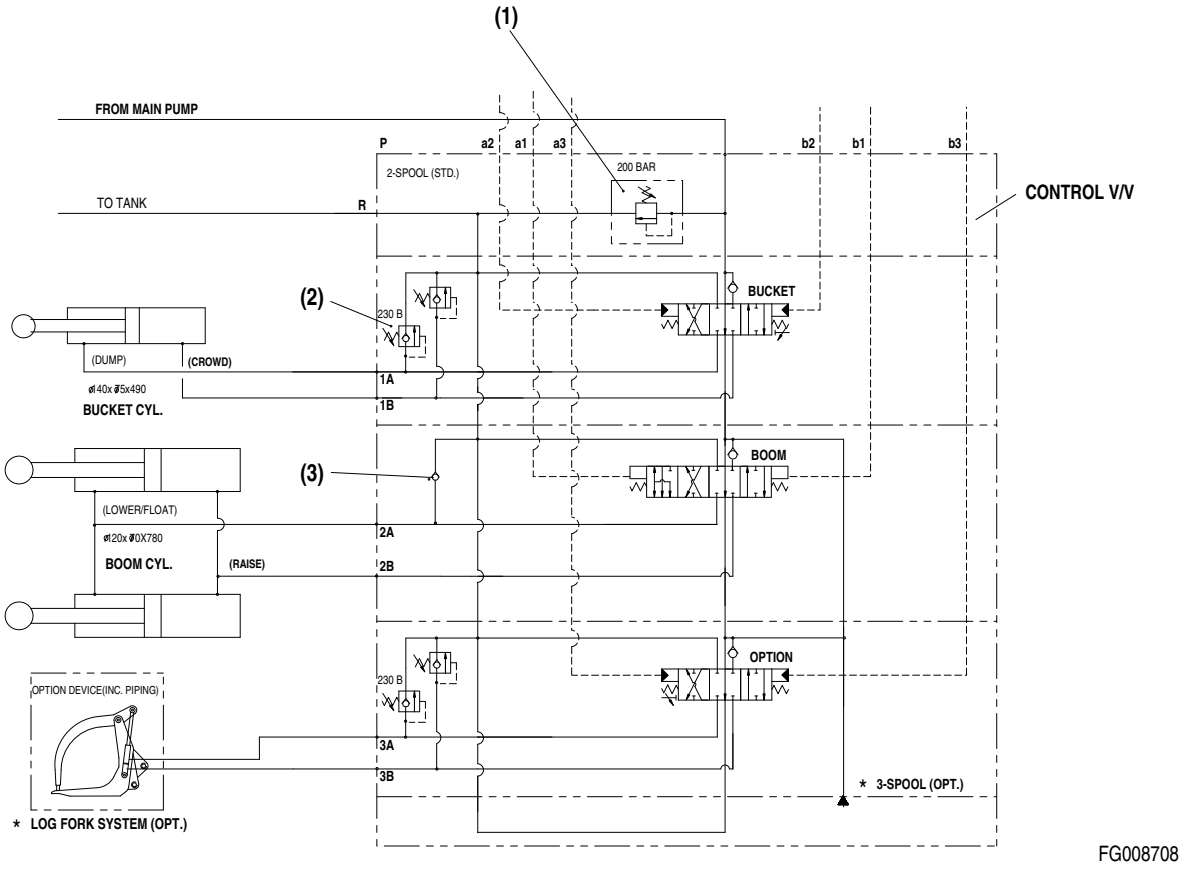


Figure 2 CONTROL VALVE HYDRAULIC CIRCUIT

Reference Number	Description
a1	Bucket Crowd Valve Port
b1	Bucket Dump Valve Port
a2	Boom Up Valve Port
b2	Boom Down Valve Port
a3	Option Valve Port
b3	Option Valve Port
A1	Bucket Crowd Port (to Bucket Cylinder Tube)
B1	Bucket Dump Port (to Bucket Cylinder Rod)

Reference Number	Description
A2	Boom Up Port (to Boom Cylinder Tube)
B2	Boom Lower Port (to Boom Cylinder Rod)
A3	Option Cylinder Port (to Option Cylinder Rod)
B3	Option Cylinder Port (to Option Cylinder Tube)
(1)	Main Relief Valve
(2)	Overload Relief Valve
(3)	Anticavitation Check Valve

Table of Contents

Load Isolation System

Cooling System

Edition 1

FAN MOTOR

The cooling fan is driven by a proportional and bi-directional fan motor.

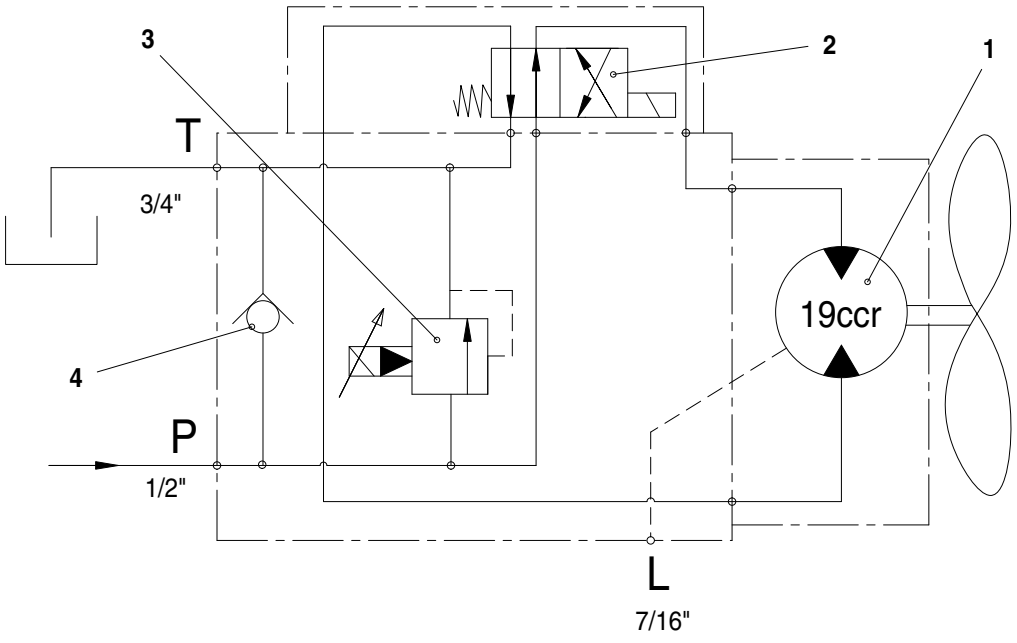


Figure 5

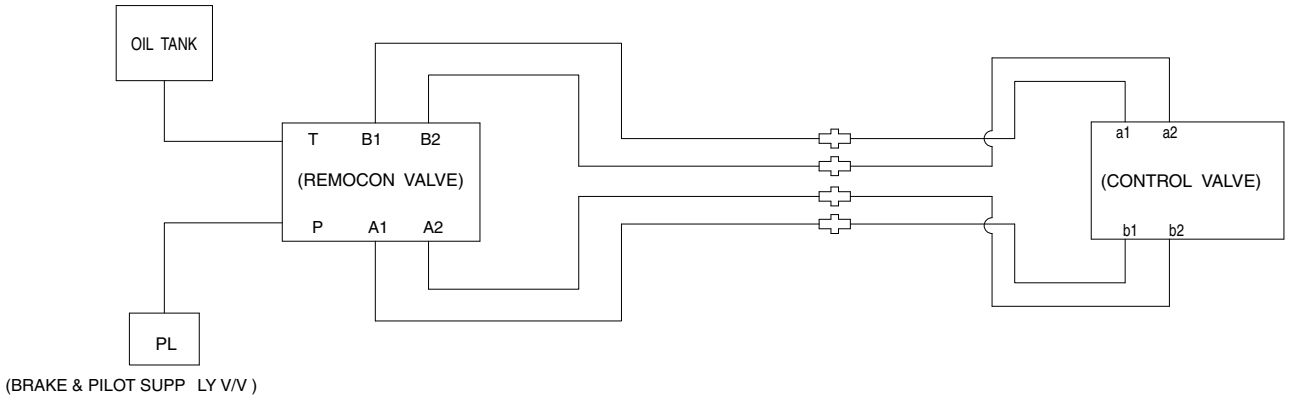
Reference Number	Description
1	Motor
2	Solenoid Operated Spool Valve

Reference Number	Description
3	Prop. Pressure Relief Cartridge
4	Check Valve

Pilot System

Edition 1

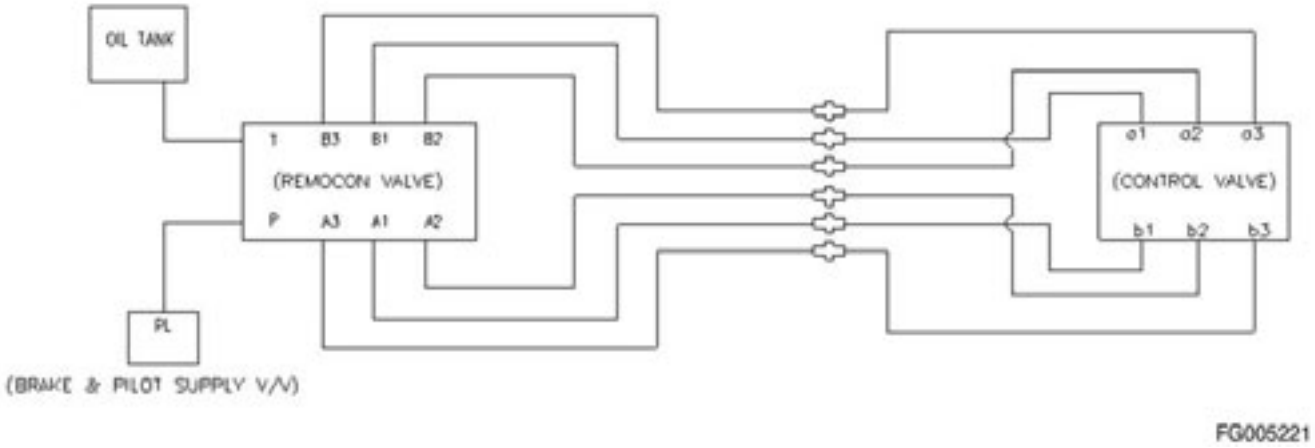
Finger-tip 2 Lever + 2 Spool Control Valve



FG006726

Figure 6

Finger-tip 3 Lever + 3 Spool Control Valve



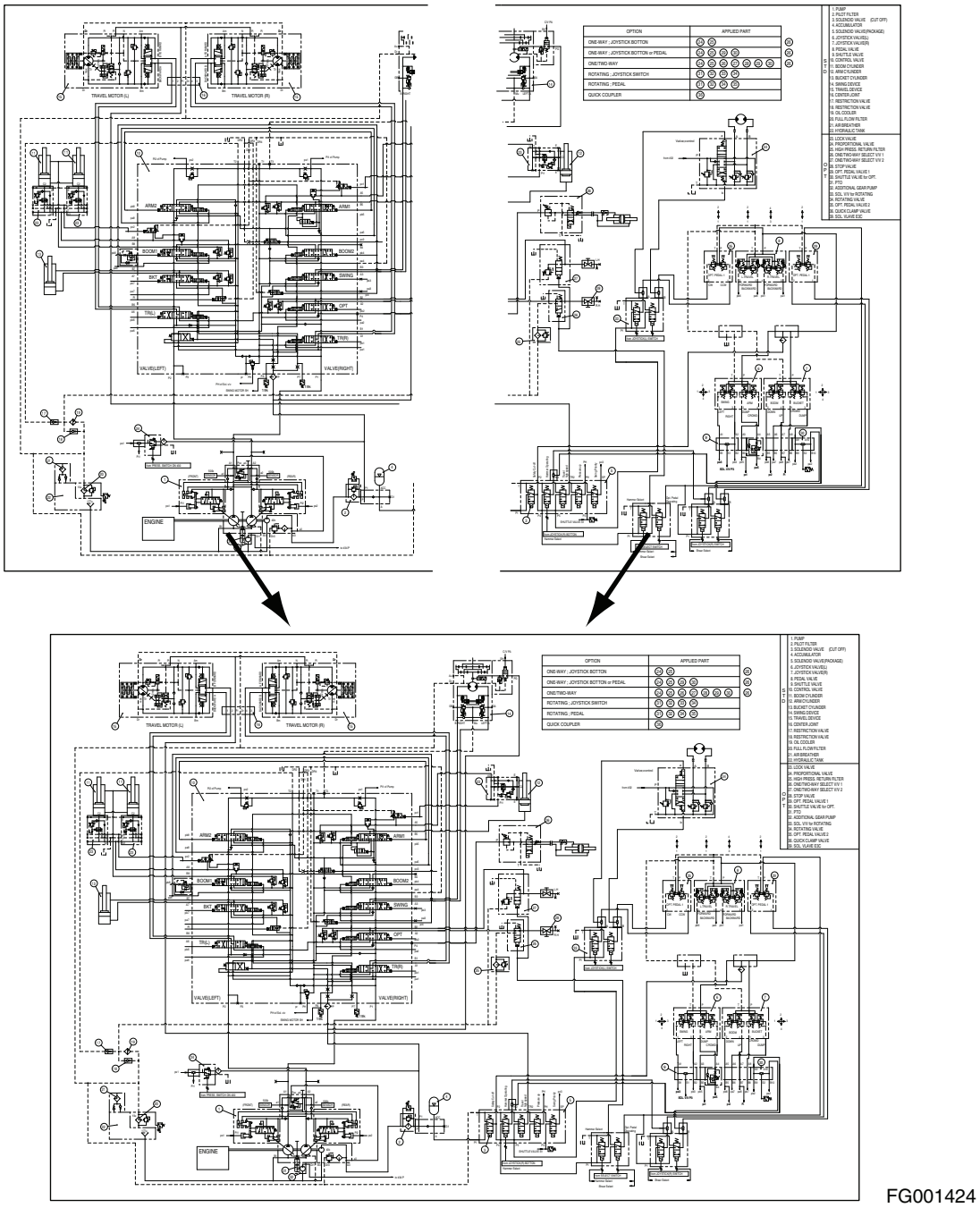
FG005221

Figure 7

GENERAL DESCRIPTION

Schematic (s) presented in this section are laid out on facing pages.

An overlapping edge has been taken into consideration so a photocopy can be made and pasted together to make a complete schematic.



FG001424

Figure 1

SAFETY PRECAUTIONS

CAUTION

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that are in good working order.

Use lifting and hoisting equipment capable of safely handling the load.

Remember, that ultimately safety is your own responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DL160	5001 and Up
DL200	5001 and Up
DL250	5001 and Up

2. Check system for vacuum leak.

   Allow system to sit for 10 minutes and check whether the system is holding the pressure. If the pressure has dropped, it must be repaired before proceeding to the next step.

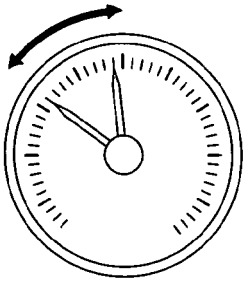
3. Vacuuming Procedure.

   If the system is holding the pressure and it has not changed for 10 minutes, vacuum out the system for an additional 20 minutes.

   A. Turn on the vacuum pump and slowly open both valves.

   B. Allow vacuum pump to run for additional 20 minutes until low-pressure gauge dial reads approximately 750 mmHg.

   C. Close both valves and stop the vacuum pump.

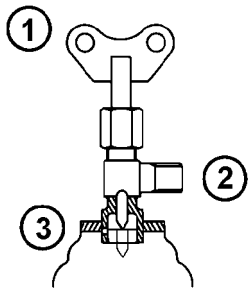


HDA6069L

Figure 18

4. Installation of Refrigerant Container.

Reference Number	Description
1	Handle
2	Hose Connection
3	Mounting Disk



HDA6070L

Figure 19

   A. Before mounting valve on the container, make sure the handle is in the counterclockwise most position, with the puncture pin retracted and the mounting disk is in the raised position.

   B. Attach the manifold gauge center hose to the valve assembly.

   C. Turn the disk in the clockwise direction and securely mount valve onto refrigerant container.

   D. Turn the valve handle in the clockwise direction and puncture the container seal with the pin.

   E. Once the can has been punctured, turn the handle in the counterclockwise direction so the refrigerant can flow into the manifold gauge center hose. Now, do not open the low and high-pressure valves of the manifold gauge.

   F. Press the manifold gauge low side valve to eliminate the trapped air in the hose.

ELECTRIC SUPPLY SYSTEM

The electric power circuit supplies electric current to each electric component. It consists of a battery, battery relay, starter switch, circuit breaker, fusible link and fuse box.

The negative terminal of the battery is grounded to the vehicle body.

Even when the starter switch is in the "OFF" position, electric current is supplied to the following components through battery, to the fusible link, and then to the fuse box.

1. Cabin light, No. 1 terminal of DC-DC converter (backup for stereo memory).
2. "B" terminal of starter switch and No. 22 terminal of air conditioner control panel (backup)
3. No. 23 and No. 68 terminals of transmission controller (backup for memory)
4. "B" terminal of blinker unit (for hazard warning light)
5. The source terminal of electric power of engine control unit (ECU).

When the starter switch (5) is in the "PREHEAT, ON and START" positions, the current flows from the battery (1), to the fusible link (3), to the fuse box (6), to the starter switch (5) "B" terminal/ starter switch "BR" terminal, to the diode (8), and then to the battery relay (2) "BR" terminal. which activates the coil of the battery relay (2) and the electric supply system is energized.

When the battery relay's contacts are connected, all electric devices can be operated.

While the engine is not running, the electric power for all electric devices are supplied by the battery. Once the engine is started the power is supplied from the alternator.

CHARGING SYSTEM

When the starter switch (5) is turned to the "ON" position, an initial excited current flows to the battery relay (2), to the circuit breaker (4), to the "B" terminal of alternator (7), and to the field coil. When the engine is started from this condition the alternator (7) starts charging. The current flows from the "B" terminal of alternator (7), to the circuit breaker (4), to the battery relay (2), and to the battery (1).

The alternator also supplies electric current to other electrical components. When the alternator (7) starts to operate, a current flows from the "I" terminal of alternator to the diode (8) and then to the battery relay (2) coil securing a path for the charging current to the battery (1). Thus, preventing the possibility of a high voltage build up and possible damage to the electrical system. The current then flows from the "I" terminal of the alternator (7) to the "2" terminal of the control unit (10), cutting power from the control unit terminal "4," and terminal "CN2-5" of gauge panel (9), to turn "OFF" the charging indicator light "L5."

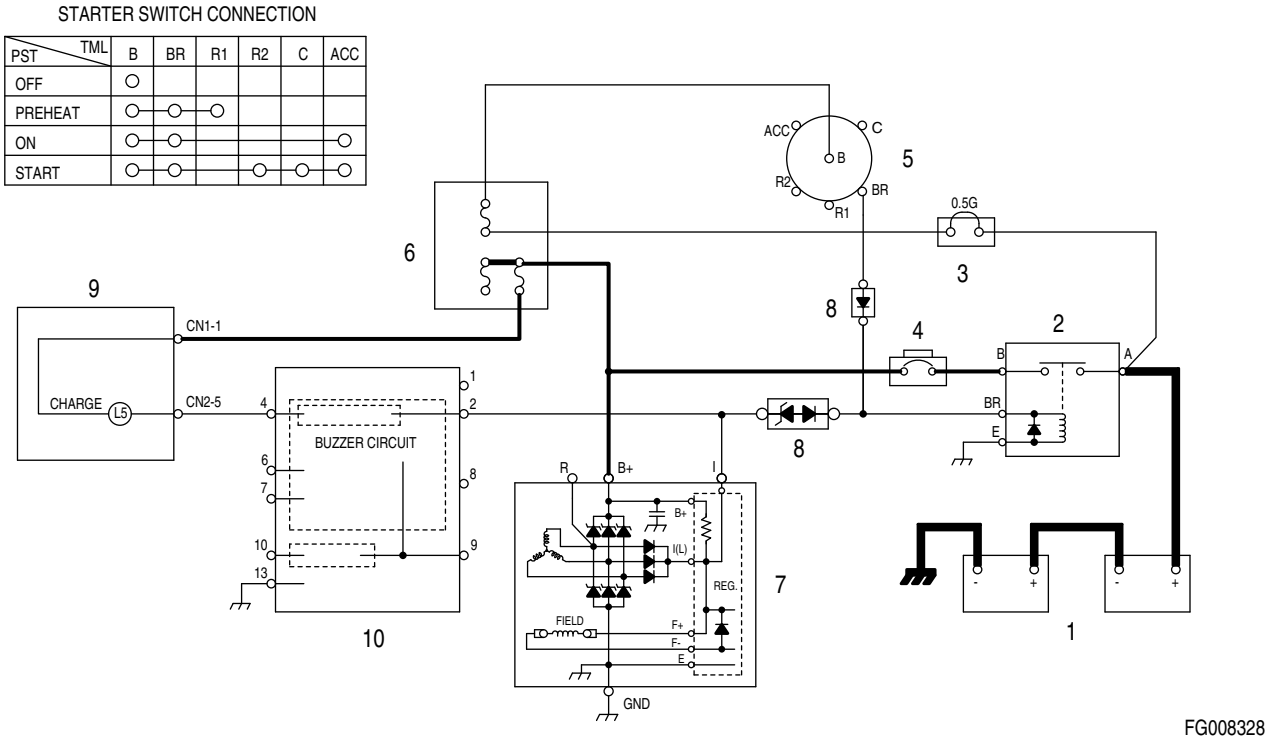


Figure 6 CHARGING CIRCUIT

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch

Reference Number	Description
6	Fuse Box
7	Alternator
8	Diode
9	Gauge Panel
10	Control Unit

Control Unit Operation

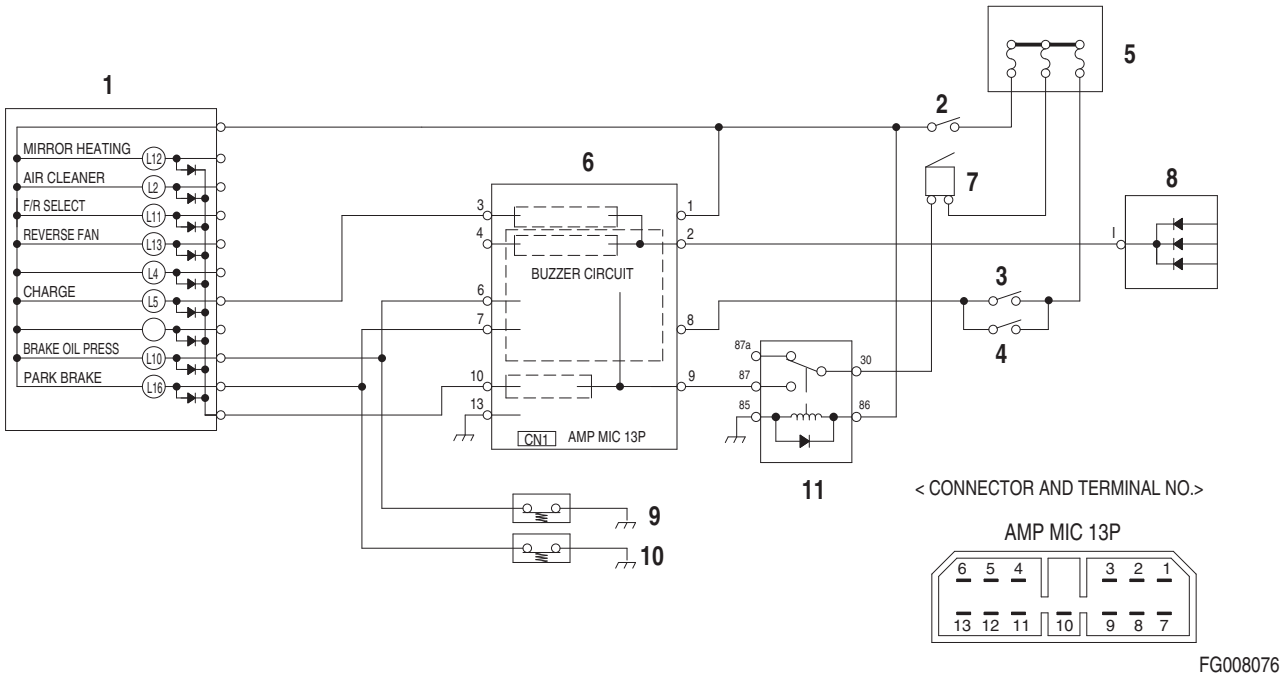


Figure 10

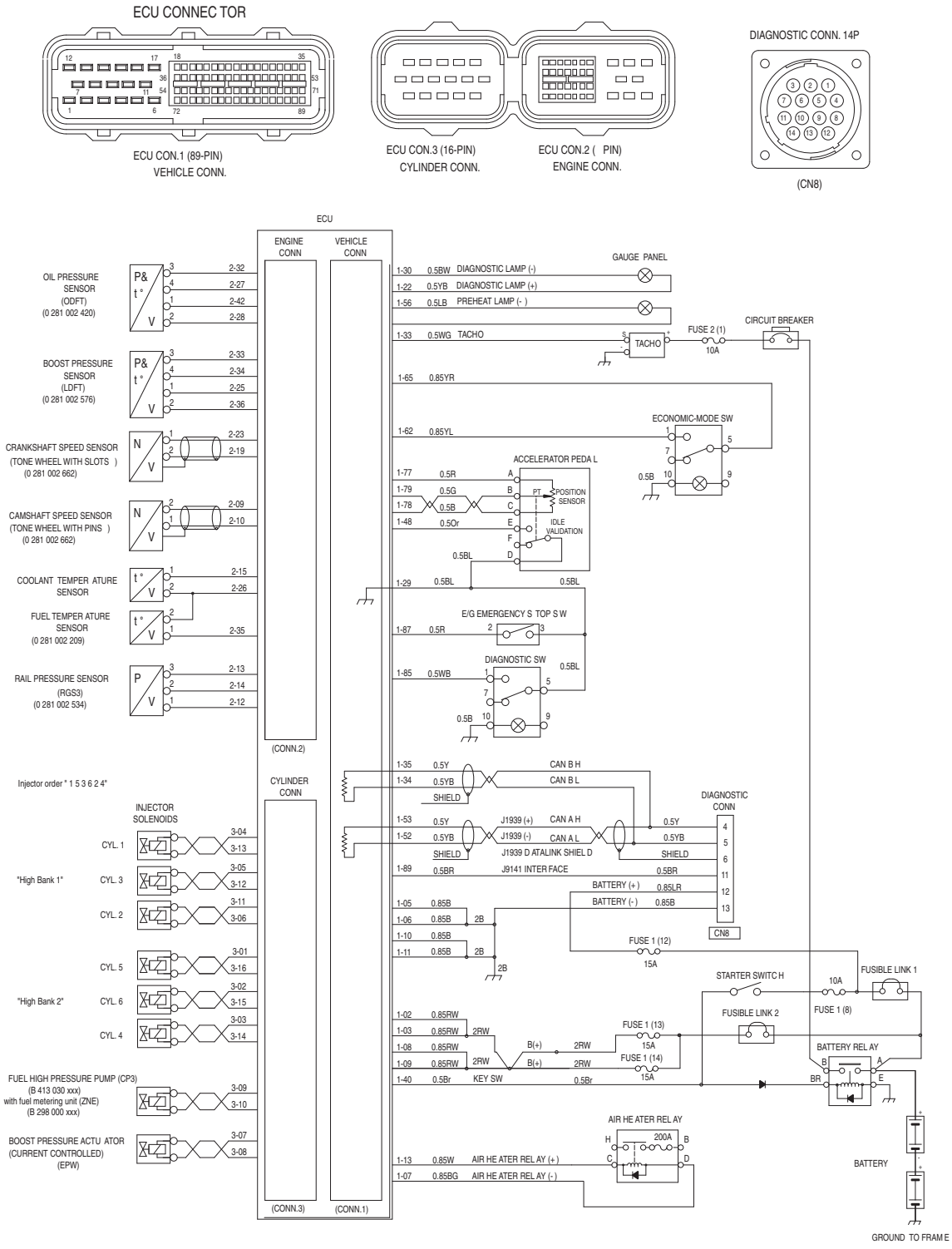
Reference Number	Description
1	Instrument Panel
2	Starter Switch
3	Forward Lever Switch
4	Reverse Lever Switch
5	Fuse Box
6	Control Unit

Reference Number	Description
7	Pilot Buzzer
8	Alternator
9	Brake Oil Pressure Switch
10	Parking Brake Pressure Switch
11	Alarm Relay 2

Characteristic of Operation

	Input		Output
1	When the starter switch is "ON."		All warning lights are turned "ON" and turned "OFF" after 2 - 2.5 seconds.
2	When "I" terminal voltage of alternator	is below 12 ±1 V	Battery warning light turns "ON," L5
		is above 12 ±1 V	Battery warning light turns "OFF," L5
3	When "I" terminal voltage of alternator is above 12 ±1 V	Brake oil pressure switch is "ON."	Warning buzzer sounds immediately
		Forward or Reverse lever switch is "ON" and Parking brake pressure switch is "ON."	Warning buzzer sounds immediately

ECU Electrical Circuit



FG006729

Figure 16

Diagram

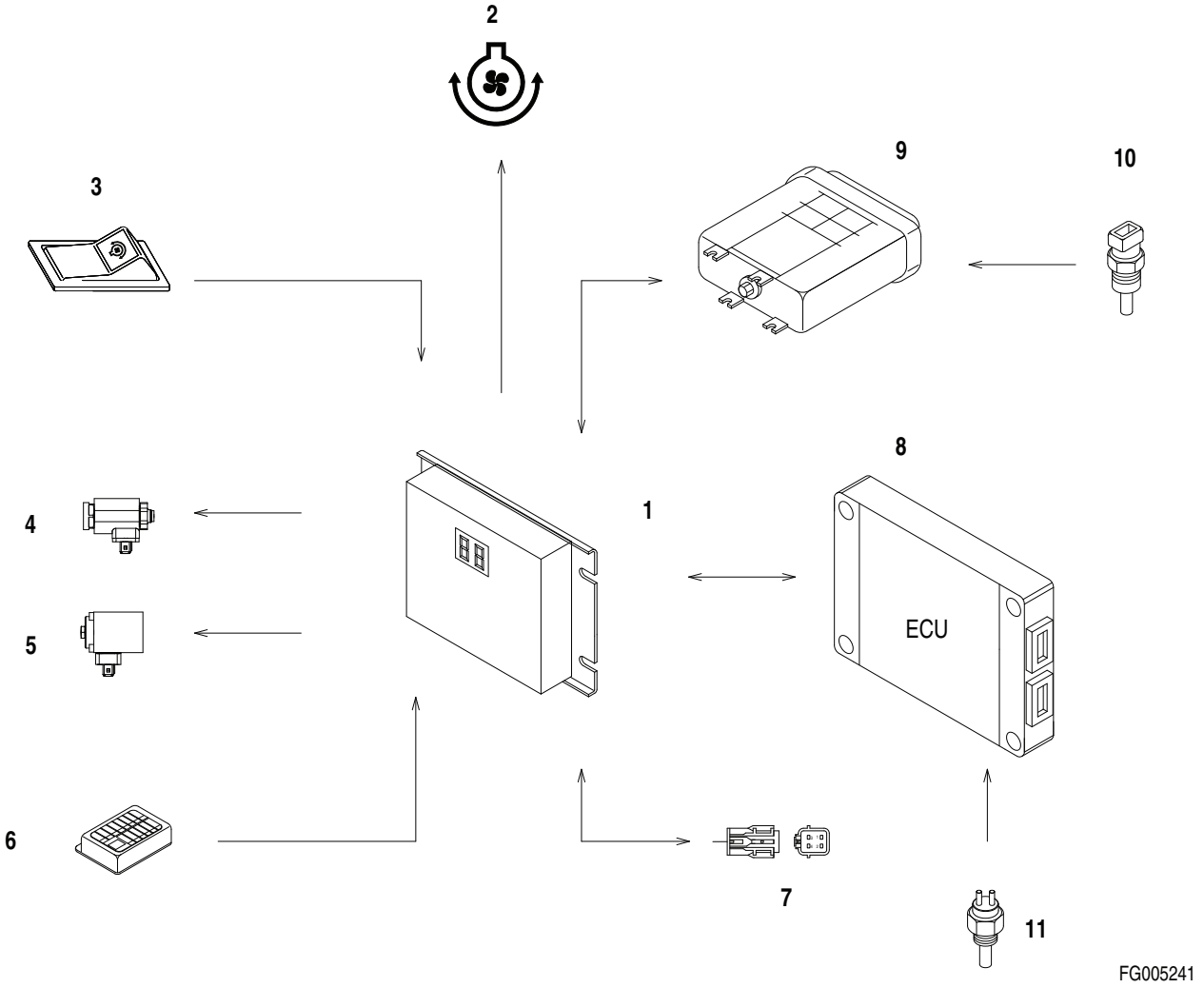
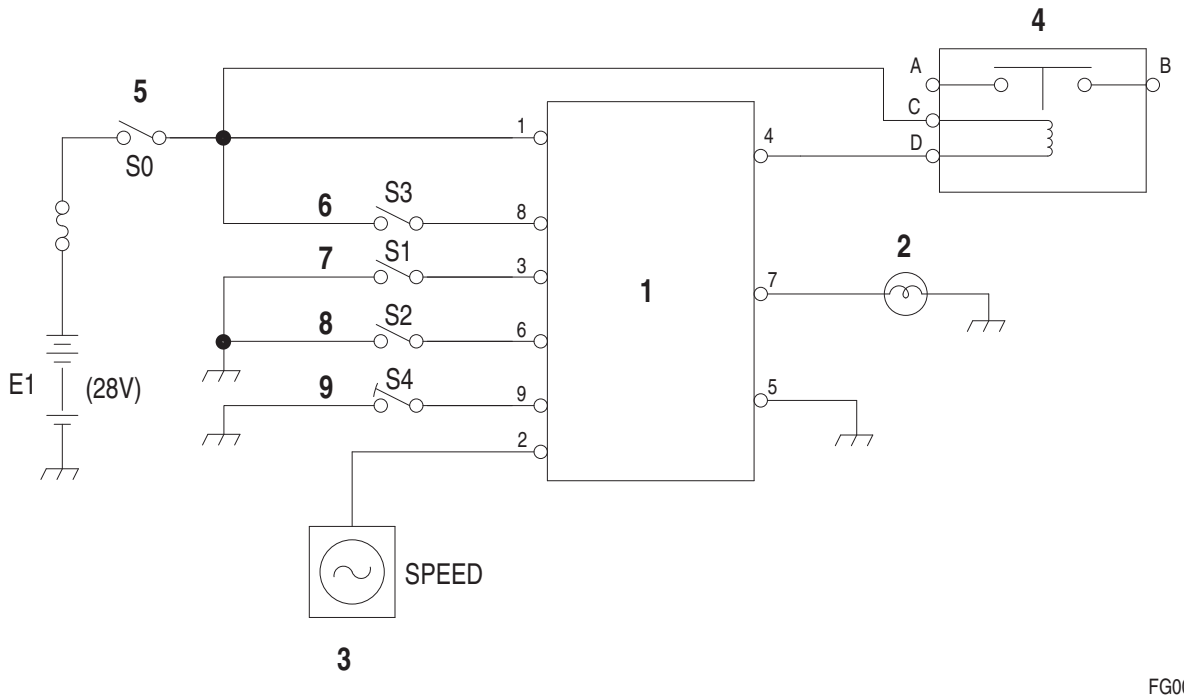


Figure 26

Reference Number	Description
1	Cooling Fan Controller
2	Reverse Rotation Light
3	Cooling Fan Reverse Switch
4	Cooling Fan Proportional Valve
5	Reverse Rotation Solenoid
6	Fuse Box

Reference Number	Description
7	Fan Check Connector
8	ECU
9	Transmission Controller (TCU)
10	Transmission Oil Temperature Sensor
11	Coolant Temperature Sensor

Emergency Steering Timer Circuit



FG004923

Figure 37

Reference Number	Description
1	Emergency Steering Timer
2	Emergency Steering Indicator
3	Transmission Controller (TCU)
4	Emergency Steering Pump
5	Starter Switch "ON"

Reference Number	Description
6	Starter Switch "START"
7	Main Steering Pressure Switch
8	Emergency Steering Pressure Switch
9	Emergency Steering Switch

Test Mode before Emergency Steering Start

Input Condition			Output	
S0	**S3**	**S4**	**Emergency Steering Pump**	**Light**
OFF →ON	OFF	OFF	will be operated only one time for 3 seconds and stop.	will be turned "ON" only one time for 3 seconds. - will be put out when S2 is "ON" . - wil be blinked continually when S2 is "OFF"
OFF →ON	ON	OFF	OFF	putting out light
OFF →ON	-	ON	Pump will be operated equally with S4 "ON" time.	Light will be turned "ON" equally with S4 "ON" time.