TE transmissions training program

- Basic converter/transmission theory
- TE transmissions
- TE 13/17/32 transmissions
- APC200 controller
- TE transmission field experience

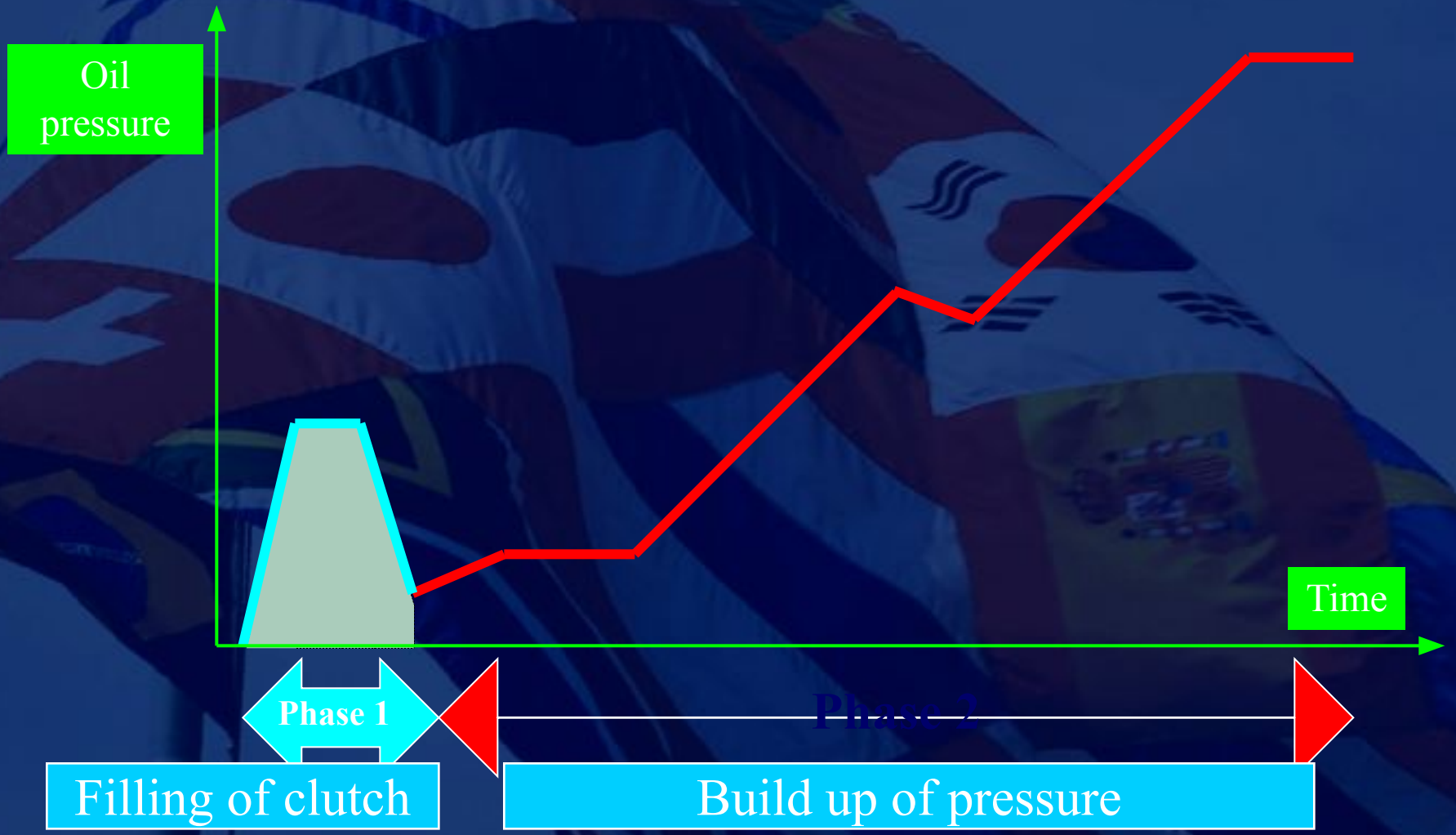
Basic connverter /transmission theory

- movie

TE transmissions

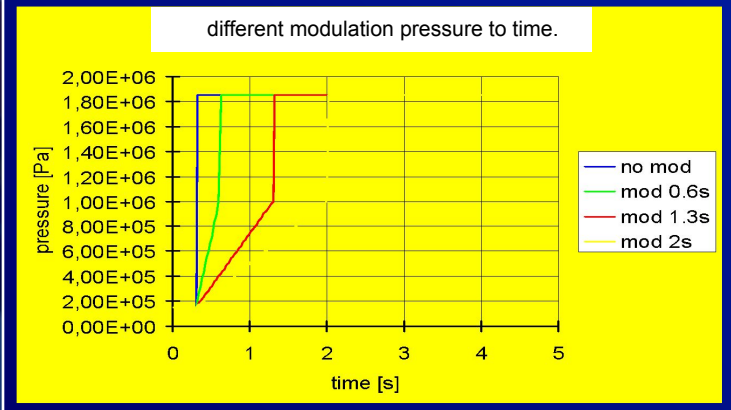
- Electronic controlled modulation
- Clutch overlap control
- Inching control

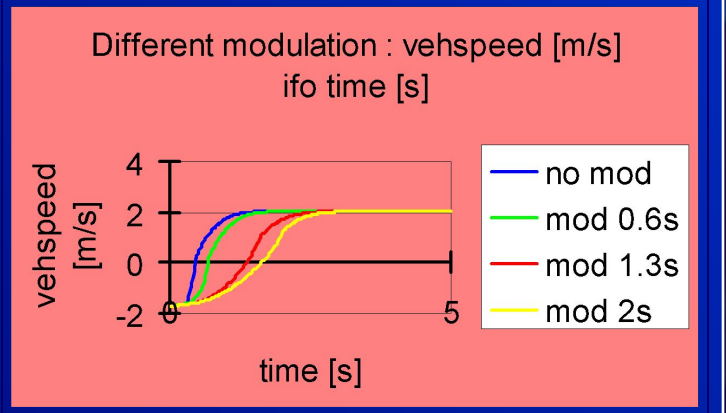
Electronic controlled modulation (E.C.M.)



Electronic controlled modulation (E.C.M.)

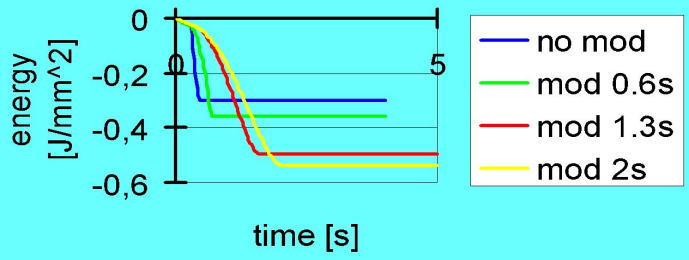
Modulated build up of pressure in the clutch



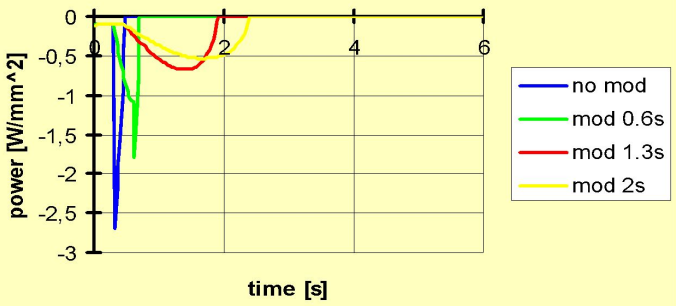


Modulated build up of pressure in the clutch

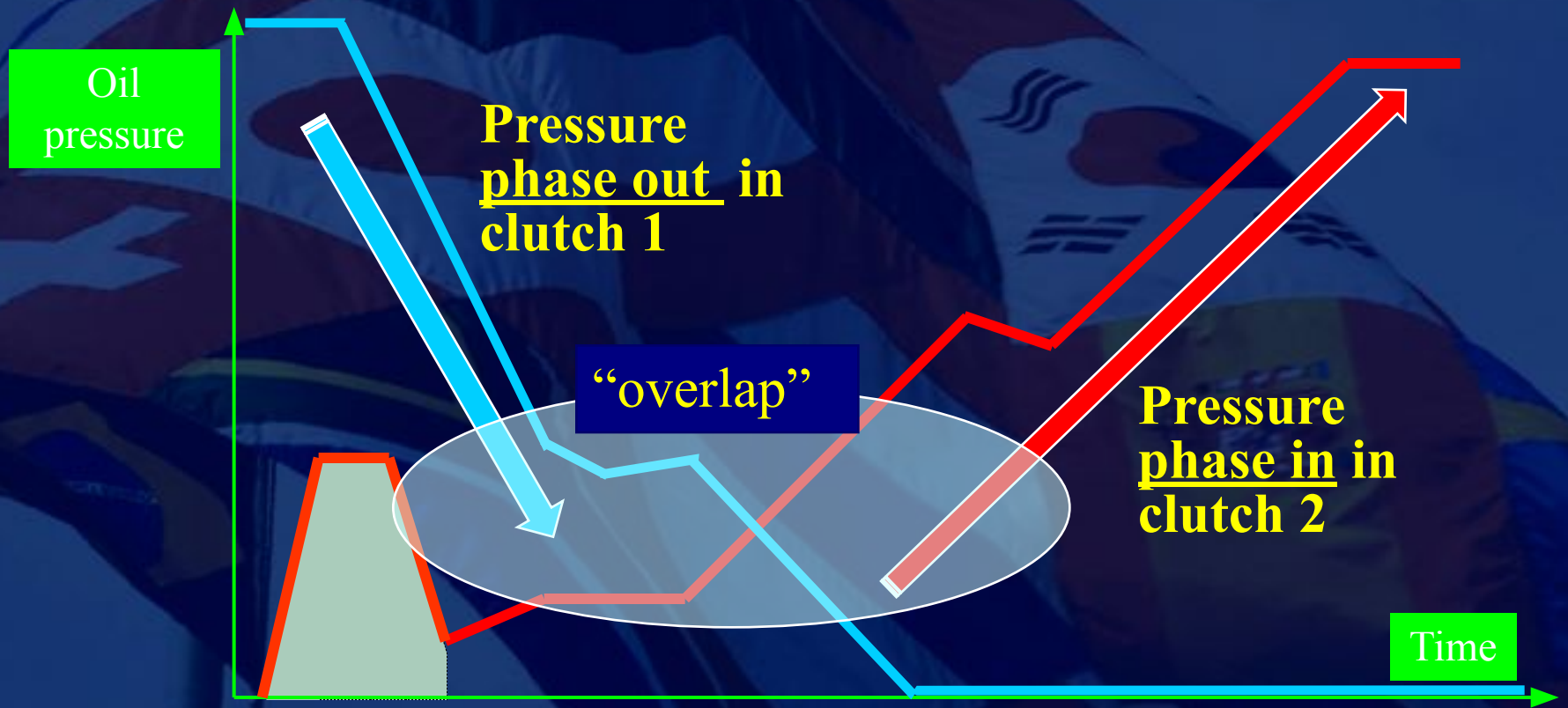
different modulation energy



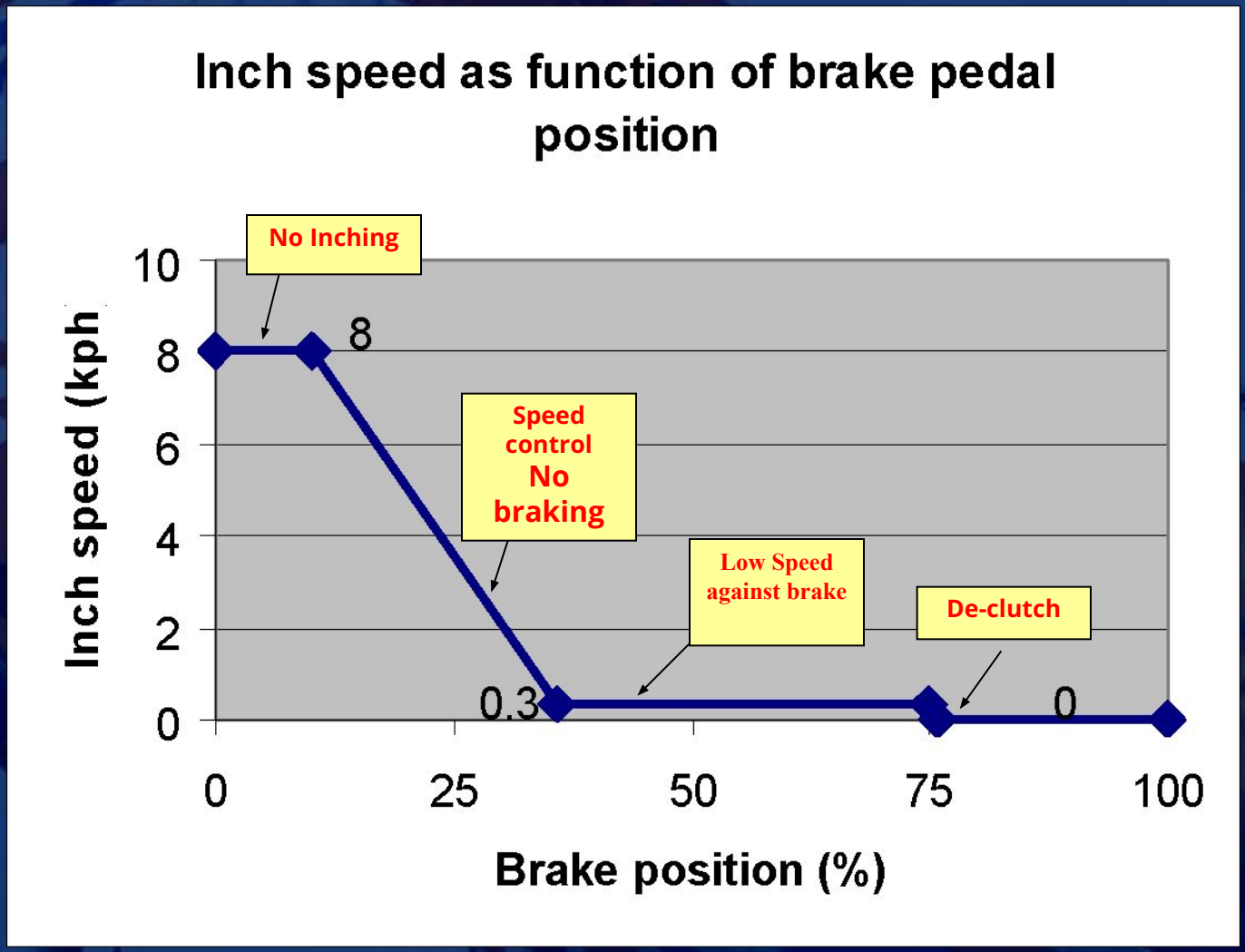
different modulation in power



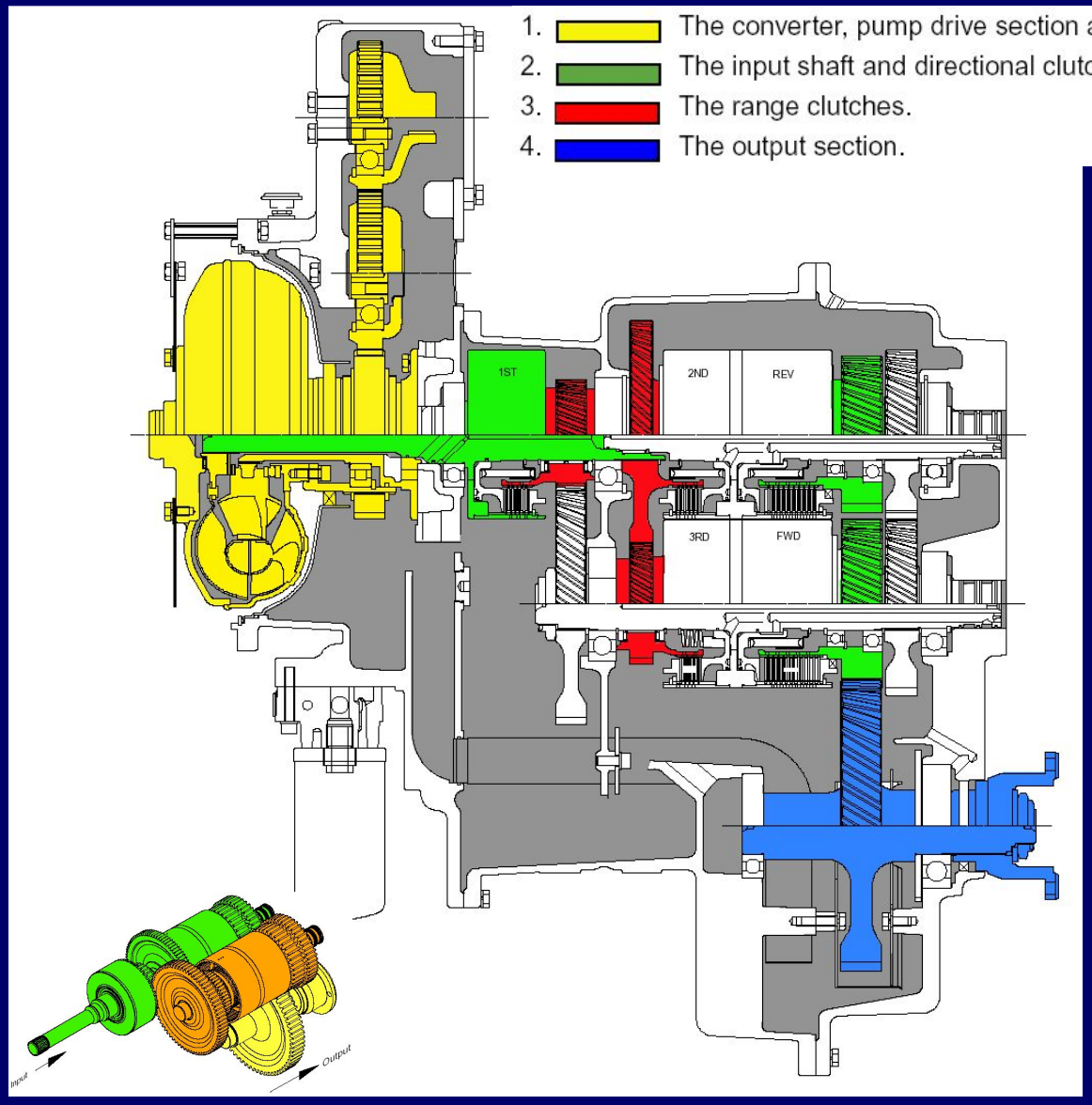
Overlap control



Electronic controlled inching



TE13/17 transmission


1. The converter, pump drive section and pressure regulating valve.
2. The input shaft and directional clutches.
3. The range clutches.
4. The output section.
1ST
2ND
REV
3RD
FWD
Input
Output

Model designation

340 F T E 13 3 XX - XX

Converter
Model Wheel Group
Converter freewheel
(optional)

Engine mount
With converter

Electronically controlled model

Model number
Transmission input rating x
100Nm

specific ¨dash number¨

specific ratio/drop

numbers of gears

Technical specifications

Converter/Transmission Oil System

Capacity 16,5L Lines and cooler not included

Oil Type **Only ATF Dexron III approved**

viscosity at 40°C: 33 → 38 cSt

viscosity at 100°C: 7 → 8 cSt

Oil change **1000 hours**

Filtration

integral spin on change every 1000 hours **first change or after**

Technical specifications

Ratios

BASIC MODEL	SPEED	FWD 1st	REV 1st	FWD 2nd	REV 2nd	FWD 3rd	REV 3rd
13310 17310	3/3	4.022	4.003	1.923	1.914	0.912	0.908

Temperature specifications

Normal operating temperature 70 - 120°C at temperature check port 71 converter out

Maximum allowed transmission temperature 120° C

Pressure specifications

Transmission regulator pressure :

25 -30 bar at 2200RPM

Clutch pressures

At 2200 RPM 24 – 29 Bar

Filter bypass

valve set at 3.9
bar

Lube pressure

In neutral 0 : 2.8-3.4 Bar at 80 l/m flow
In FWD 0 – REV 0 : 1.2-1.8 Bar at 80l/m flow

Internal leakage

Converter : 1.0 -4.0 l/m
Each range clutch : 1.5-4.5 l/m
Each directional clutch : 5.5-9.0 l/m

Safety valve

cracking pressure 7,5
bar

Converter out pressure (to cooler)

3.0 – 3.5 bar. at max stall speed

Pump flow

At 2200 RPM : 90 to 110 lpm

Electrical specifications

- Electronic controlled modulation valves (Fwd/Rev/2nd/1st-3rd).
  coil resistance : 4.35 ± 0.35 Ω at 25°C [77°F].

- Total neutral and 1st/3rd range solenoid:
  coil resistance : 28 ± 2 Ω at 20°C [68°F].

- Speed sensor :
  - type: magneto resistive sensor.
  - sensing distance: 1,8 mm [0.07"].
  - Sensor signal: generates a square current with a fixed amplitude changing between 7 and 14 mA.

Hydraulic cooler line specifications

HYDRAULIC COOLER LINES SPECIFICATIONS.

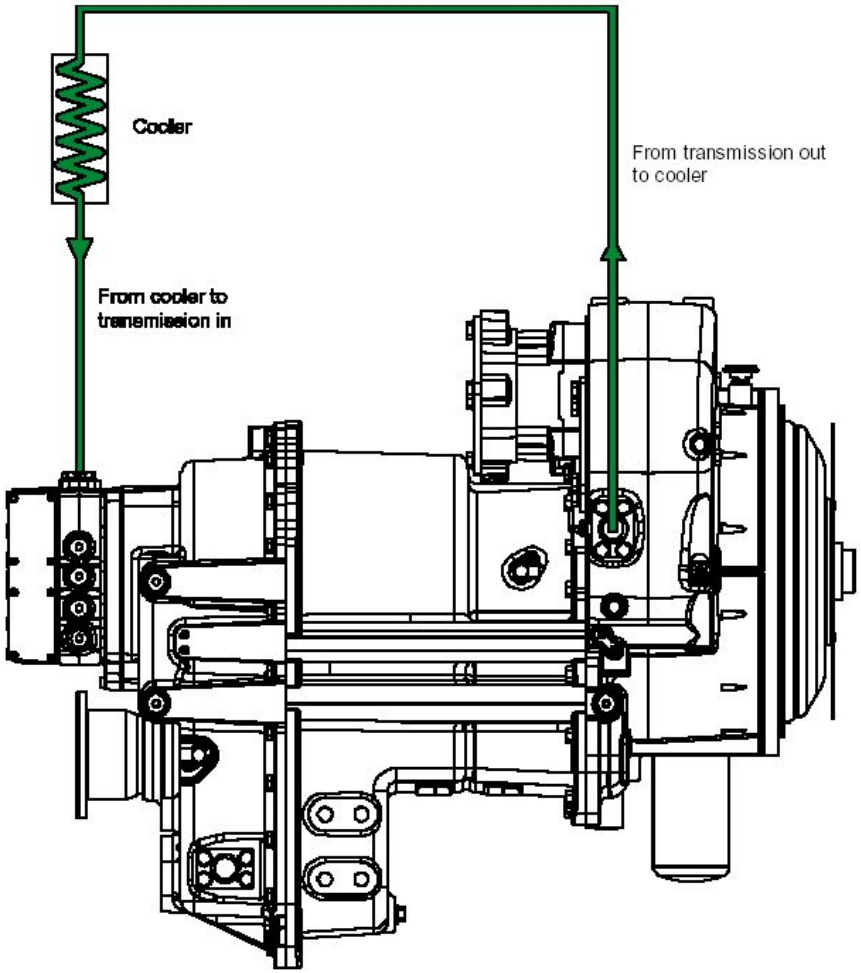
Minimum 19 mm internal diameter for lines and fittings.

Suitable for operation from ambient to 120° C continuous operating temperature.

Must withstand 30 bar continuous pressure and 45 bar intermittent surges.

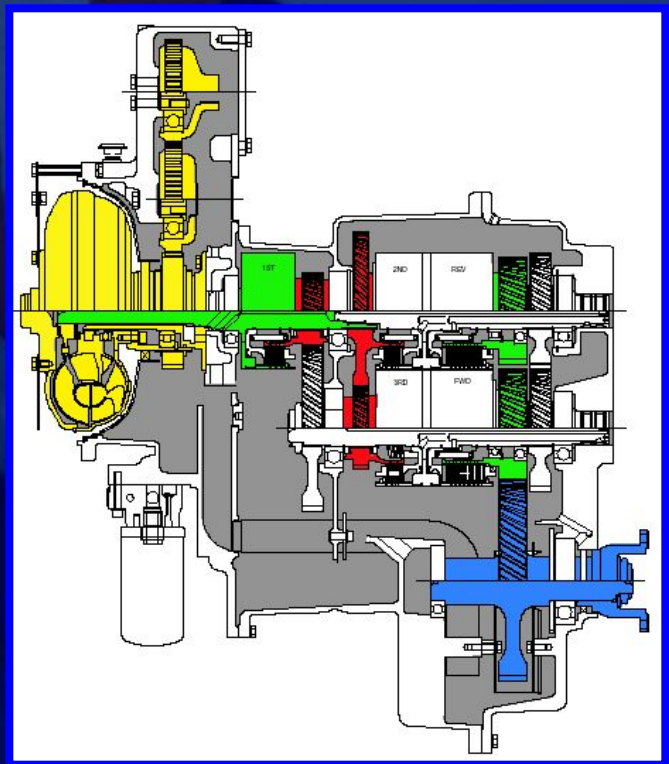
Conform SAE J1019 and SAE J517, 100RI.

EXTERNAL PLUMBING

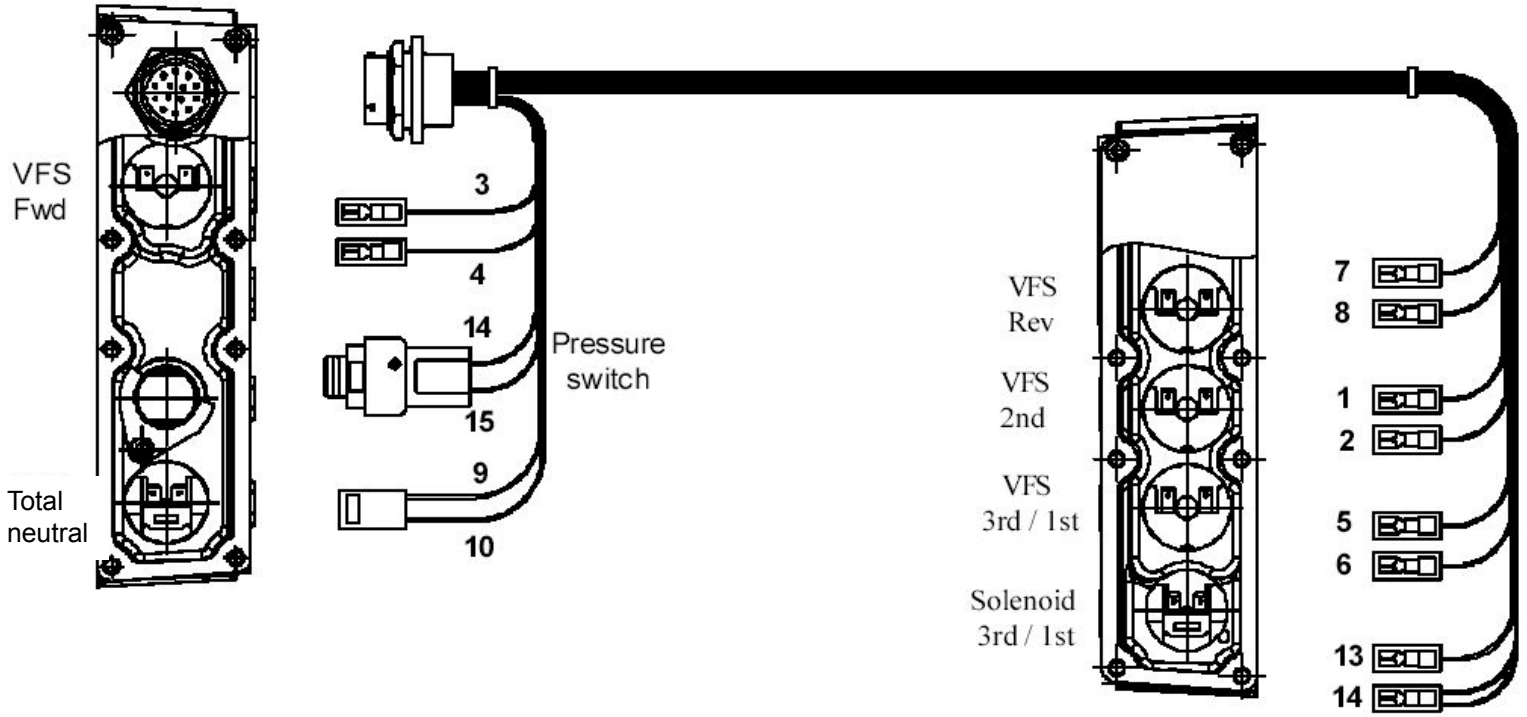


Additional signals

- Speed sensors
  - Engine speed combined
    with oil temperature pick up located at pump gear
  - Turbine speed located on input gear forward
  - Drum speed located on low drum
  - Output speed located on output gear
- Pressure feedback sensor
- Oil temperature
- Converter out temperature switch



Wiring schematics



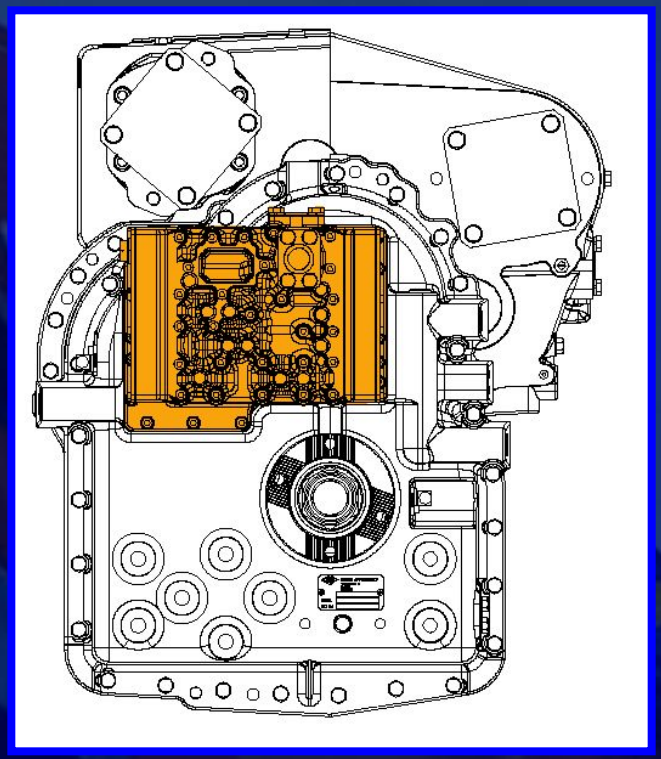
VFS = Variable Force Solenoid
Depending on input current (from 0 to 1000mA), output pressure is regulated from (6 to 0 bar)

Wiring schematics

Pin	Wire Colour	Function
1-2	Blue	VFS 2nd
3-4	Green	VFS Fwd
5-6	Yellow	VFS 3rd / 1st
7-8	Red	VFS Rev
9-10	Black	Total Neutral
11	White	Pressure switch
12	-	-
13	Orange	Solenoid 3rd / 1st
14	White	Common ground

Control valve

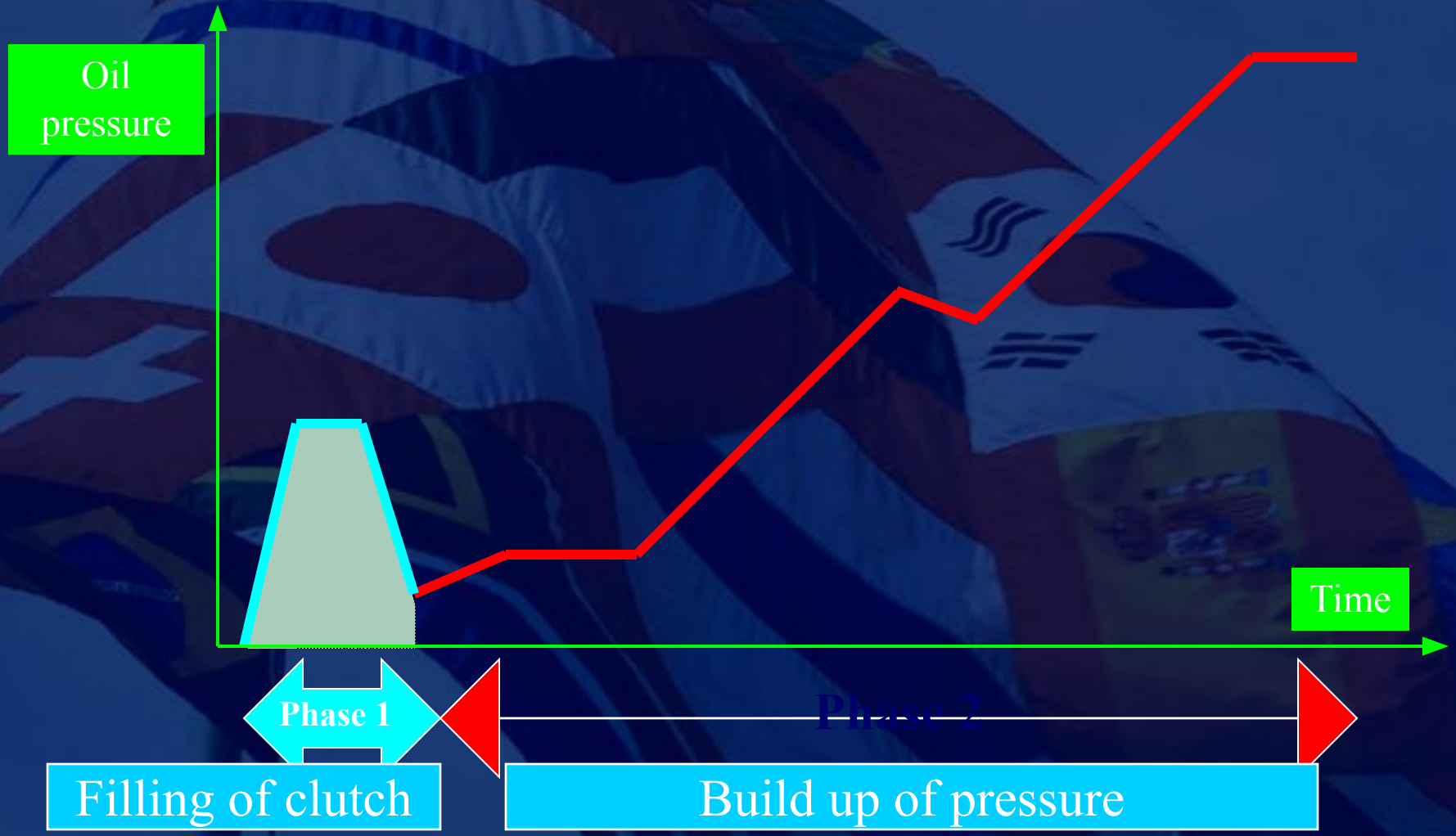
- Variable force solenoids (VFS)
  - VFS0 for forward
  - VFS1 for 2nd
  - VFS2 for reverse
  - VFS3 for 1st / 3rd
- Pressure reducer
- Pressure intensifiers for each VFS



Solenoid activation

Transmission Gear	Activated Solenoids	Activated VFS	Activated Clutches
Forward 3	Total neutral	Rev, 2nd	Fwd, 3rd
Forward 2	Total neutral	Rev, 1st/3rd	Fwd, 2nd
Forward 1	Total neutral, 1st/3rd	Rev, 2nd	Fwd, 1st
Neutral 1	Total neutral, 1st/3rd	Rev,Fwd, 2nd	1st
Reverse 3	Total neutral	Fwd, 2nd	Rev, 3rd
Reverse 2	Total neutral	Fwd,1st/3rd	Rev, 2nd
Reverse 1	Total neutral,1st/3rd	Fwd, 2nd	Rev, 1st

Electronic controlled modulation (E.C.M.)



Operation of transmission

The transmission is controlled by an APC200 box. This unit has a microprocessor that receives certain inputs (gear selector position, speed sensors,…), which are processed and will give output signals to the control valve.

Operation of the valve

Regulated pressure (25-30 bar) is directed to the total neutral shift spool and the pressure reducer that will decrease the pressure to 10 bar.

This reduced pressure will be used to supply the variable force solenoids(VFS), total neutral solenoid and 3rd/1st solenoid.

The VFS will give an output pressure curve from 0 to 6 bar proportional to a current from 1000 mA to 0 mA. The pressure intensifiers with a ratio of 5:1 will multiply this pressure curve so that a curve from 0 to 30 bar is available for each directional and range clutch. Between each VFS a pressure intensifier is placed and an accumulator to dampen any hydraulic vibration.

Directional selection

When a direction (forward or reverse) is selected , total neutral solenoid is activated and the required directional VFS will provide a pressure rise from 0 to 6 bar. The directional clutch is then fed with modulated pressure supplied through the pressure intensifier.

Operation of transmission

Range selection

When 1 st clutch is selected , the 3rd/1st solenoid is activated and 1st/3rd VFS will provide a pressure curve from 0 to 6 bar. The pressure intensifier will multiply this pressure and will feed 1st clutch via the activated 3rd/1st spool.

When 2nd clutch is selected the 2nd VFS will provide a pressure curve from 0 to 6 bar . this pressure is fed to 2 nd clutch via the pressure intensifier, at the same time 1st/3rd VFS will decrease pressure from 6 to 0 bar, thus allowing the release of 1 st clutch in a controlled fashion, which will provide clutch overlap.

When 3rd clutch is selected the 3rd/1st solenoid is not activated. The 1st/3rd VFS will provide a pressure curve from 0 to 6 bar and will feed 3rd clutch via a pressure intensifier and the deactivated 3rd/1st spool. At the same time the 2nd VFS will decrease pressure from 6 to 0 bar providing the clutch overlap.

Neutral selection

When neutral is selected (1st, 2nd or 3rd) , the total neutral solenoid is activated and the VFS's for forward and reverse are fed by a 1000mA current, which will result in a 0 bar output, thus providing 0 bar pressure to the forward and reverse clutch. The range clutches 1, 2 or 3 remain activated by their respective VFS.

Operation of transmission

Total neutral selection

Total neutral is only selected by the APC200 in case a severe error is detected which will cause a shutdown

When total neutral is selected, the total neutral solenoid is not activated and as a result no pressure is supplied to the pressure intensifiers.

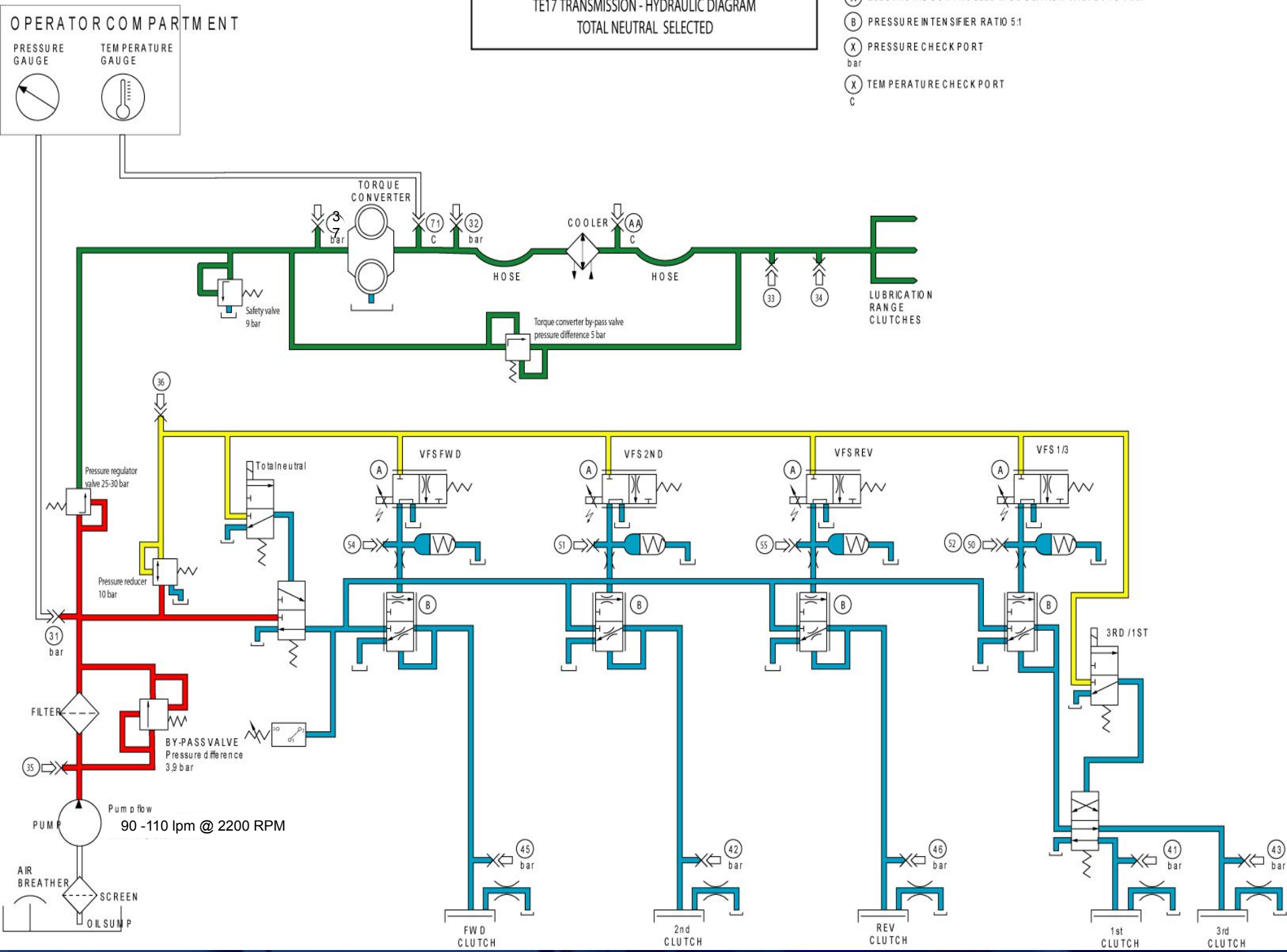
Pressure switch

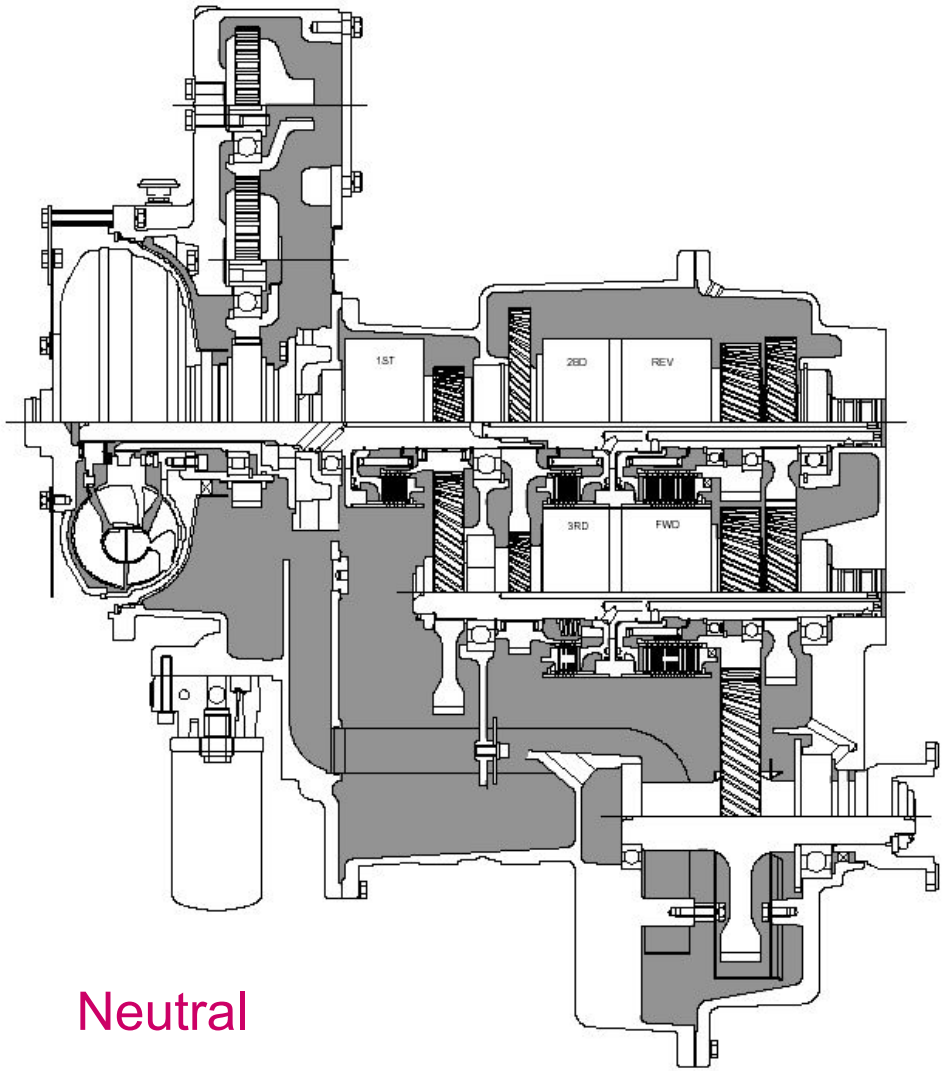
The control valve also has a pressure switch installed between the total neutral shift spool and the pressure intensifiers supply. This switch will verify that a minimum pressure of 12 bar to the various pressure intensifiers is supplied only when the total neutral solenoid is activated. This information is an input of the APC200 box.

If a pressure is detected below 12 bar the controller will put the transmission in total neutral which causes a shut down.

TE17 TRANSMISSION - HYDRAULIC DIAGRAM
TOTAL NEUTRAL SELECTED

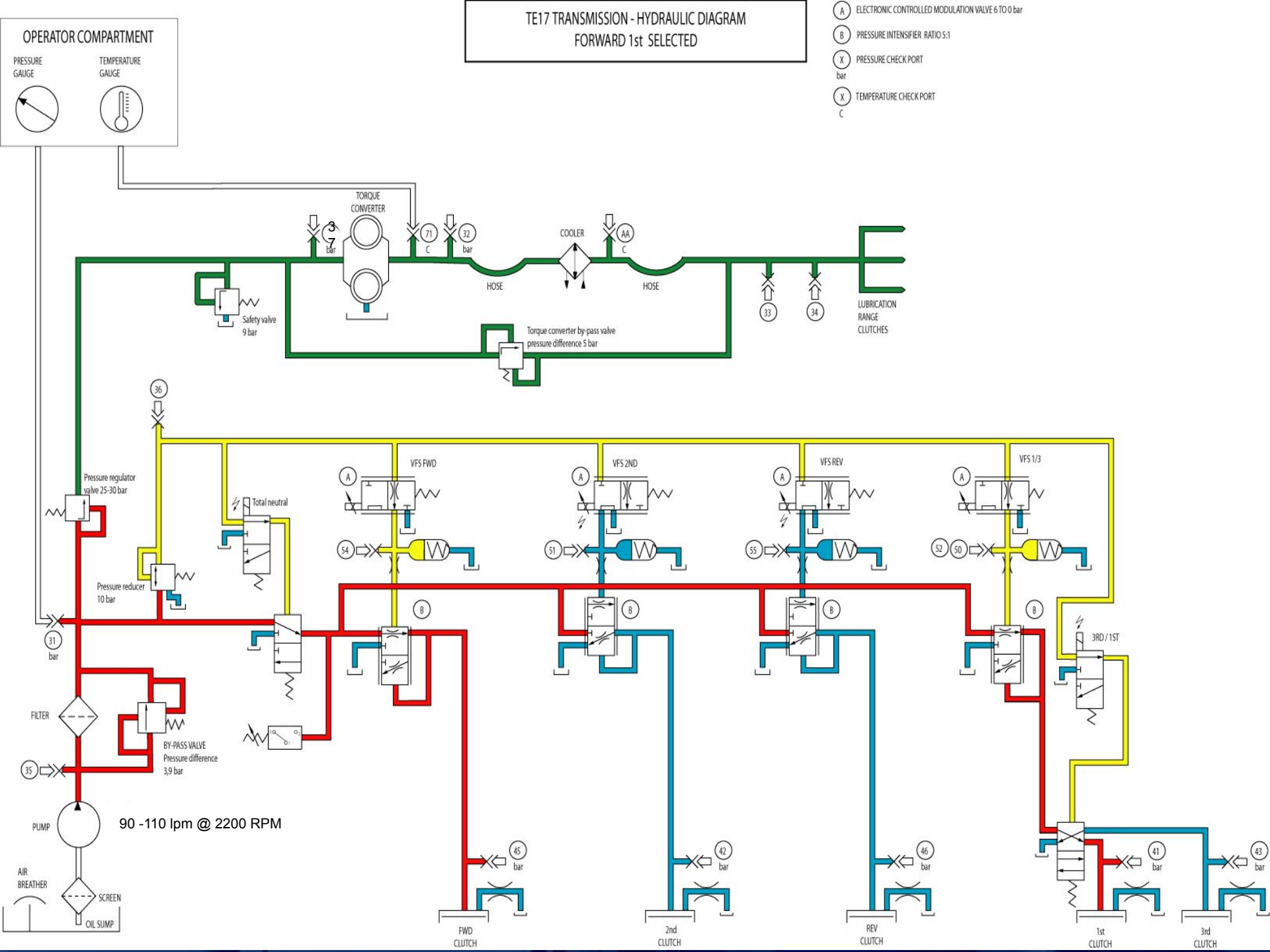
(A) ELECTRONIC CONTROLLED MODULATION VALVE 6 TO 0 bar
(B) PRESSURE INTENSIFIER RATIO 5:1
(X) PRESSURE CHECK PORT bar
(X) TEMPERATURE CHECK PORT C

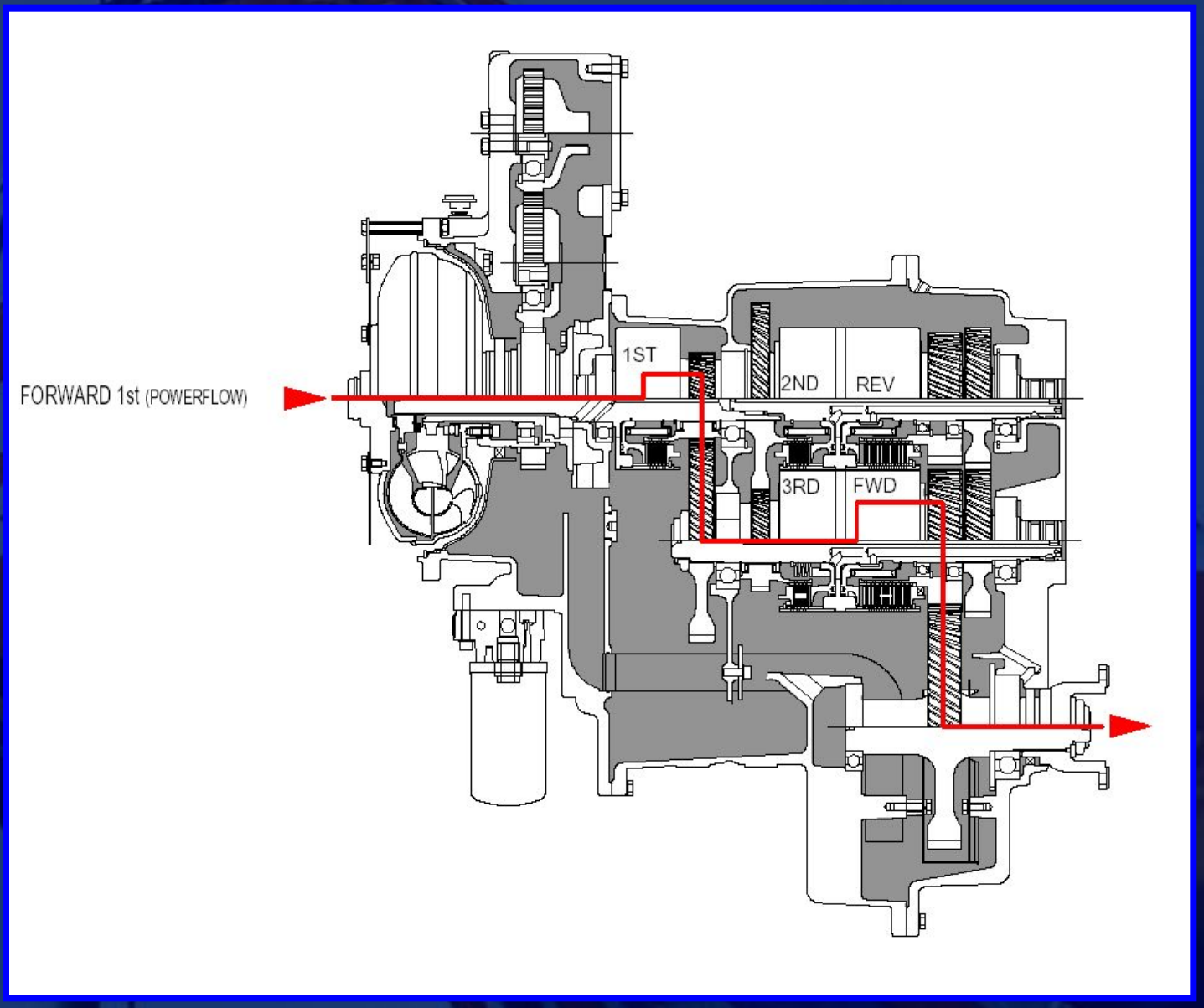




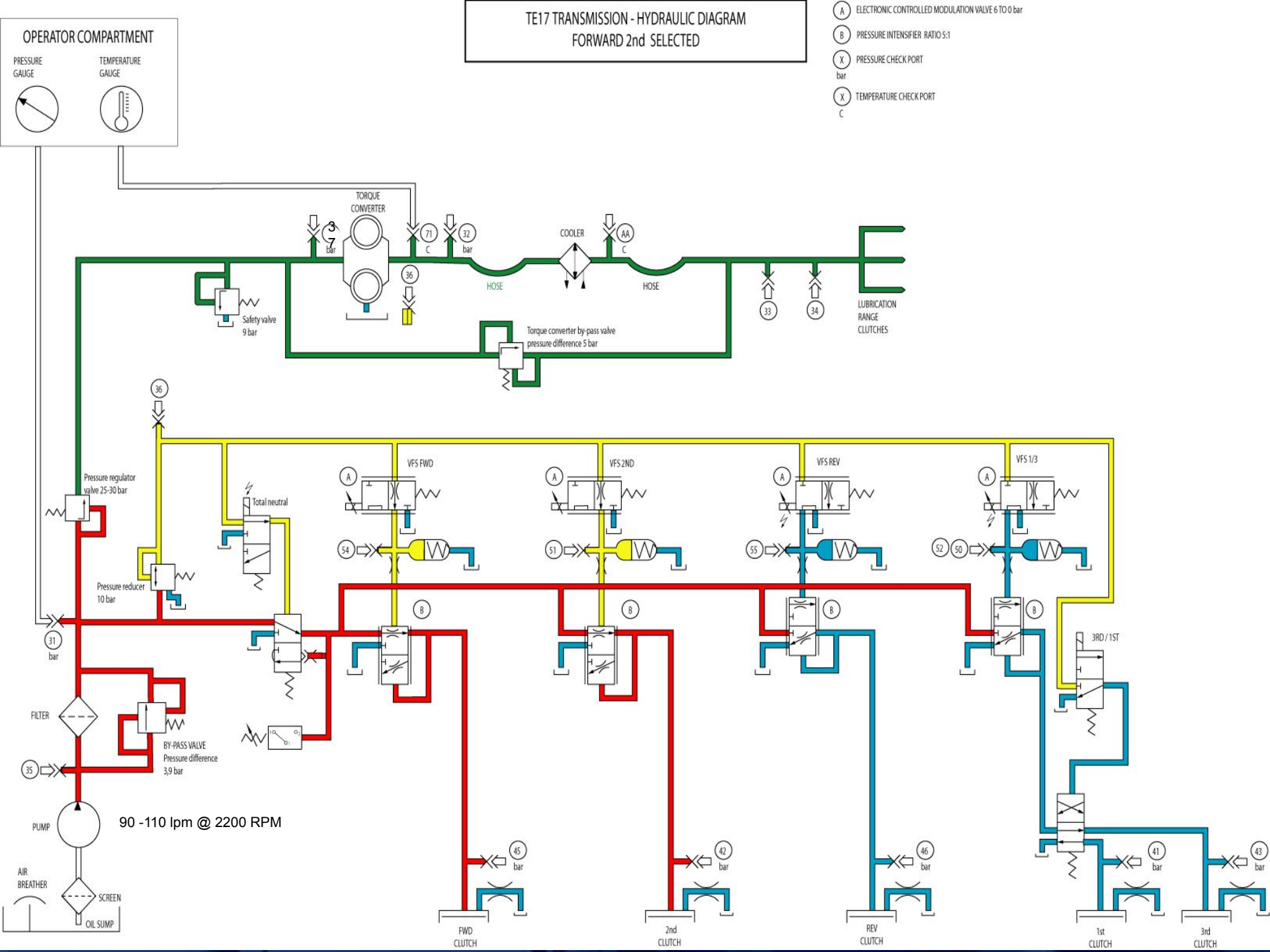
Neutral

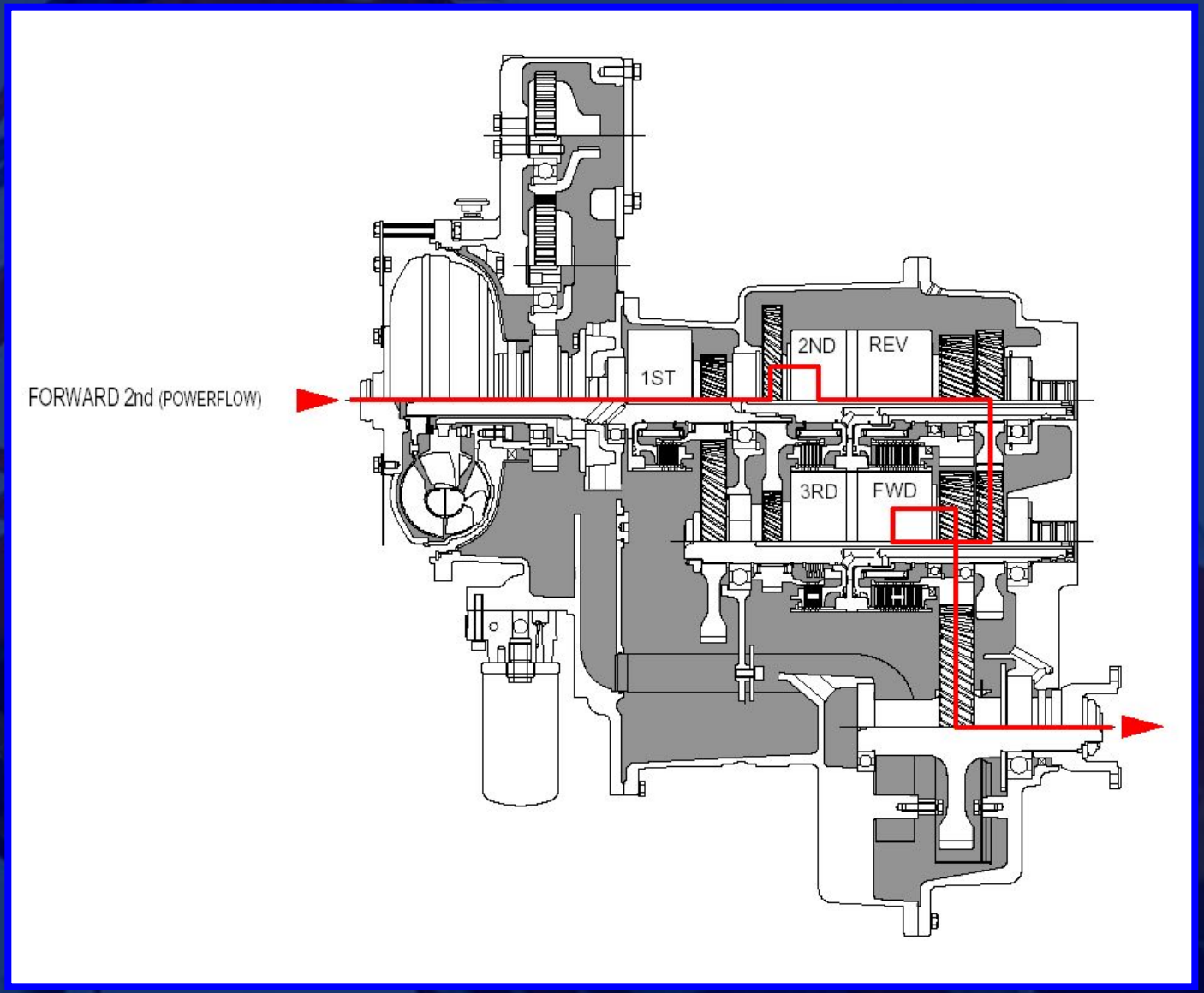
TE17 TRANSMISSION - HYDRAULIC DIAGRAM
FORWARD 1st SELECTED



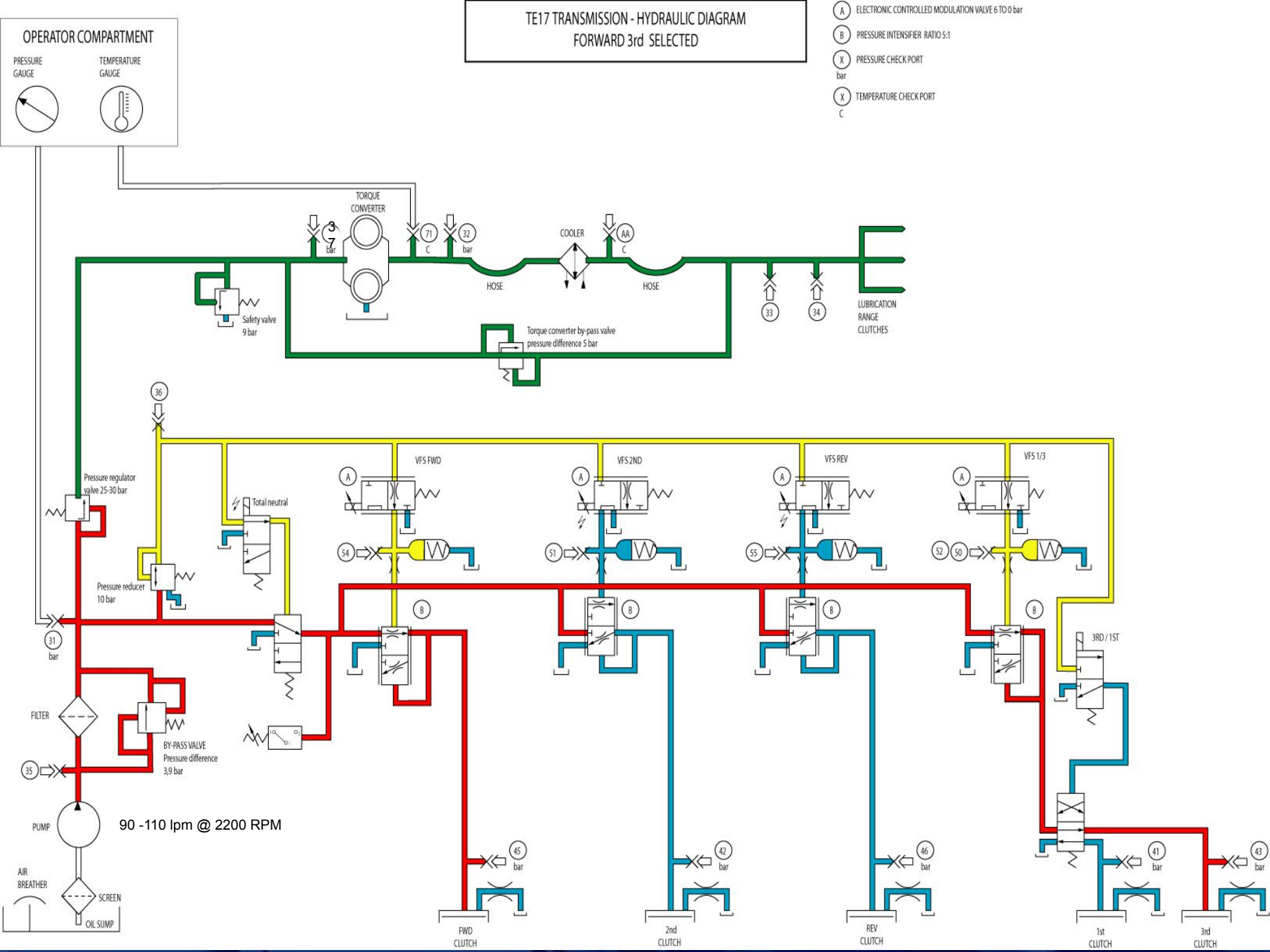

FORWARD 1st (POWERFLOW)
1ST
2ND
REV
3RD
FWD

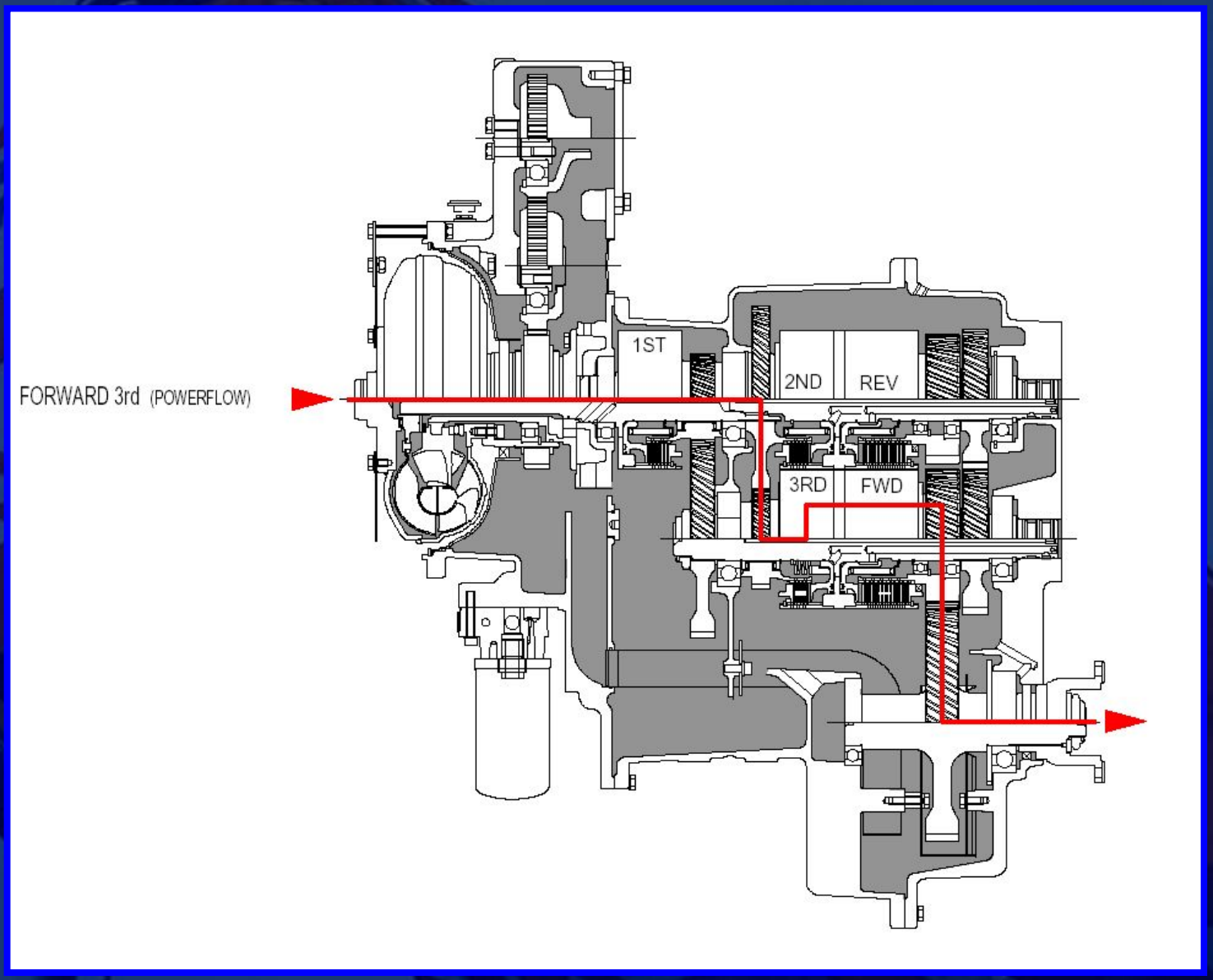
TE17 TRANSMISSION - HYDRAULIC DIAGRAM
FORWARD 2nd SELECTED



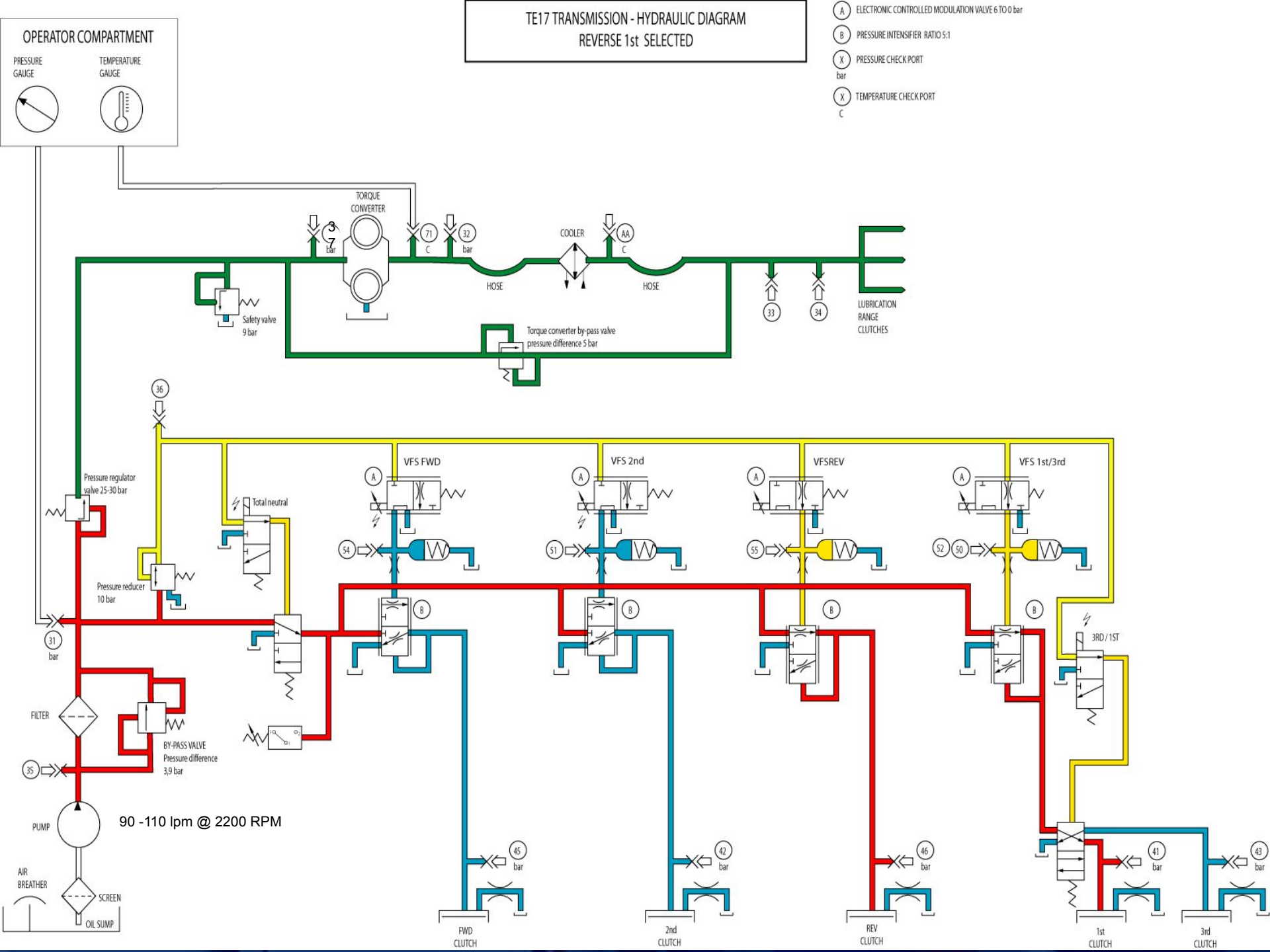

FORWARD 2nd (POWERFLOW)
1ST
2ND
REV
3RD
FWD

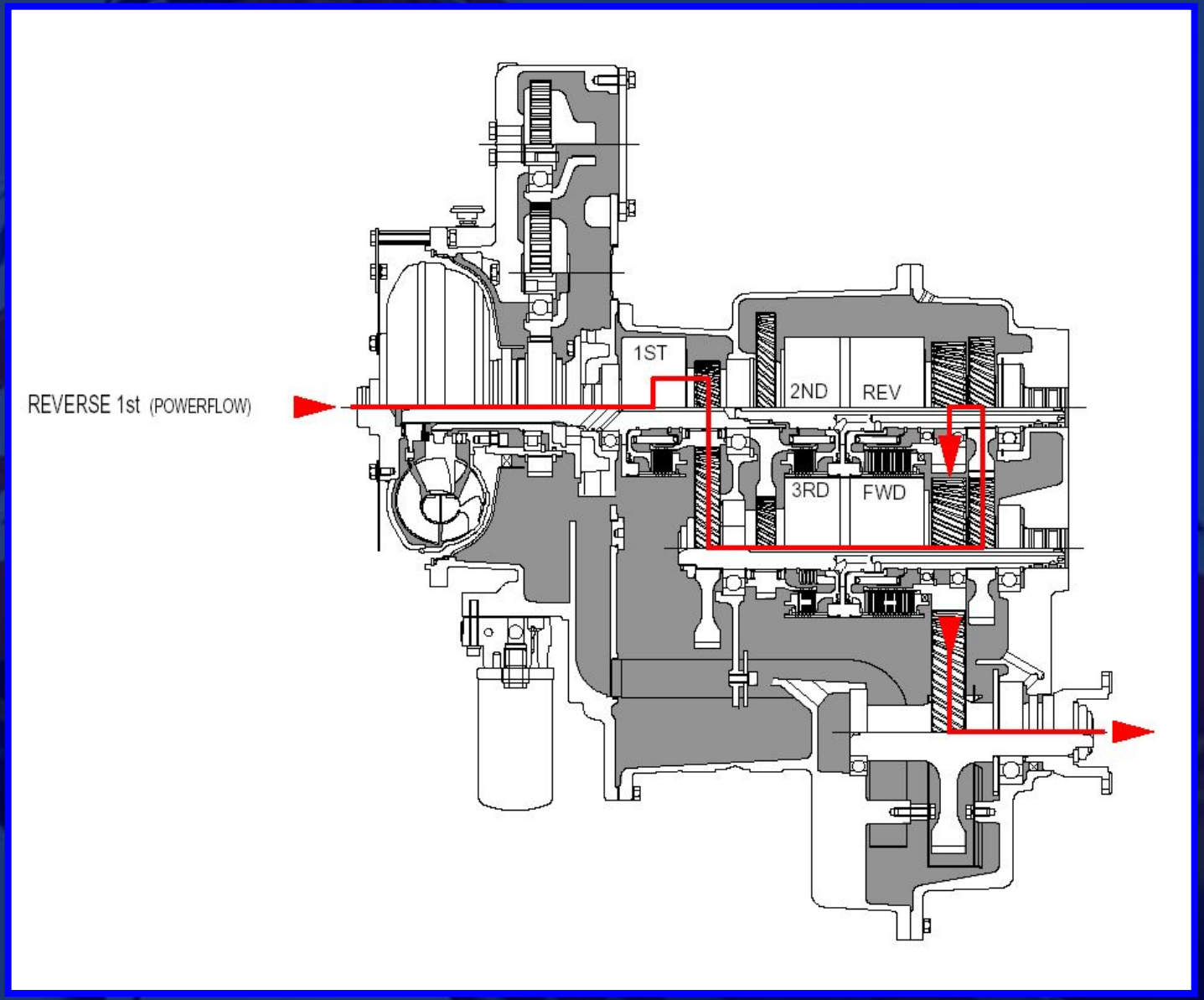
TE17 TRANSMISSION - HYDRAULIC DIAGRAM
FORWARD 3rd SELECTED



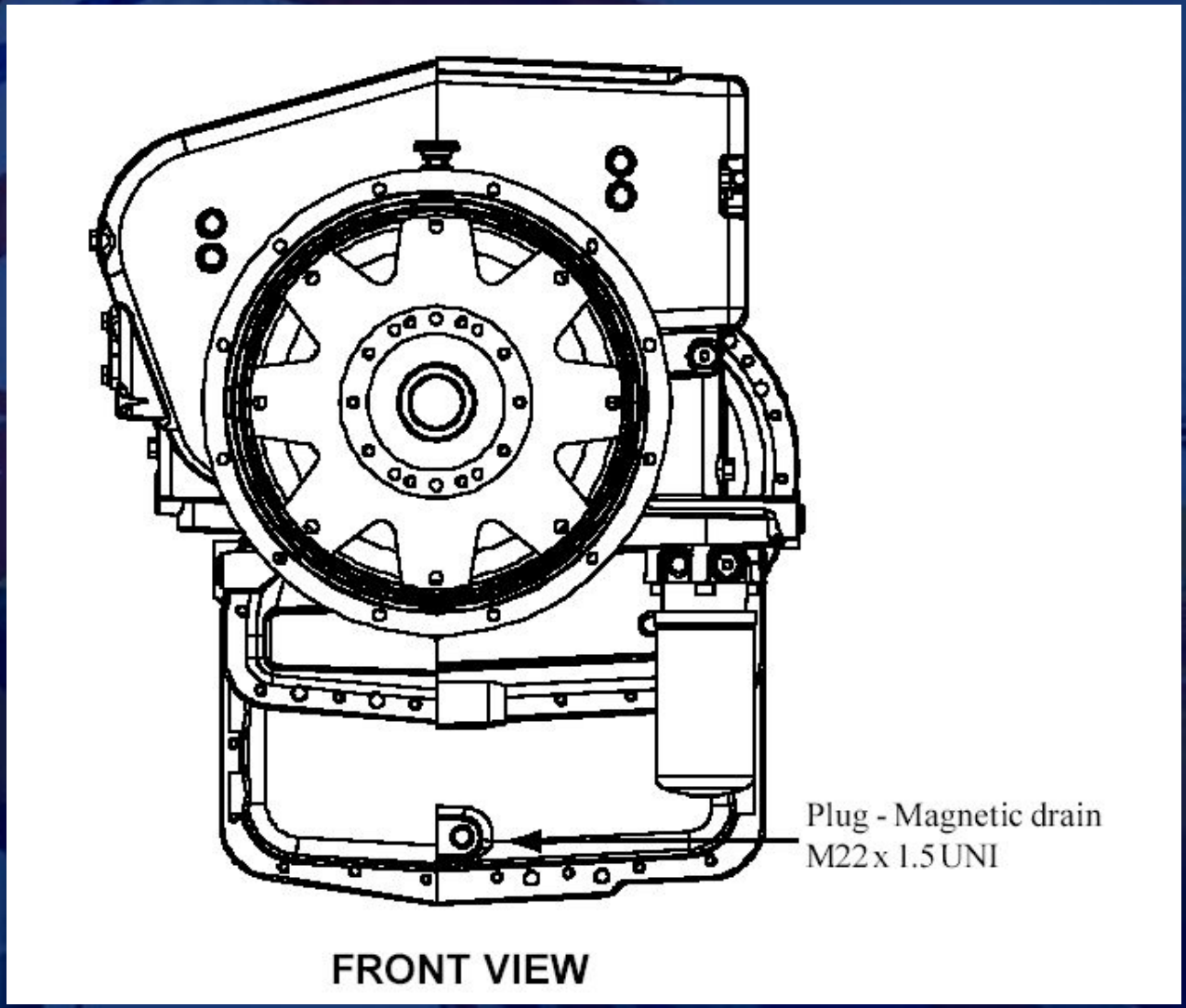

FORWARD 3rd (POWERFLOW)
1ST
2ND
REV
3RD
FWD

TE17 TRANSMISSION - HYDRAULIC DIAGRAM
REVERSE 1st SELECTED

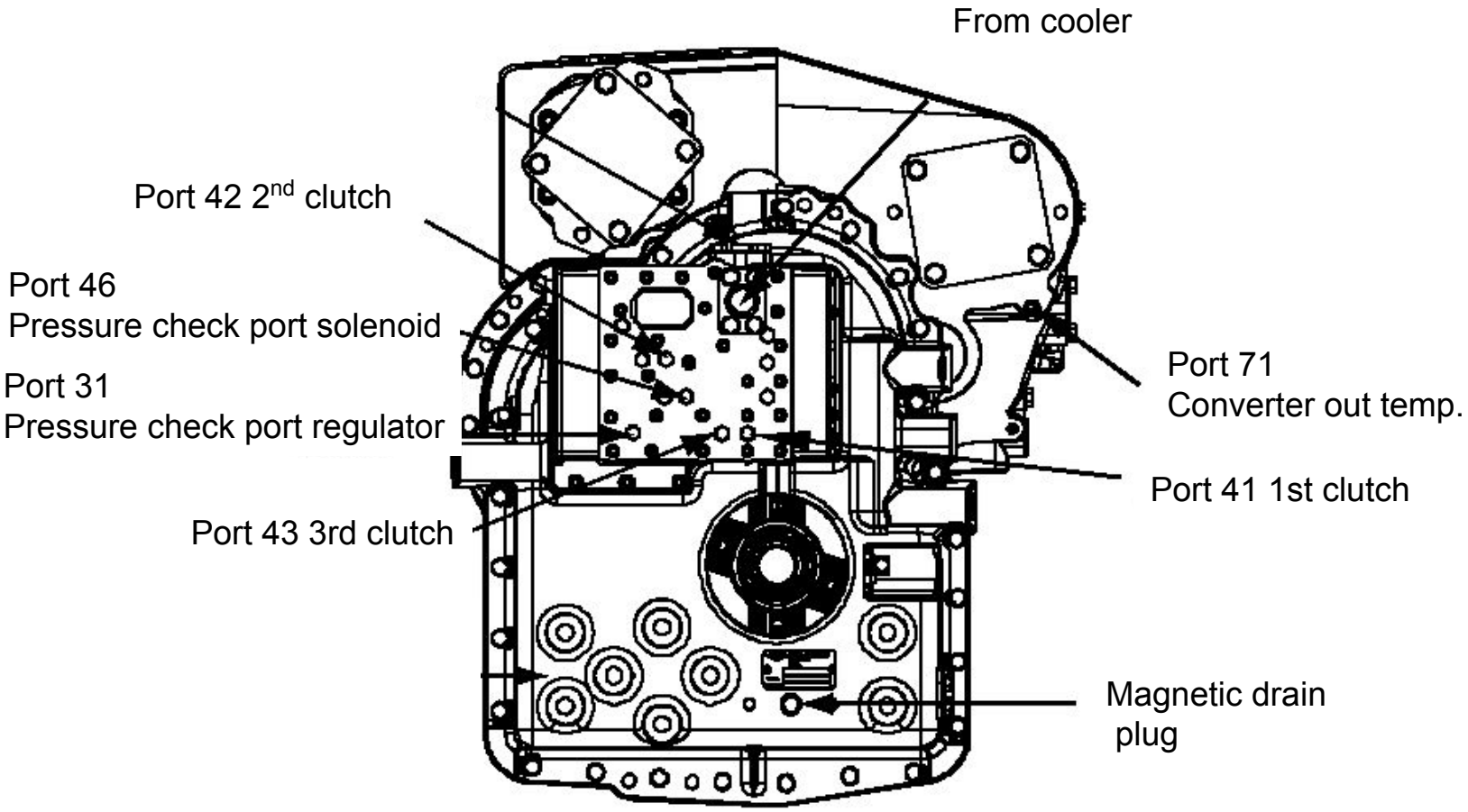



REVERSE 1st (POWERFLOW)
1ST
2ND
REV
3RD
FWD
H

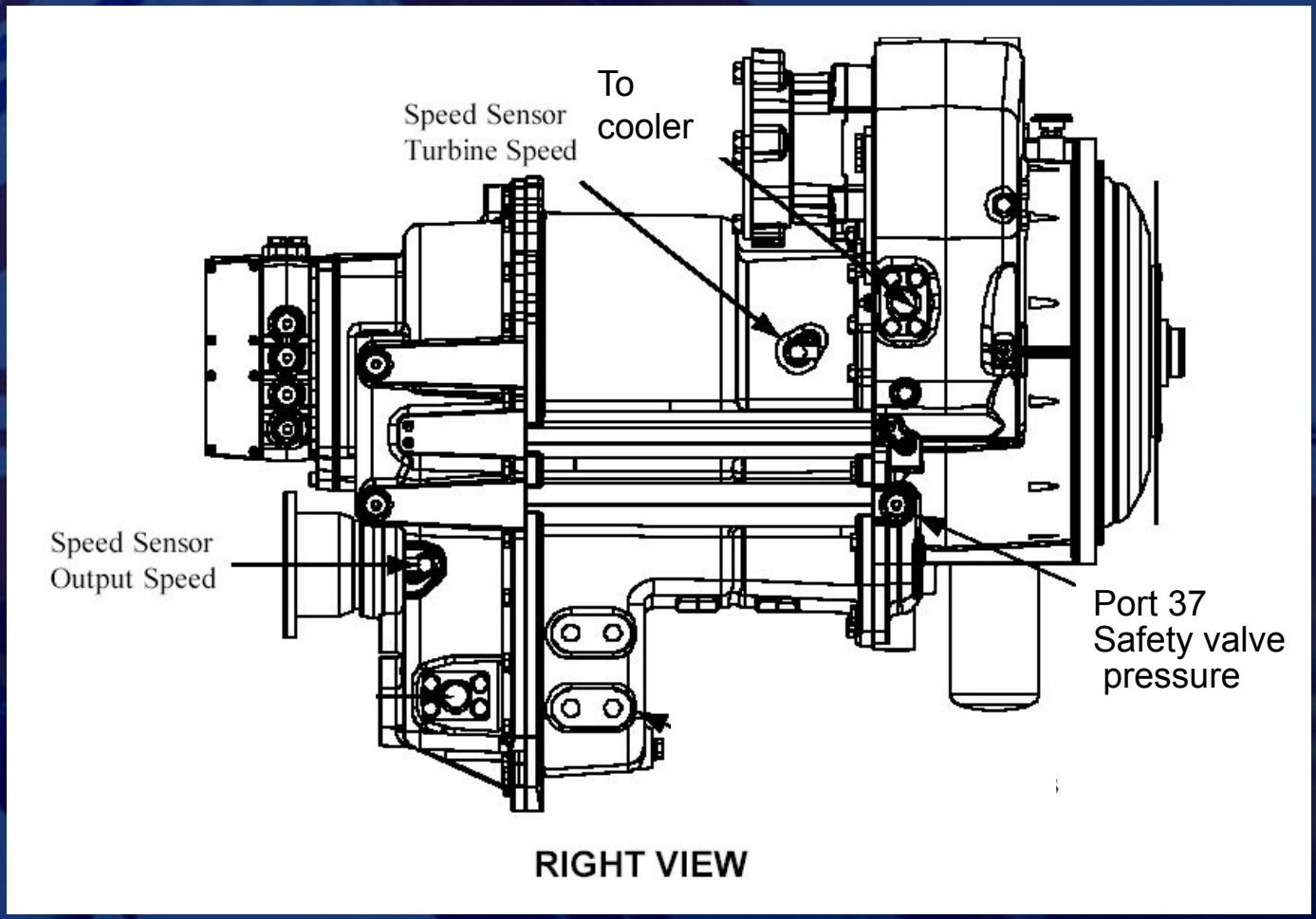
Check ports



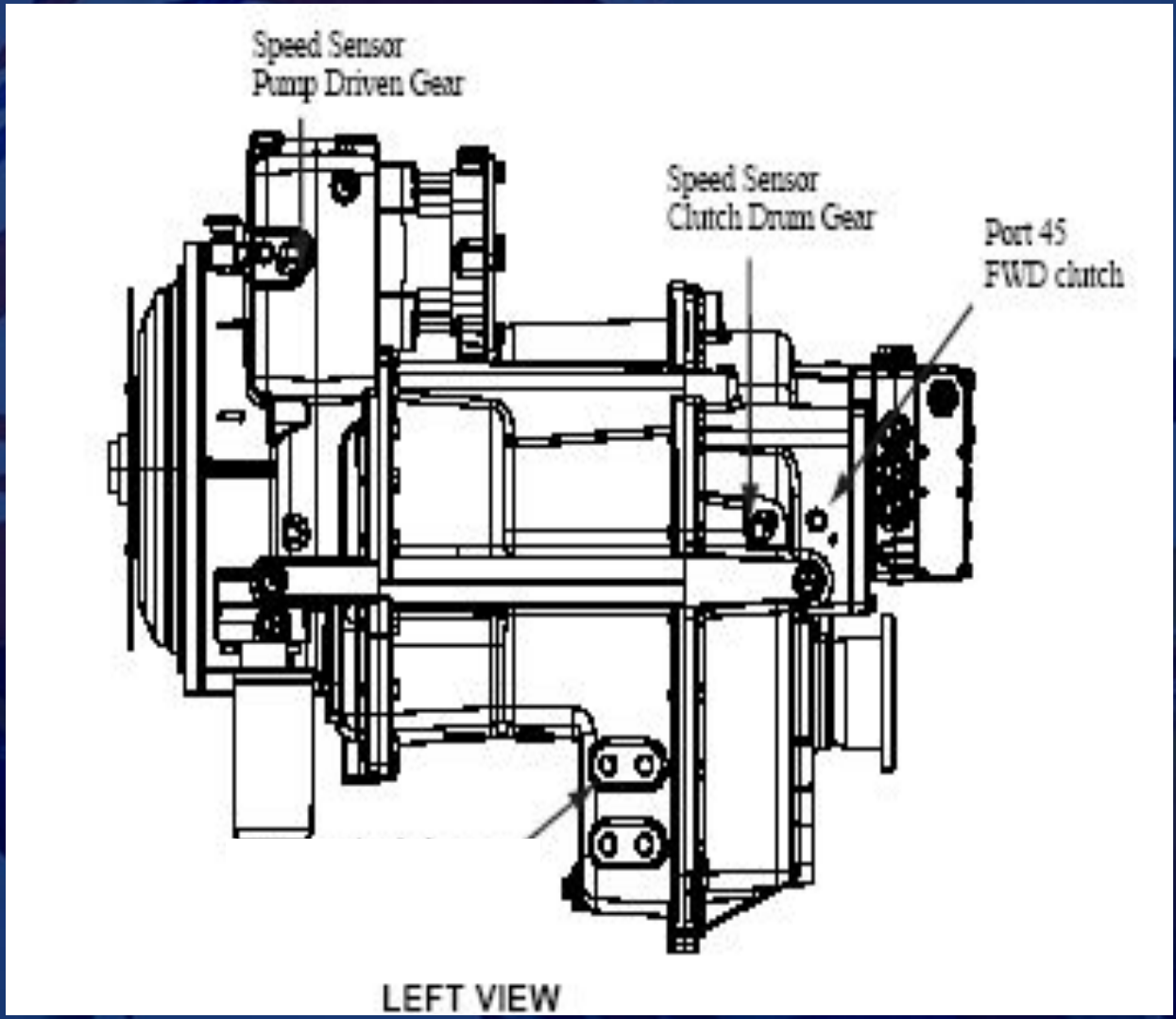
Check ports


From cooler
Port 42 2nd clutch
Port 46
Pressure check port solenoid
Port 31
Pressure check port regulator
Port 43 3rd clutch
Port 71
Converter out temp.
Port 41 1st clutch
Magnetic drain
plug
REAR VIEW

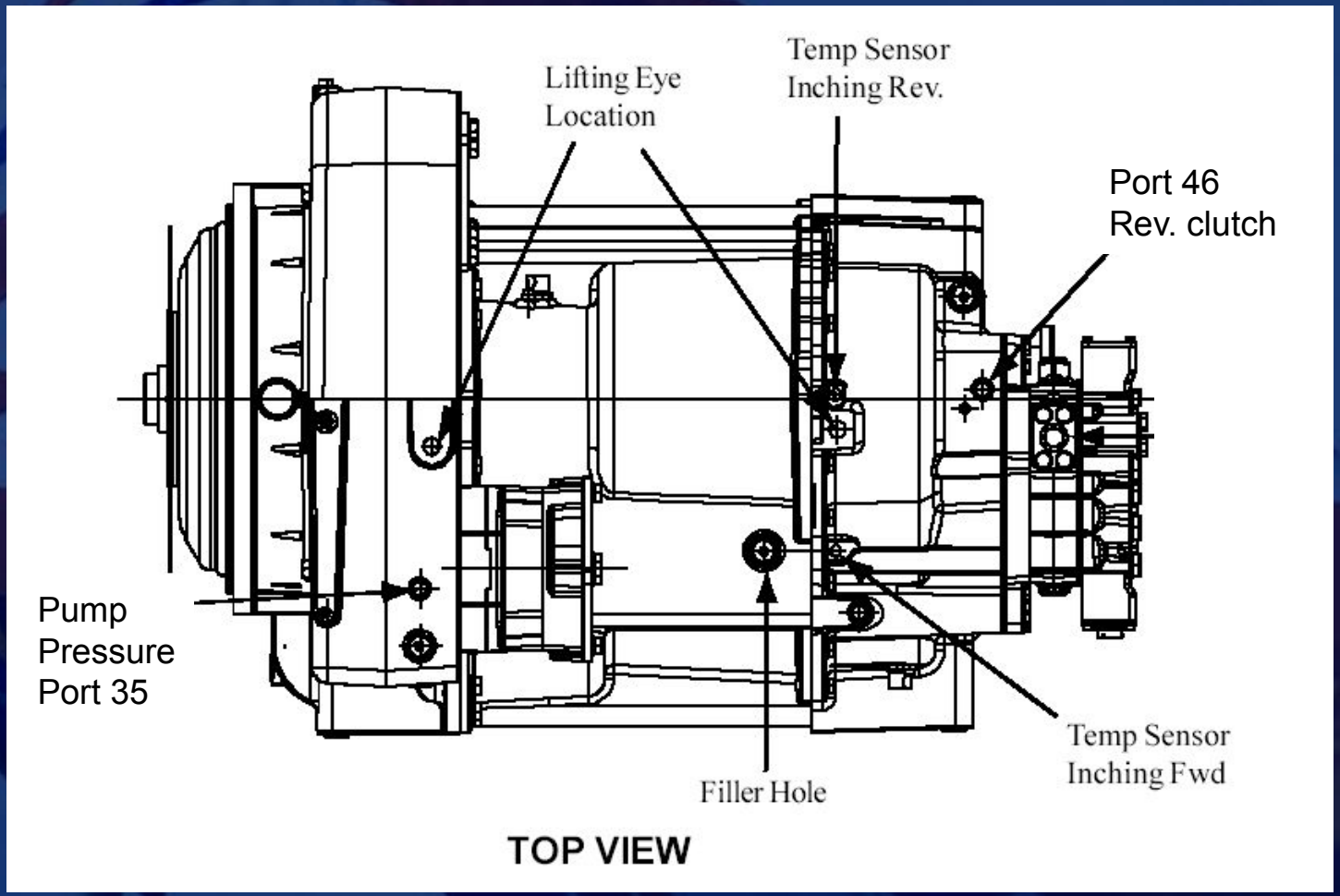
Check ports


Speed Sensor
Turbine Speed
To
cooler
Speed Sensor
Output Speed
Port 37
Safety valve
pressure
RIGHT VIEW

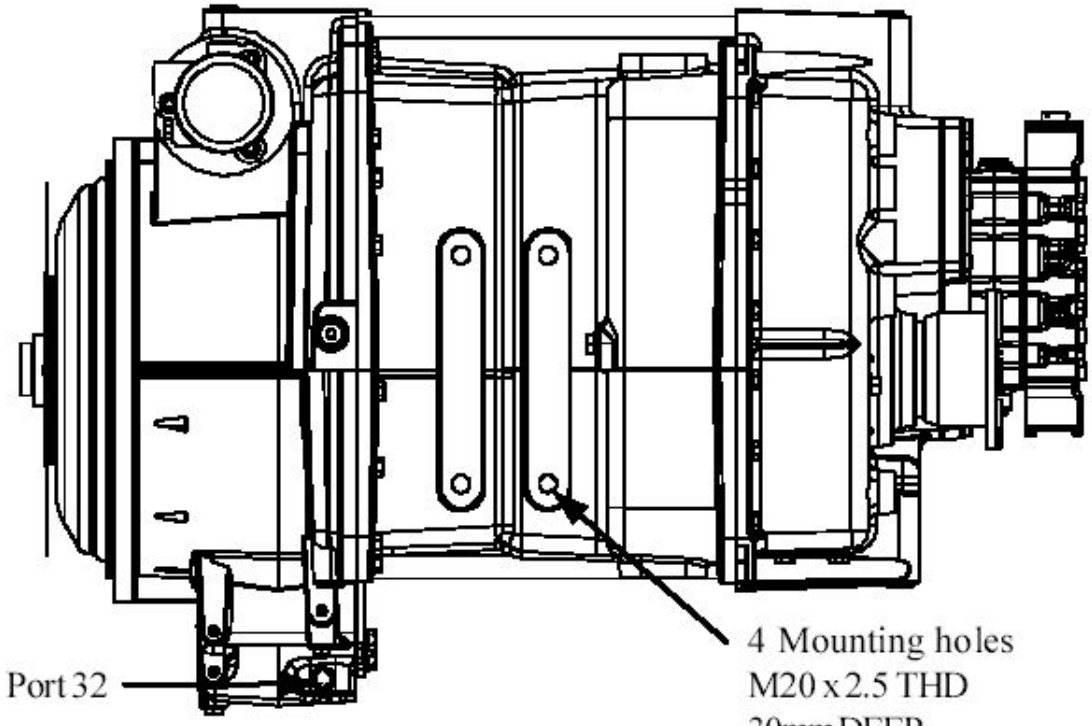
Check ports


Speed Sensor
Pump Driven Gear
Speed Sensor
Clutch Drum Gear
Port 45
FWD clutch
LEFT VIEW

Check ports


Lifting Eye
Location
Temp Sensor
Inching Rev.
Port 46
Rev. clutch
Pump
Pressure
Port 35
Filler Hole
Temp Sensor
Inching Fwd
TOP VIEW

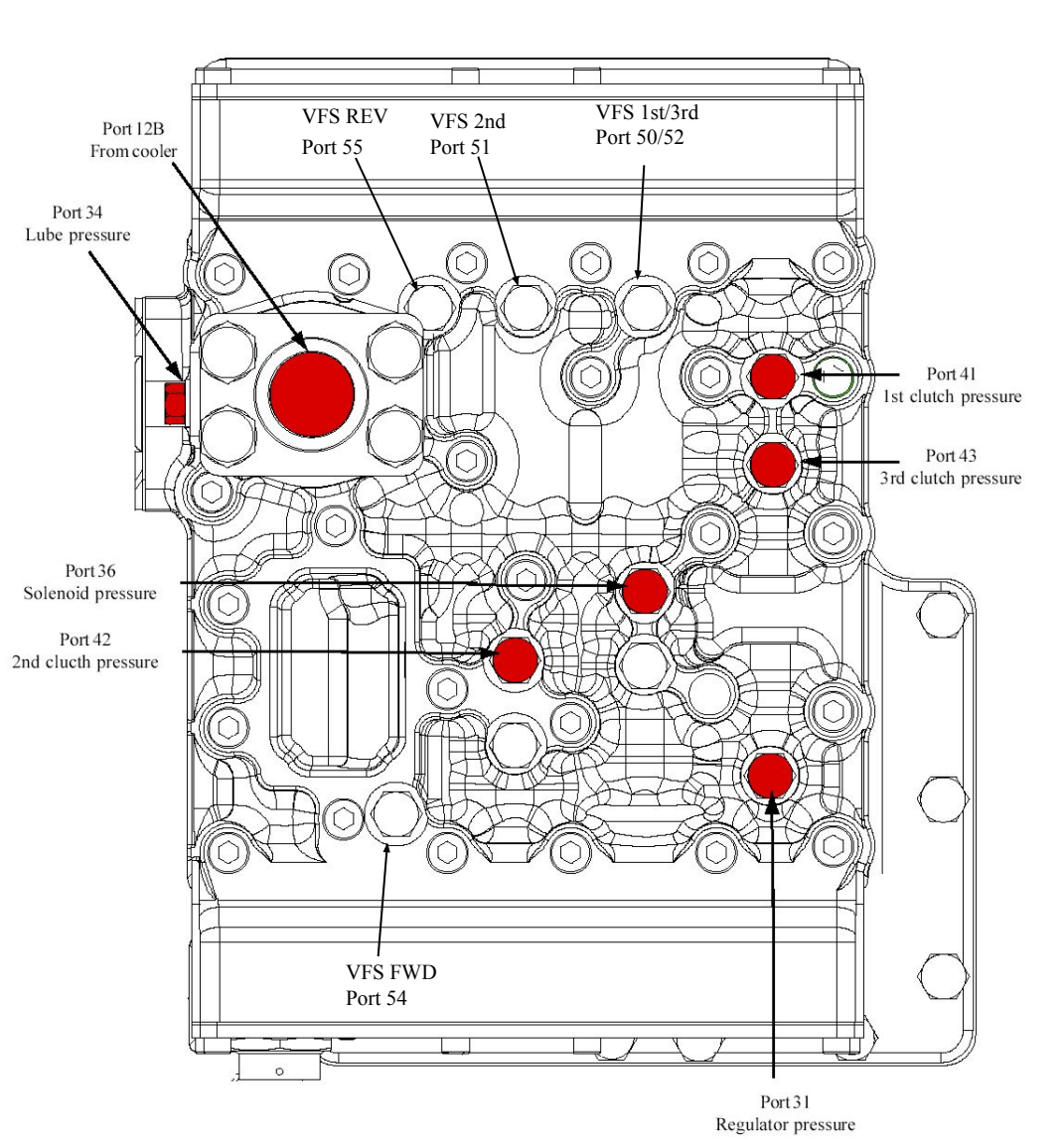
Check ports



Pressure
To cooler
Port 32

BOTTOM VIEW

Check ports Control valve



Control valve installation instruction

Removing the valve

1.Make sure that the area around the valve is clean and that no dirt can fall into the valve during the disassembly procedure.

2.Unscrew the 7 bolts (marked green with a star on the drawing 1) until you feel that the tension is out of the bolt. **Do not remove them!**

3.Unscrew the 20 other bolts (marked blue on drawing 1) some turns. When all bolts are loose, you should be able to move the valve a bit

4.Remove 2 bolts (marked blue on drawing 1)and replace with aligning studs.

5.Remove the 15 bolts (marked pink on drawing 2)

6.Remove the remaining bolts (marked blue on drawing 1) and remove valve, note the sandwich plate between valve and housing

Control valve installation instruction

Installing the valve

1. Unscrew the 7bolts (marked green with a star on drawing 1) untill all tension is out of the bolt. **Do not remove them!**

2. Using aligning studs, install valve, sandwich plate and a new gaskets.

3. Hand tighten all bolts(marked blue and green on drawing 1) according to the sequence you find on the drawing 1.

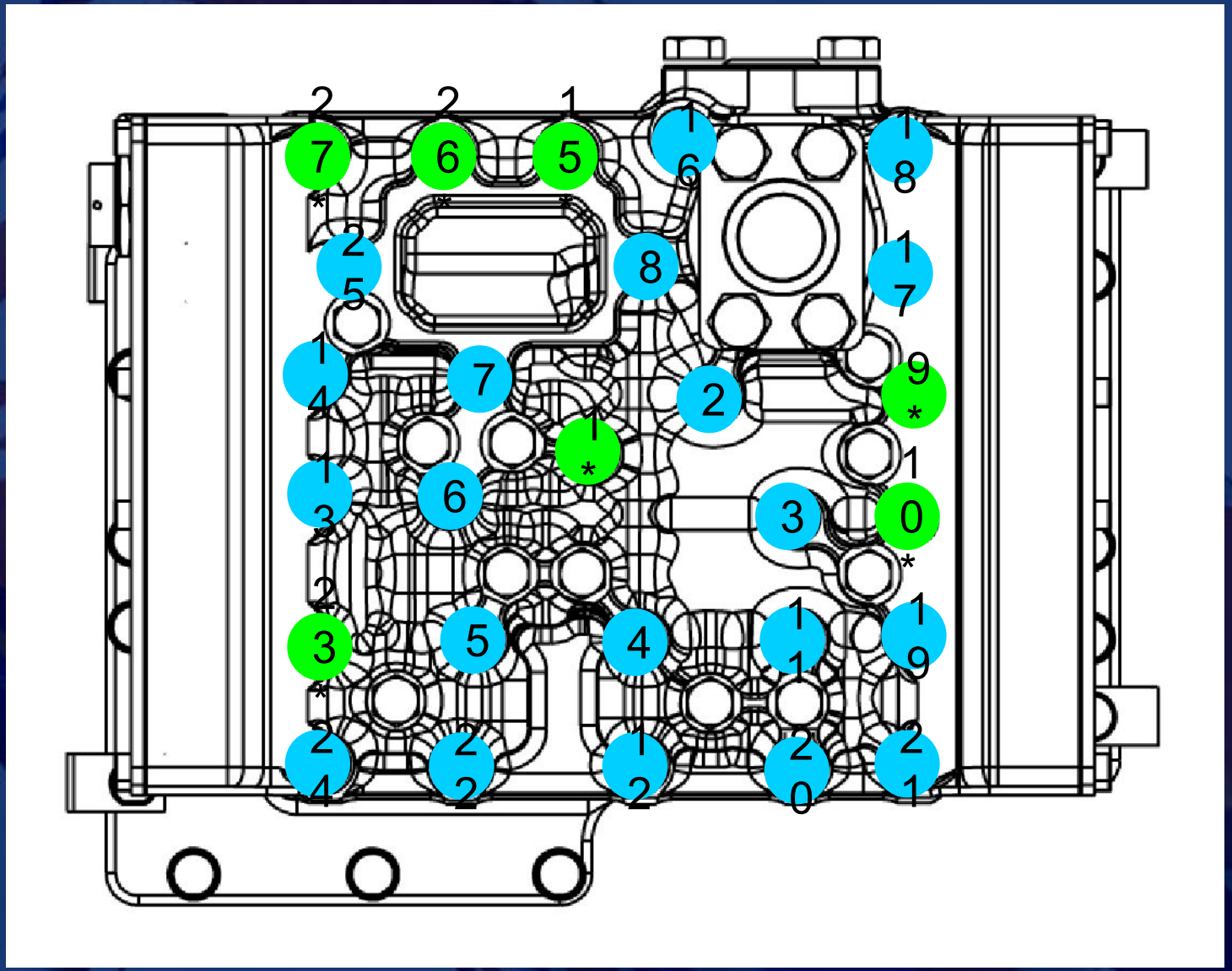
4. Torque all bolts in the same sequence as on drawing 1 to a torque of 25Nm

5. Hand tighten the 15 bolts(marked pink on, drawing 2) and torque to 25Nm to the sequence as shown on drawing 2

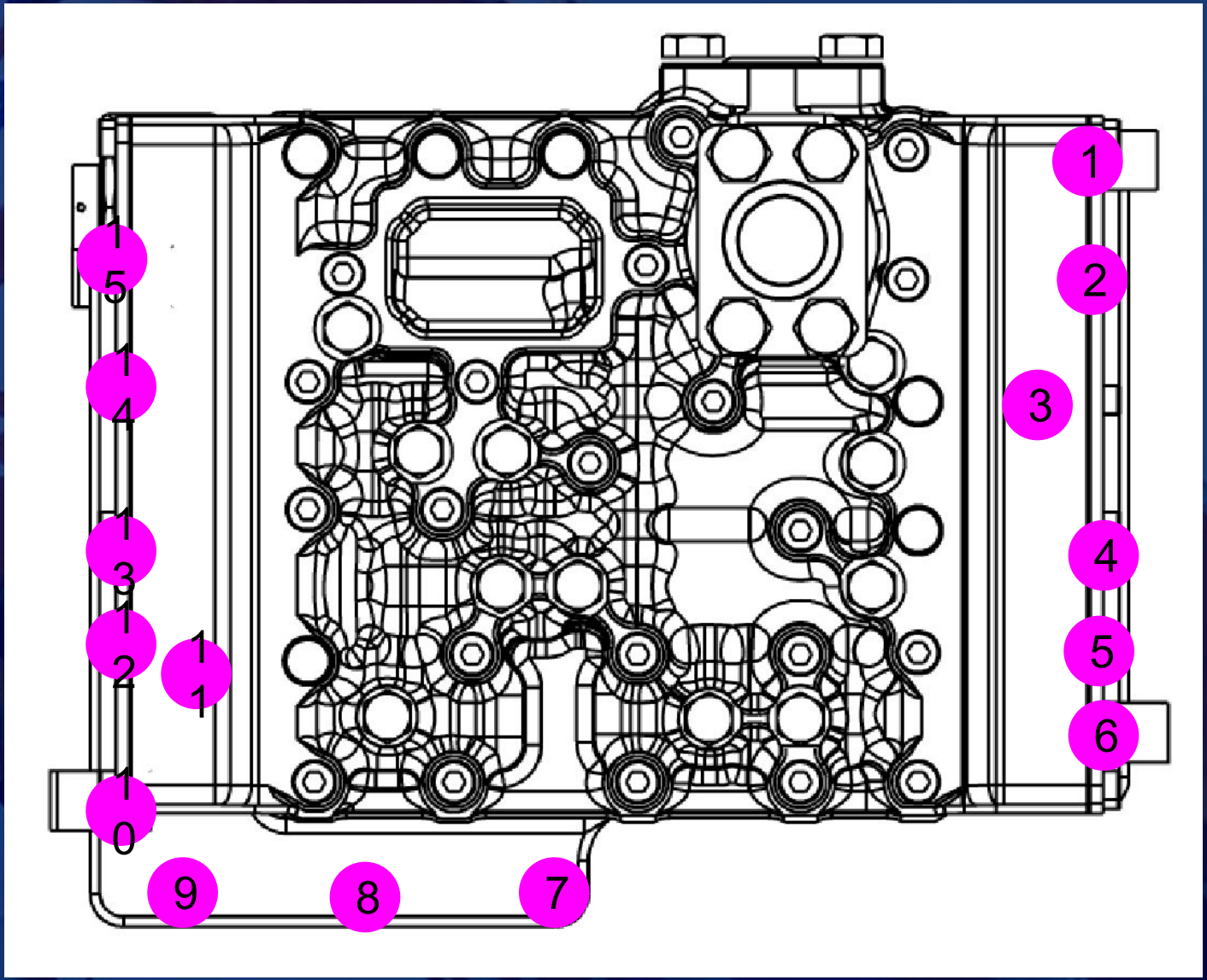
6 Retorque all bolts (drawing 1 and 2) again to the sequences as shown

7. Recalibrate the transmission

Control valve installation instruction



Control valve installation instruction

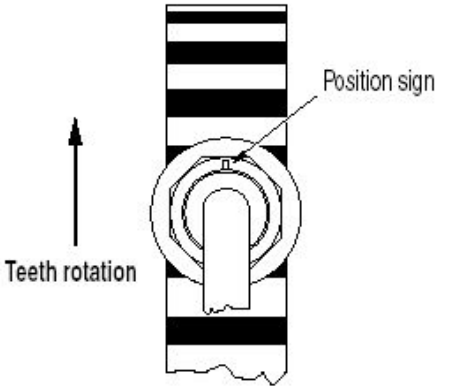


Speed sensor installation

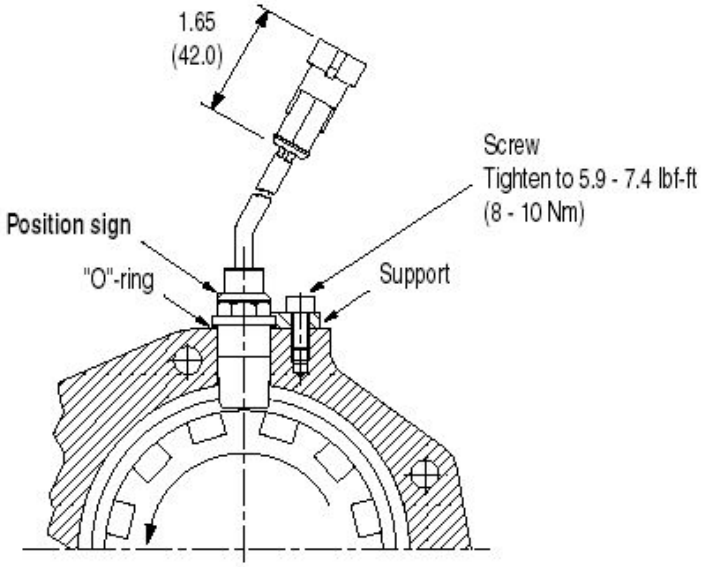
Turbine, drum and output (x3)speed sensor

Combined engine speed sensor and temperature

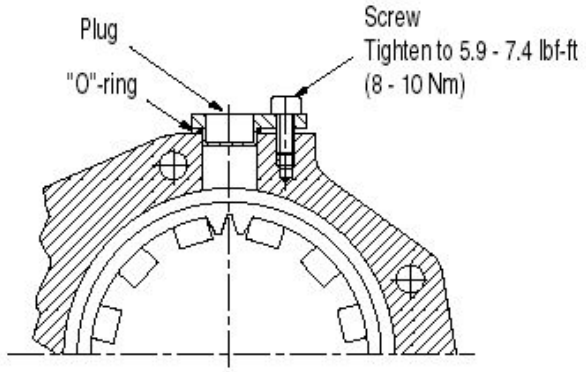
Speed sensor installation



On the sensor body there is a small plastic triangular position sign.
Make sure the position sign on the sensor points as shown below
in the direction of the movement of the gearteeth (Teeth rotation as shown).

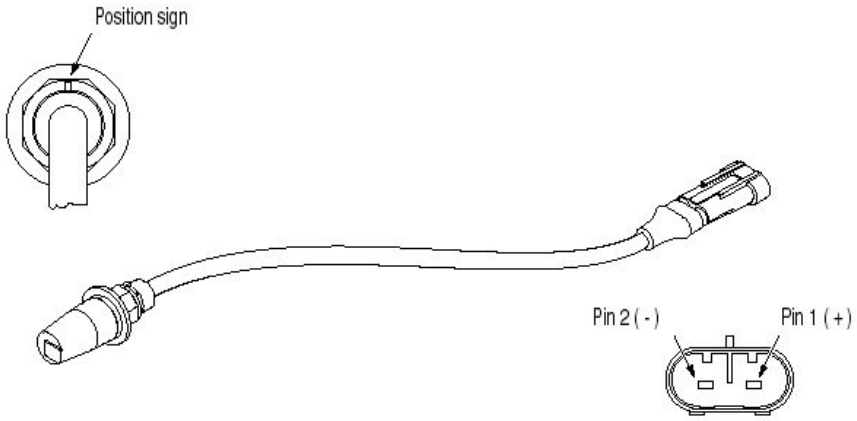


Sensor installed



Hole plugged

Speed sensor installation



The magneto resistive sensor generates a square wave current with a fixed amplitude changing between 7 mA and 14 mA. The sensor has an integrated AMP superseal 2 pin connector.
The two pins are numbered 1 and 2.
Following table shows the relation between wire colour, pin number and connection.

COLOUR	PIN NUMBER	FUNCTION	CONNECTION
BROWN	1	Current input	Hot wire
BLUE	2	Current output	Ground wire

Note

THE SENSOR WIRES HAVE A POLARITY.

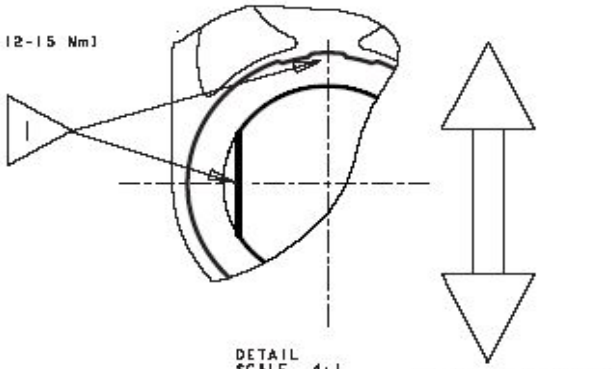
BE SURE TO CORRECTLY OBSERVE SENSOR POLARITIES, AS WRONG CONNECTIONS WILL DEACTIVATE THE SENSOR !

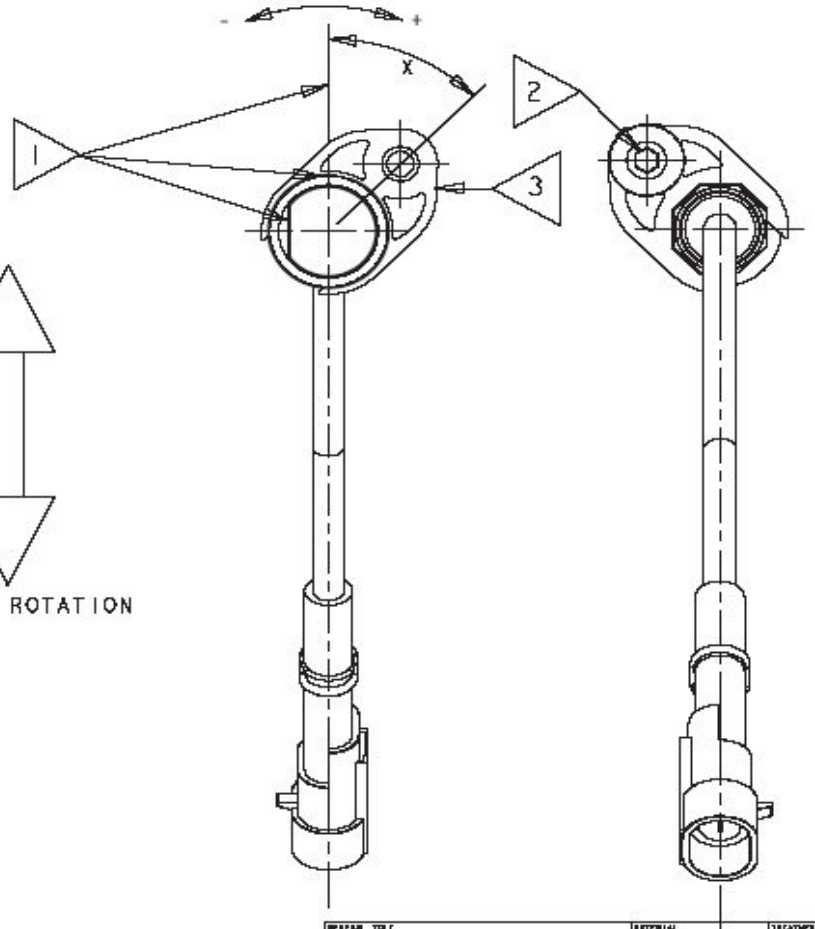
Speed sensor installation

1 INSTALL SENSOR WITH POSITION SIGN POINTING IN THE DIRECTION OF GEAR TEETH MOVEMENT OR 180° ROTATED

2 TORQUE SCREW : 8-11 lbs.ft (12-15 Nm)

3 INSTALL CLIP UNDER ANGLE X (SEE TABLE)





TRANSMISSION MODEL	ASSY PARTNR	CONNECTOR	TYPE	X POSITION
TE10	4209752	AMP 2 PINS	DRUM SPEED TURBINE SPEED OUTPUT SPEED	0 DEGREES 0 DEGREES 0 DEGREES
	4209784	AMP 3 PINS	ENGINE SPEED/ TEMPERATURE	0 DEGREES
TE13/17	4209831	DEUTZ 2 PINS	DRUM SPEED OUTPUT SPEED	-45 DEGREES -45 DEGREES
	4209832	DEUTZ 2 PINS	TURBINE SPEED	-45 DEGREES
	4209833	DEUTZ 3 PINS	ENGINE SPEED/ TEMPERATURE	-135 DEGREES
TE27/32	4209784	AMP 3 PINS	ENGINE SPEED/ TEMPERATURE	0 DEGREES
	4209752	AMP 2 PINS	DRUM SPEED	0 DEGREES
	4209750	AMP 2 PINS	OUTPUT SPEED	0 DEGREES
	4209751	AMP 2 PINS	TURBINE SPEED	-90 DEGREES

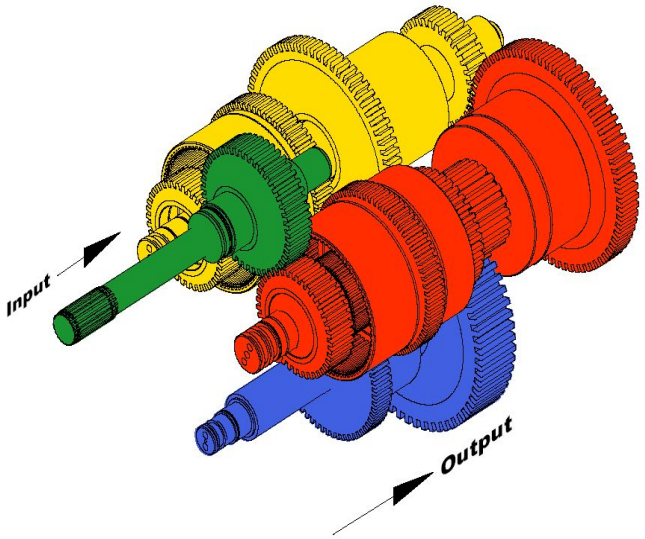
ASSY-SPEED SENSOR
INSTALLATION INSTRUCTIONS

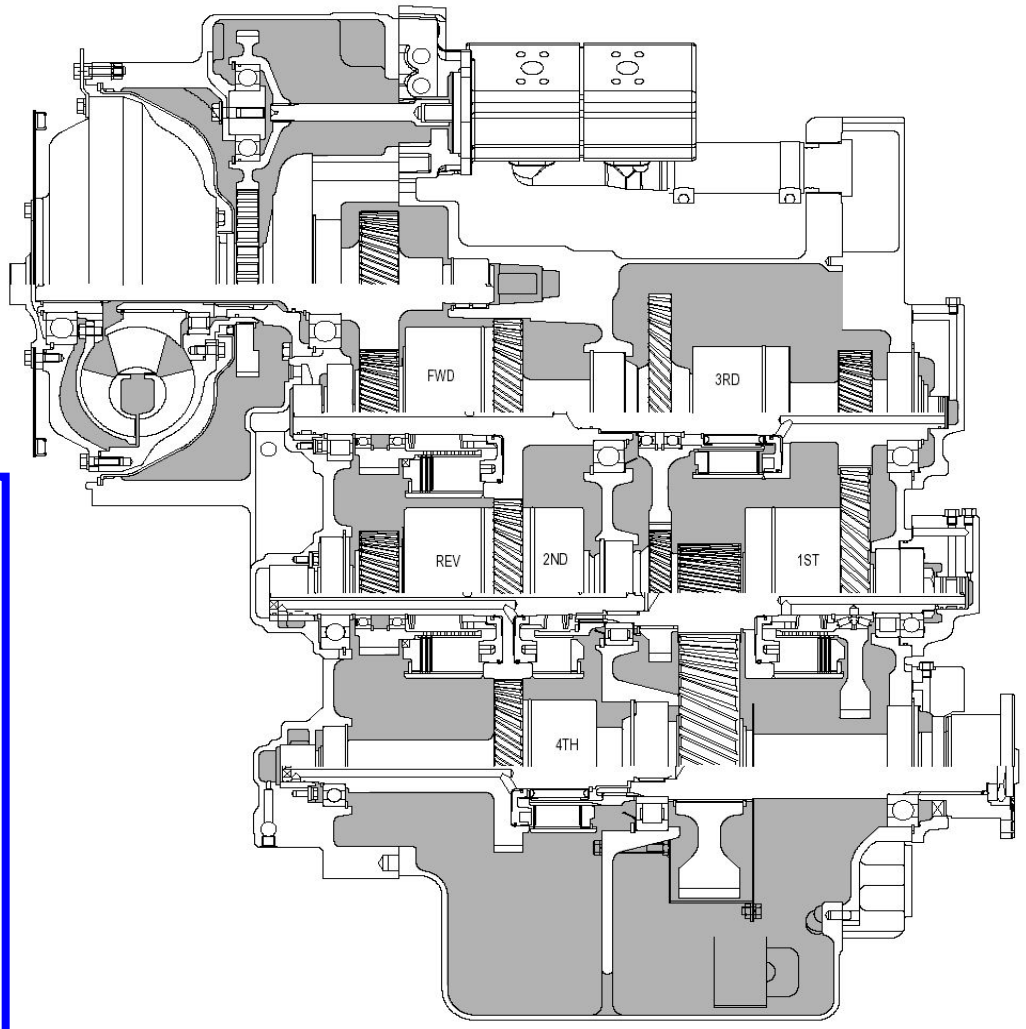
TE32 transmission

Overview

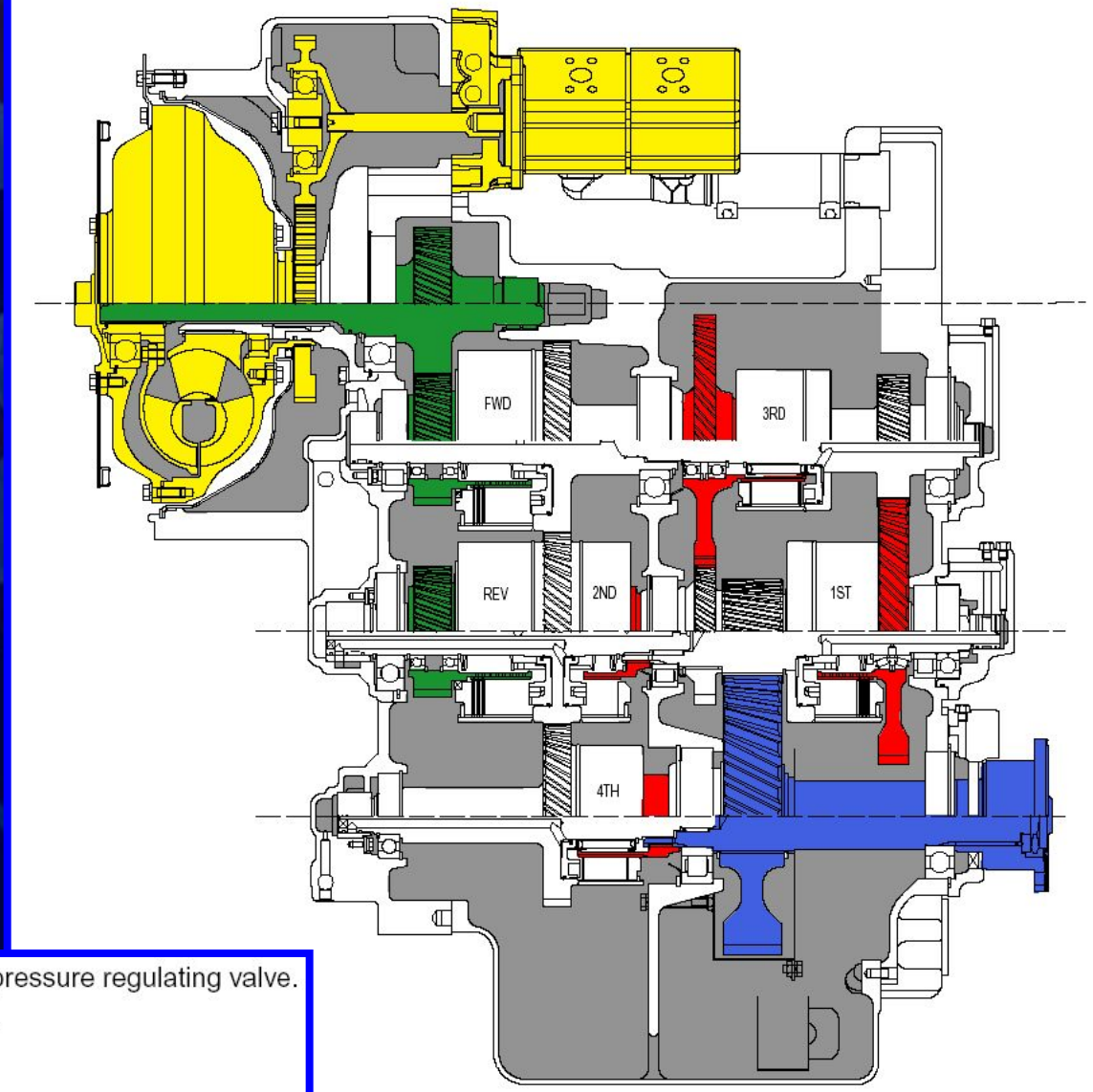
TE32 :

- short drop
- 4 speed Fwd/Rev





Transmission Layout



1. The converter, pump drive section and pressure regulating valve.
2. The input shaft and directional clutches.
3. The range clutches.
4. The output section.

Model designation

1X.X T E 32 4 X X - XX

Converter
Model Wheel Group
Mounting type
Engine mount =T
Remote mount =RT
Mid mount =MT
of gears
Electronically controlled model

specific ¨dash number¨
specific ratio

even n° :long drop
odd n° : short drop

transmission input rating
(x 100Nm)

numbers

Technical specifications

Ratio TE32418

TE32418	F1	F2	F3	F4	R1	R2	R3	R4
RATIO	5.065	2.422	1.379	0.784	5.065	2.422	1.379	0.784
SPREAD		2.091	1.757	1.760		2.091	1.757	1.760
TOT SPD				6.464				6.464
F/R ratio					1.00			

Technical specifications

Output flange rotation – (transmission forward clutch engaged)

Model	Output
Short Drop	Opposite
Long Drop	Same

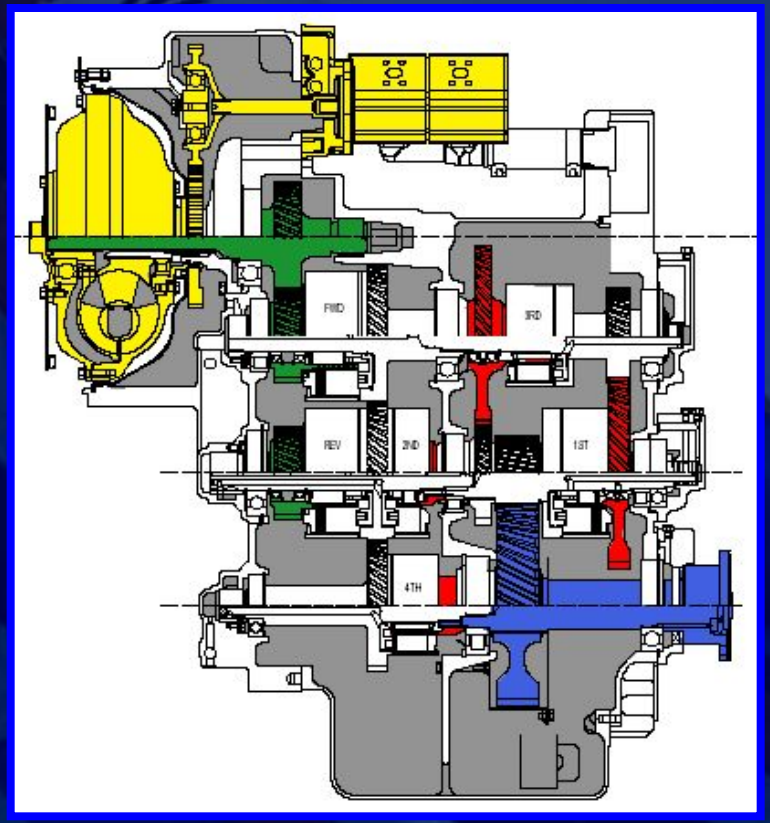
Drop :

- Long Drop 624.6mm
- Short Drop 317.8mm

Technical specifications

Speed pick-up :

- Engine speed combined with temperature located on pump drive gear
- Turbine speed located on input gear
- Drum speed located on forward drum
- Output speed located on output shaft gear



Technical specifications

Converter/Transmission Oil System

Capacity (Approximate: measured at 600 RPM input speed and oil temp between 60 and 70°C, neutral)
□ Short drop 60L □ Long drop 75L Lines and cooler not included

Oil Type □ **ONLY ATF Dexron III approved**
viscosity at 40°C: 33 → 38 cSt
viscosity at 100°C: 7 → 8 cSt
flash point: min 160°C
pour point: max –42°C

Oil change □ **1000 hours**

Filtration □ **2 x Spin On**
change every 1000 hours
first change: 100 hrs or after rebuild

Temperature specifications

Normal operating temperature 70 - 120°C at temperature check port converter out

Maximum allowed transmission temperature 120° C

Pressure specifications

Transmission regulator pressure :

- 600 RPM 22.5-24.5 bar
- 2200 RPM 23.5-25.5 bar

Clutch pressures

At 1800 RPM 20.5 - 24.5 bar

Filter bypass

valve set at 4.1 to 4.5
bar

Lube pressure

0.9 – 1.4 bar at 100 l/min. lube flow.(+/-1000RPM)

Internal leakage @ 1800 RPM

Fwd/Rev max 4 l/min

1st max 9.2 l/min

2nd/3rd/4th max 4 l/min

Savety valve

cracking pressure 8.8-9.6 bar

Converter out pressure (to cooler)

5 bar min. at 2000 RPM and max. 8.5 bar at no load governed speed.

Pump flow

System pump flow : 108-128 l/min at 2200 RPM.

Lube pump flow : 80-95 l/min at 2200 RPM.

Electrical specifications

Variable force solenoids(VFS)

VFS 2nd/4th - VFS 1st/3rd - VFS Fwd -VFS Rev

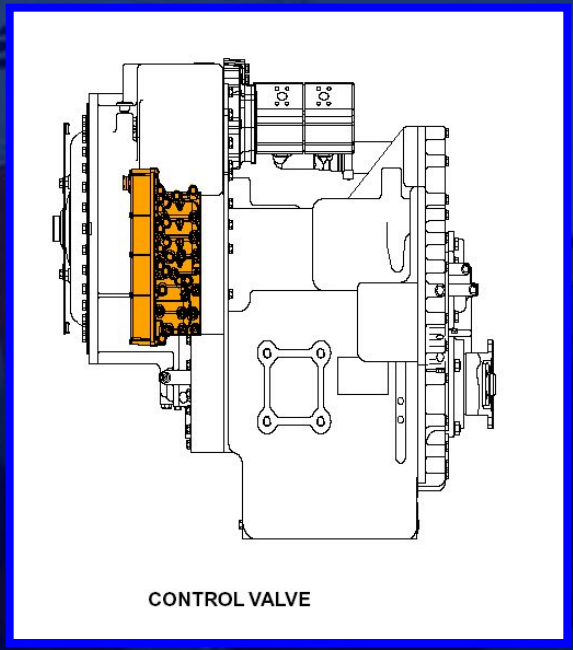
Coil resistance 4.35 ± 0.35 OHMS. at 25° C

On/Off Solenoids

Total neutral , 1st/3rd & 2nd/4th range solenoids

Coil resistance 12V - 28 ± 2 . OHMS at 20° C

Coil resistance 24V - 87 ± 2 . OHMS at 20° C



CONTROL VALVE

Speed sensors

Type Magneto resistive sensor.

Sensing distance up to 1.8 mm

Sensor signal generates a square current with a fixed amplitude changing between 7 and 14 mA.

Drum speed sensor

Turbine and output (x2) speed sensor

Combined engine speed sensor and temperature

Hydraulic cooler line specifications

HYDRAULIC COOLER LINES SPECIFICATIONS.

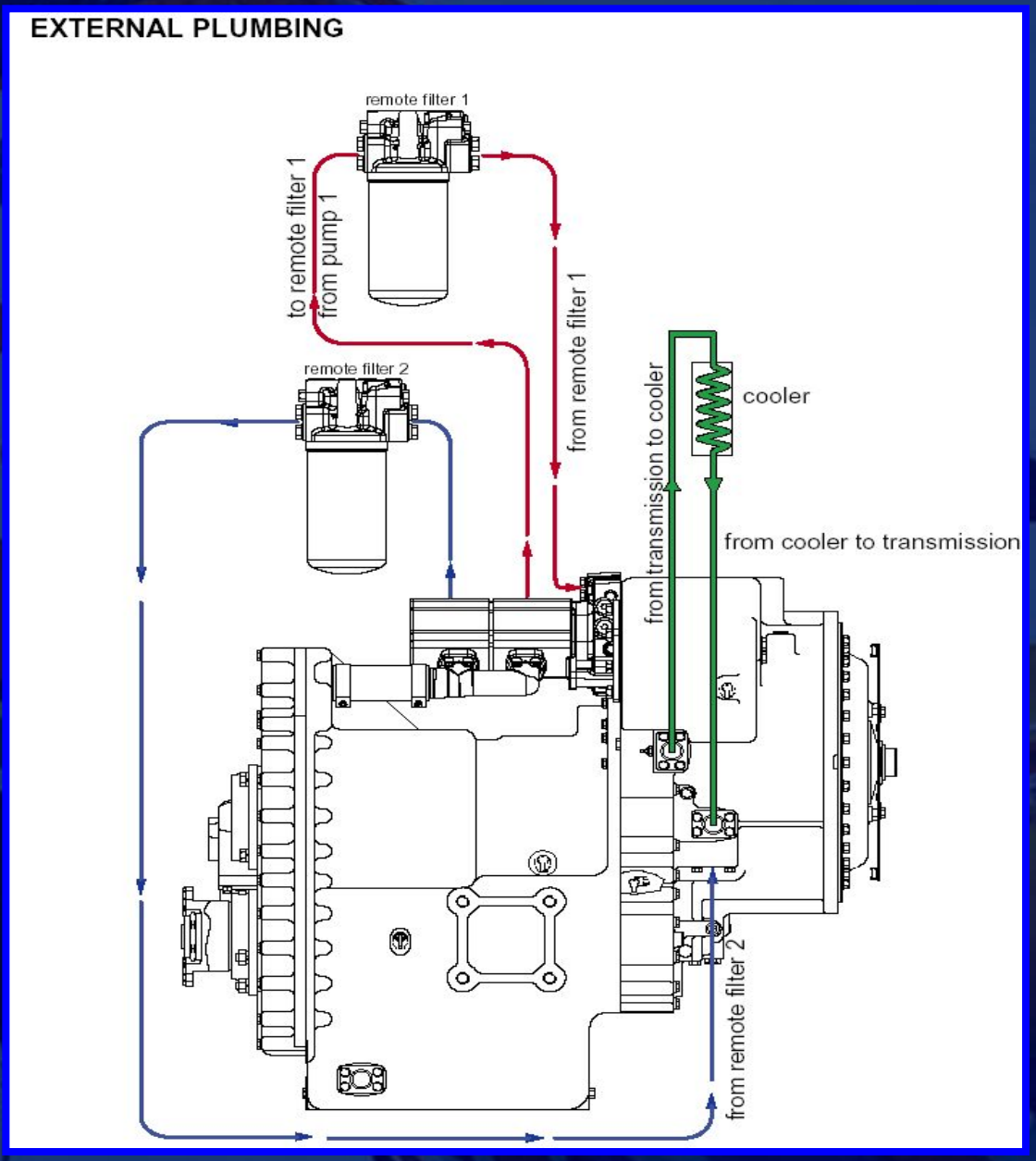
Minimum 32 mm internal diameter for lines and fittings.

Suitable for operation from ambient to 120° C continuous operating temperature.

Must withstand 30 bar continuous pressure and 45 bar intermittent surges.

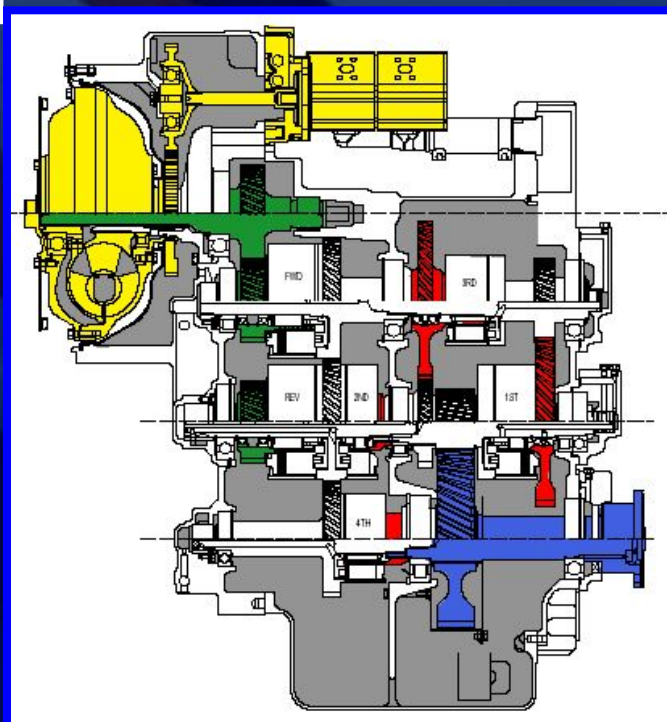
Conform SAE J1019 and SAE J517, 100RI.

EXTERNAL PLUMBING

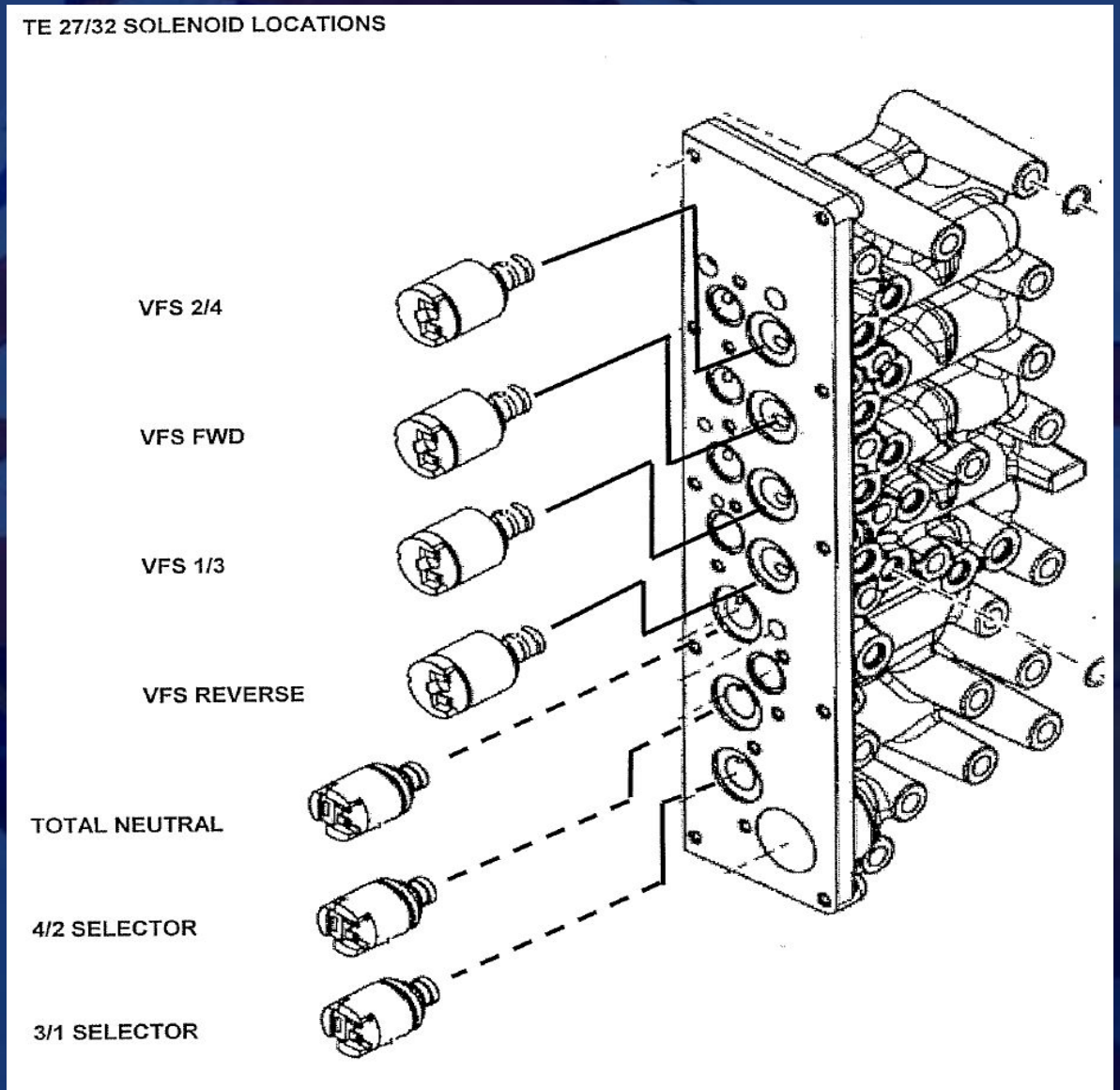


Additional signals

- Speed sensors
  - Engine speed combined
    with oil temperature pick up located at pump gear
  - Turbine speed located on input gear
  - Drum speed located on forward drum
  - Output speed located on output gear
- Pressure feedback sensor
- Oil temperature
- Converter out temperature switch



Wiring schematics



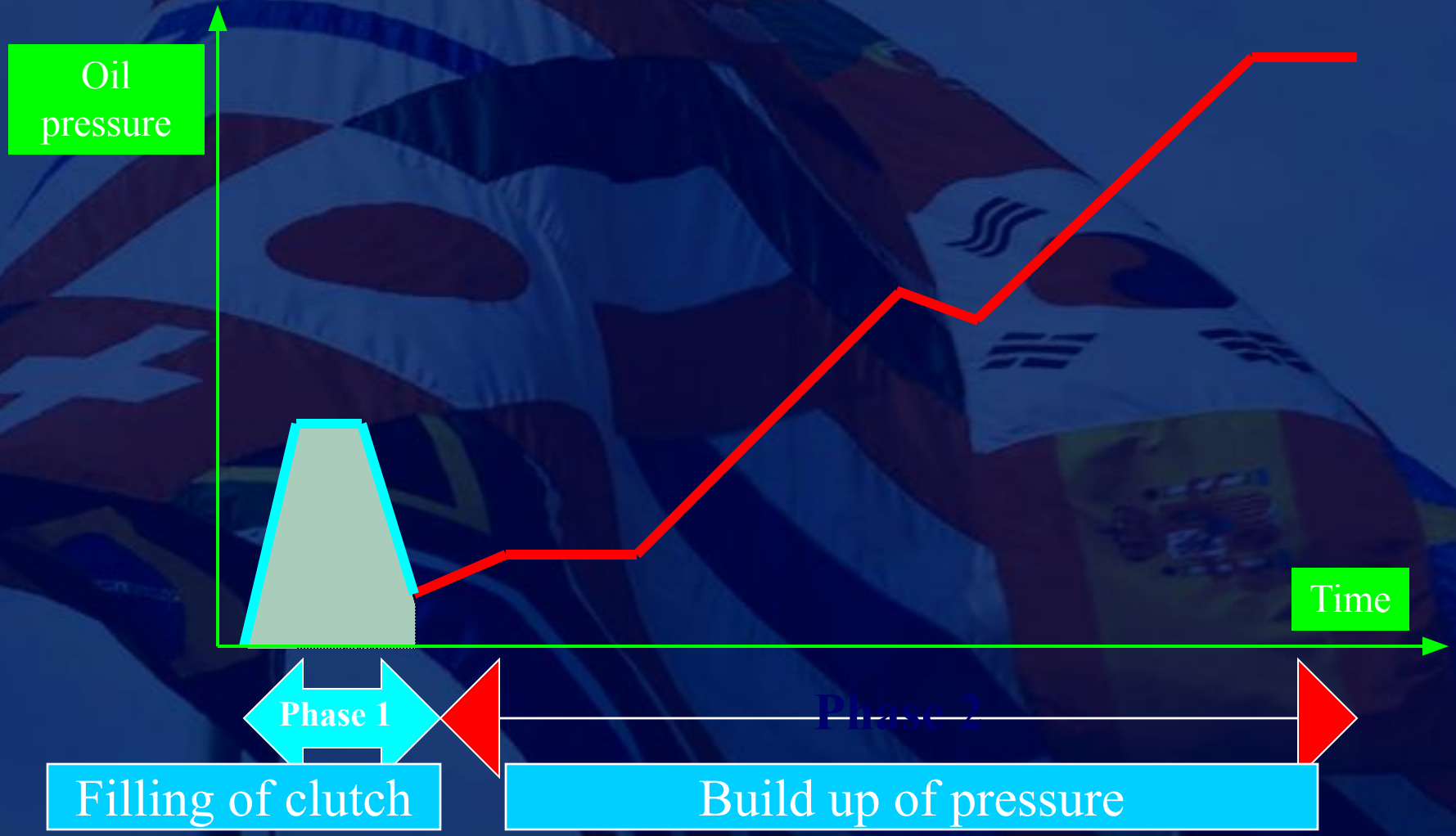
Wiring schematics

Pin	Wire color	Function
1-2	blue	VFS 4th/2nd
3-4	green	VFS FWD
5-6	yellow	VFS 3rd/1st
7-8	red	VFS REV
9-10	black	Total neutral
11	white	Presssure switch
12	yellow	Solenoid 4th/2nd
13	orange	Solenoid 3rd/1st
14	white	common ground sol 4/2 and 3/1
15	white	ground pressure switch
16		not used

Solenoids activated

Transmission gear	Activated on /off solenoids	Activated VFS's	Activated Clutches
Forward 4	Total neutral	Reverse, 1/3	Forward, 4th
Forward 3	Total neutral	Reverse, 2/4	Forward, 3rd
Forward 2	Total neutral, 2/4 selector	Reverse, 1/3	Forward, 2nd
Forward 1	Total neutral, 1/3, 2/4 selector	Reverse, 2/4	Forward, 1st
Neutral 4	Total neutral	Forward, Reverse, 1/3	4th
Neutral 3	Total neutral	Forward, Reverse, 2/4	3rd
Neutral 2	Total neutral, 2/4 selector	Forward, Reverse, 1/3	2nd
Neutral 1	Total neutral, 1/3, 2/4 selector	Forward, Reverse, 2/4	1st
Reverse 4	Total neutral	Forward, 1/3	Reverse, 4th
Reverse 3	Total neutral	Forward, 2/4	Reverse, 3rd
Reverse 2	Total neutral, 2/4 selector	Forward, 1/3	Reverse, 2nd
Reverse 1	Total neutral, 1/3, 2/4 selector	Forward, 2/4	Reverse, 1st

Electronic controlled modulation (E.C.M.)



Operation of transmission

The transmission is controlled by an APC200 box. This unit has a microprocessor that receives certain inputs (gear selector position, speed sensors,…), which are processed and will give output signals to the control valve.

Operation of the valve

Regulated pressure (22.5-25.5 bar) is directed to the total neutral shift spool and the pressure reducer that will decrease the pressure to 10 bar.

This reduced pressure will be used to supply the variable force solenoids(VFS), total neutral solenoid , 3rd/1st solenoid and 4th/2nd solenoid.

The VFS will give an output pressure curve from 0 to 6 bar proportional to a current from 1000 mA to 0 mA. The pressure intensifiers with a ratio of 3.5:1 will multiply this pressure curve so that a curve from 0 to 20 bar is available for each directional and range clutch. Between each VFS a pressure intensifier is placed and an accumulator to dampen any hydraulic vibration.

Directional selection

When a direction (forward or reverse) is selected , total neutral solenoid is activated and the required directional VFS will provide a pressure rise from 0 to 6 bar. The directional clutch is then fed with modulated pressure supplied through the pressure intensifier.

Operation of transmission

Range selection

When 1 st clutch is selected , the 3rd/1st and 4th/2nd solenoids are activated. The 1st/3rd VFS will provide a pressure curve from 0 to 6 bar. The pressure intensifier will multiply this pressure and will feed 1st clutch via the activated 3rd/1st spool.

When 2nd clutch is selected, The 3th/1st VFS will decrease pressure from 6 to 0 bar, thus releasing the 1 st clutch in a controlled fashion. At the same time the 4th/2nd VFS will provide a pressure curve from 0 to 6 bar . This pressure is fed to 2 nd clutch via the pressure intensifier, which will provide clutch overlap.

When the shift is finalised the 3rd/1st solenoid is deactivated.

When 3rd clutch is selected the 3rd/1st solenoid is not activated. The 1st/3rd VFS will provide a pressure curve from 0 to 6 bar and will feed 3rd clutch via a pressure intensifier and the deactivated 3rd/1st spool. At the same time the 4th/2nd VFS will decrease pressure from 6 to 0 bar providing the clutch overlap.

When the shift is finalised the 4th/2nd solenoid is deactivated.

When 4th clutch is selected , the 4th/2nd VFS will provide a pressure curve from 0 to 6 bar and will feed 4th clutch via a pressure intensifier and the deactivated 4th/2nd spool. At the same time the 3rd/1st VFS will decrease pressure from 6 to 0 bar providing the clutch overlap

Operation of transmission

Neutral selection

When neutral is selected (1st, 2nd, 3rd or 4th) , the total neutral solenoid is activated and the VFS's for forward and reverse are fed by a 1000mA current, which will result in a 0 bar output, thus providing 0 bar pressure to the forward and reverse clutch. The range clutches 1, 2,3 or 4 remain activated by their respective VFS.

Total neutral selection

Total neutral is only selected by the APC200 in case a severe error is detected which will cause a shutdown

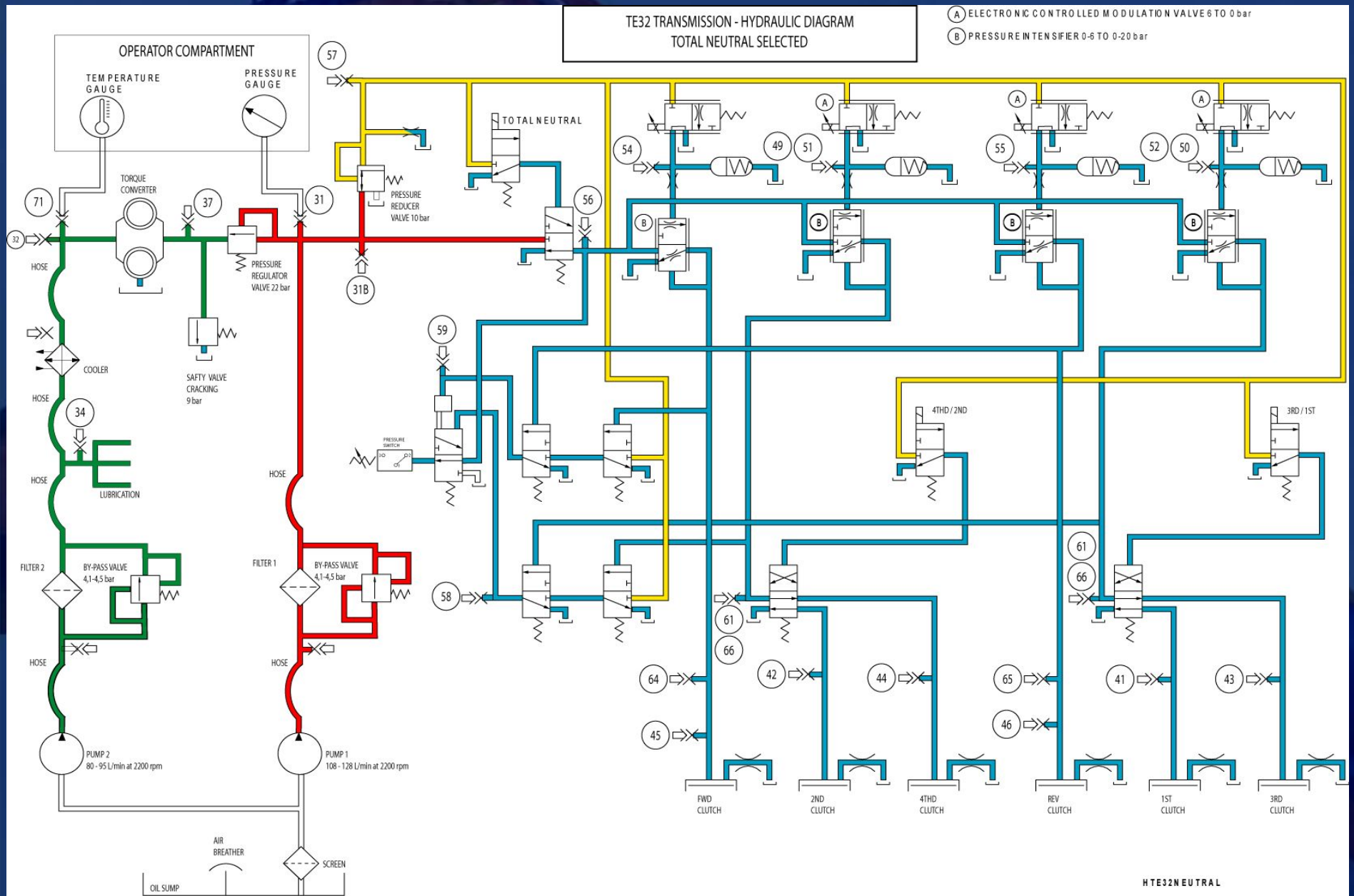
When total neutral is selected, the total neutral solenoid is not activated and as a result no pressure is supplied to the pressure intensifiers.

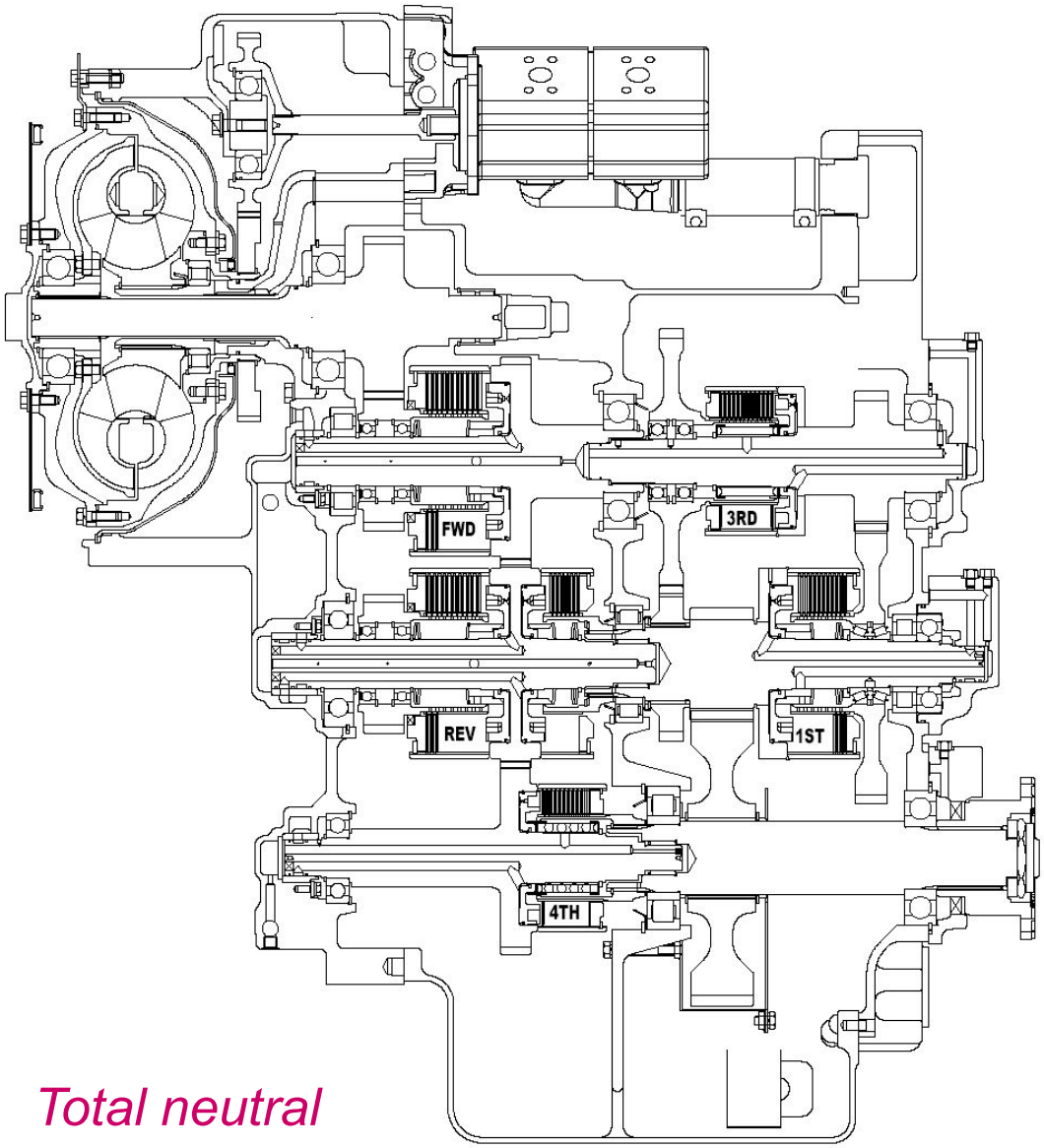
Operation of transmission

Pressure switch

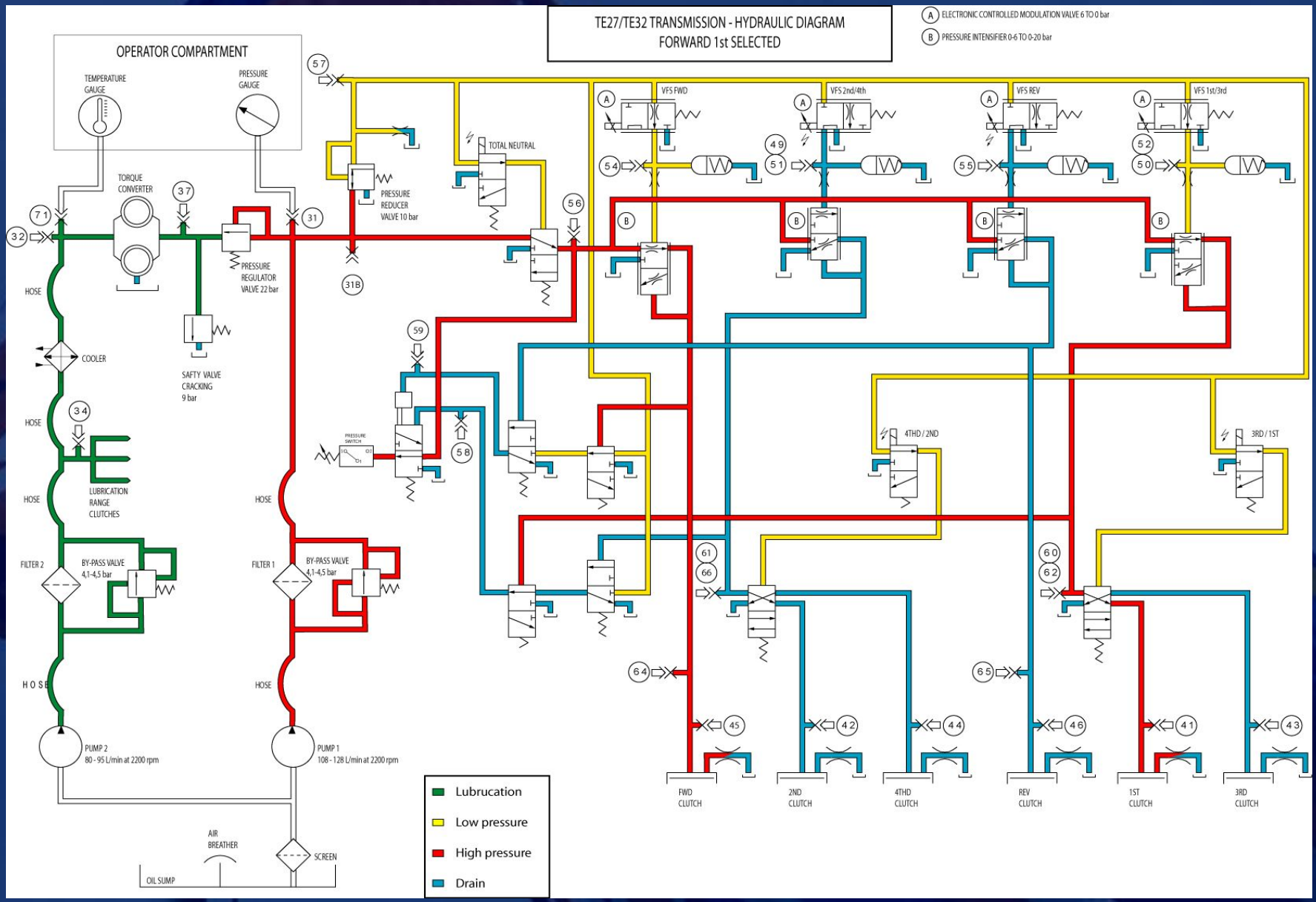
The control valve also has a pressure switch installed between the total neutral shift spool and the pressure intensifiers supply. This switch has 2 functions :

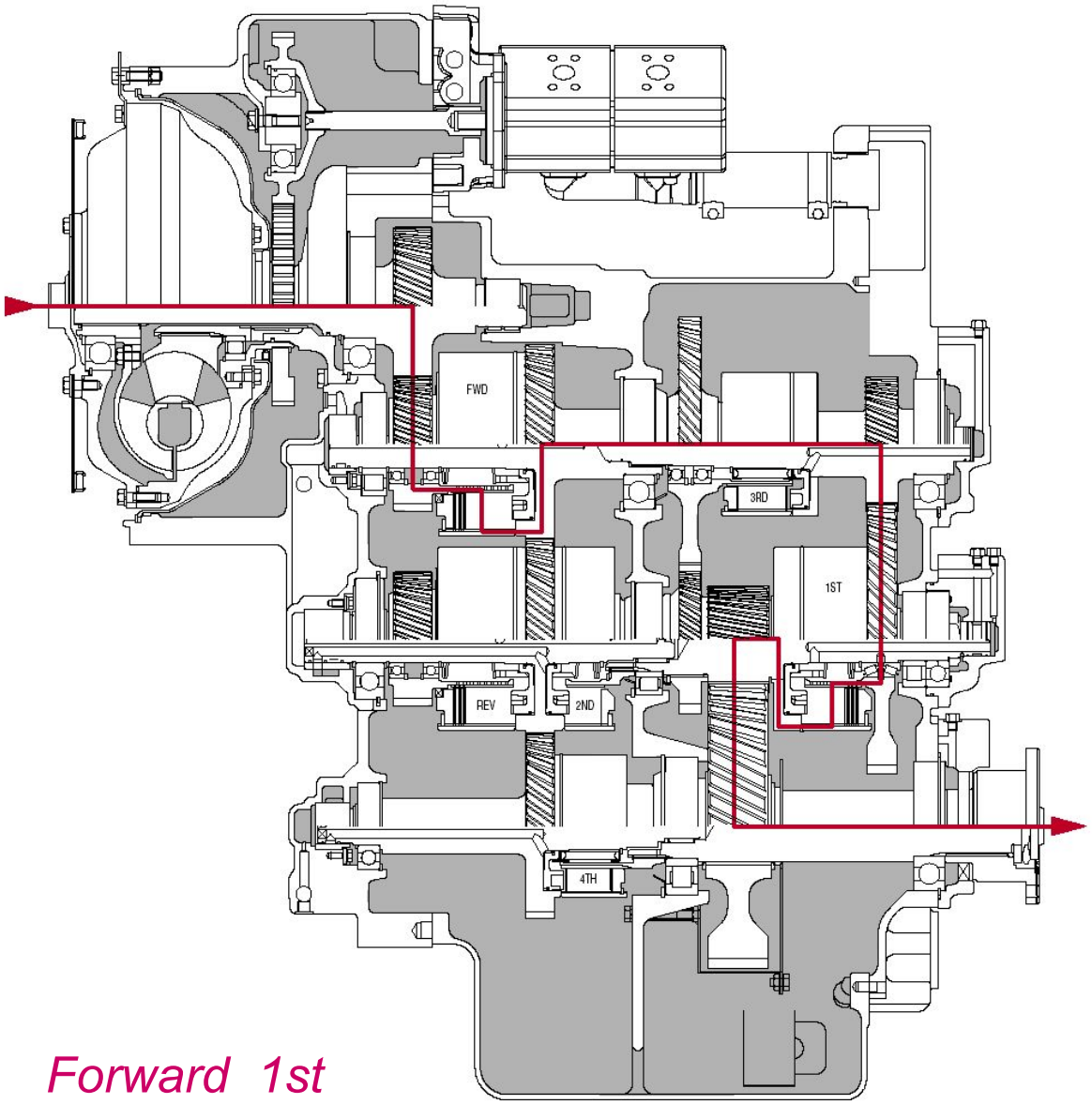
1. It will verify that a minimum pressure of 12 bar to the various pressure intensifiers is supplied only when the total neutral solenoid is activated. This information is an input of the APC200 box and if a pressure is detected below 12 bar the controller will put the transmission in total neutral which causes a shut down.
2. It will verify if only 1 direction clutch and 1 range clutch is activated when the shift is finalised. If detection is made that 2 direction clutches or 2 range cluthes are hydraulically activated it will provide an input signal to the APC200 which will put the transmission in total neutral which causes a shutdown.


TE32 TRANSMISSION - HYDRAULIC DIAGRAM
TOTAL NEUTRAL SELECTED
A ELECTRONIC CONTROLLED MODULATION VALVE 6 TO 0 bar
B PRESSURE INTENSIFIER 0-6 TO 0-20 bar
OPERATOR COMPARTMENT
TEMPERATURE GAUGE
PRESSURE GAUGE
TOTAL NEUTRAL
PRESSURE REDUCER VALVE 10 bar
TORQUE CONVERTER
PRESSURE REGULATOR VALVE 22 bar
SAFTY VALVE CRACKING 9 bar
COOLER
LUBRICATION
HOSE
FILTER 2
FILTER 1
BY-PASS VALVE 4,1-4,5 bar
PUMP 2
80 - 95 L/min at 2200 rpm
PUMP 1
108 - 128 L/min at 2200 rpm
AIR BREATHER
SCREEN
OIL SUMP
4THD / 2ND
3RD / 1ST
FWD CLUTCH
2ND CLUTCH
4THD CLUTCH
REV CLUTCH
1ST CLUTCH
3RD CLUTCH
HTE32NEUTRAL

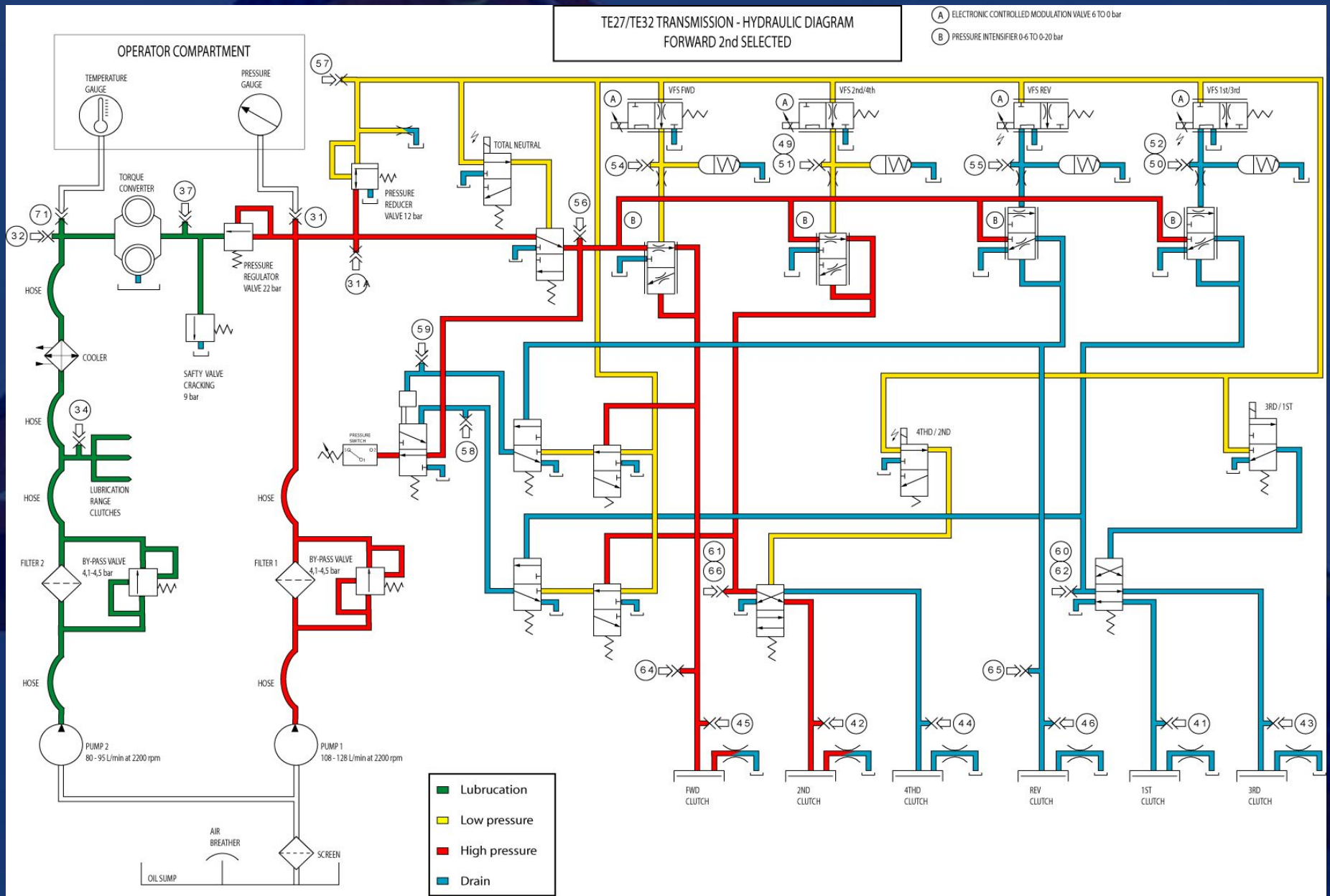


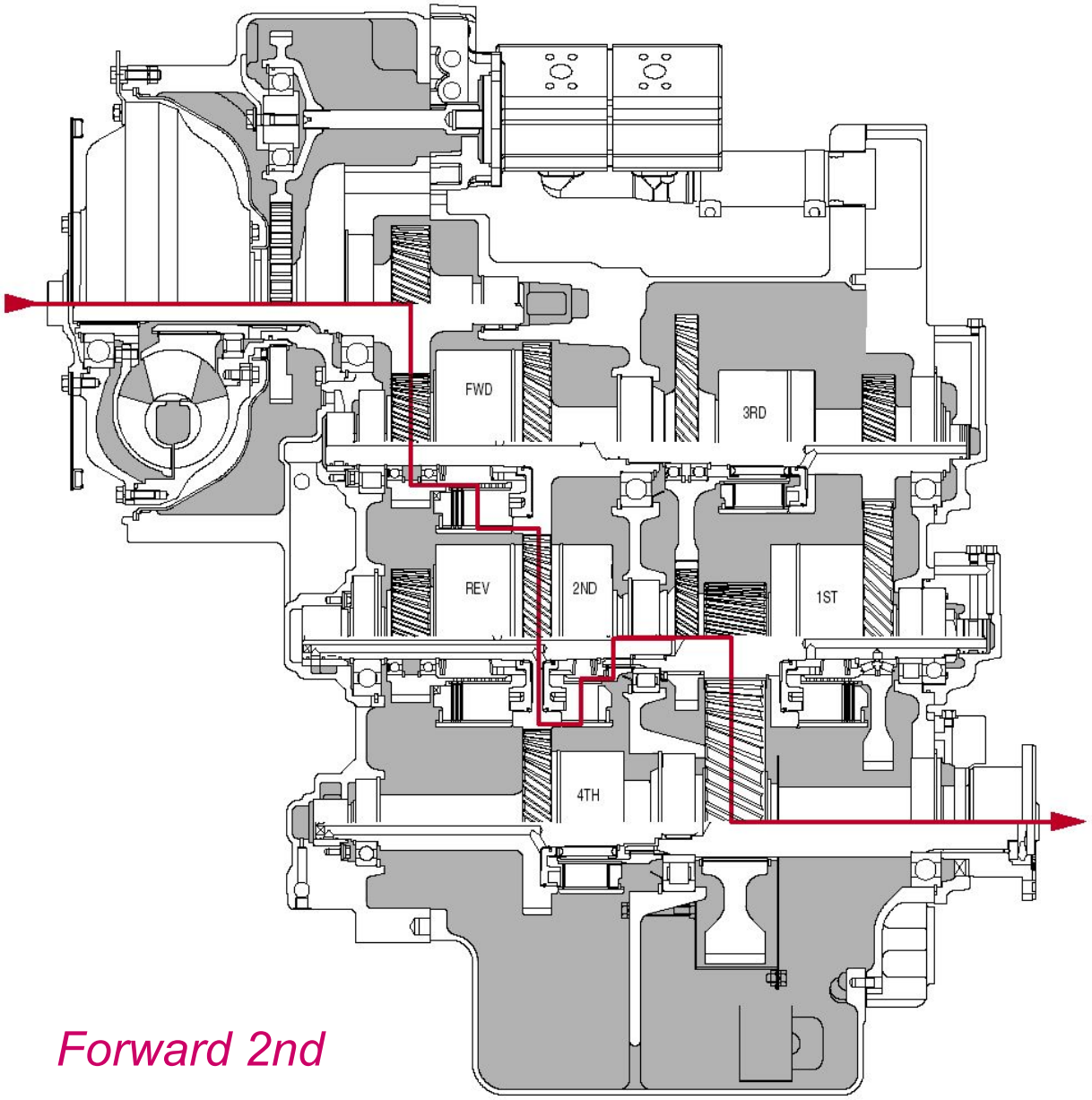
Total neutral


TE27/TE32 TRANSMISSION - HYDRAULIC DIAGRAM
FORWARD 1st SELECTED
A ELECTRONIC CONTROLLED MODULATION VALVE 6 TO 0 bar
B PRESSURE INTENSIFIER 0-6 TO 0-20 bar
OPERATOR COMPARTMENT
TEMPERATURE GAUGE
PRESSURE GAUGE
TORQUE CONVERTER
PRESSURE REDUCER VALVE 10 bar
TOTAL NEUTRAL
PRESSURE REGULATOR VALVE 22 bar
SAFTY VALVE CRACKING 9 bar
COOLER
HOSE
LUBRICATION RANGE CLUTCHES
FILTER 2
FILTER 1
BY-PASS VALVE 4,1-4,5 bar
PUMP 2 80 - 95 L/min at 2200 rpm
PUMP 1 108 - 128 L/min at 2200 rpm
AIR BREATHER
SCREEN
OIL SUMP
VFS FWD
VFS 2nd/4th
VFS REV
VFS 1st/3rd
4THD / 2ND
3RD / 1ST
FWD CLUTCH
2ND CLUTCH
4THD CLUTCH
REV CLUTCH
1ST CLUTCH
3RD CLUTCH
Lubrucation
Low pressure
High pressure
Drain

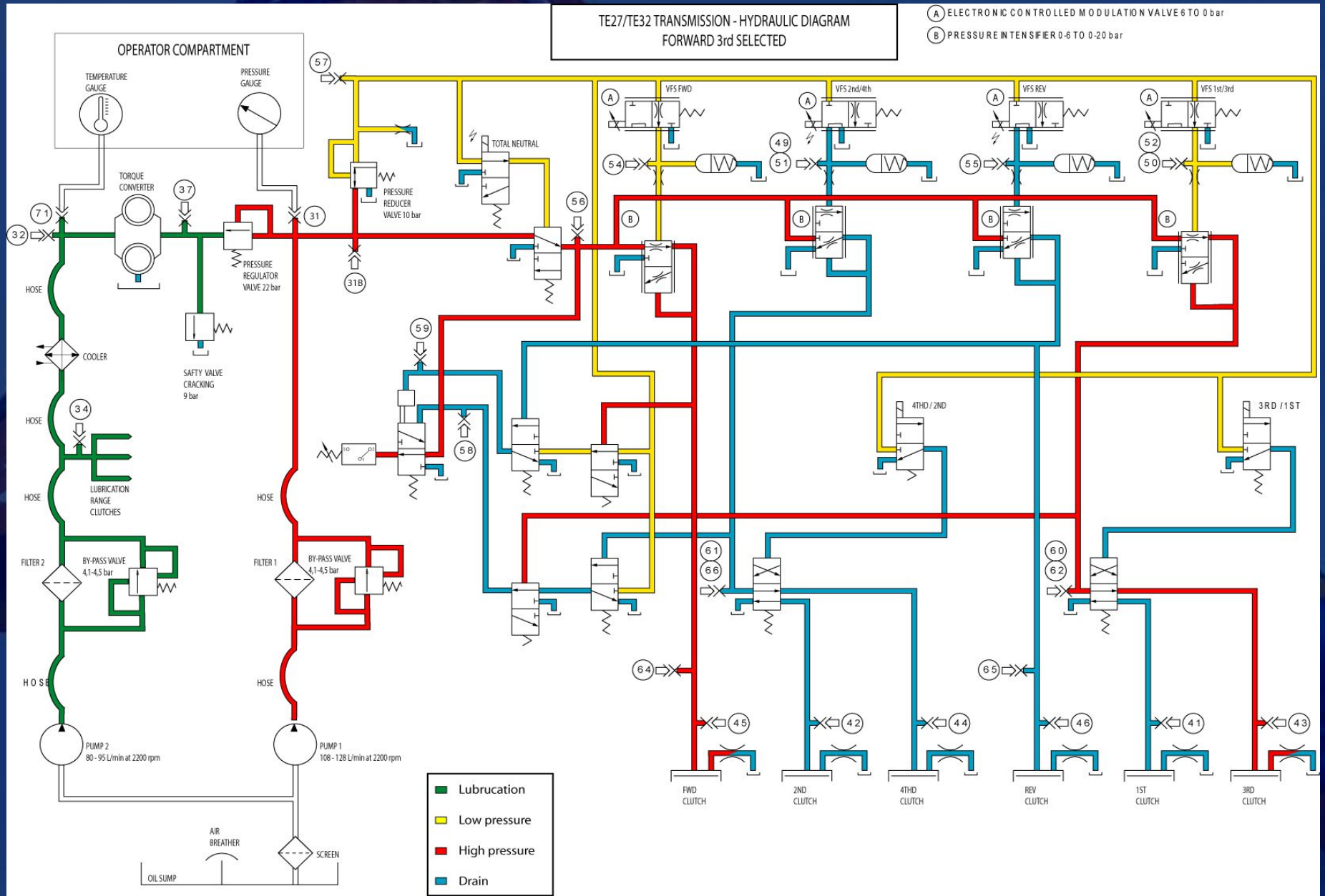


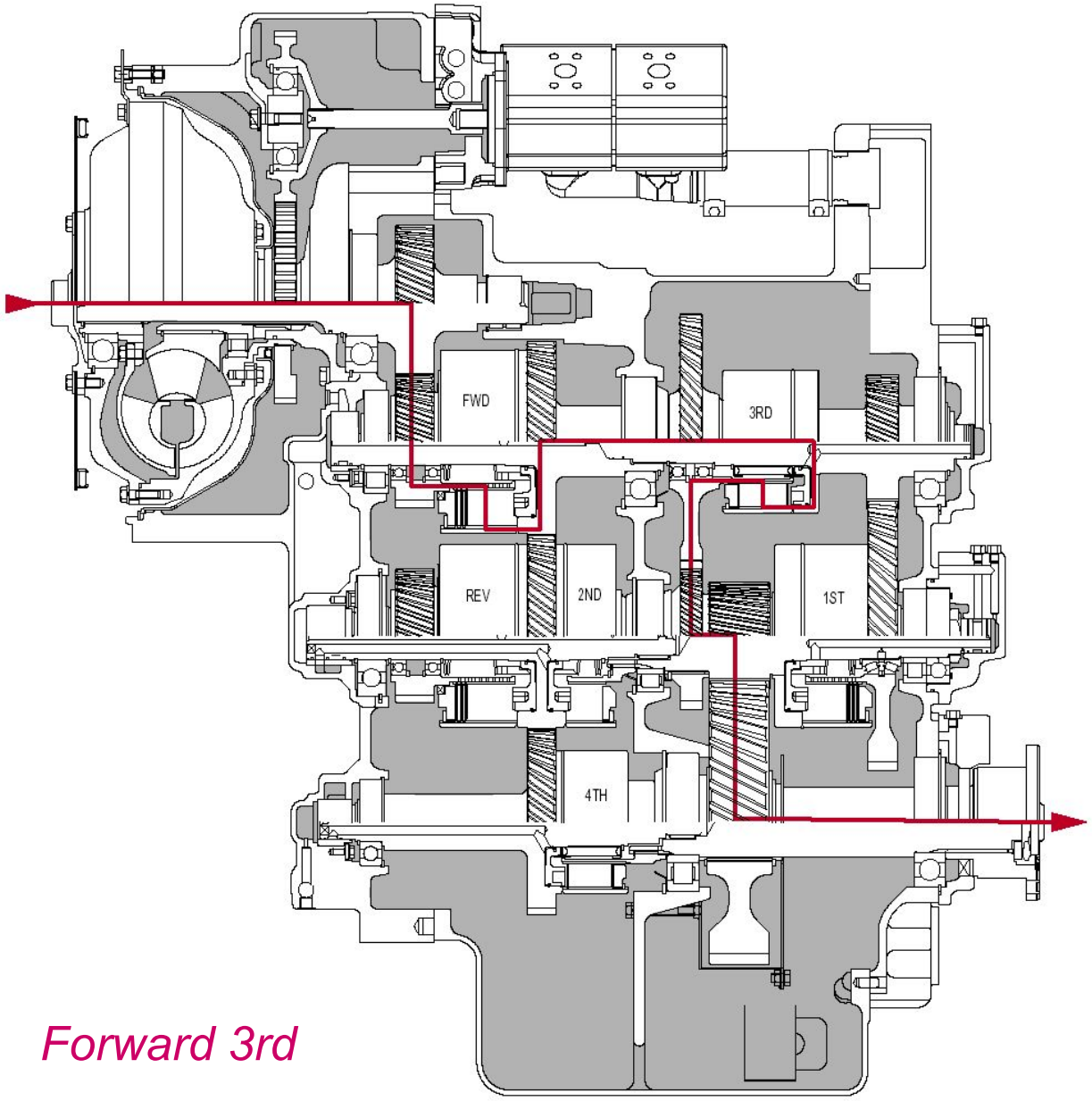
Forward 1st


TE27/TE32 TRANSMISSION - HYDRAULIC DIAGRAM
FORWARD 2nd SELECTED
A ELECTRONIC CONTROLLED MODULATION VALVE 6 TO 0 bar
B PRESSURE INTENSIFIER 0-6 TO 0-20 bar
OPERATOR COMPARTMENT
TEMPERATURE GAUGE
PRESSURE GAUGE
TORQUE CONVERTER
PRESSURE REDUCER VALVE 12 bar
TOTAL NEUTRAL
PRESSURE REGULATOR VALVE 22 bar
SAFTY VALVE CRACKING 9 bar
COOLER
HOSE
LUBRICATION RANGE CLUTCHES
BY-PASS VALVE 4,1-4,5 bar
FILTER 2
FILTER 1
PUMP 2 80 - 95 L/min at 2200 rpm
PUMP 1 108 - 128 L/min at 2200 rpm
AIR BREATHER
SCREEN
OIL SUMP
VFS FWD
VFS 2nd/4th
VFS REV
VFS 1st/3rd
4THD / 2ND
3RD / 1ST
FWD CLUTCH
2ND CLUTCH
4THD CLUTCH
REV CLUTCH
1ST CLUTCH
3RD CLUTCH
Lubrucation
Low pressure
High pressure
Drain

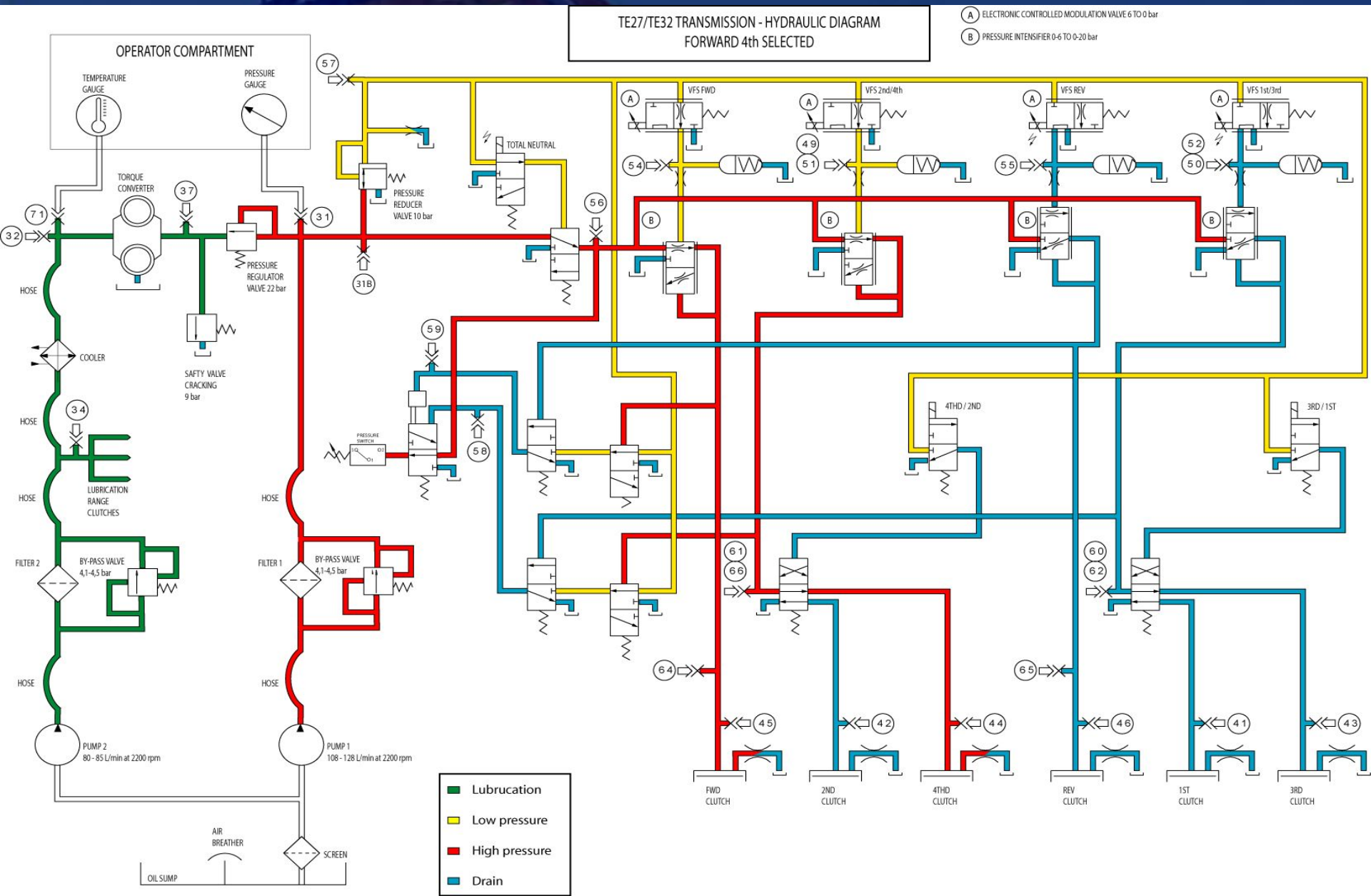


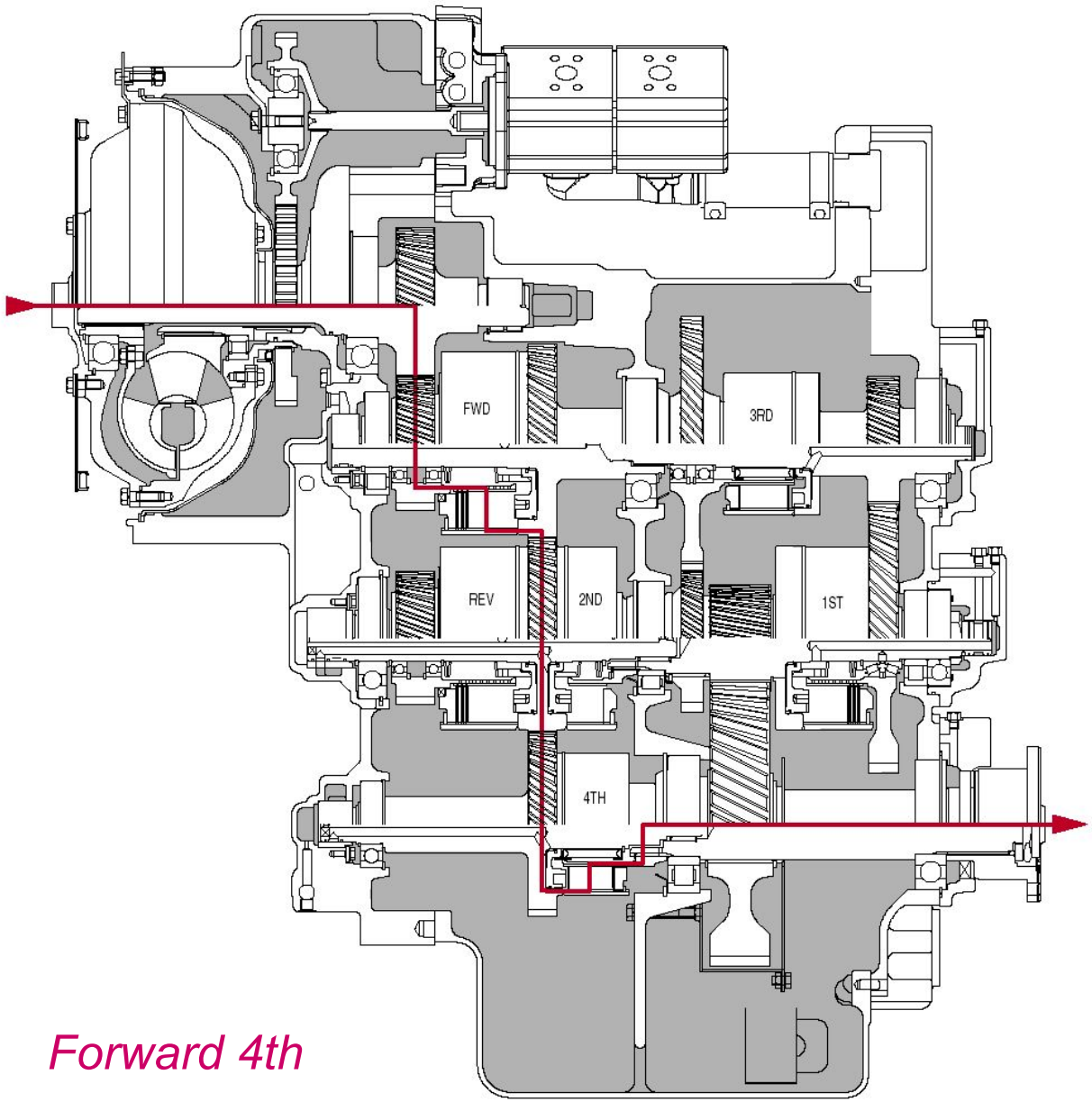
Forward 2nd


TE27/TE32 TRANSMISSION - HYDRAULIC DIAGRAM
FORWARD 3rd SELECTED
A ELECTRONIC CONTROLLED MODULATION VALVE 6 TO 0 bar
B PRESSURE INTENSIFIER 0-6 TO 0-20 bar
OPERATOR COMPARTMENT
TEMPERATURE GAUGE
PRESSURE GAUGE
TORQUE CONVERTER
PRESSURE REGULATOR VALVE 22 bar
PRESSURE REDUCER VALVE 10 bar
TOTAL NEUTRAL
VFS FWD
VFS 2nd/4th
VFS REV
VFS 1st/3rd
HOSE
COOLER
SAFTY VALVE CRACKING 9 bar
LUBRICATION RANGE CLUTCHES
FILTER 2
BY-PASS VALVE 4,1-4,5 bar
FILTER 1
BY-PASS VALVE 4,1-4,5 bar
PUMP 2
80 - 95 L/min at 2200 rpm
PUMP 1
108 - 128 L/min at 2200 rpm
AIR BREATHER
SCREEN
OIL SUMP
4THD / 2ND
3RD / 1ST
FWD CLUTCH
2ND CLUTCH
4THD CLUTCH
REV CLUTCH
1ST CLUTCH
3RD CLUTCH
Lubrucation
Low pressure
High pressure
Drain

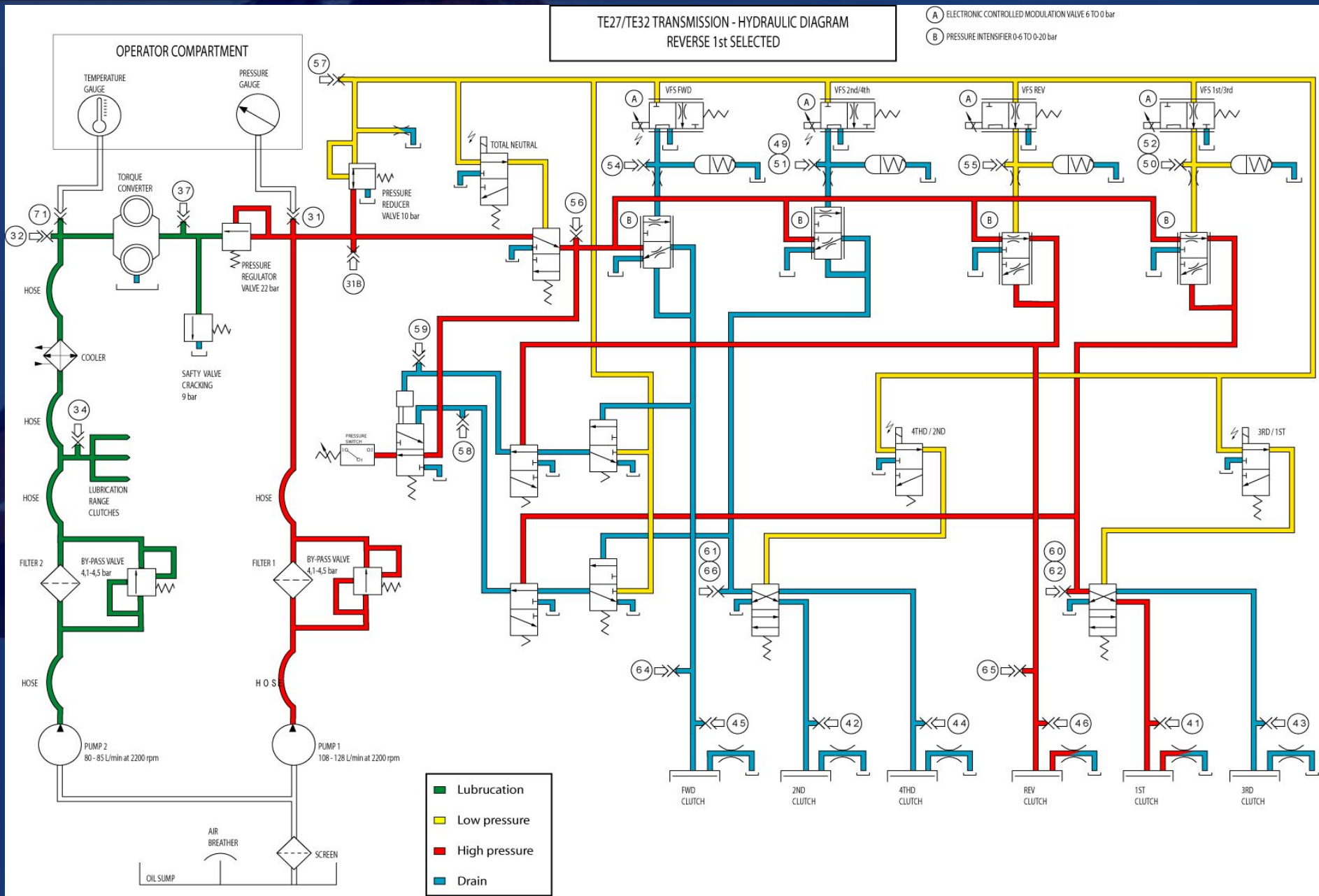


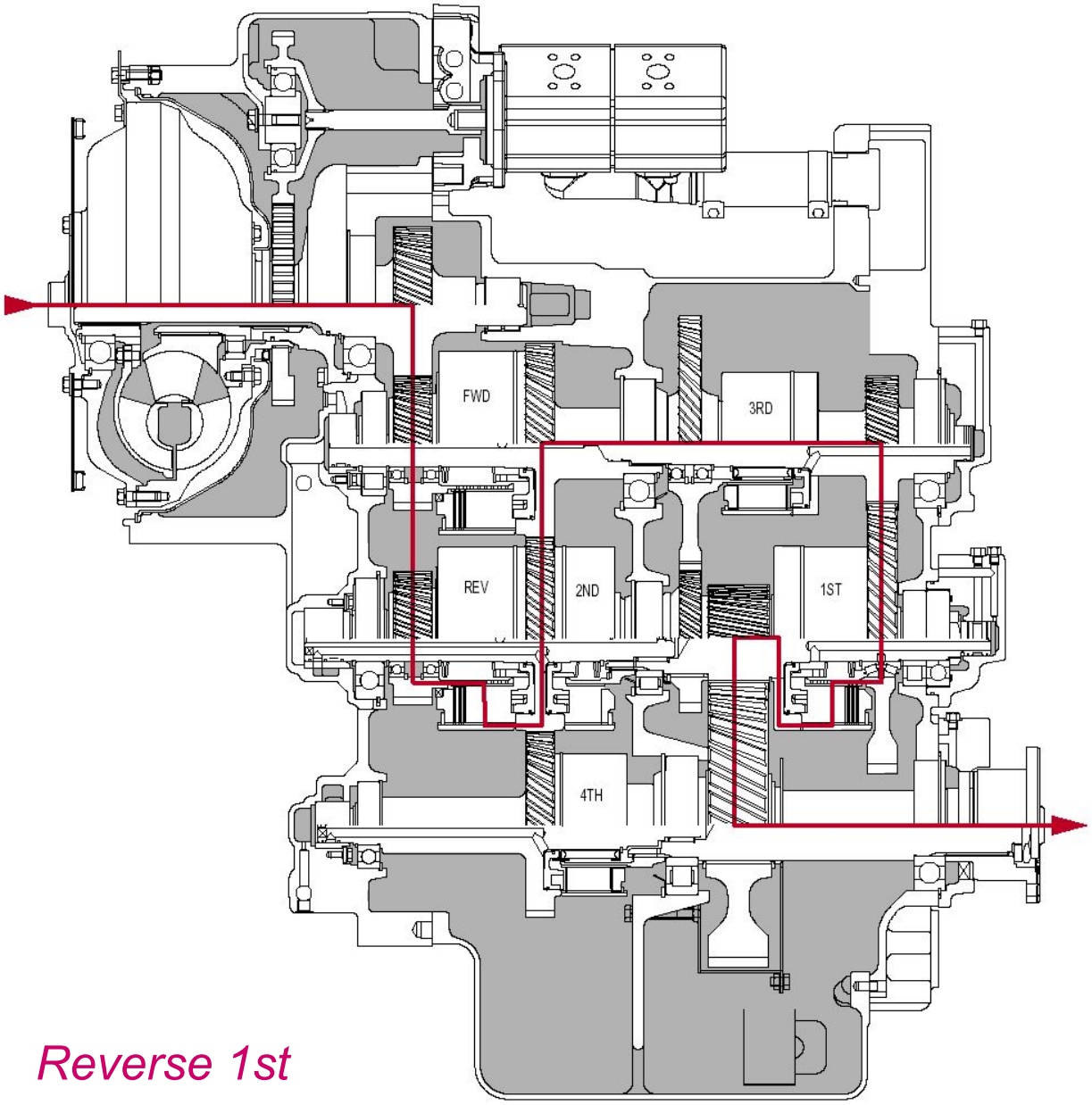
Forward 3rd


TE27/TE32 TRANSMISSION - HYDRAULIC DIAGRAM
FORWARD 4th SELECTED
A ELECTRONIC CONTROLLED MODULATION VALVE 6 TO 0 bar
B PRESSURE INTENSIFIER 0-6 TO 0-20 bar
OPERATOR COMPARTMENT
TEMPERATURE GAUGE
PRESSURE GAUGE
TORQUE CONVERTER
PRESSURE REGULATOR VALVE 22 bar
PRESSURE REDUCER VALVE 10 bar
TOTAL NEUTRAL
SAFTY VALVE CRACKING 9 bar
COOLER
LUBRICATION RANGE CLUTCHES
BY-PASS VALVE 4,1-4,5 bar
BY-PASS VALVE 4,1-4,5 bar
FILTER 2
FILTER 1
HOSE
PUMP 2 80 - 85 L/min at 2200 rpm
PUMP 1 108 - 128 L/min at 2200 rpm
AIR BREATHER
SCREEN
OIL SUMP
PRESSURE SWITCH
VFS FWD
VFS 2nd/4th
VFS REV
VFS 1st/3rd
4THD / 2ND
3RD / 1ST
FWD CLUTCH
2ND CLUTCH
4THD CLUTCH
REV CLUTCH
1ST CLUTCH
3RD CLUTCH
Lubrucation
Low pressure
High pressure
Drain



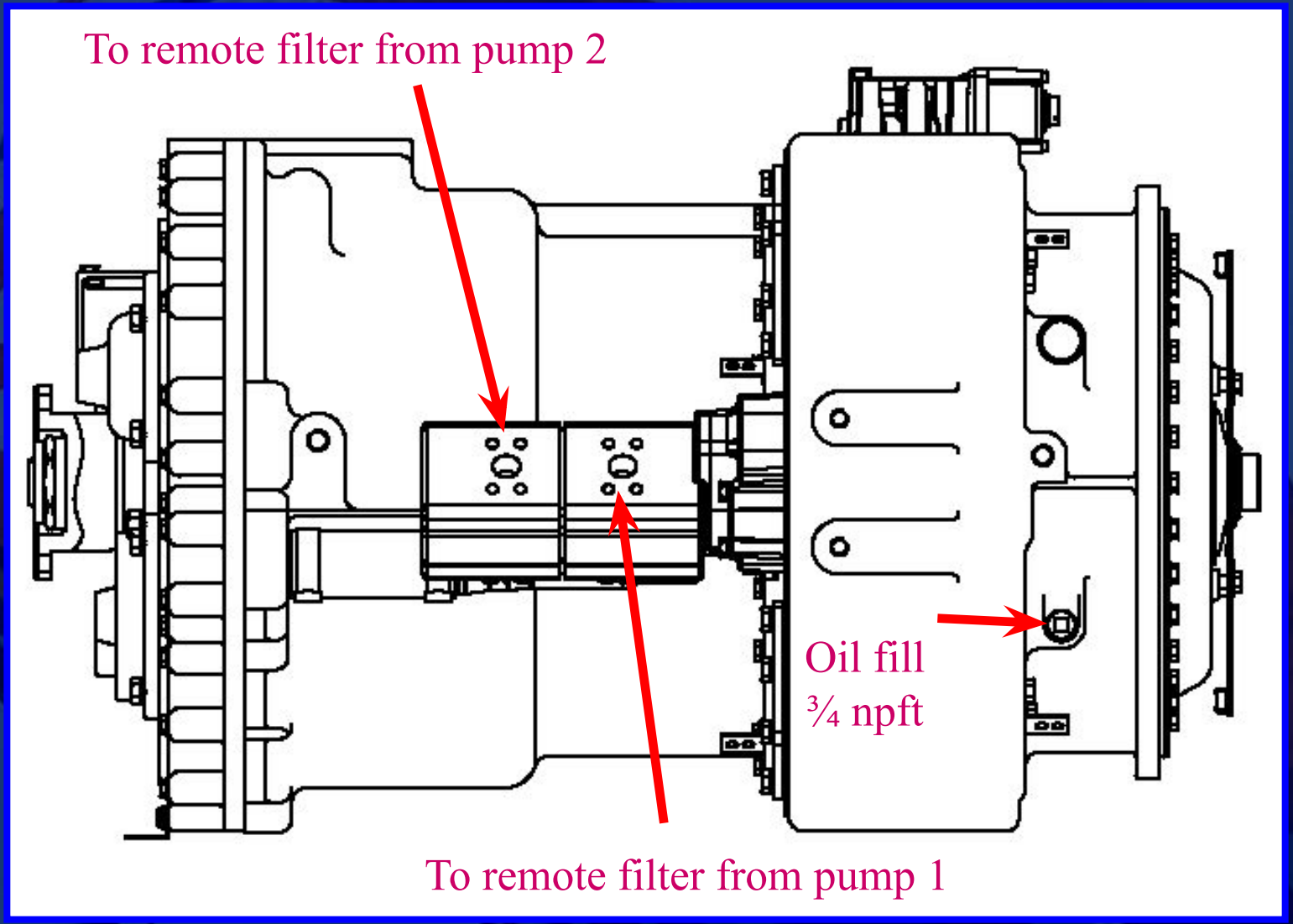
Forward 4th


TE27/TE32 TRANSMISSION - HYDRAULIC DIAGRAM
REVERSE 1st SELECTED
A ELECTRONIC CONTROLLED MODULATION VALVE 6 TO 0 bar
B PRESSURE INTENSIFIER 0-6 TO 0-20 bar
OPERATOR COMPARTMENT
TEMPERATURE GAUGE
PRESSURE GAUGE
TORQUE CONVERTER
PRESSURE REDUCER VALVE 10 bar
TOTAL NEUTRAL
PRESSURE REGULATOR VALVE 22 bar
SAFTY VALVE CRACKING 9 bar
COOLER
LUBRICATION RANGE CLUTCHES
BY-PASS VALVE 4,1-4,5 bar
FILTER 2
FILTER 1
HOSE
PUMP 2 80 - 85 L/min at 2200 rpm
PUMP 1 108 - 128 L/min at 2200 rpm
AIR BREATHER
SCREEN
OIL SUMP
VFS FWD
VFS 2nd/4th
VFS REV
VFS 1st/3rd
4THD / 2ND
3RD / 1ST
FWD CLUTCH
2ND CLUTCH
4THD CLUTCH
REV CLUTCH
1ST CLUTCH
3RD CLUTCH
Lubrucation
Low pressure
High pressure
Drain

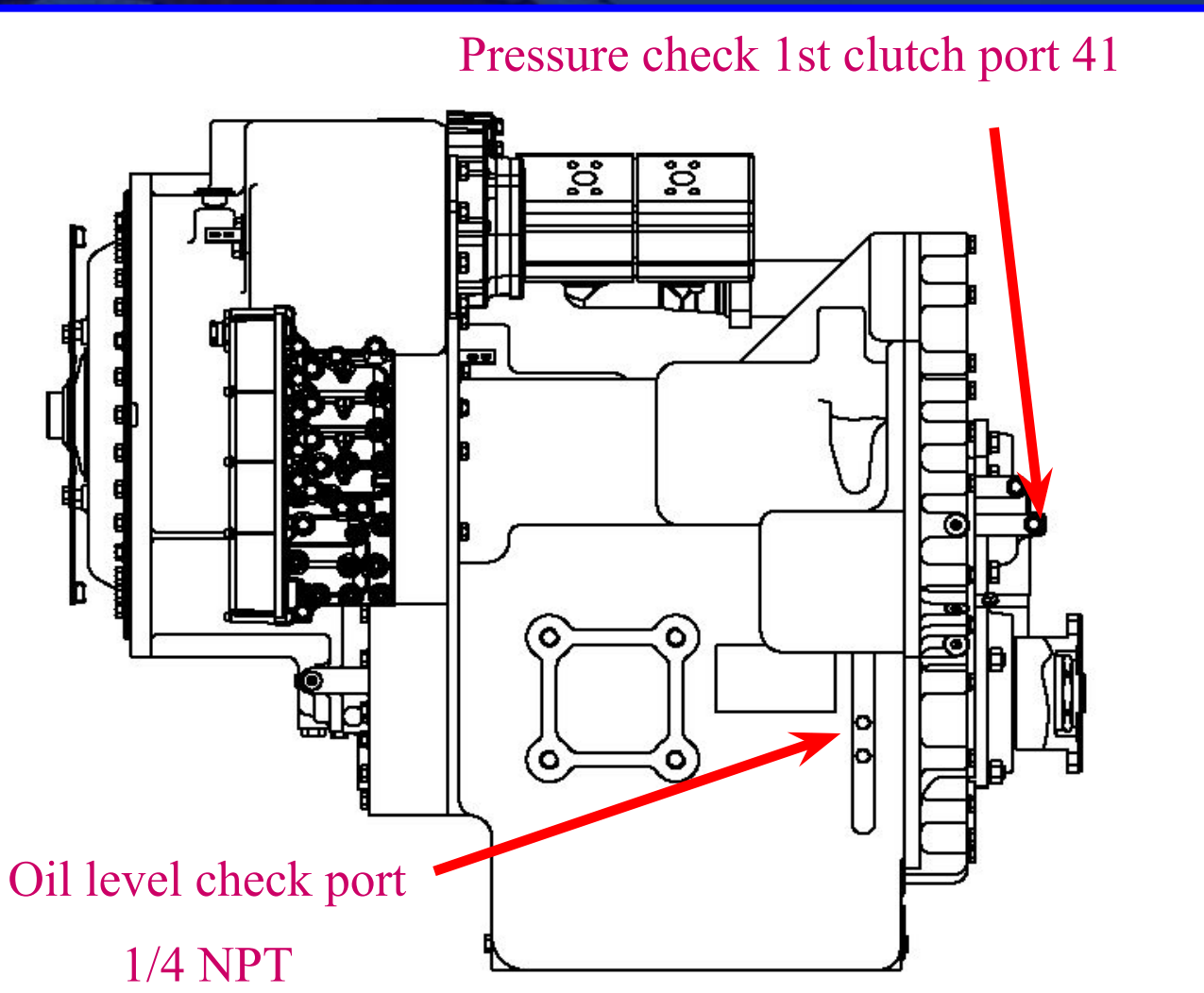


Reverse 1st

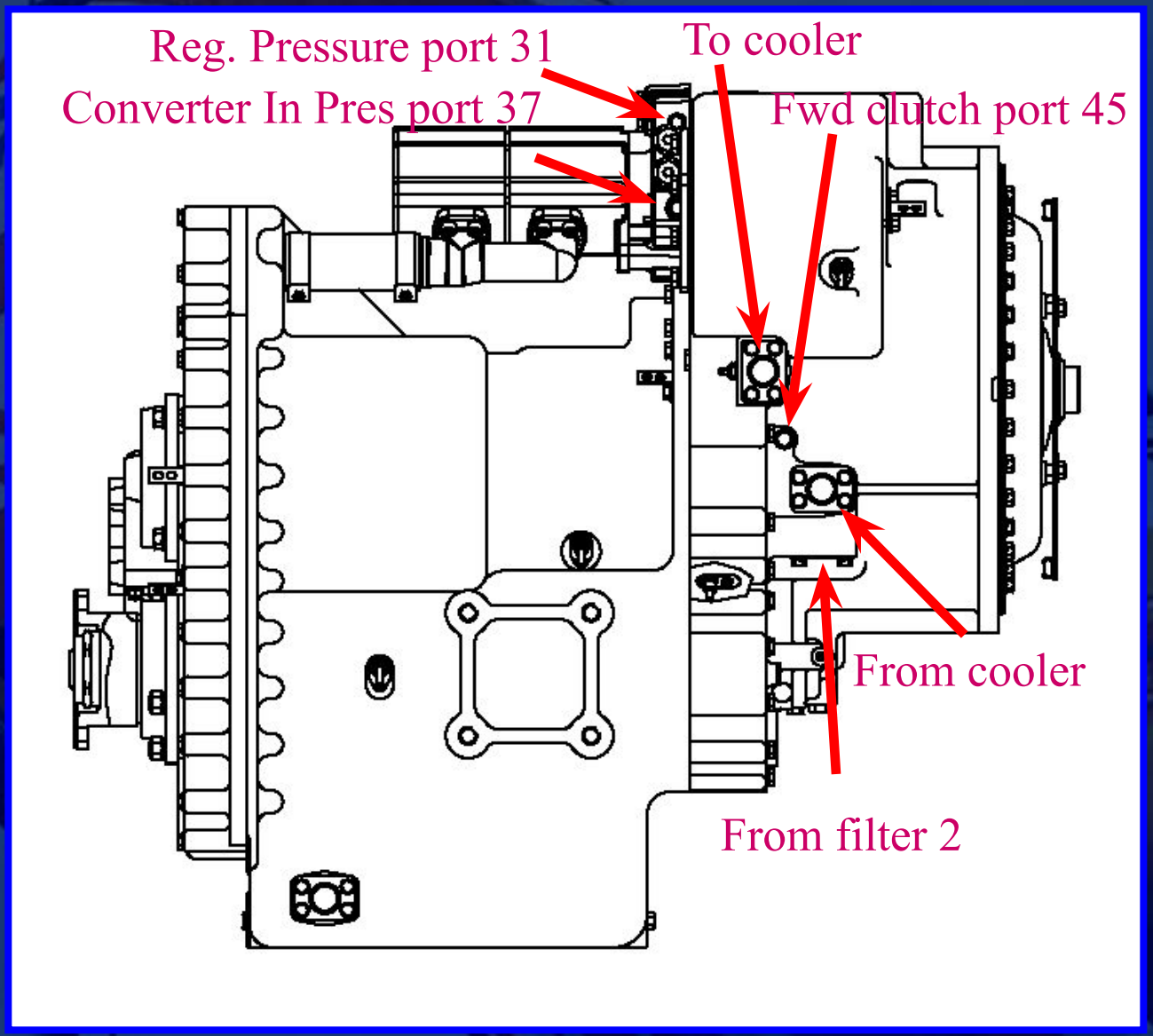
Connections - top view



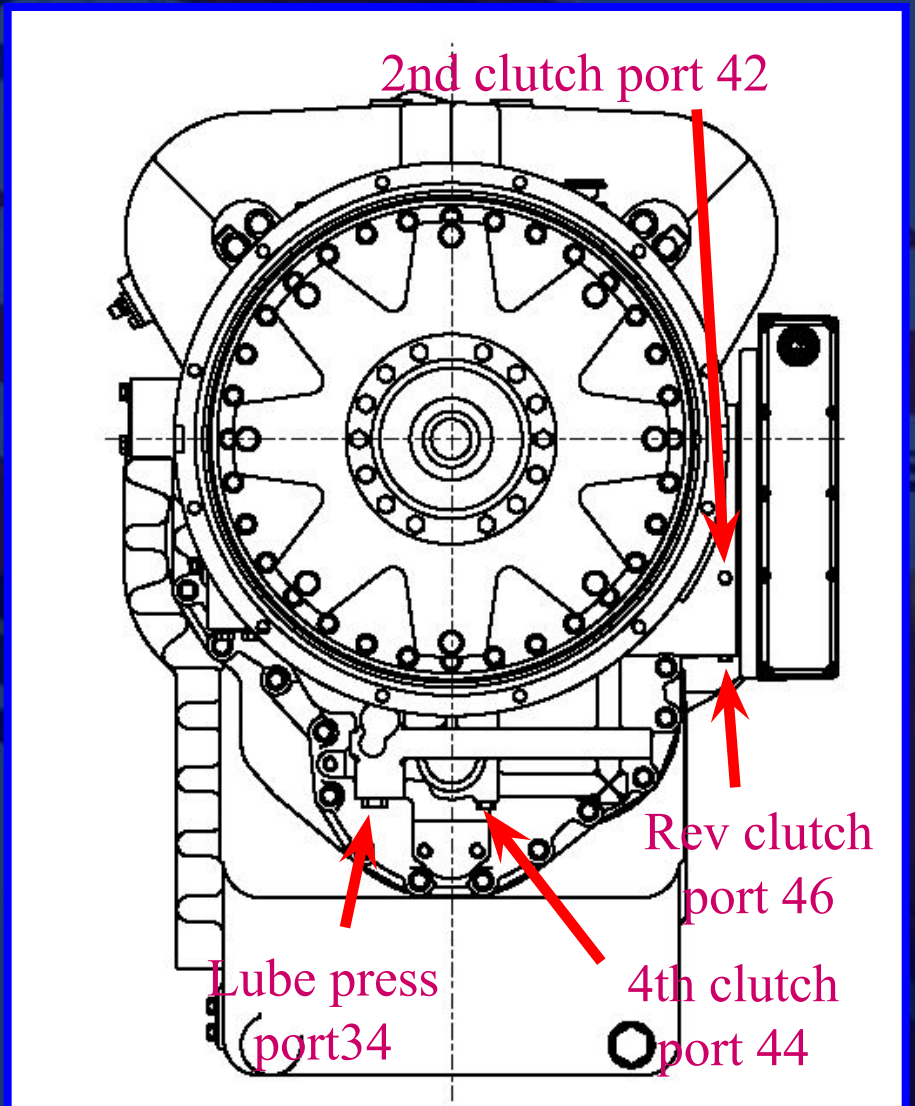
Checkports - left view



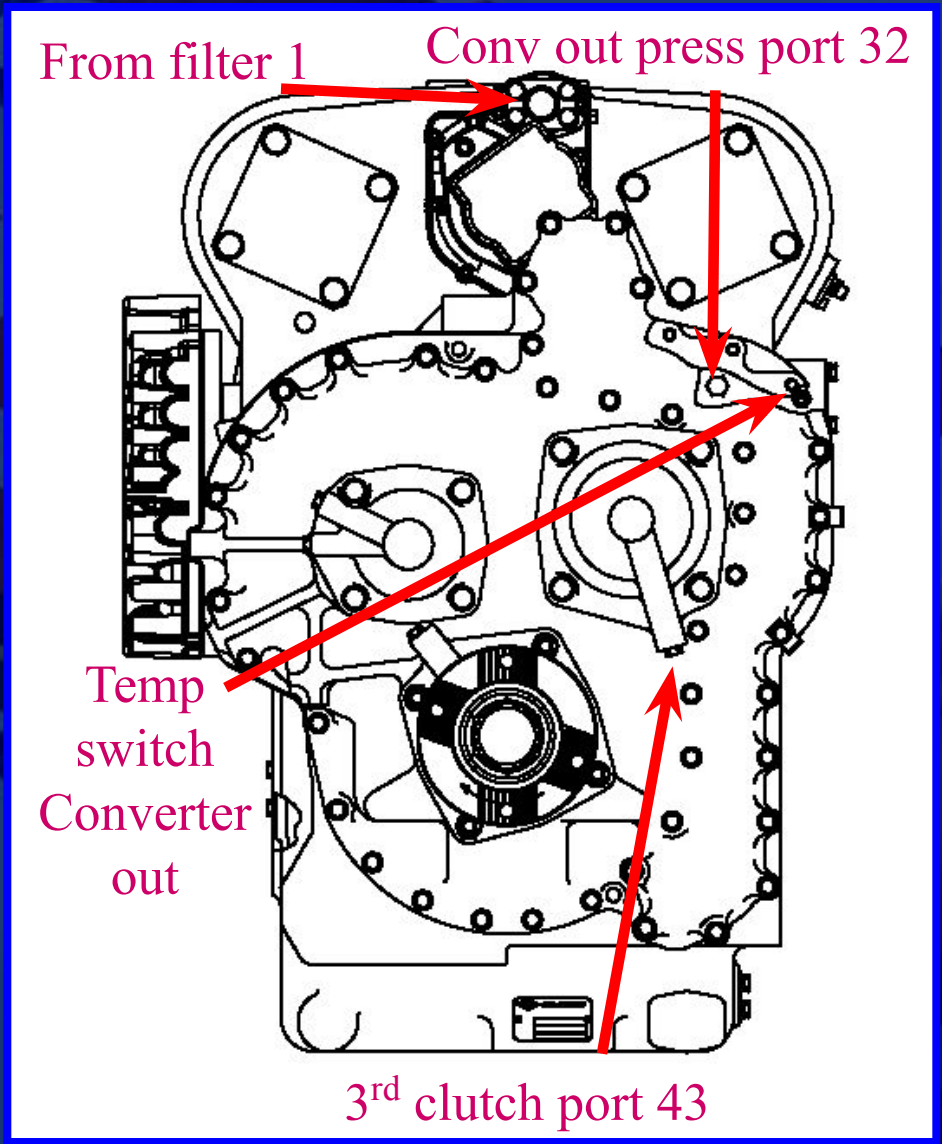
Checkports - right view



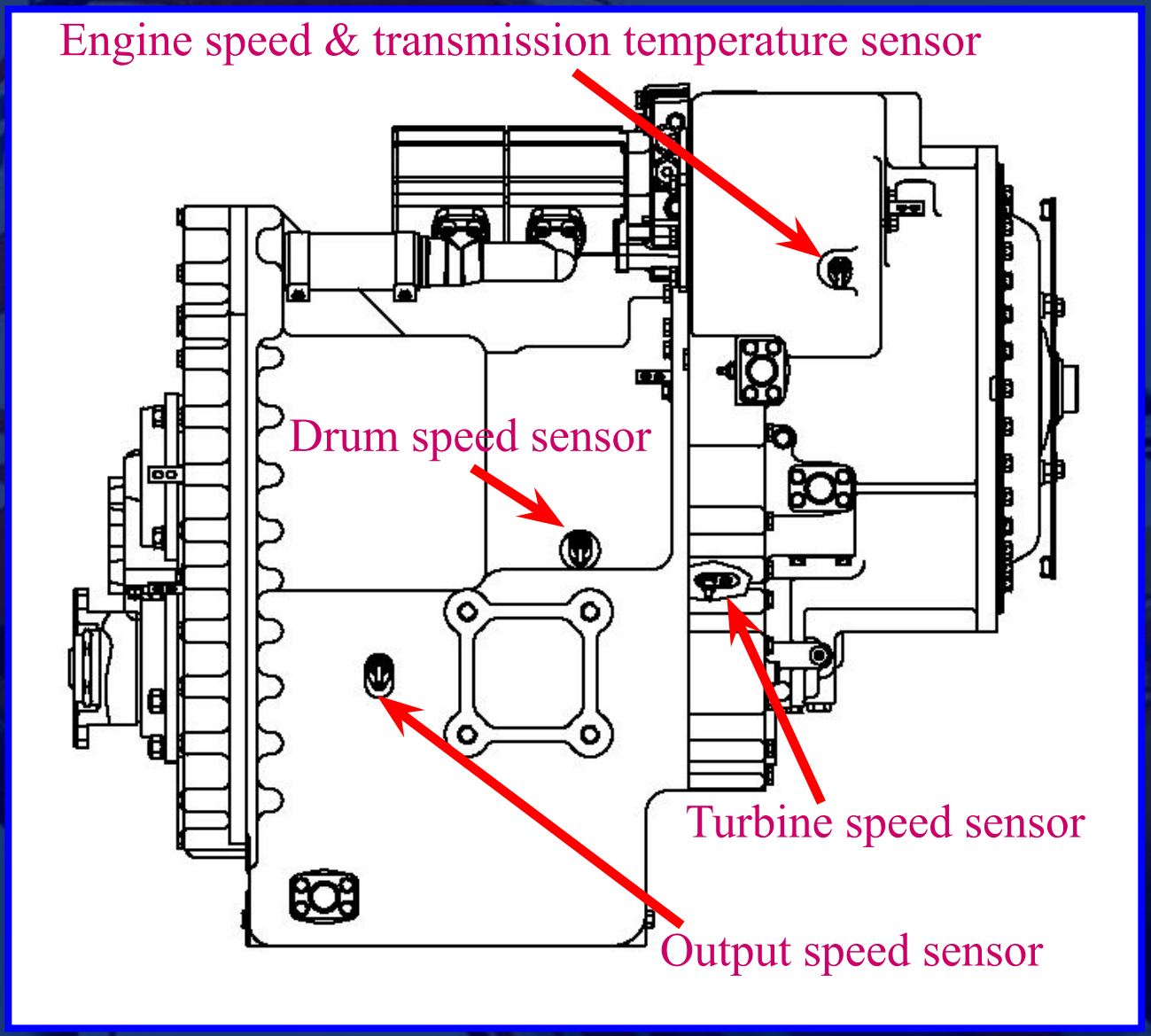
Checkports - front view



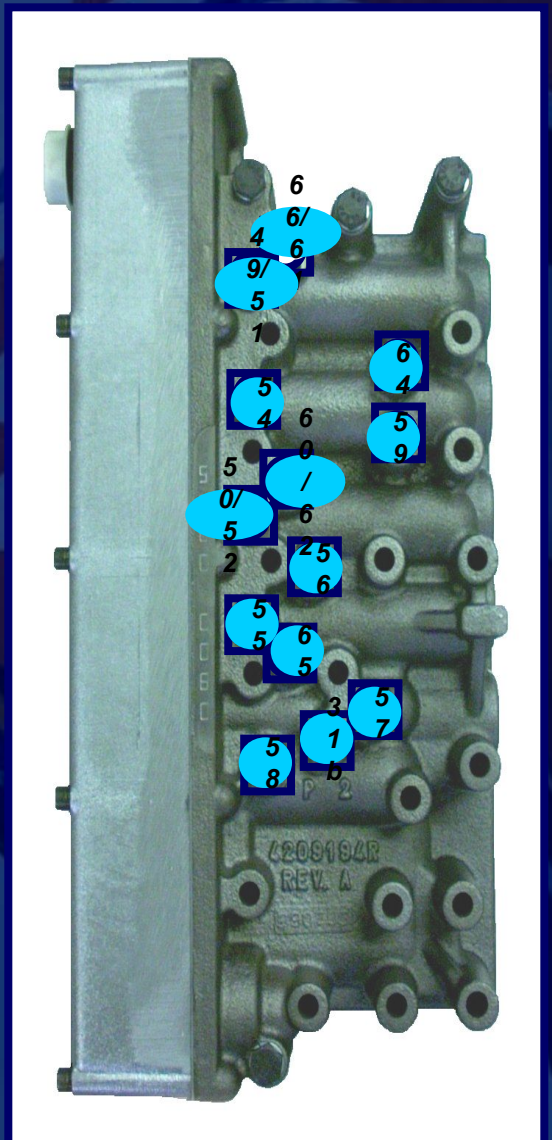
Checkports - rear view



Speed sensor location



Checkports control valve



Checkport	4/4 SPEED (TE32)
31b	Regulator pressure (before total neutral)
49/51	VFS 4th/2nd
50/52	VFS 3rd /1st
54	VFS FWD
55	VFS REV
56	System pressure (after Total Neutral)
57	Solenoid (pilot)pressure
58	Press check range clutches
59	Press check direction clutches
66/61	Pressure intensifier 4th/2nd
60/62	Pressure intensifier 1st/3rd
64	Pressure intensifier FWD
65	Pressure intensifier REV

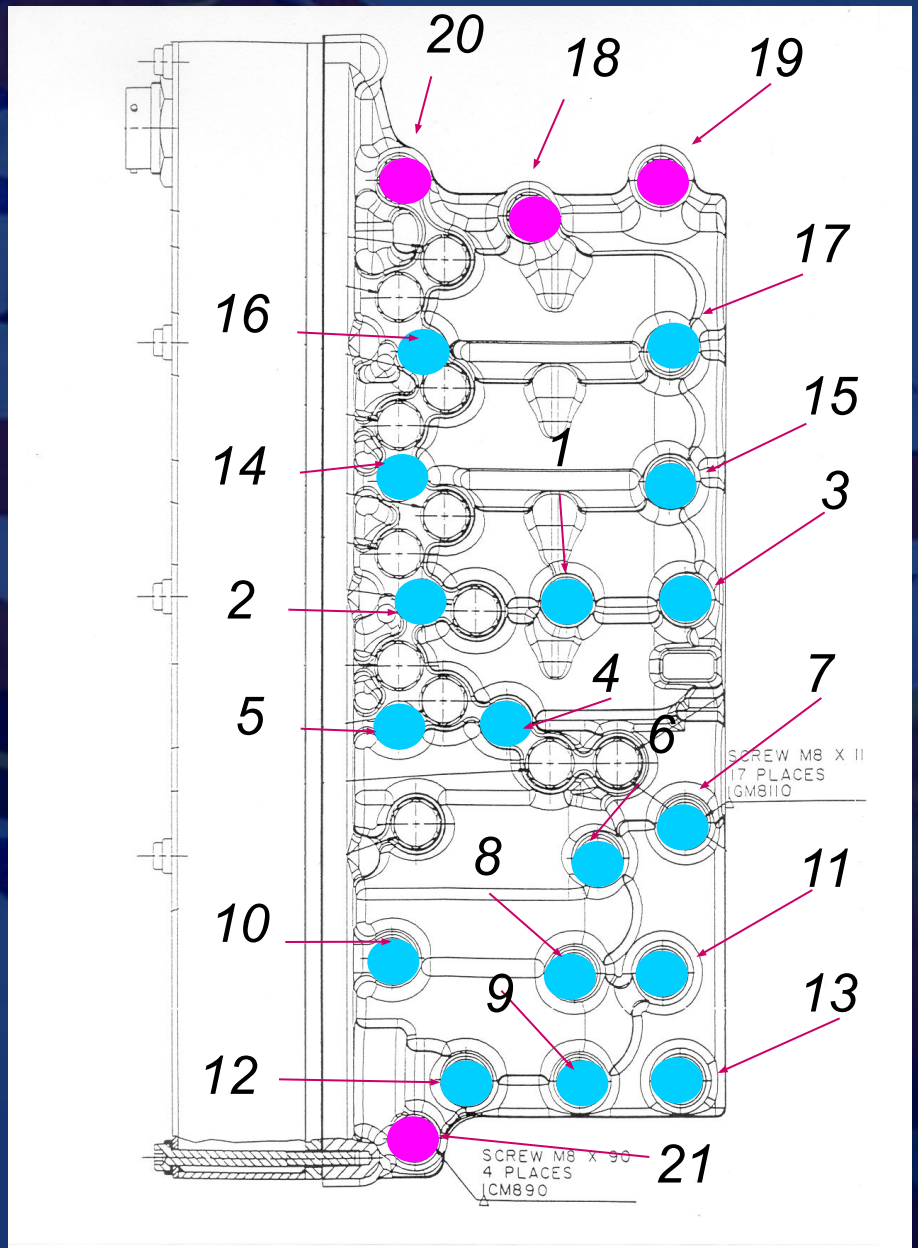
Control valve replacement

Removing the valve

1.Make sure that the area around the valve is clean and that no dirt can fall into the valve during the disassembly procedure.
2.Unscrew the 4 hex bolts (marked pink on drawing) until you feel that the tension is out of the bolt.
Do not remove them!
3.Unscrew the 15 other bolts (marked blue) some turns. When all bolts are loose, you should be able to move the valve a bit.
4.Remove 2 bolts (marked blue)and replace with aligning studs;
5.Remove the remaining bolts (marked blue) and remove valve

Installing the valve

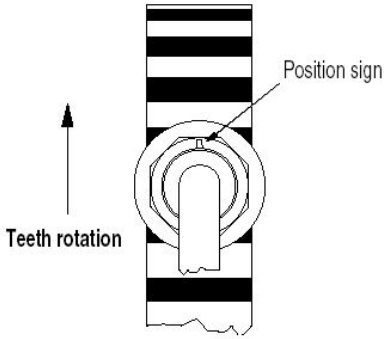
1.Unscrew the 4 hexbolts (marked pink on drawing) untill all tension is out of the bolt.
Do not remove them!
2. Using aligning studs, install valve and a new gasket.
3. Hand tighten all bolts(21) according to the sequence you find on the drawing.
4. Torque all bolts 2X in the same sequence as on the drawing to 25Nm
5. Recalibrate the transmission

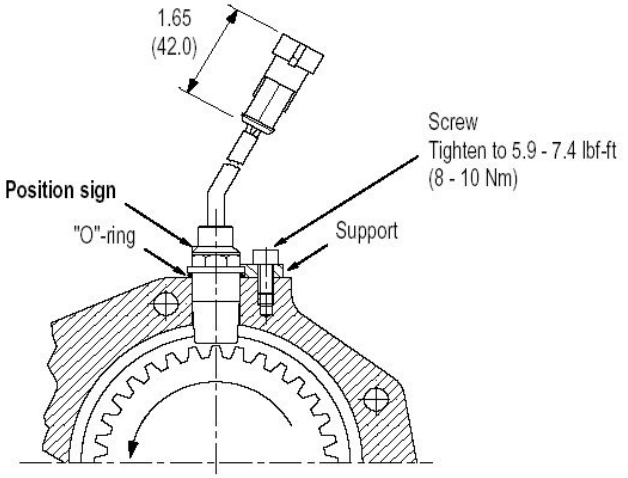

20
18
19
17
16
15
14
1
3
2
4
7
5
6
SCREW M8 X II
17 PLACES
GM8110
8
11
10
9
13
12
21
SCREW M8 X 90
4 PLACES
CM890

Speed sensor installation

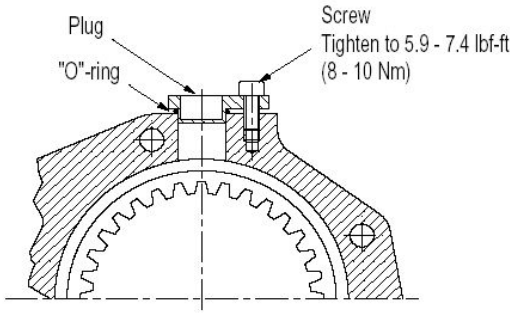
5.4 SPEED SENSOR INSTALLATION

On the sensor body there is a small plastic triangular position sign.
Make sure the position sign on the sensor points as shown below
in the direction of the movement of the gearteeth (Teeth rotation as shown).





Sensor installed

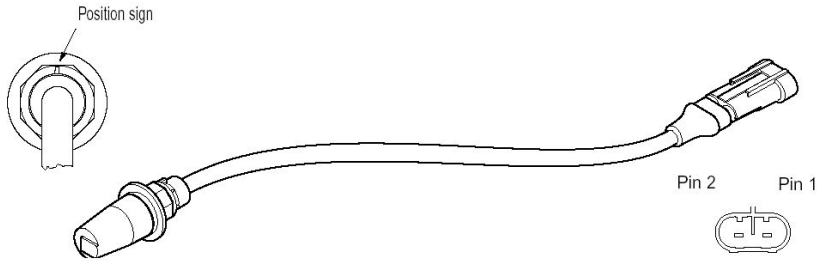


Hole plugged

Sensor position on transmission

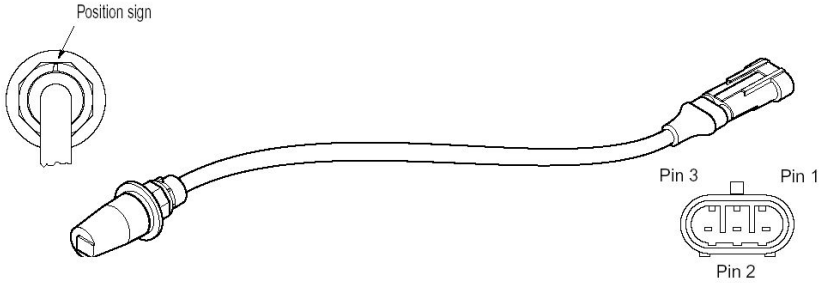
Speed sensor installation

5.4 SPEED SENSOR INSTALLATION (CONTINUED)



The magneto resistive sensor generates a square wave current with a fixed amplitude changing between 7 mA and 14 mA. The sensor has an integrated AMP superseal 2 pin connector. The two pins are numbered 1 and 2. Following table shows the relation between wire colour, pin number and connection.

Colour	Pin Number	Function	Connection
BROWN	1	Current Input	Hot wire
BLUE	2	Current Output	Ground Wire



The magneto resistive sensor generates a square wave current with a fixed amplitude changing between 7 mA and 14 mA. The sensor has an integrated AMP superseal 2 pin connector. The two pins are numbered 1 and 2. Following table shows the relation between wire colour, pin number and connection.

Colour	Pin Number	Function	Connection
RED	1	Current Input	Hot Wire
BLUE	2	Current Output	Ground Wire
GREEN	3	Temp. Input	Hot Wire

NOTE:

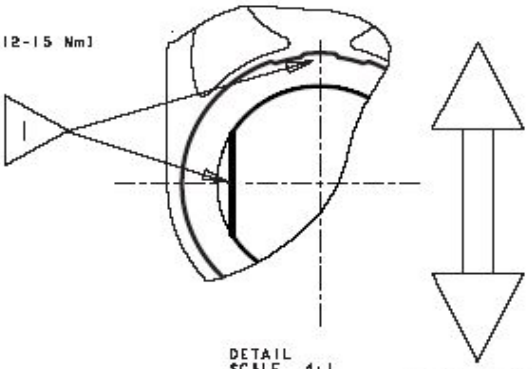
THE SENSOR WIRES HAVE A POLARITY.
BE SURE TO CORRECTLY OBSERVE SENSOR POLARITIES, AS WRONG CONNECTIONS WILL DEACTIVATE THE SENSOR.

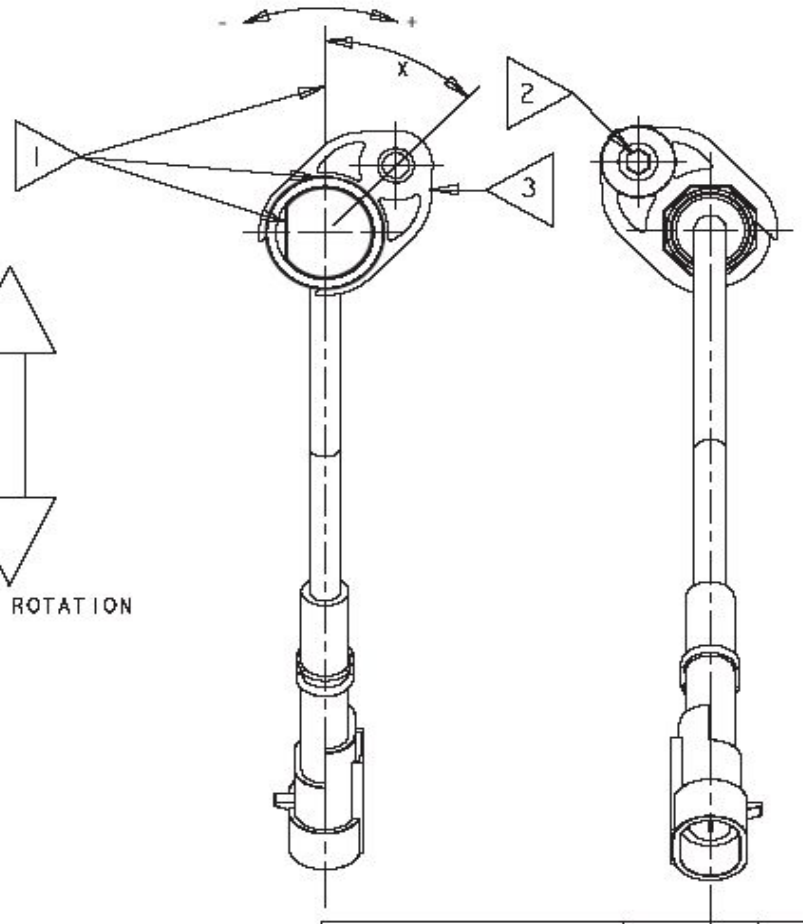
Speed sensor installation

1 INSTALL SENSOR WITH POSITION SIGN POINTING IN THE DIRECTION OF GEAR TEETH MOVEMENT OR 180° ROTATED

2 TORQUE SCREW : 8-11 lbs.ft (12-15 Nm)

3 INSTALL CLIP UNDER ANGLE X (SEE TABLE)





TRANSMISSION MODEL	ASSY PARTNR	CONNECTOR	TYPE	X POSITION
TE10	4209752	AMP 2 PINS	DRUM SPEED TURBINE SPEED OUTPUT SPEED	0 DEGREES 0 DEGREES 0 DEGREES
	4209784	AMP 3 PINS	ENGINE SPEED/ TEMPERATURE	0 DEGREES
TE13/17	4209831	DEUTZ 2 PINS	DRUM SPEED OUTPUT SPEED	-45 DEGREES -45 DEGREES
	4209832	DEUTZ 2 PINS	TURBINE SPEED	-45 DEGREES
	4209833	DEUTZ 3 PINS	ENGINE SPEED/ TEMPERATURE	-135 DEGREES
TE27/32	4209784	AMP 3 PINS	ENGINE SPEED/ TEMPERATURE	0 DEGREES
	4209752	AMP 2 PINS	DRUM SPEED	0 DEGREES
	4209750	AMP 2 PINS	OUTPUT SPEED	0 DEGREES
	4209751	AMP 2 PINS	TURBINE SPEED	-90 DEGREES

ASSY-SPEED SENSOR
INSTALLATION INSTRUCTIONS

APC200 CONTROLLER

Overview

- Link with the transmission
- APC200
- APC200 display modes
- APC200 diagnostics
- System calibration

Transmission Input signals

- Speed sensors
  - Engine speed
  - Turbine speed
  - Drum speed
  - Output speed
- Pressure feedback switch
- Sump temperature sensor
- Converter out temperature switch

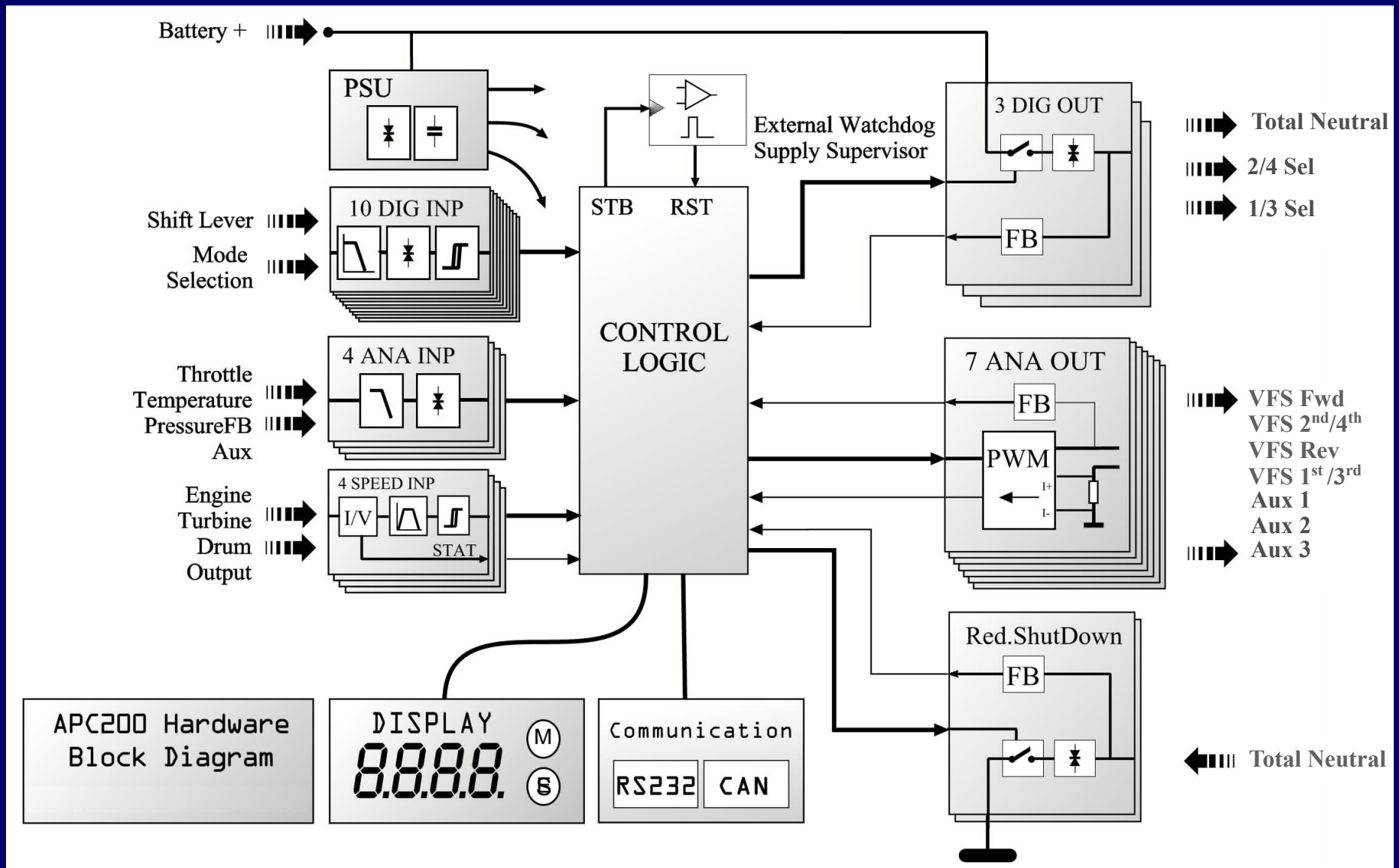
Control valve

- Proportional solenoids (VFS = “Variable Force Solenoid”)
  - VFS0 for forward
  - VFS1 for 2nd/4th (if used)
  - VFS2 for reverse
  - VFS3 for 1st / 3rd
- Pressure reducer
- Pressure intensifiers for each VFS (“boosters”)
- Selector solenoid 1st/3rd
- Selector solenoid 2nd/4th(if used)
- Total neutral solenoid

APC 200

- Device for shifting Spicer Off Highway Products ECM powershift transmissions (TE transmissions)
- ECM -> Electronic Controlled Modulation
  - a transmission control technology, available on a range of transmission models
- ECI -> Electronic Controlled Inching
  - to run at very low controlled speed at virtually any engine speed
- Overlap control
- Self diagnostics
- Throttle by Wire – engine control
- CAN Network Integration

Block diagram APC 200



Block diagram APC 200 : inputs

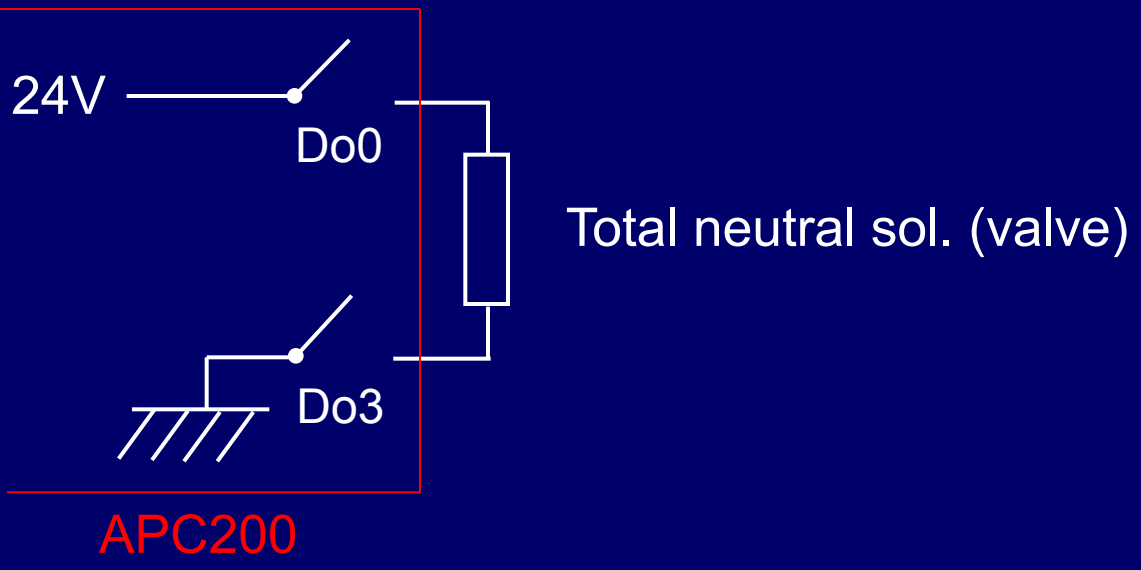
- 10 digital inputs
- 6 (7) analogue inputs
  - Ani0 Pressure feedback switch (resistance)
  - Ani1 Sump temperature (resistance)
  - Ani2 Converter out temperature switch (voltage)
  - Ani3 Aux f.ex. brake pedal (voltage)
  - (Ani4 Aux1 of anal. outputs (-pin) (reference voltage 5V))
  - Ani5 Aux2 of anal. outputs (-pin) f.ex. servo feedback (voltage)
  - Ani6 Aux3 of anal. outputs (-pin) f.ex. throttle pedal (voltage)
  - ⇒ input 0 to 2 have a fixed use
  - ⇒ input 3, 5 and 6 can be linked to external devices
- 4 speed inputs

Block diagram APC 200 : outputs (1/3)

- 4 digital outputs
  - Do0 RSP Drive Solenoid +
  - Do1
    - 2nd/4th selector (VFS1 is used for 2nd & 4th) on 4-speed
    - can be used for warning lamp on 3-speed transm. (Kalmar)
  - Do2 1st/3rd selector (VFS3 is used for 1st & 3rd)
  - Do3 RSP Drive Solenoid -

Block diagram APC 200 : outputs (2/3)

- Do0 and Do3 : RSP Drive Solenoid = “Total neutral” solenoid
- RSP = Redundant ShutDown Path
- ⇒ need of a fully reliable device to cut off pressure of all clutches in case of important failures (shutdown)
- Scheme :



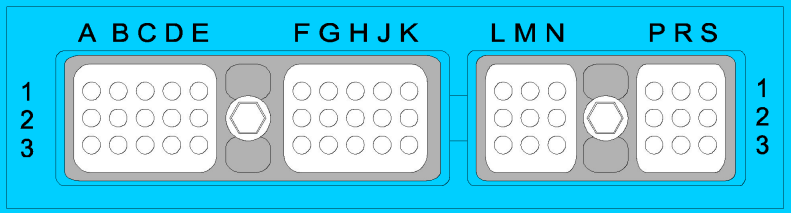
Block diagram APC 200 : outputs (3/3)

- 7 analogue outputs
  - Closed loop current regulation for the VFS's :
    - VFS0 (fwd)
    - VFS1 (2nd/4th)
    - VFS2 (rev)
    - VFS3 (1st/3rd)
  - Aux1 to Aux3 : open loop current regulation
    - VFS4+ (servomotor engine control A)
    - VFS5+ (servomotor engine control B)
    - VFS6+ (analogue brake valve)
  - Remark servomotor : hardware version with H-bridge requested

Block diagram APC 200 : example

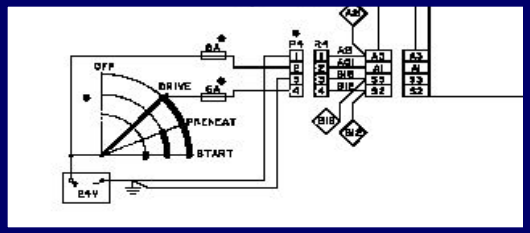
WIRE		PIN	FUNC	TYPE	DESCRIPTION 3/3 & 4/4 SPEED
A01	***A1***	***A1***	***PPWR***	***Pwr***	***Permanent Battery Plus***
A02	***A2***	B1	VFS0+	Pwm	Fwd VFS Hi Side Out
A03	***A3***	C1	VFS0-	Sns	Fwd VFS Lo Side In
A04	***A4***	D1	VFS1+	Pwm	2nd/4th VFS Hi Side Out
A05	***A5***	E1	VFS1-	Sns	2nd/4th VFS Lo Side In
A06	***A6***	F1	VFS2+	Pwm	Rev VFS Hi Side Out
A07	***A7***	G1	VFS2-	Sns	Rev VFS Lo Side In
A08	***A8***	H1	VFS3+	Pwm	1th/3th VFS Hi Side Out
A09	***A9***	J1	VFS3-	Sns	1th/3th VFS Lo Side In
A10	***A10***	K1	DO0	Stp	RSP Drive Solenoid +
A11	***A11***	A2	ANI0	Ptg	Pressure feedback
A12	***A12***	B2	DIGIN0	Ptp	Shiftlever 1-2
A13	***A13***	C2	DIGIN1	Ptp	Shiftlever 2-3
A14	***A14***	D2	DIGIN2	Ptp	Shiftlever 3-4
A15	***A15***	E2	DO1	Stp	2/4 VFS selector or alarm output
A16	***A16***	F2	DO2	Stp	1/3 VFS selector
A17	***A17***	G2	DIGIN3	Ptp	Shiftlever NEU
A18	***A18***	H2	DIGIN4	Ptp	Shiftlever FWD
A19	***A19***	J2	DIGIN5	Ptp	Shiftlever REV
A20	***A20***	K2	DO3	Stg	RSP Drive Solenoid -
A21	***A21***	A3	GND	Gnd	Supply ground
A22	***A22***	B3	SS0	Sns	Drum speed sensor+
A23	***A23***	C3	SS0	Gnd	Drum speed sensor -
A24	***A24***	D3	SS1	Sns	Output speed sensor+
A25	***A25***	E3	SS1	Gnd	Output speed sensor -
A26	***A26***	F3	SS2	Sns	Engine speed sensor+
A27	***A27***	G3	SS2	Gnd	Engine speed sensor -
A28	***A28***	H3	ANI1	Ptg	TransmTemperature
A29	***A29***	J3	ANI2	Ptg	Cooler input temperature
B00	***A30***	K3	GND	Gnd	Signal ground

WIRE		PIN	FUNC	TYPE	DESCRIPTION 3/3 & 4/4 SPEED
B01	***B1***	L1	VFS4+	HbrgA	Engine control motor A
B02	***B2***	M1	ANI4	Sns	5V Reference voltage out
B03	***B3***	N1	VFS5+	HbrgB	Engine servo motor B
B04	***B4***	P1	ANI5	Sns	Engine servo pos. input 0-5V
B05	***B5***	R1	VFS6+	Pwm	Analog brake valve
B06	***B6***	S1	ANI6	Sns	Accelerator pedal analog input 0-5V
B07	***B7***	L2	CANL	Comm	CAN Lo
B08	***B8***	M2	CANH	Comm	CAN Hi
B09	***B9***	N2	RXD	Comm	RS232 RXD
B10	***B10***	P2	TXD	Comm	RS232 TXD / SPEEDO OUT
B11	***B11***	R2	SS3	Sns	Turbine speed sensor+
B12	***B12***	S2	SPWR	Pwr	Switched Battery Plus
B13	***B13***	L3	DIGIN6	Ptp	Inching Enable switch
B14	***B14***	M3	DIGIN7	Ptp	manual / automatic selection
B15	***B15***	N3	DIGIN8	Ptp	Parking Brake OFF/ON
B16	***B16***	P3	DIGIN9	Ptp	
B17	***B17***	R3	ANI3	Ptg	Brake pedal analog input 0-5V
B18	***B18***	S3	SGND	Gnd	Signal Ground



PSU = Power Supply Unit

- Version : 12V or 24V
- Two power lines
  - PPWR : permanent power
    - Connected directly to the battery
  - SPWR : switched power
    - Connected via key contact to the battery



Bootstrap and reset circuit

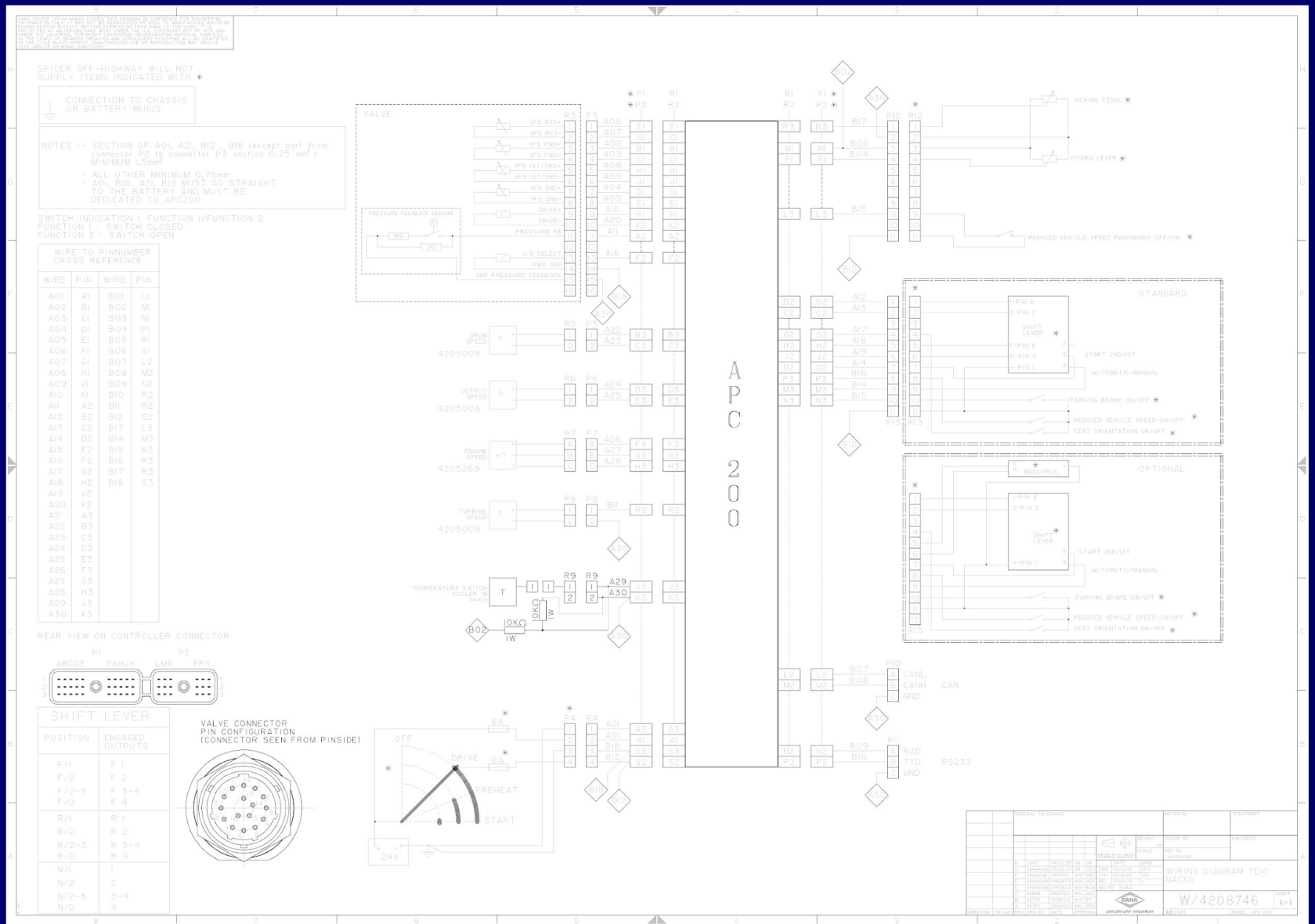
- Bootstrap:
  - Special mode, controller wants to receive serial data, to program the firmware into the program memory
  - While in bootstrap all output functions are hold off
  - Start : during power up both buttons pressed

- Reset circuit : watchdog & supply supervisor will reset the CPU if either the feedback from the watchdog is outside 10% of timing tolerance or if the CPU has “forgotten” to re-trigger the watchdog trigger

Functions

- Manual / automatic shifting
- Electronic modulation
- Overlap control
- Electronic inching
- Start 1st / 2nd
- Limit vehicle speed
- Reduce vehicle speed (by use of an input)
- Limit engine speed
- Direction change protection (speed and engine RPM)
- Declutch (in normal mode : neutral / in inching : offset pressure)
- Engine control
- Seat orientation
- Hydro lever function in neutral

Functions on wiring diagram



Communication

- CAN 2.0 B

  - Communicate with different controllers and PC

- RS 232

  - To flash a new firmware (main program)
  - To download the parameter settings (APT-file)
  - To edit specific parameters (GDE-file)

Parameter setting

1 approved drive-line = 1 APT-file

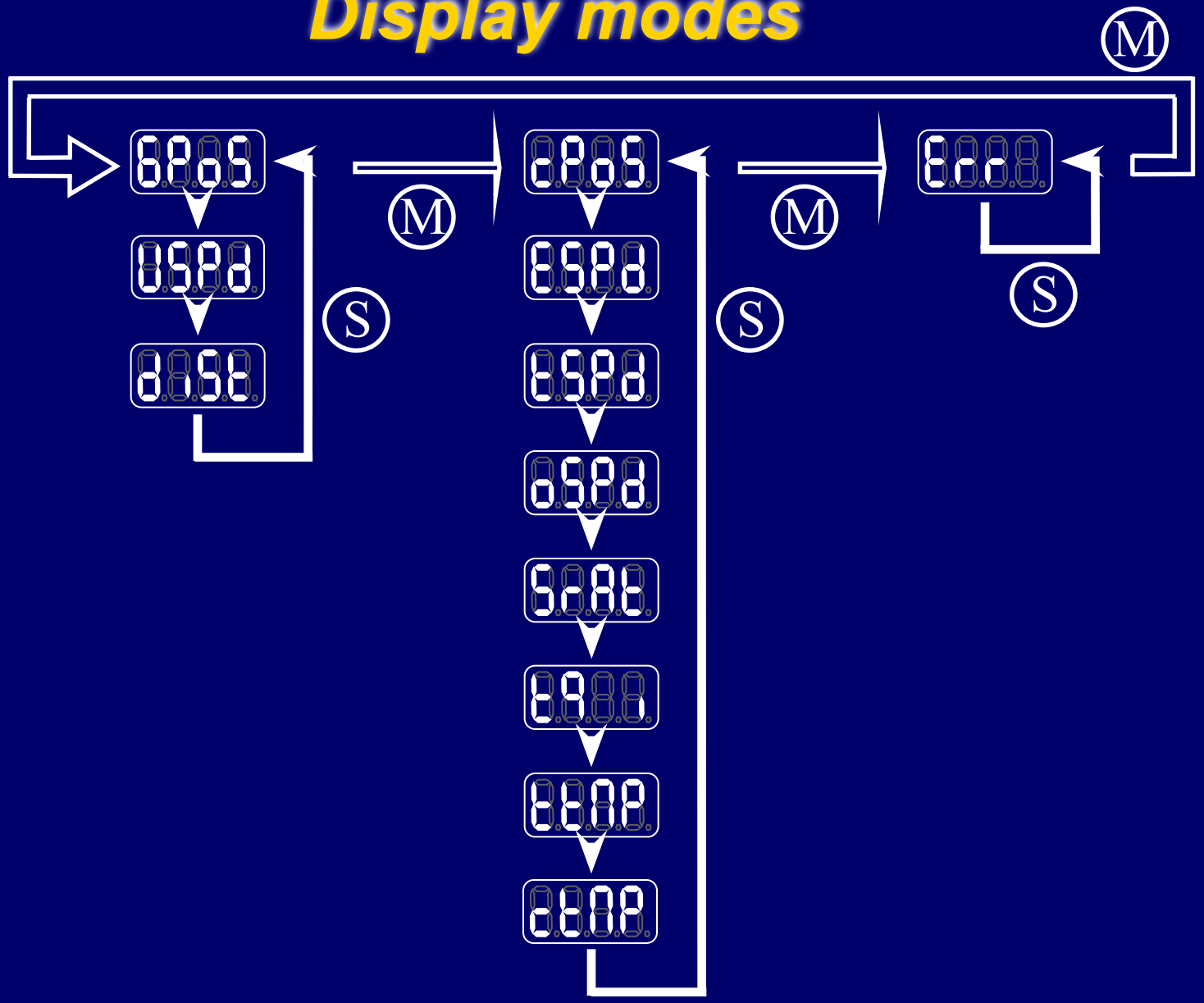
Approved drive-line =

Specific type of vehicle + specific engine + specific transmission (+ axle + tires)

Display

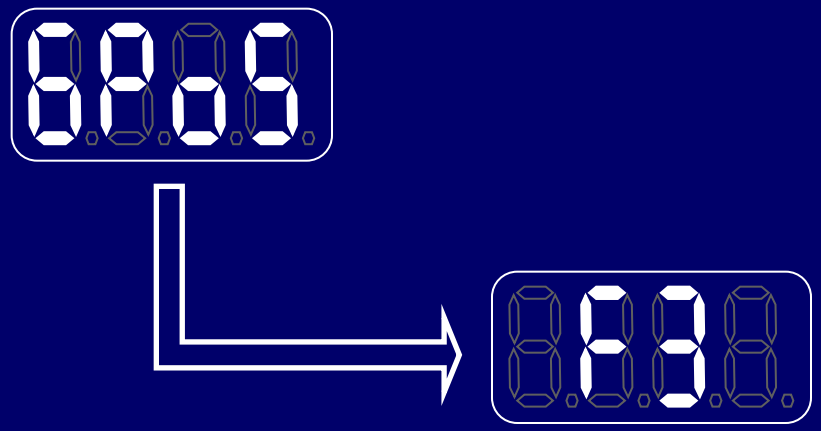
- 4 red 7-segment LED digits
- 3 status LED lamps
  - D -> yellow, test modes
  - E -> yellow, faults
  - F -> red, APC 200 in reset conditions (f.ex. bootstrap)
- 2 push buttons
  - M -> which information group
  - S -> item within group

Display modes



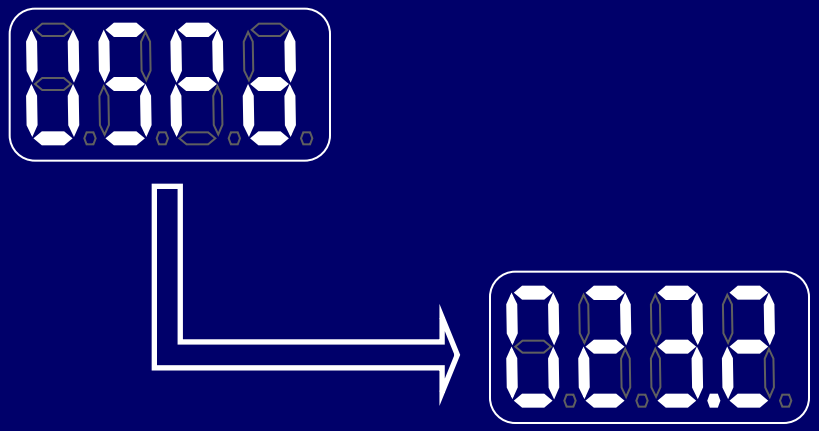
Display modes

- "GPOS" display
  - Reflects the actually engaged transmission direction and range



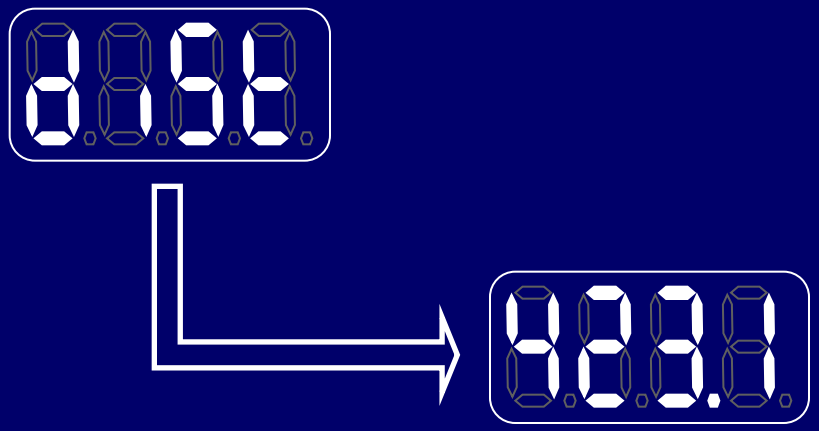
Display modes

- “VSPD” display
  - Shows the vehicle speed in km/h or MPH, with a resolution of 0.1 km/h or 0.1 MPH



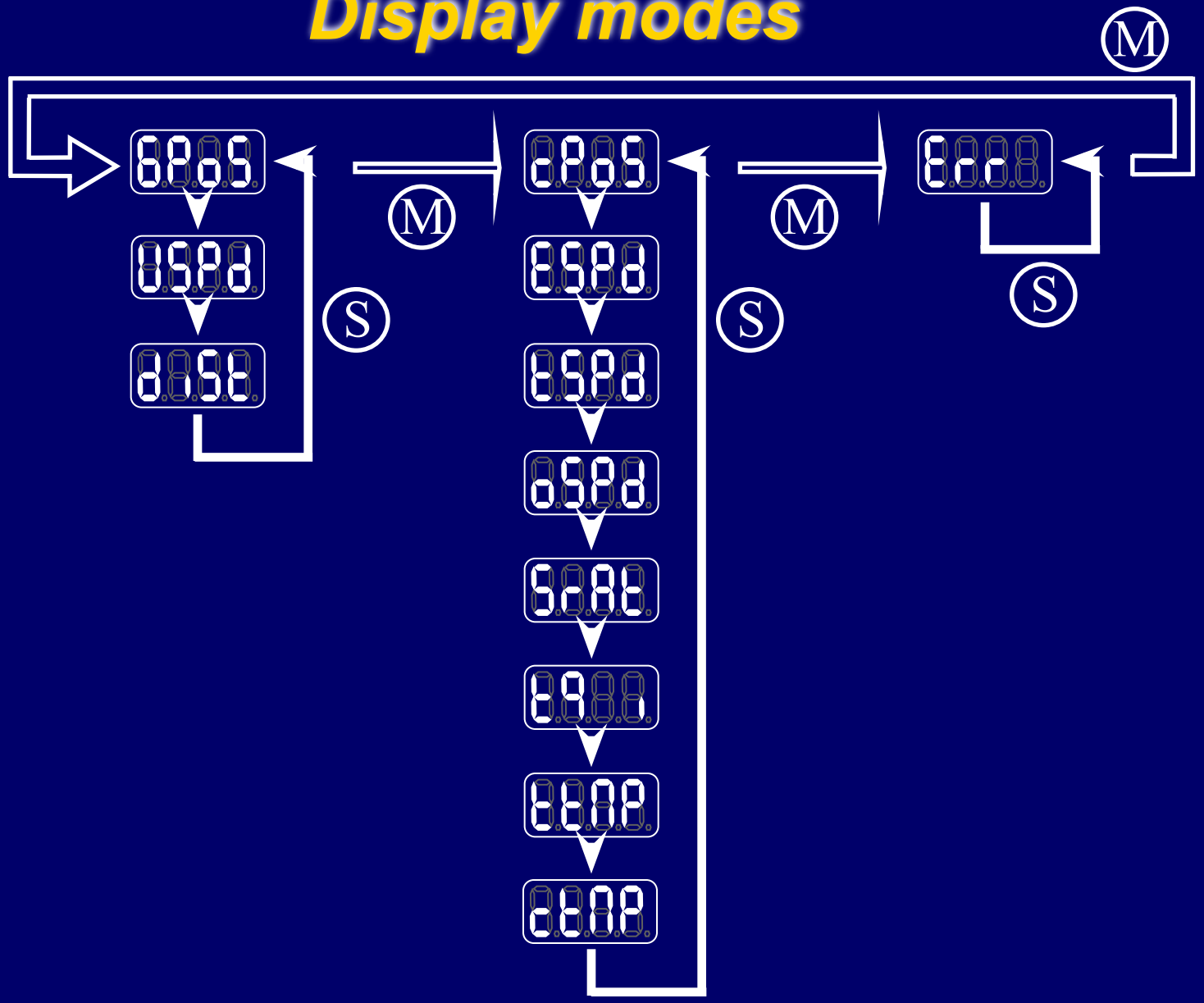
Display modes

- "dist" display
  - Shows the distance travelled in km or miles, with a resolution of 0.1 km or 0.1 miles



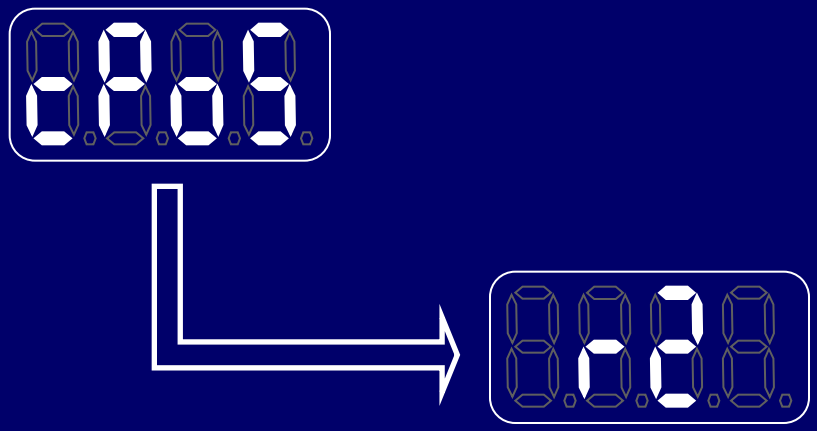
Note : the distance can be reset by pushing the "s" button during 3 seconds when being in this display mode.

Display modes



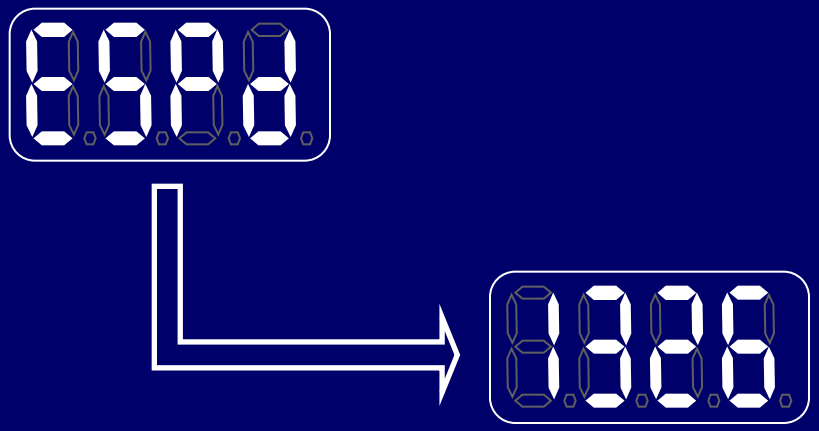
Display modes

- “CPOS” display
  - Reflects the actually shiftlever position



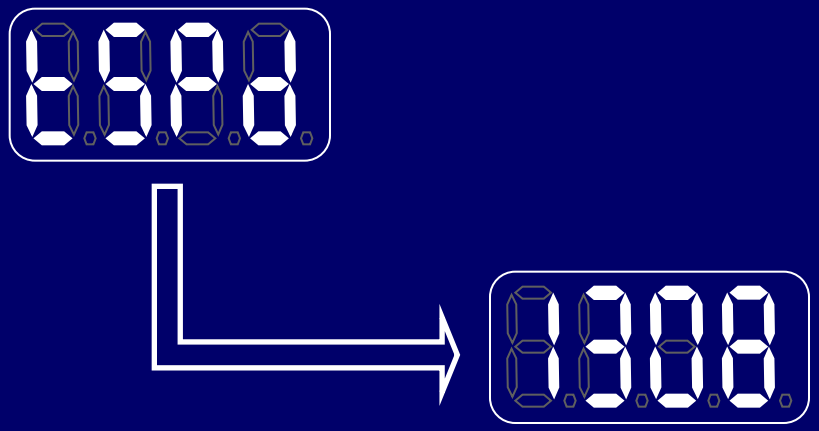
Display modes

- “Espd” display
  - Shows the measured engine speed in RPM



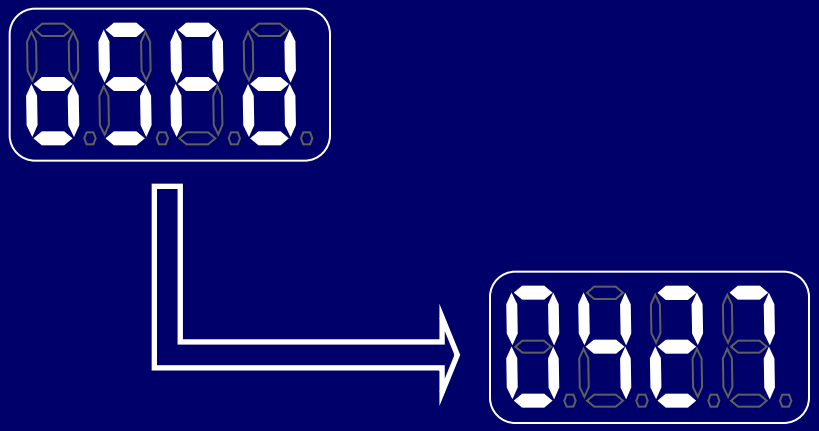
Display modes

- "Tspd" display
  - Shows the measured turbine speed in RPM



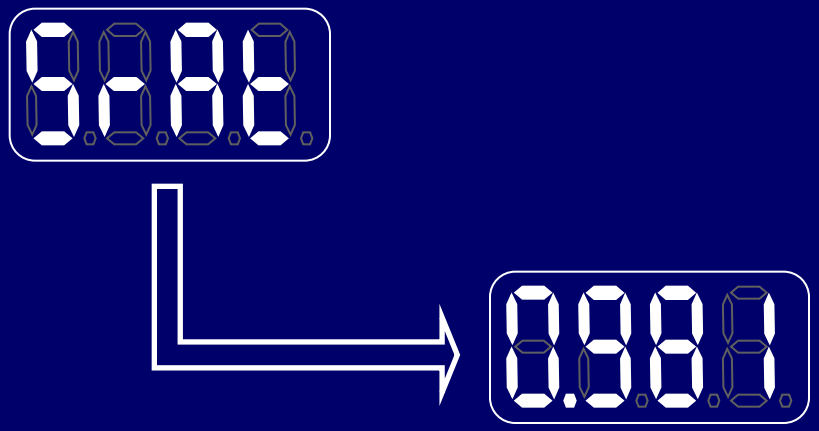
Display modes

- “Ospd” display
  - Shows the measured output speed in RPM



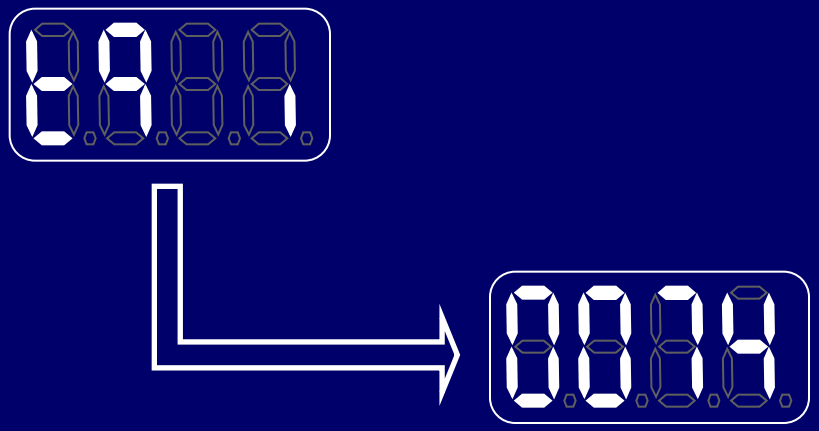
Display modes

- “Srat” display
  - Reflects the current speed ration (Tspd / Espd), which is an important factor in automatic shifting



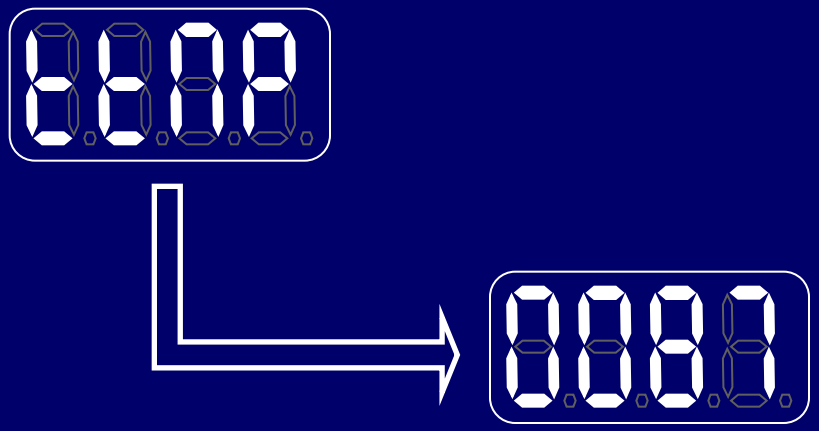
Display modes

- "TQ I" display
  - Reflects the measured torque (turbine torque) at the transmission input side in Nm



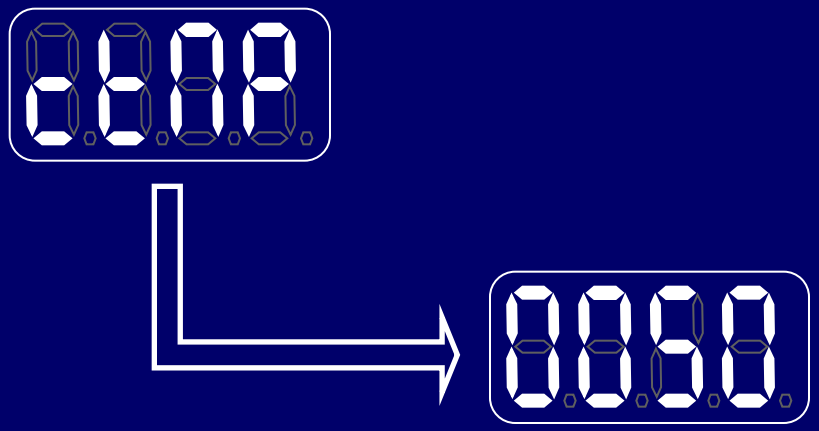
Display modes

- “Ttmp” display
  - Shows the transmission sump temperature in °C



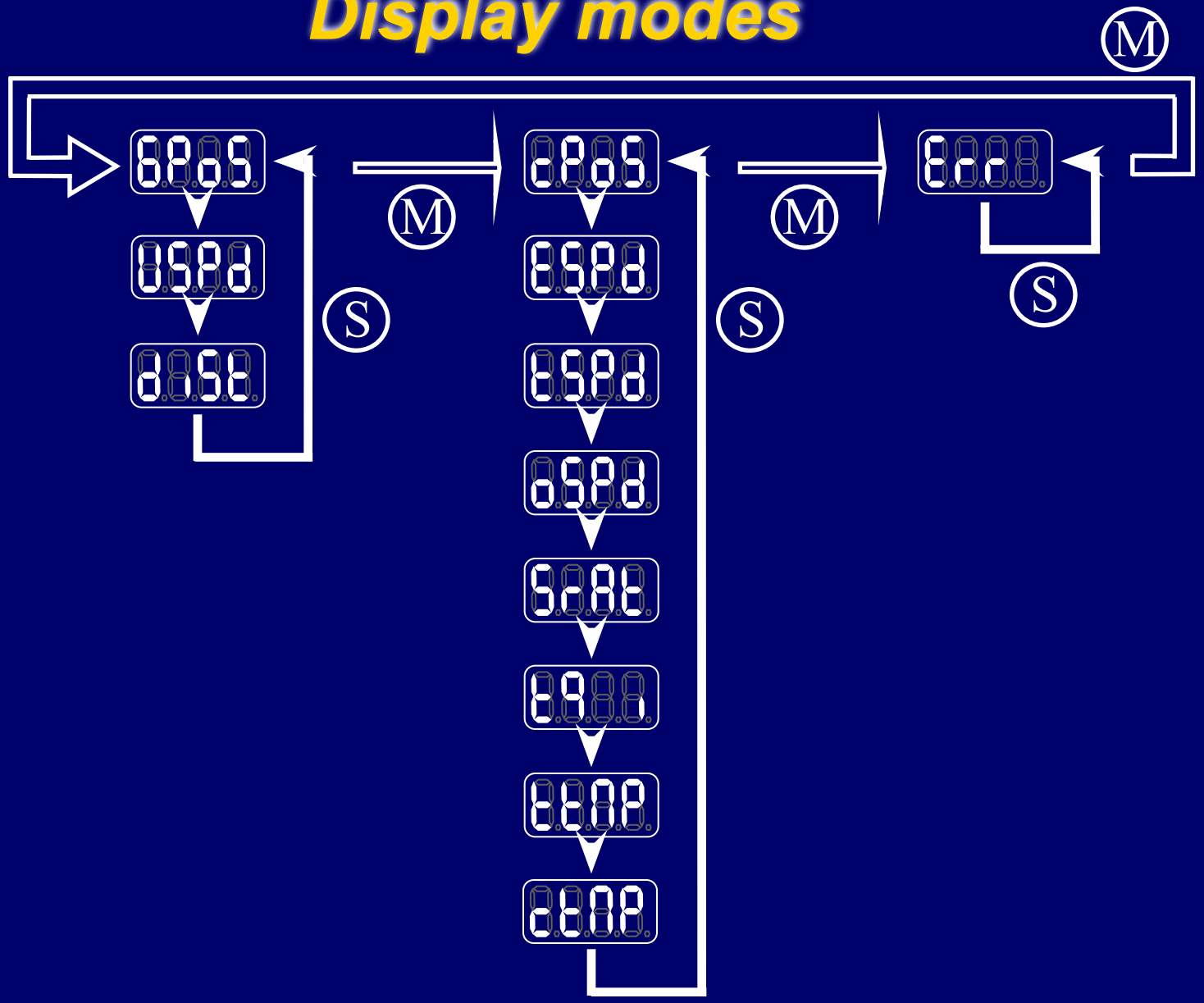
Display modes

- "Ctmp" display
  - Shows the Converter out temperature in °C



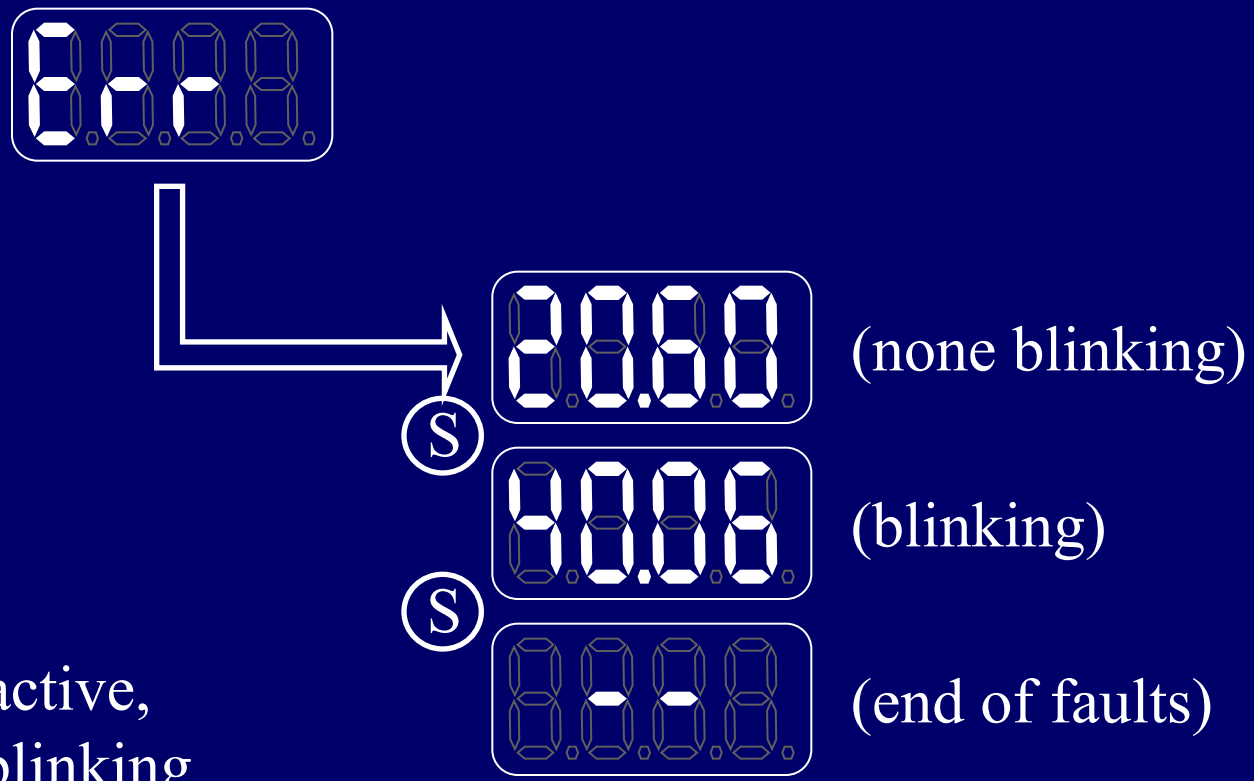
Note : due that the converter out temperature is measured by a temperature switch : 50 on the display means below 120° C
150 on the display means above 120° C

Display modes



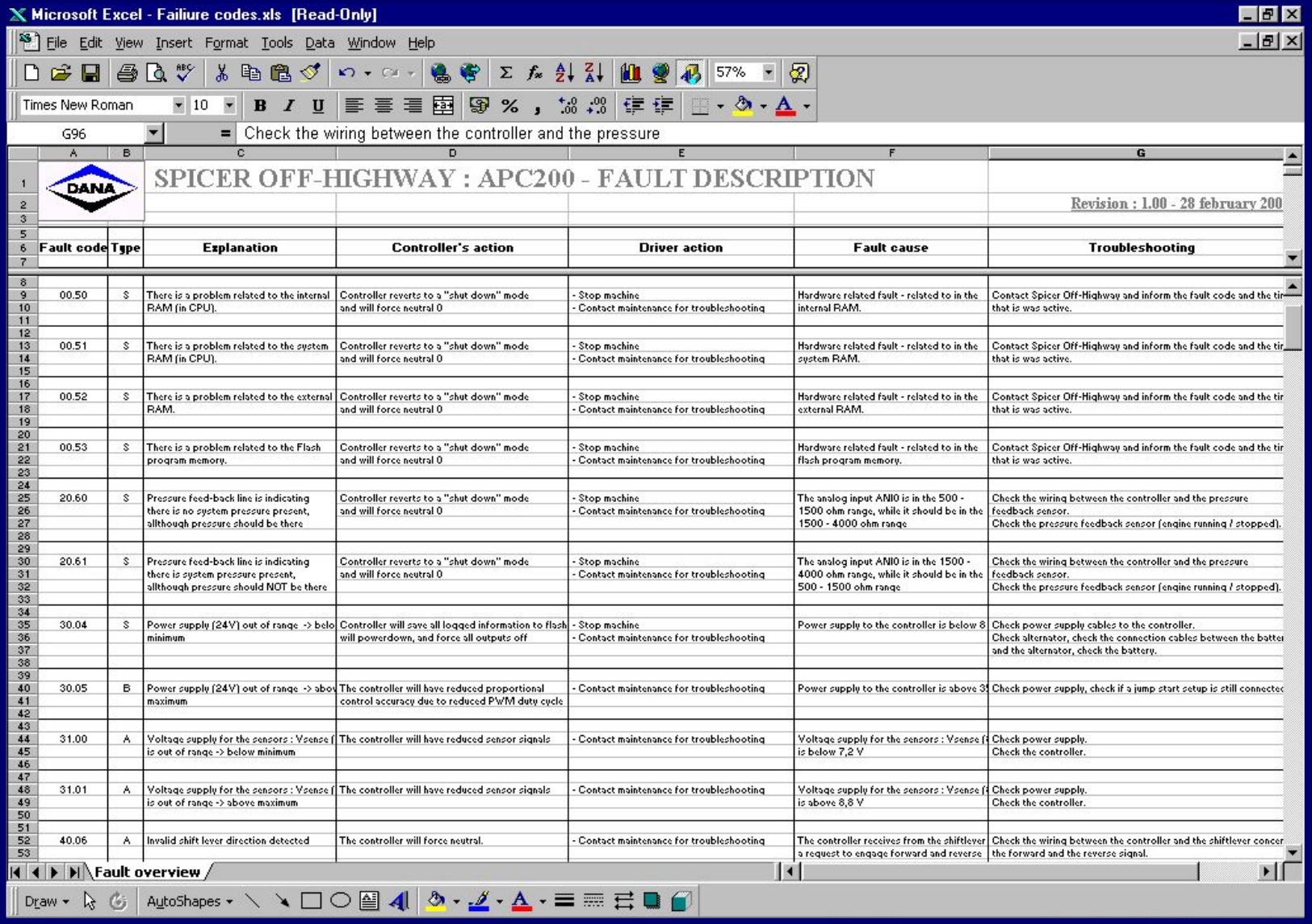
Display modes

- "Err" display
  - Shows all existing error codes (none blinking error code) and error codes detected in the past (blinking error code).



Note : when an error is active,
the error led will be blinking

Error codes list



Microsoft Excel - Failiure codes.xls [Read-Only]

File Edit View Insert Format Tools Data Window Help

Times New Roman 10 B I U 57%

G96 = Check the wiring between the controller and the pressure

SPICER OFF-HIGHWAY : APC200 - FAULT DESCRIPTION

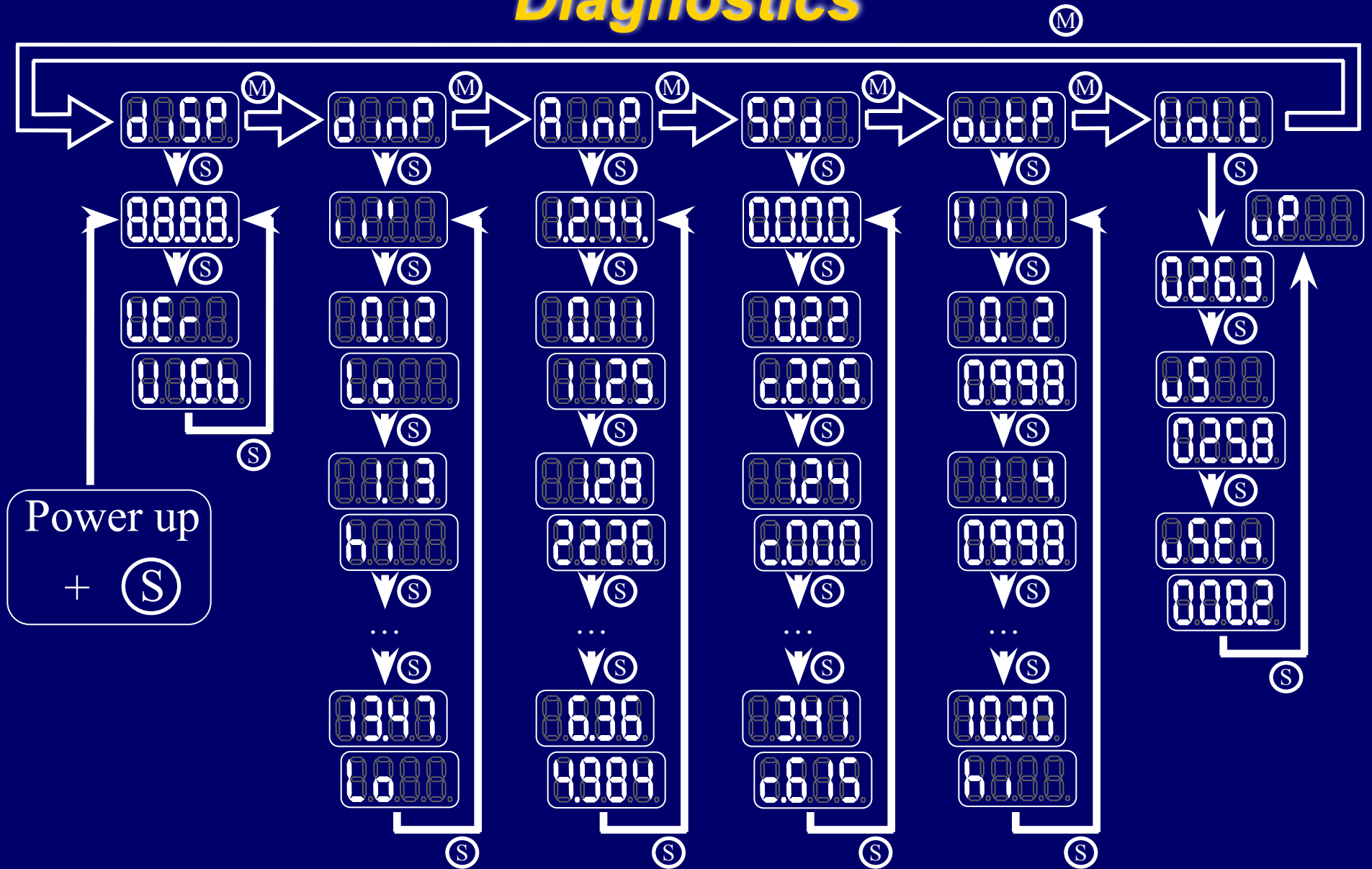
Revision : 1.00 - 28 february 200

Fault code	Type	Explanation	Controller's action	Driver action	Fault cause	Troubleshooting
00.50	S	There is a problem related to the internal RAM (in CPU).	Controller reverts to a "shut down" mode and will force neutral 0	- Stop machine - Contact maintenance for troubleshooting	Hardware related fault - related to in the internal RAM.	Contact Spicer Off-Highway and inform the fault code and the tir that is was active.
00.51	S	There is a problem related to the system RAM (in CPU).	Controller reverts to a "shut down" mode and will force neutral 0	- Stop machine - Contact maintenance for troubleshooting	Hardware related fault - related to in the system RAM.	Contact Spicer Off-Highway and inform the fault code and the tir that is was active.
00.52	S	There is a problem related to the external RAM.	Controller reverts to a "shut down" mode and will force neutral 0	- Stop machine - Contact maintenance for troubleshooting	Hardware related fault - related to in the external RAM.	Contact Spicer Off-Highway and inform the fault code and the tir that is was active.
00.53	S	There is a problem related to the Flash program memory.	Controller reverts to a "shut down" mode and will force neutral 0	- Stop machine - Contact maintenance for troubleshooting	Hardware related fault - related to in the flash program memory.	Contact Spicer Off-Highway and inform the fault code and the tir that is was active.
20.60	S	Pressure feed-back line is indicating there is no system pressure present, allthough pressure should be there	Controller reverts to a "shut down" mode and will force neutral 0	- Stop machine - Contact maintenance for troubleshooting	The analog input ANI0 is in the 500 - 1500 ohm range, while it should be in the 1500 - 4000 ohm range	Check the wiring between the controller and the pressure feedback sensor. Check the pressure feedback sensor (engine running / stopped).
20.61	S	Pressure feed-back line is indicating there is system pressure present, allthough pressure should NOT be there	Controller reverts to a "shut down" mode and will force neutral 0	- Stop machine - Contact maintenance for troubleshooting	The analog input ANI0 is in the 1500 - 4000 ohm range, while it should be in the 500 - 1500 ohm range	Check the wiring between the controller and the pressure feedback sensor. Check the pressure feedback sensor (engine running / stopped).
30.04	S	Power supply (24V) out of range -> belo minimum	Controller will save all logged information to flash will powerdown, and force all outputs off	- Stop machine - Contact maintenance for troubleshooting	Power supply to the controller is below 8	Check power supply cables to the controller. Check alternator, check the connection cables between the batter and the alternator, check the battery.
30.05	B	Power supply (24V) out of range -> abov maximum	The controller will have reduced proportional control accuracy due to reduced PWM duty cycle	- Contact maintenance for troubleshooting	Power supply to the controller is above 3	Check power supply, check if a jump start setup is still connecte
31.00	A	Voltage supply for the sensors : Vsense is out of range -> below minimum	The controller will have reduced sensor signals	- Contact maintenance for troubleshooting	Voltage supply for the sensors : Vsense is below 7,2 V	Check power supply. Check the controller.
31.01	A	Voltage supply for the sensors : Vsense is out of range -> above maximum	The controller will have reduced sensor signals	- Contact maintenance for troubleshooting	Voltage supply for the sensors : Vsense is above 8,8 V	Check power supply. Check the controller.
40.06	A	Invalid shift lever direction detected	The controller will force neutral.	- Contact maintenance for troubleshooting	The controller receives from the shiftlever a request to engage forward and reverse	Check the wiring between the controller and the shiftlever concer the forward and the reverse signal.

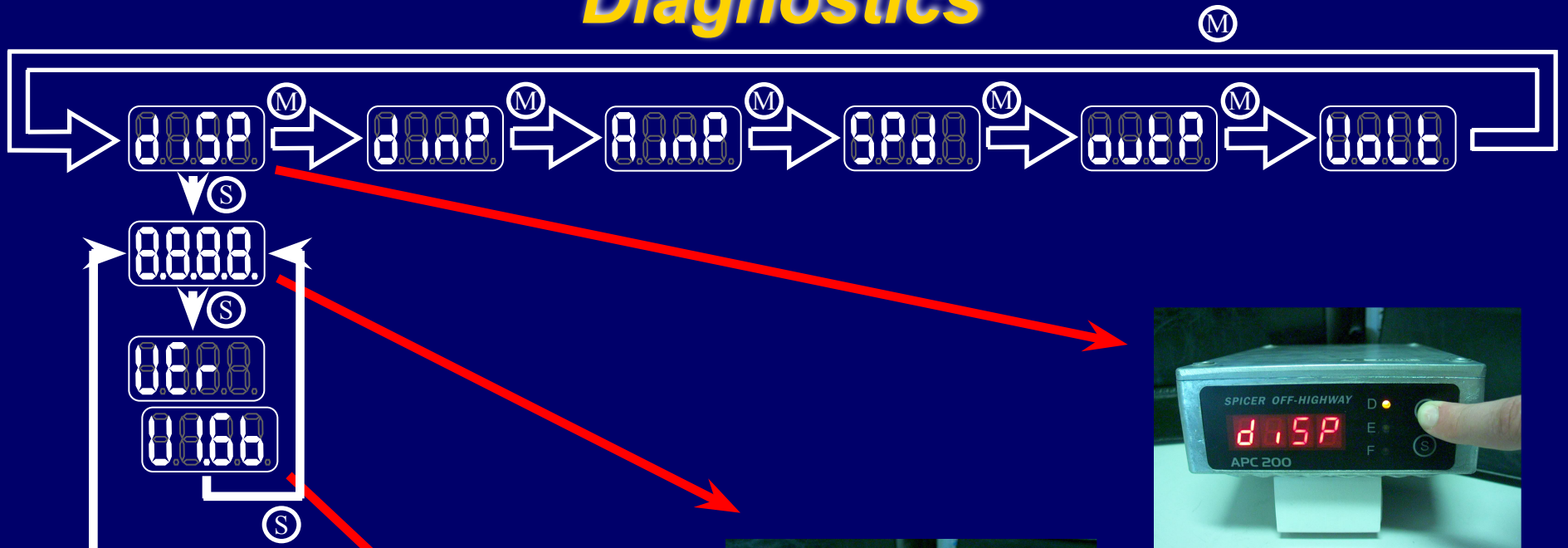
Fault overview

Draw AutoShapes

Diagnostics



Diagnostics

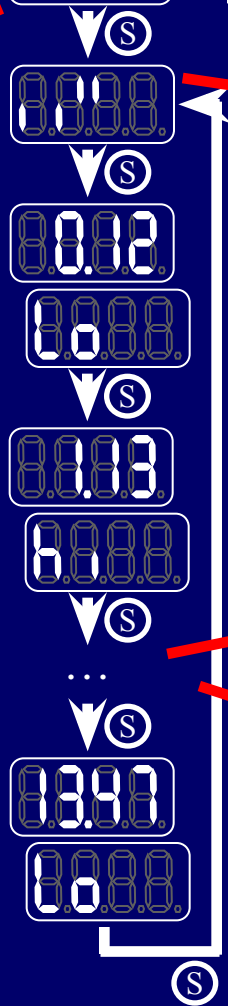


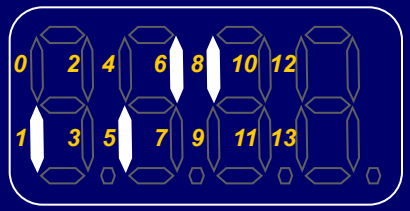
Display test

Note : for the firmware version, the display is using a scrolling text moving to the left (continuously).

Diagnostics

Digital input test





Digital input reference

Digital input 3 on wire 17

input not active

Note : input 10 till 13 are the 4 analog inputs, which could be used as digital inputs

Diagnostics

Analog input test

No . meaning the value is in Ω

1st value (kΩ or V) of the 1st 4 analog inputs

A . meaning the value is in Volts

Analog input 3 on wire 47
(47 – 30 pins on connector A = B17)

Diagnostics

Speed sensor 0 on wire 22

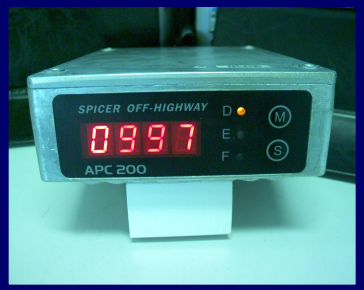
C informs the sensor is a current sensor, value is expressed in Hz or kHz (ex.: c2.45)

Speed sensor test

1st value (kHz) of the 4 speed sensors

Diagnostics

Analog output 3 on wire 8



Analog output Current of 997 mA

output active

Digital output 1 *(7 – 6 = 1)* on wire 10

Output test

Note : 0 till 6 are analog outputs, and 7 till 10 are digital outputs.

Diagnostics

Voltage test

Voltage switched power

22.7 volt

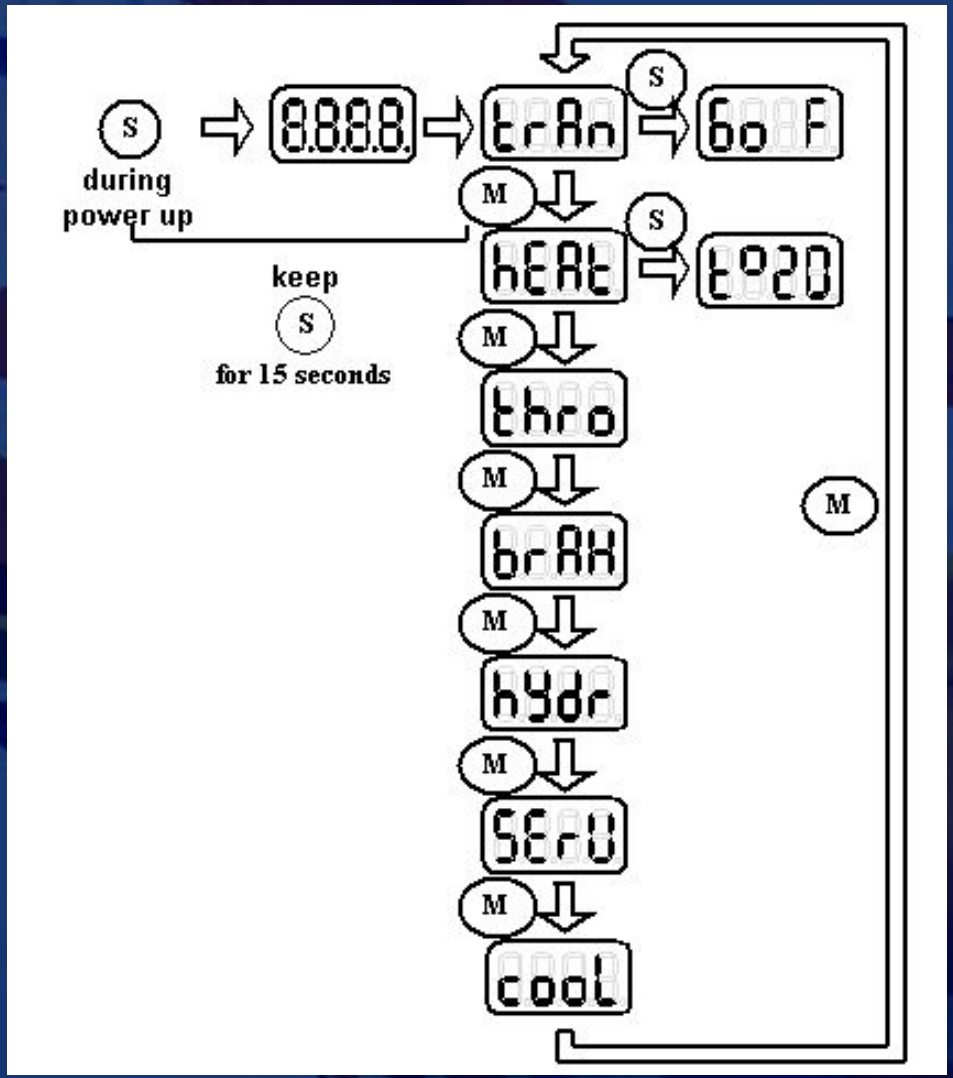
Voltage sensor power supply

8.1 volt

Calibration APC200-Transmission

- Menu structure overview
- Transmission calibration (clutch filling)
- Heat mode
- Calibration of the analogue inputs :
  - Throttle pedal
  - Brake pedal
  - Hydro lever
  - Servo motor

Menu structure overview



Transmission calibration (clutch filling) Introduction

- What?
- Is determining volume of oil that is needed to fill up the clutch, untill clutch plates start to transfer torque.
- This start of torque transfer is the point when the programmed modulation curve starts to act.
- Since each transmission, clutch ,valve and VFS has its own tolerances, this fill capacity needs to be determined on newly assembled units and every time any of these components is changed.

Transmission calibration (clutch filling) Introduction

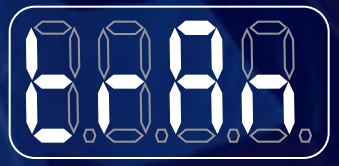
- How ?
- Direction (FWD/REV)clutches are calibrated by fully activating 2nd range clutch, and then by gradually increasing the pressure signal from the directionalVFS untill a drop in turbine RPM is noted. This drop in turbine RPM is the touch detection i.e. the point at which the clutch starts to transfer torque. This VFS signal is stored in the memory of the APC200 and is used as the start point for the modulation which was predetermined during prototype testing.
- Range clutches (1st, 2nd,3th and 4th) are calibrated by fully activating forward clutch and then by gradually increasing the pressuure signal to the corresponding range VFS as above.

Transmission calibration (clutch filling) Introduction

- A transmission calibration has to be performed :
  - when the vehicle is built at the OEM
  - after 2000 hours driving in gear (forward or reverse)
  - when the valve is changed
  - when an overhaul of the transmission is done
  - when the transmission is repaired / replaced
  - when the APC200 is replaced
  - when firmware and APT-file are updated
- Goal :
  - guarantee the best shift quality during the complete life of the transmission

Transmission calibration (clutch filling) How ? (1/3)

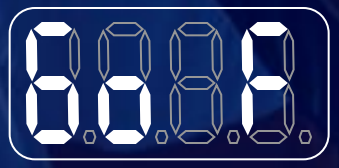
- Enter the calibration menu by pressing the S-button on the APC200 display for 15 s during power up of the APC :



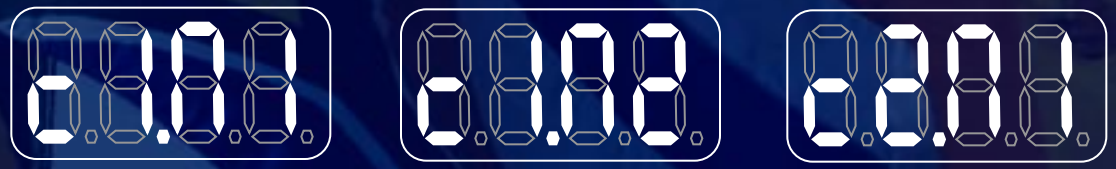
- Push the S-button to trigger the transmission calibration
- Before the calibration can be started, a number of conditions need to be fulfilled :
  - parking brake has to be activated
  - sump temperature has to be > 60°C (cfr. Heat mode)
  - engine speed has to be kept within 800 ± 200 rpm (note: if the APC has control over the engine, the speed will be adapted automatically)

Transmission calibration (clutch filling) How ? (2/3)

- If all these conditions are met, the APC will ask to shift to forward to start the calibration :



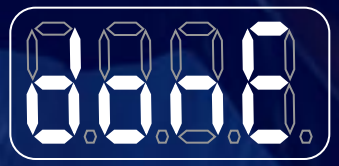
- The transmission calibration now starts. This is indicated on the APC200-display :



etc. (‘c1’ = clutch 1 I.e. fwd ; ‘M1’ = mode 1 of the calibration)

Transmission calibration (clutch filling) How ? (3/3)

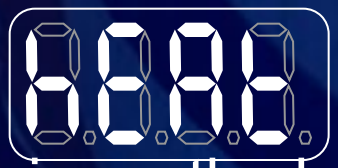
- When all clutches have been calibrated, the APC200 displays :



- This means the calibration has been completed success-fully. Normal duration : about 15 min.
- Now switch off the ignition key of the vehicle and let the APC power down.
- When restarting the vehicle, the calibration results will be activated automatically.
- Important : by selecting REVERSE, the calibration is stopped immediately (APC powers down).

Heat mode (1/3)

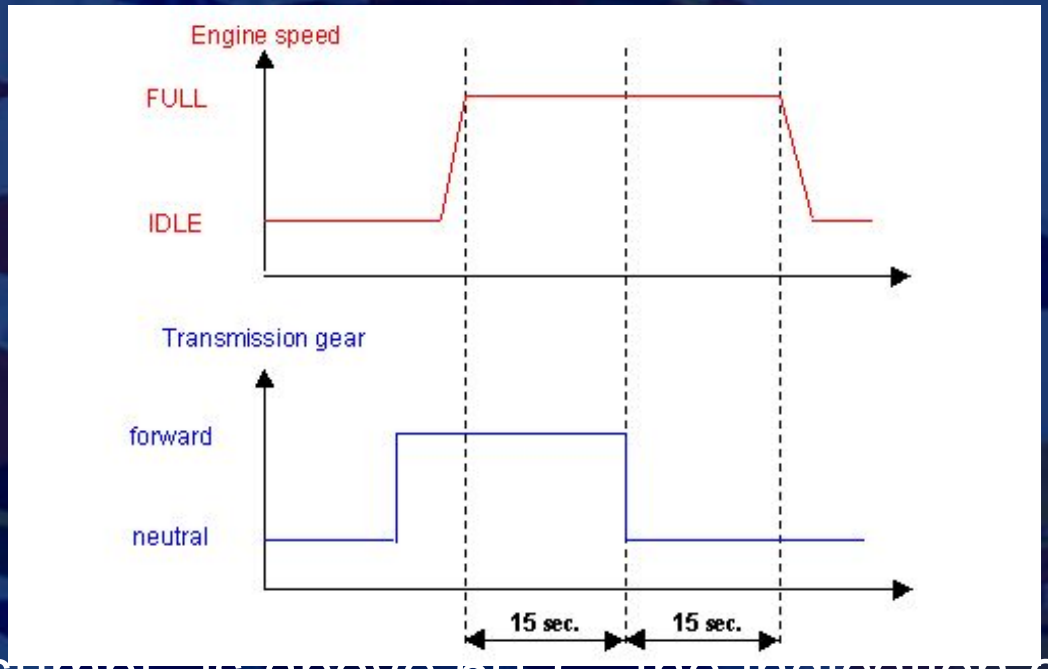
- Goal : warm up transmission in a fast way (stall)
- Specific to heat mode :
  - fwd/rev can be selected while the parking brake is on
  - disables inching and declutch
  - the highest gear is forced (3rd or 4th)
- How ? Push M-button when ‘trAn’ is on the display :



- Push the S-button to trigger the heat mode : actual sumpt°

Heat mode (2/3)

- Perform the following scheme to warm up the transmission :



- When the sump° is above 60°C, the indication on the APC display starts blinking.
- Now push the M-button until you come back to ‘trAn’

Heat mode (3/3)

- Note : When the converter out temperature would exceed 120°C, the engine speed will be limited to half throttle (if APC has engine control) or the transmission will be forced to neutral (when APC has no engine control).

Other messages during calibration (1/5)

- 1. Calibration condition messages

6o n	The APC200 expects the shift lever to be in neutral, but finds it in another position (forward or reverse).	Put the shift lever back to neutral.
PbOn	The APC200 expects the parking brake to be on while it is off.	Put the parking brake to on.
StoP	The APC200 has detected output speed.	Verify if the parking brake is on and working properly. If this is already the case, you will be obliged to keep to machine at standstill by using the footbrake. Once the machine has been stopped, the APC200 will ask the driver to shift to forward before continuing the calibration.
rPn_	Engine rpm is too low according to the limit that is necessary for calibration.	If the vehicle is equipped with throttle-by-wire, the engine rpm will be automatically adapted. In the other case, the driver has to change the throttle pedal position until the display looks as follows : rPn-
rPn¯	Engine rpm is too high according to the limit that is allowed for calibration.	
rPn-	After being too low or too high, the engine rpm is coming back into the correct boundaries for calibration.	

Other messages during calibration (2/5)

- 1. Calibration condition messages (part 2)

t°44	When during the automatic transmission calibration the temperature becomes too low, the APC200 display indicates the actual transmission temperature.	Use the M-button on the APC200 to go back to the 'HEAT'-mode and the S-button to trigger this mode. Now, you have to warm up the transmission again until the temperature is above 60° C. Then go back to the automatic tuning mode by the M-button and trigger this one again to continue the calibration.

Other messages during calibration (3/5)

- 2. Calibration error messages

 E1.25 : during calibration, early touch detect.

Possible causes :

- Too much clutch drag because of too thick oil, recalibrate at higher temperature 90 -100 °C)
- Sticking or burnt clutch which causes turbine to drop before pressure is applied,

 E1.26 : during calibration,no touch detect.

Possible causes :

- VFS faulty (no out put pressure)
- Slipping clutch or too high internal leakage

Other messages during calibration (4/5)

- 2. Calibration error messages continued

- E1.10 : during calibration, shift inhibit.

  Possible causes :

  - Caused by shutdown e.g; in combination with 20/60 error;
  - Resolve cause of shutdown before recalibation

Other messages during calibration (5/5)

- 2. Calibration error messages continued

  - E2.14 : calibration failed ,fill time out.

  Possible causes :

  - Turbine speed does not decrease caused by too high internal leakage and or slipping clutch

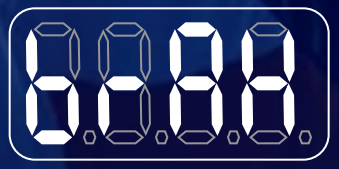
  - E2.16 : calibration failed , turbine pull down too early.

  Possible causes :

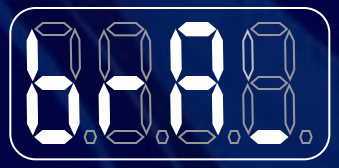
  - Faulty turbine speed sensor

Calibration of analogue imputs Example : brake pedal (1/4)

- Enter the calibration menu by pressing the S-button on the APC200 display for 15 s during power up of the APC.
- When having ‘trAn’ on the display, push the M-button until you see



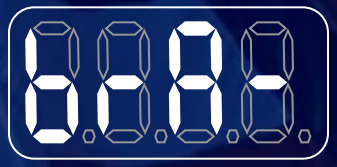
- Push the S-button to trigger the brake pedal calibration
- The APC now asks for the idle position of the brake pedal (no play in the pedal anymore) :



- Push the S-button to confirm the position.

Calibration of analogue imputs Example : brake pedal (2/4)

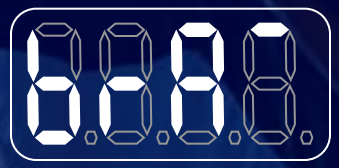
- Then, the APC asks for the mid position of the brake pedal (point where the brakes start to operate) :



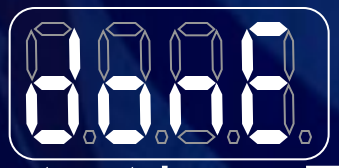
- With hydraulic brakes : this point corresponds to the moment the brakes start ‘sissing’
- With dry brakes : push the pedal a little bit, just enough to make the position led stop blinking (if blinking, there is not enough position difference / former position). When doing so, the midpoint is automatically clipped at 5%.
- Push again the S-button to confirm the position.

Calibration of analogue imputs Example : brake pedal (3/4)

- Finally, the APC asks for the full brake position :

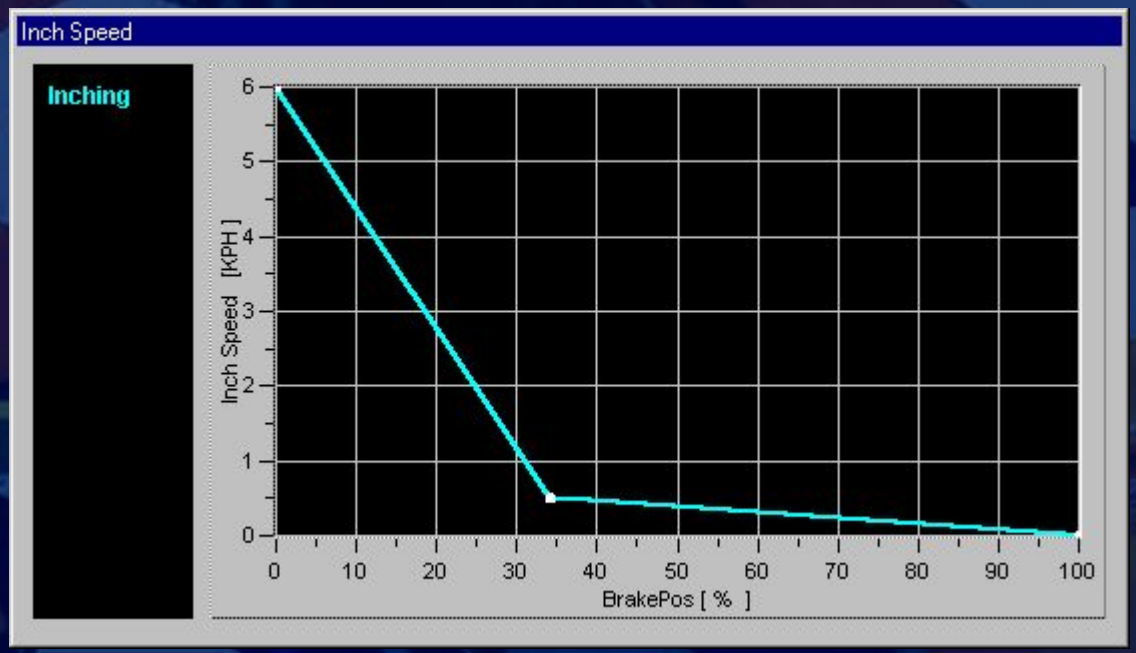


- Apply full brake and press the S-button to confirm.
- If the calibration has been successful, the APC display will show



- Now switch off the contact key. The calibration values are automatically stored into the APC200.

Calibration of analogue imputs
Example : brake pedal (4/4)



TE transmission field experience

- TE13/17 field campaign
- Speed sensor changes
- Case studies

TE transmission field experience

- TE13/17 field campaign

  Clutch end plate snapring jumps out of groove, causing slipping clutch.

  Only cluthes in combination with a spacer between endplate and snapring are affected

  Fix is a one piece endplate

  Population : all units built prior to April 2004

TE transmission field experience

- Speed sensor changes.

  Cracked speedsensor housing causes potting material to swell which results in speed sensor touching the gear.

  solved by changing potting material and new speed sensors moulds

  Latest version is recognisable by a coloured ring around the housing

  Installation : refer to drawing

TE transmission field experience

- Case studies

1. Vehicle stops error 00.50

   action 1 : Change APC and calibrate

   error E1.25 and E2.14 in 2nd

   vehicle only drives in second

   action 2 : changed valve and recalibrate

   error 20.60 before calibration can start

   action 3 : measure cluch pressure (0 bar), measure lube pressure (0bar), check pump (OK) found sandwich plate on valve not fitted during exchange, refitted sandwich plate and recalibrate

   error E1.25 and E2.14

   vehicle only drives in 2nd and blocks in 1st and 3rd

   action 4 : replace transmission, faulty unit had a burnt 2nd clutch

   Comments, A 20/60 error indicates a system pressure fault, 1st step should be to check system pressure

TE transmission field experience

- Case studies

2. Vehicle has a delay when downshifting, no error codes

action 1 : replace speed sensors and valve

no improvement

action 2 : test drive confirms that downshiftspeedpoints are lower than on similar vehicle, recalibrate throttle switch

No improvement

action 3 : test drive shows that speed ratio and turbine speeds are correct when down shift is made, indicating a changed converter characteristic which causes loss of tractive effort ; measure stall speed which shows only 1200 RPM i.o. 1800 RPM.

Replace transmission which shows a failed converter freewheel

Comments: the delay was not clearly understood. This case proofs that basic converter/transmission troubleshooting is still valid (measure stall speed),

TE transmission field experience

- Case studies

3. Tel call : machine sometimes shows 20.60error code

action 1 : recalibrate transmission

Error codes : E1.26; E2.14

vehicle symptons : slips in third, oil is contaminated

replace transmission which shows a 3 rd clutch failure

commnets, The 20/60 appeared only when 3rd clutch is selected, this indicates a high 3rd clutch leakage? The symptons confirm this; behind the 20/60 error a 42.05 should have been found, but this was not checked.

A 20/60 only on TE32 can also indicate that two range or direction cluthes are engaged at the same time. Pressure checks should confirm this .

TE transmission field experience

Case studies

4. Tel call : unit shocks when 4th is selected and goes back to 3rd , no error codes

action 1 check 4th clutch pressure : 5 bar

action remove transmission and send for repair

nothing found wrong, reinstalled unit and is OK… for 2 days when problem reappears

action 2 : check CPOS and GPOS on APC200

CPOS shows only FWD 3

action 3 : replace cab control

Problem solved

comments : The cab control had an intermittent fault causing 4th to engage and disengage; this causes the VFS 4/2 to rise and fall in pressure quickly which explains the 5 bar measured . The suspected 4 th clutch failure should have been confirmed by error codes.

TE transmission field experience

- Case studies

5. Tel call : failure code 20/61 with engine not running

   pressure switch blocked in closed position.

   Action 1 : replace pressure switch

   problem solved

   comment : 20/61 indicates system pressure when it should not be there. Since engine is not running there can be no system pressure indicating a jammed switch

   If 20/61 occurs with engine running it is most probably caused by a faulty engine speed sensor which generates 0 RPM

TE transmission field experience

- Case studies

6. Tel call : error code 42/04 (speed ratio (Turbine/Output) too low

   action 1 replace turbine speed sensor

   Problem solved

   comment : too low speed ratio is a wrong speed measurement or a wrong ratio. Since a wrong ratio is least likely the turbine or output speed sensor are at fault

   42/05 error (speed ratio too high) can be caused by the same speed sensors if this fault appears in all speeds/directions. If it only appears in one speed or one direction you have to assume a slipping clutch.

Thanks