

# Maintenance Manual



## CX201 & CN201 Suction Sweeper

Part No. 7020861

Revision Level G

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CHAPTER

**P**

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CHAPTER

1

**Scheduled Maintenance**

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## Maintenance & Adjustment Instructions

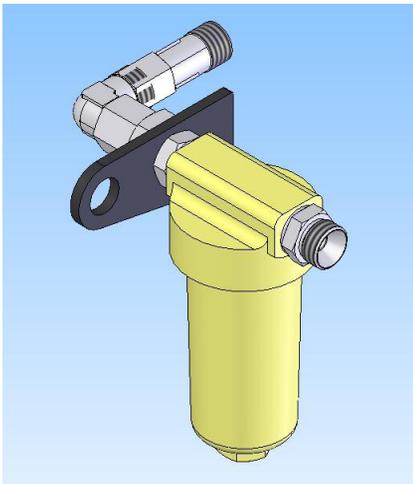
For Routine Maintenance Schedules please refer to the C201 Operator's Guide.

For engine specific maintenance instructions please refer to the VM Engine Instructions Manual (supplied with each engine/vehicle).

The following items are not covered in the Operator's Guide.

Many parts of the hydraulic circuit are protected by a high pressure, canister type filter. The filter can be unscrewed using a suitable spanner.

**Note:** Ensure that used filter elements are disposed of in accordance with applicable environmental regulations.



### Hydraulic Cylinder Maintenance

Periodically inspect cylinder rods for damage, blemishes or build up of materials such as tar, cement, paint etc. The rods can be cleaned with fine wire wool and/or spirit which should be done to enhance long life.

### Windscreen Washers

The windscreen washer bottle is mounted behind the front centre console. The bottle should be kept topped up with water and a proprietary windscreen washer fluid.

The jets for the washers are mounted on the pantograph wiper arm and should be checked to ensure they do not become blocked. They can be cleaned using a fine needle to unblock the orifice.



## Mesh Screens

### Hopper Door

The hopper mesh screens must be clean at all times for optimum suction performance. Although these screens can be cleaned in situ by opening hopper door, it is preferable to remove them for cleaning using a broom and hosepipe. Removal is simply by grabbing the screen by the handle provided after first removing the lynch pins, and lifting out of the hopper.



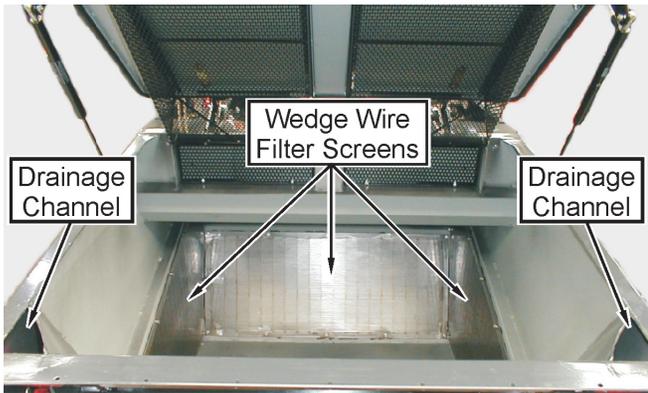
Refitting of the hopper mesh screens can be done either in the reverse order of removal, or it may be found easier to refit the meshes by fully lifting the hopper and offering up the mesh. The mesh should be lifted into the retaining channel and one at a time, the lynch pins should be fitted.

**Note:** With the meshes removed it is advisable to ensure the ducts in the roof of the hopper are clean and free from debris.



Meshes should only be removed with the hopper in the lowered position.

### Recirculation Screens



Periodically the wedge wire filter stainless steel screens in the front and the sides of the hopper may require cleaning. There are two drainage channels provided in the hopper for the cleaning of the cavity behind the screen which will tend to build up with fine material. The hopper should be lifted to full height and these channels flushed out with a high pressure washer or hosepipe.

### Tier 3 Engine Actuator Setup

The information that follows outlines the correct procedure for the adjustment of the C201 Tier 3 engine speed settings.

1. Engine Base Idle (with actuator rod disconnected) is set to 950 rpm.
2. Actuator Idle (with actuator rod connected) is set to 1000 rpm.

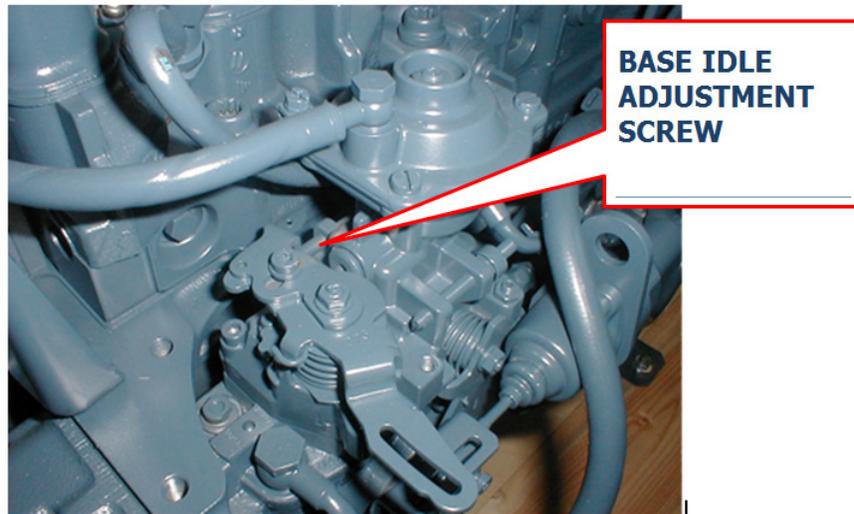
#### Step One: Engine Base Idle RPM Adjustment

- 1.1 Start the engine and run machine until normal running temperature is obtained before setting engine base idle.
- 1.2 Disconnect the throttle actuator rod from the engine fuel injection pump.
- 1.3 Observe the engine RPM on the JVM display. The engine base idle should be set to 950 rpm, see Figure One.



**Figure One: JVM Display Engine RPM**

- 1.4 If adjustment is required, loosen the locknut on idle adjustment screw, see Figure Two.
- 1.5 Using a flat-bladed screwdriver, turn screw until tick over of 950 rpm is obtained.
- 1.6 Retighten locknut.
- 1.7 Switch off engine.



**Figure Two: Location of base idle adjustment screw**

### Step Two: Actuator Idle RPM Adjustment

- 2.1 Remove actuator rod from the actuator and engine fuel pump.
- 2.2 Adjust the actuator rod length to 187mm as per the Figure Three. Ensure lock nuts are retightened.



**Figure Three: Actuator Rod Length**

- 2.3 Reconnect the actuator rod to the engine fuel pump and actuator.
- 2.4 Start the engine and observe the engine idle speed. The Tx5 controller will automatically control the actuator position to achieve an engine speed of 1000 rpm.

### Tools Required

1. Flat bladed screwdriver
2. Ruler (Sufficient to measure 187mm)
3. 10mm spanner
4. 10mm socket and ratchet

**Torque Wrench Settings**

<b>Torque And Adjustment Operation</b>		
<b>No.</b>	<b>Description</b>	<b>Setting</b>
1	Front Axle Suspension Bolts (M10 Nyloc in 7009171)	56 Nm
2	Depress front spring and dampers by 5mm (7012508 & in 7009171)	5 mm
3	Rear Wheel Motor Bolts (M12 Bolt/Capscrew in 7013647 / 7010645)	2WS - 85 Nm 4WS - 85 Nm With Loctite 243
4	Front Axle Suspension Pivot Bolts (71156-1 in 7011542)	550 Nm
5	Rear Suspension Bolts (100-114 in 7010645 & 701364)	550 Nm
6	Cab Mounting Bolts (M16 Bolt in 7015265)	120 Nm
7	Tow Hitch Mounting Bolts (Option) (M16 Bolt in 7008527 & 7008528)	240 Nm
8	Wheel Motor Adaptors (3/4" BSP adaptor in 7013691 & 7013689)	240 Nm With Loctite 542
9	Brace Bar Bolts (M20 Capscrew 12.9 in 7011926)	408 Nm Or 363 Nm with GTP600 lubricant
10	Gimbal Bolts (M12 Capscrew 12.9 in 7010651)	120 Nm
11	4WS Linkage Bar & Steering Cylinders (M14 Nut & M14 Nyloc in 7009424)	90 Nm
12	4WS Steering Cylinder to Chassis Crossmember (M10 Screw in 7009424)	50 Nm
13	Rear Engine Mounts Bracket (M10 Screws in )	50Nm

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## CHAPTER

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## Maintenance Instructions

Please refer to Operator's Guide for additional information.

### General Description

The hydraulic system is divided into three circuits; one for the sweep system and all its associated functions, the second for the power steering system of the machine, and finally the hydrostatic transmission system.

The sweep system and steering system are driven by a tandem gear pump mounted in line with the hydrostatic transmission pump, all pumps are driven from the engine's flywheel by-way of a torsionally damped coupling. The prime pump powers the suction fan, brushes (rotation, raise/lower, position), nozzle (raise/lower), water pump, and hopper (raise/lower). The fan, brushes and water pump are all driven by hydraulic motors. The brushes and nozzle are lifted and positioned by hydraulic cylinders. The hopper is also raised and lowered using, single stage hydraulic cylinders. Control of these operations is by way of a unique three spool, electrically controlled solenoid valve mounted on the RH chassis sidemember.

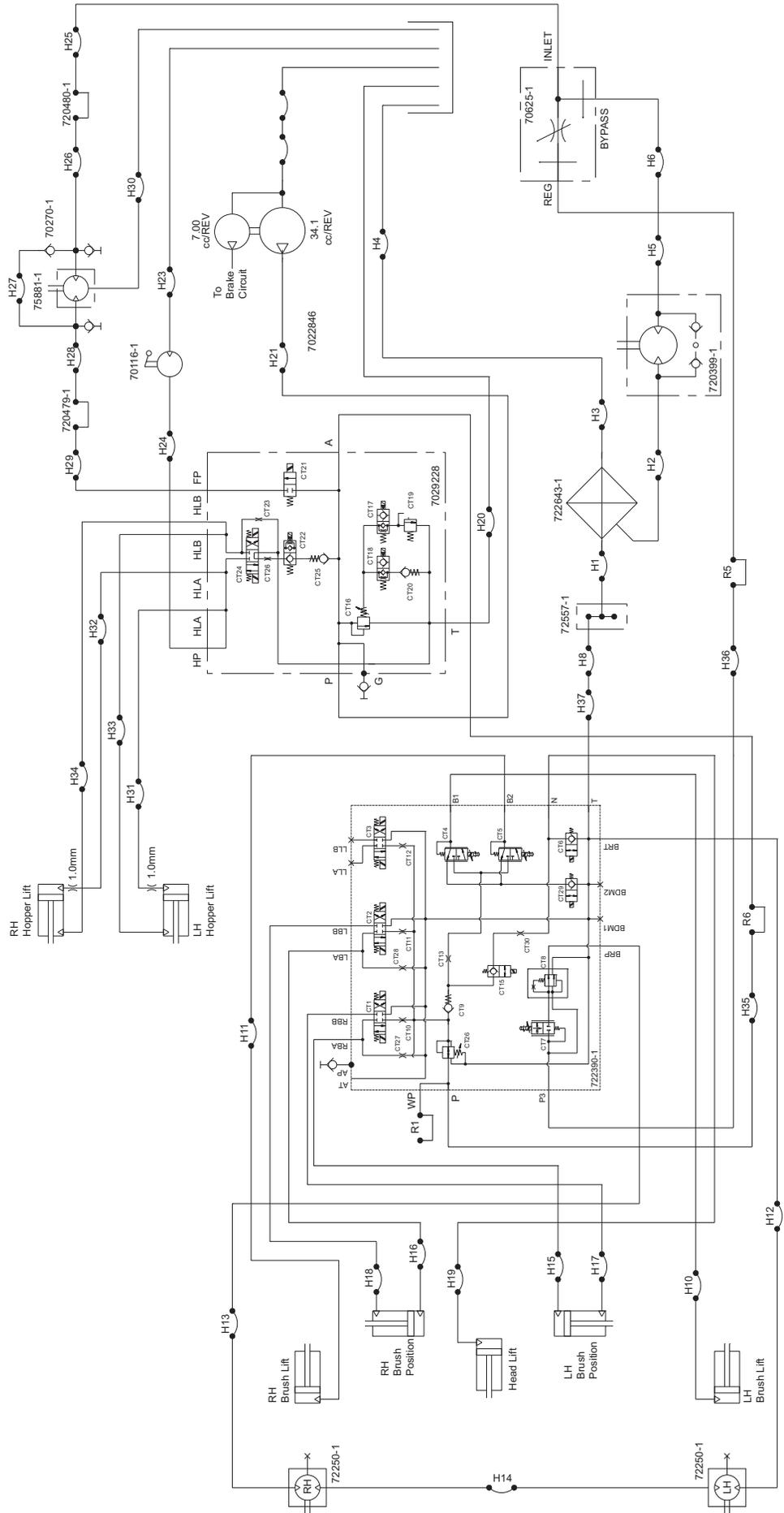
The secondary pump provides power for the power steering system, (PAS). Steering is effected using a double acting cylinder integral with the front axle assembly. Control of the steering is done by a special steering servo valve, mounted within the steering column.

Filtration for both systems is provided by suction strainers situated within the hydraulic reservoir, together with a replaceable canister type return line filter acting on the PAS circuit, this filter is located towards the rear of the drivers cab.

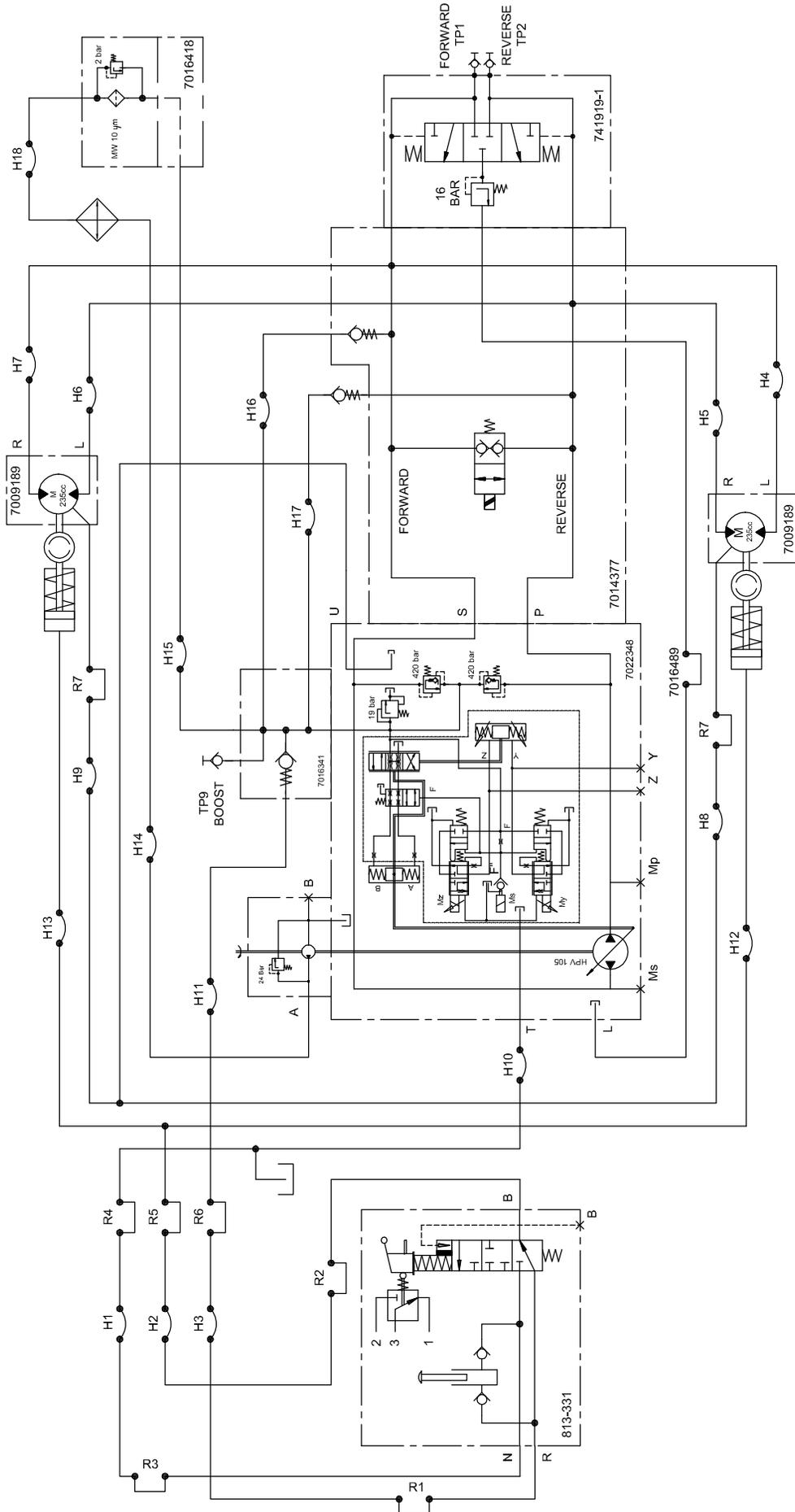
The third hydraulic system is the vehicle transmission system which is driven by an axial piston pump mounted direct to the engine flywheel housing. This provides oil to the two rear wheel motors. The system is a closed circuit with a separate header tank, the oil is cooled and filtered separately to the other sweeping and steering systems.

The steering circuit and hydrostatic systems both have their pressures factory preset and only suitably qualified personnel should effect any adjustments. The various pressure settings being shown on the circuit diagrams.

**Sweep System Hydraulic Circuit**  
(drawing reference: 7011983 - Issue I)

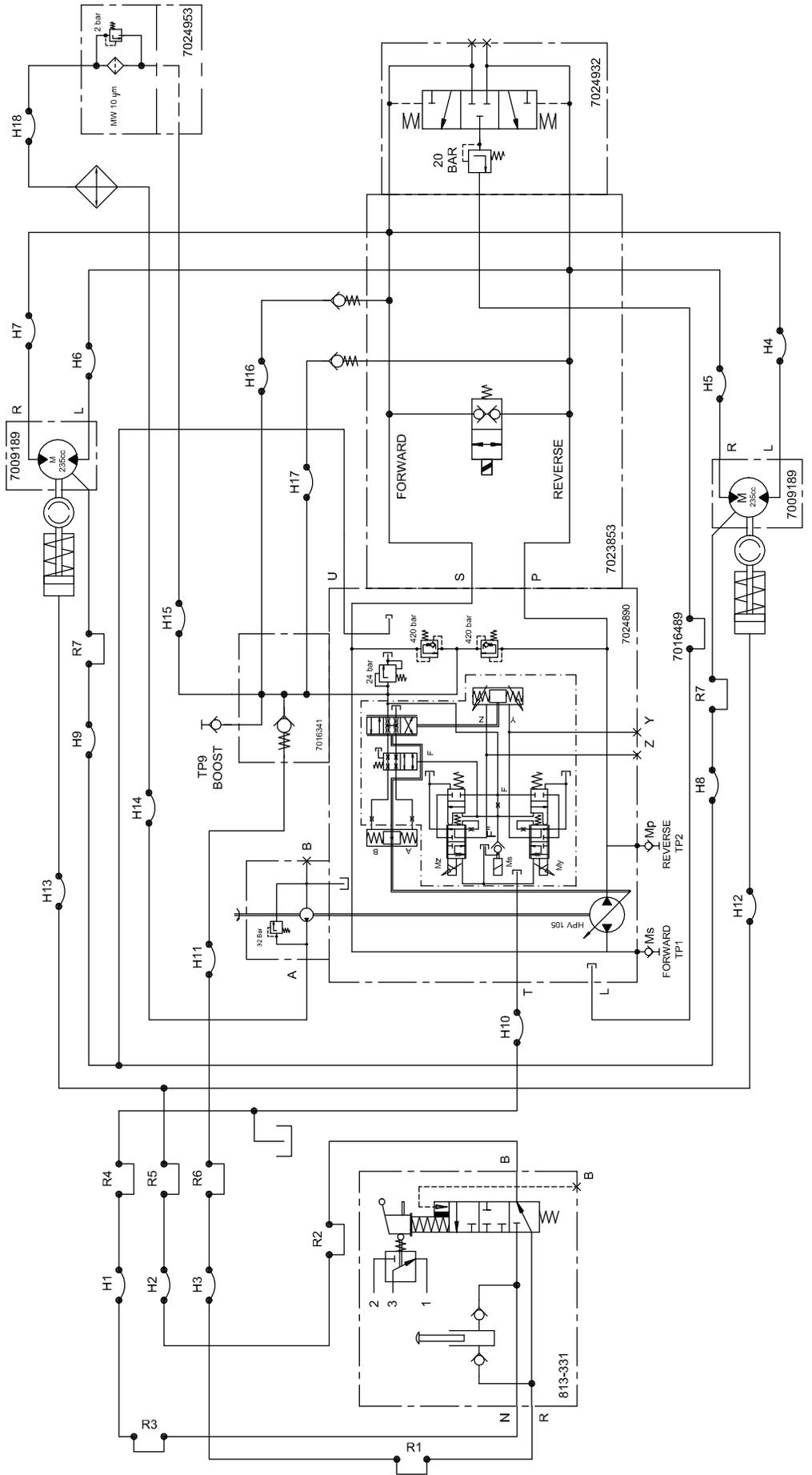


**Low Pressure Boost Transmission System Hydraulic Circuit**  
(drawing reference: 7011976 - Issue G)

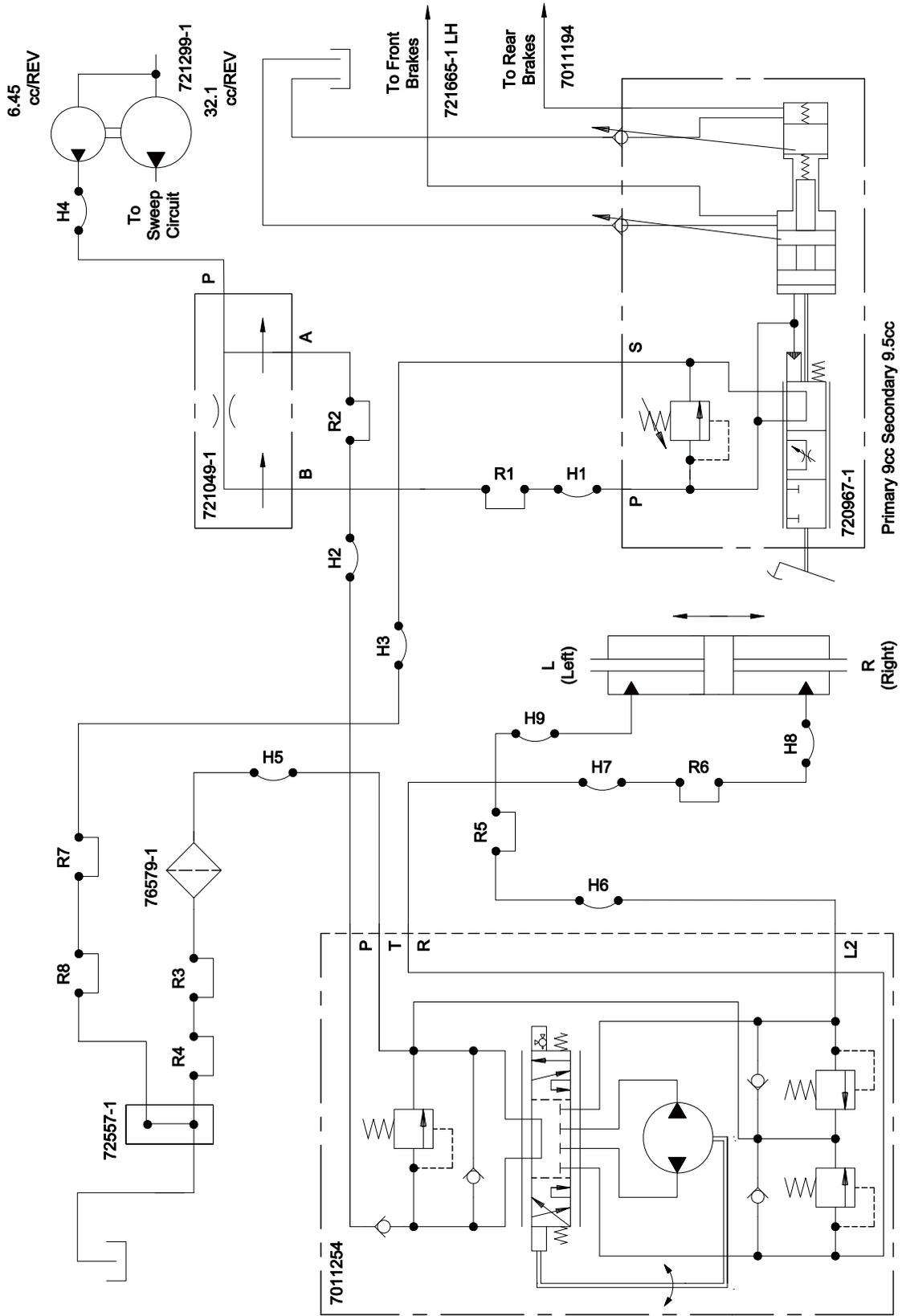


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### High Pressure Boost Transmission System Hydraulic Circuit (drawing reference: 7024989 - Issue A)

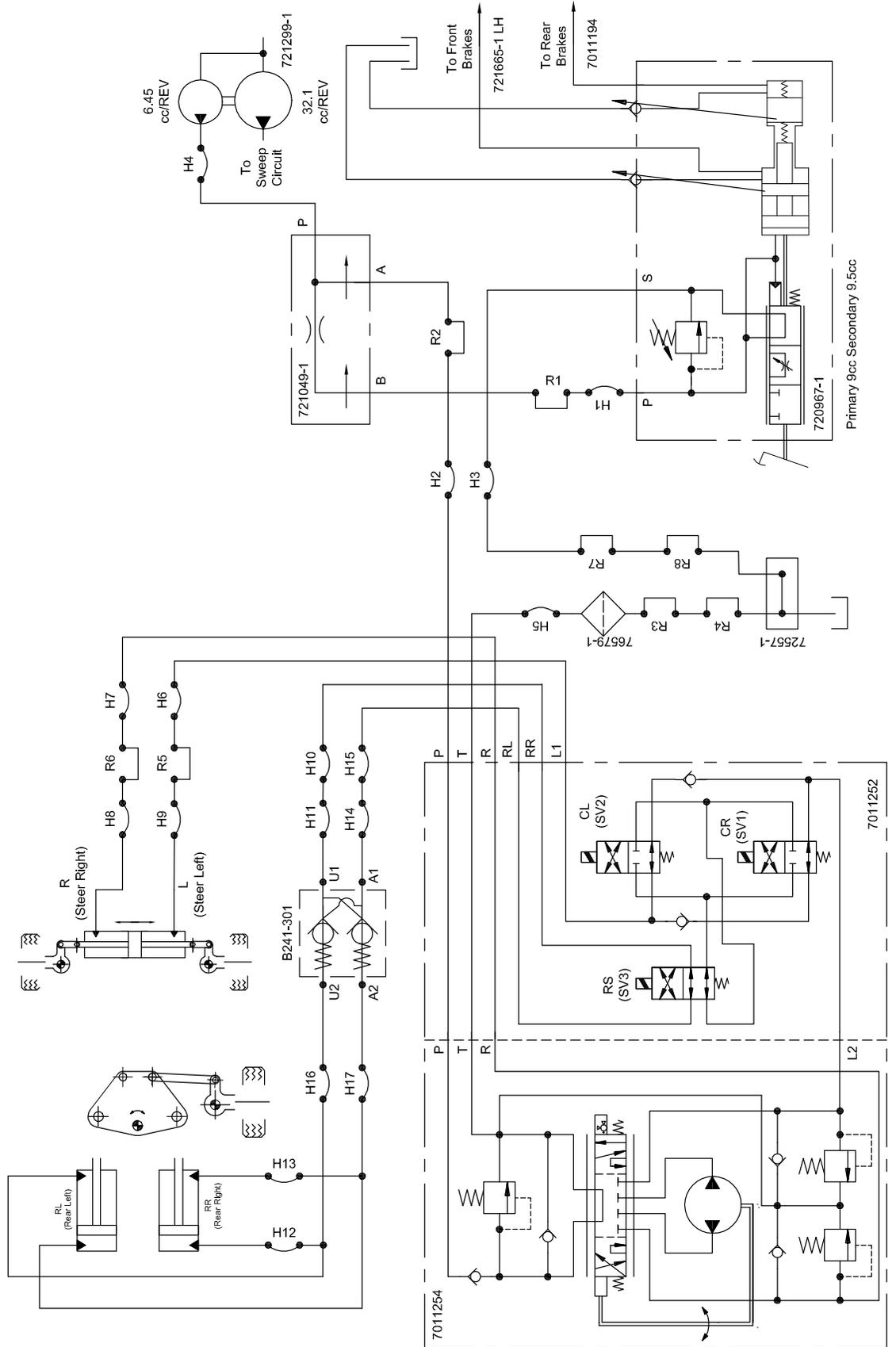


**2WS Steering System Hydraulic Circuit**  
 (drawing reference: 7011978 (LH) 7011979 (RH) - Issue E

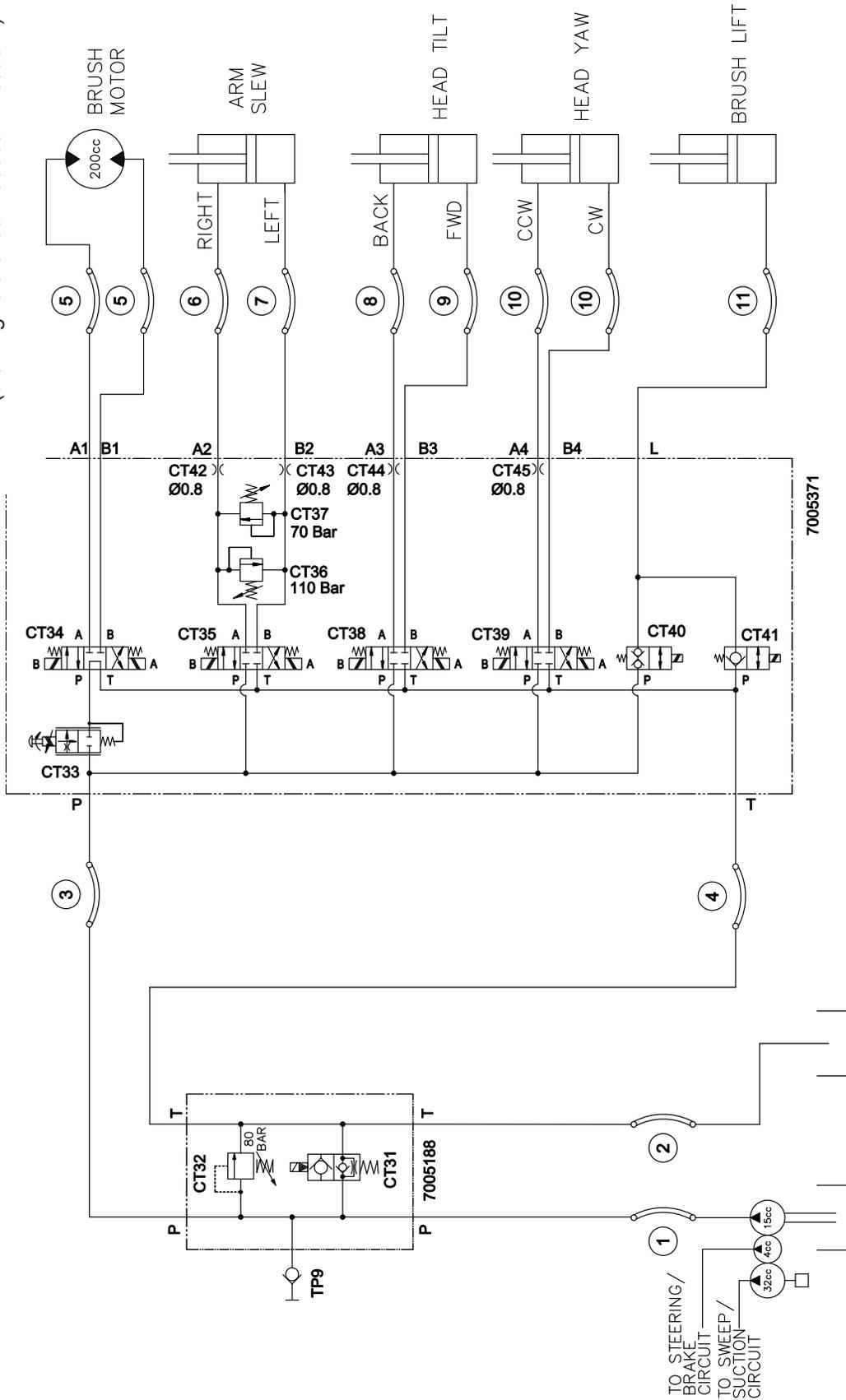


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**4WS Steering System Hydraulic Circuit**  
(drawing reference: 7011981 (LH) 7011982 (RH) - Issue H

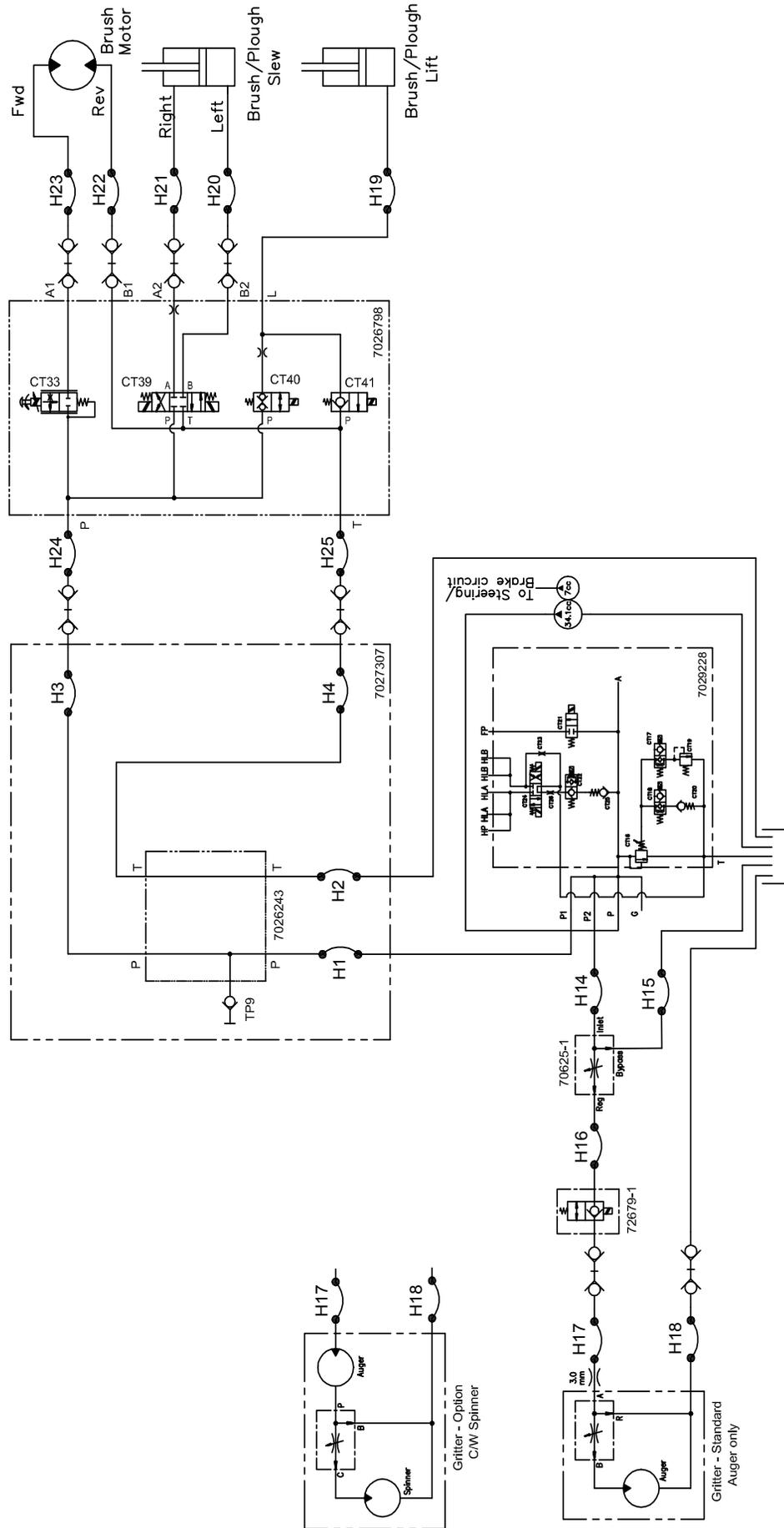


**3rd Brush Hydraulic Circuit**  
(drawing reference: 7005697 - Issue B)

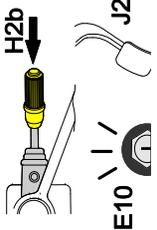
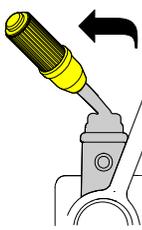
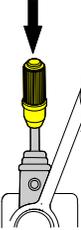


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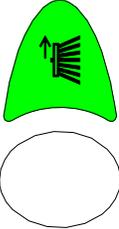
**Winter Equipment Hydraulic Circuit**  
(drawing reference: 7027307 - Issue C)



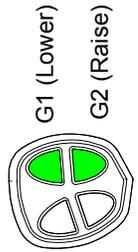
**CX/CN201 Modus Operandi**

Operation	Switch Number	Function	Valve Operation (Active Solenoids)	Notes
1.	E10, H2b & J2 	Turn E10 to 'ON' position, press H2b to start engine, whilst also pressing J2 as safety interlock.	Ignition after starting CT1b, CT2b, CT3b, CT14, CT15, CT18. CT4 & CT5 @ 100% current. All for 6 seconds.	
1a.	F 	Transit mode (forward gear) pressure applied to brush arms & nozzle to prevent dropping.	CT14 & CT15 = ON CT4 & CT5 = 15%	
1b.	H2b 	Work Mode Select (include memory of operation 2 or 3 when switched off).	Enable palm rest controls. Engine speed now increased to 1100 RPM (min). With 3 <sup>rd</sup> brush mounted; CT31 = ON.	Engine speed switch (G8 & G9) can now be used to alter engine speed between 1100 – 1500 rpm.

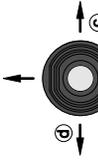
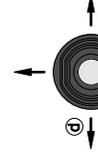
**CX/CN201 Modus Operandi**

2.	<p>G10</p> 	<p>LH Sweep Selector; rotates fan, brushes, water sprays and lowers sweep gear fully. After 6 seconds reverts to previous LH memory settings for brush pressure and brush speed.</p>	<p>@ 0 secs – CT4 &amp; CT5 = 0% CT1a, CT2a, CT6, CT17, CT18, CT21, CT29 = ALL ON. CT7 = (ramps to saved LH setting). @ 1.5 secs – CT1a &amp; CT2a = OFF @ 3 secs – CT14 = ON CT4 &amp; CT5 (memory LH setting) @ 5 secs – Water sprays enabled Brush un-park sequence completed Default sweeping valves – CT14, CT17, CT18, CT21 &amp; CT29 remain on during sweeping.</p>	<p>Valves CT4 &amp; CT5 are set to previously saved brush pressures. Valve CT7 ramps to previously saved brush speed setting. Press G10 in transit mode for automatic sweep gear deployment on selection of workmode, H2b.</p>
3.	<p>G12</p> 	<p>RH Sweep Selector; rotates fan, brushes, water sprays and lowers sweep gear fully. After 6 seconds reverts to previous RH memory settings for pressure and brush speed.</p>	<p>@ 0 secs – CT4 &amp; CT5 = 0% CT1a, CT2a, CT6, CT17, CT18, CT21, CT29 = all ON CT7 = (ramps to saved setting) @ 1.5 secs – CT1a &amp; CT2a = OFF @ 3 secs – CT14 = ON CT4 &amp; CT5 (memory setting) @ 5 secs – Water sprays enabled Brush un-park sequence completed Default sweeping valves – CT14, CT17, CT18, CT21, CT29 remain on during sweeping.</p>	<p>Valves CT4 &amp; CT5 are set to previously saved brush pressures. Valve CT7 ramps to previously saved brush speed setting. Press G12 in transit mode for automatic sweep gear deployment on selection of workmode, H2b.</p>

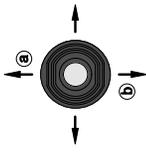
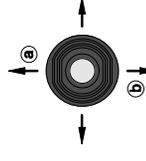
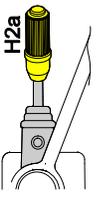
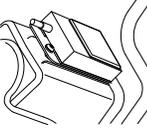
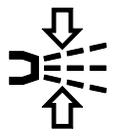
**CX/CN201 Modus Operandi**

4.	E8 	Suction Fan Only (Wanderhose)	Fan only switched on – CT17, CT18, CT21 = ON Fan only switched off – CT3b, CT15, CT18 = ON for 3 secs	Use switches G1 & G2 to raise & lower nozzle. When fan is switched off, nozzle lifts automatically. G11 = cancel.
5.	G11 	Sweep 'OFF'; cancels fan, brushes, water sprays and returns sweep gear to stowed position. Also cancels fan only mode. Press G11 in transit mode to cancel automatic sweep gear deployment.	@ 0 secs – CT14, CT15, CT17, CT18, CT21 = ON CT4 & CT5 = 100% CT7 = OFF @ 1 secs – CT1b, CT2b, CT3b = ON @ 6 secs – CT1b, CT2b, CT3b, CT14, CT15, CT17, CT18, CT21, CT4 & CT5 = 0% Water sprays disabled for sweep mode selection.	Slow brushes gradually. Current to valve CT7 ramp to zero %. Release CT7 slowly. (If fan only running, this will cancel function).
6.	E6 	Hopper Raise/Lower	Raise Hopper CT18, CT22 & CT24b = ON Lower Hopper CT18, CT22, CT24b = ON	Neutral selected, handbrake ON, Sweeping OFF. During hopper raise, engine increased by 100 RPM.
7.		Nozzle Hop; Up/Down	Lower nozzle (G1) CT6 = ON (remains on) Nozzle manual mode = OFF Raise nozzle (G2) Pulse – CT15 = ON, CT6 = OFF, nozzle manual mode = ON	Used during sweeping and fan only mode. Press G10 or G12 to cancel manual nozzle control, valve CT6 = will energise.

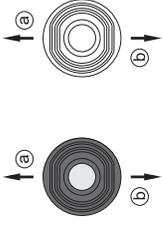
CX/CN201 Modus Operandi

8.	 G3 (Close) G4 (Open)	Nozzle Flap; Close/Open	Pulse CT3a (Open) Pulse CT3b (Close)	Used during sweeping and fan only mode.
9.	 G16c G16d	LH Brush Position; joystick left/right	CT1a (out) – G16d CT1b (in) – G16c	Position brush L – R as required during operation 2 or 3.
10.	 G17c G17d	RH Brush Position; joystick left/right	CT2a (out) – G17c CT2b (in) – G17d	Position brush L – R as required, during operation 2 or 3.
11.	 G5 G6	Brush Speed Increase/Decrease with G14 active (red LED on) 3 <sup>rd</sup> Brush Speed Increase/Decrease	CT7  CT33 0 – 100%	Apply current to CT7 to control brush speed.  Apply current to CT33 to control brush speed. Speed saved to memory.

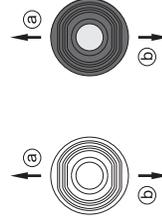
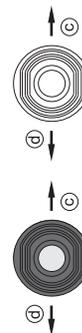
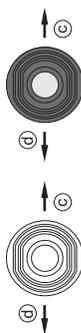
**CX/CN201 Modus Operandi**

12.	G16a G16b 	Brush Balance; Pressure Left Hand Brush	CT4 – increase current G16a CT4 – decrease current G16b	Apply current to CT4 to control brush balance. No operation for 6 seconds during un-parking sequence. (operations 2 & 3).
13.	G17a G17b 	Brush Balance; Pressure Right Hand Brush	CT5 – increase current G17a CT5 – decrease current G17b	Apply current to CT5 to control brush balance. No operation for 6 seconds during un-parking sequence. (operations 2 & 3).
13a.	H2a 	For reverse travel – lift nozzle..	CT15 De-energize CT6	When in operation 2 or 3 select reverse to lift nozzle.
14.	J1 	Reverse Lift; Nozzle override & brush scrub	De-energize CT15, re-energize CT6, only when reverse selected. De-energize CT4 & CT5 whilst depressed and continue for 8 seconds.	Return to last set brush balance pressure after 8 seconds.
15.	E3 	Supawash	CT18 & K (remote)	Work mode only with or without fan running, not whilst sweeping.

CX/CN201 Modus Operandi

16.	G11 	With G14 active.	CT34a & CT34b = OFF	
17.	G13 	With G 14 active; press G13 to engage clockwise brush rotation.	CT34a = OFF CT34b = ON	
18.	G15 	With G14 active; press G15 to engage anti-clockwise brush rotation.	CT34a = OFF CT34b = ON	
19.	G14 	Select G14 to activate 3 <sup>rd</sup> brush mode.		
20.	G16a + G16b 	3 <sup>rd</sup> Brush Arm – Raise & Lower.	Direction a (lower) CT41 = ON Direction b (raise) CT40 = ON	

**CX/CN201 Modus Operandi**

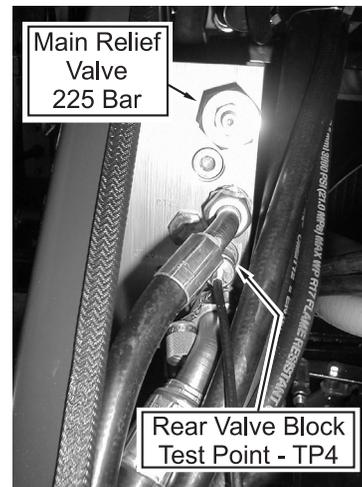
21.	 <p>G17a + G17b</p>	<p>3<sup>rd</sup> Brush Head – Tilt Forwards/Backwards.</p>	<p>Direction a (forwards) CT38a=ON Direction b (backwards) CT38b)=ON</p>	
22.	 <p>G16c + G16d</p>	<p>3<sup>rd</sup> Brush Arm – Slew Left/Right.</p>	<p>Direction c (left) CT35b = ON Direction d (right) CT35a = ON</p>	
23.	 <p>G17c + G17d</p>	<p>3<sup>rd</sup> Brush Head – Wrist Angle Clockwise / Counterclockwise</p>	<p>Direction c (cw) CT39b = ON Direction d (ccw) CT39a = ON</p>	

## Test Point Function Table

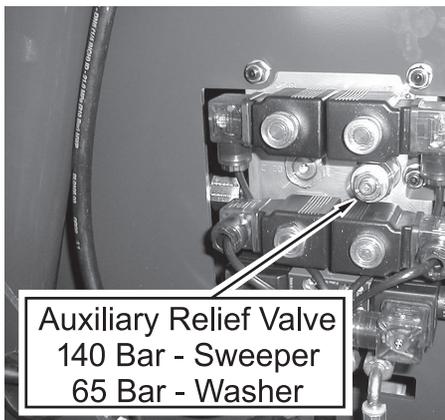
Test Point	Location	Function
TP1	Purge Valve	Forward
TP2	Purge Valve	Reverse
TP3	Transmission Pump	Boost
TP4	Rear Valve Block	Main System Pressure
TP5	Front Valve Block	Brush Control
TP6	Fan Motor Block	Input
TP7	Fan Motor Block	Output
TP8	Water Valve Bank (Washer)	Water Pressure
TP9	3rd Brush Primary Block	Pressure Relief

### To Set/Check Main Relief Valve

1. Start engine and raise hopper.
2. Engage workmode, set engine speed to 1500 rpm (sweeper) or 1600 rpm (washer).
3. Press Menu button on CANview screen, scroll down to Service Menu and press Enter.
4. Select 'Set System Pressure' and press enter. Follow screen prompts. Only adjust valve pressure once ten seconds has elapsed.
5. Adjust main relief valve (CT16), if necessary, on rear valve block to set pressure to 225 bar ( $\pm 2$ ). Select 'Set System Pressure' on the CANview screen to recheck valve pressure.
6. Disengage work mode.



### To Set/Check Auxiliary (Hopper/Tank) Relief Valve



1. Start engine and raise hopper.
2. Engage workmode, set engine speed to 1500 rpm (sweeper) or 1600 rpm (washer).
3. Press Menu button on CANview screen, scroll down to Service Menu and press Enter.
4. Select 'Set Hopper/Tank Pressure' and press enter. Follow screen prompts. Only adjust valve pressure once ten seconds has elapsed.
5. Adjust auxiliary relief valve (CT19), if necessary, on rear valve block to set pressure to 140 Bar ( $\pm 1$ ) for a sweeper or 65 Bar ( $\pm 1$ ) for a washer. Select 'Set Hopper/Tank Pressure' on the CANview screen to recheck valve pressure.
6. Disengage work mode.

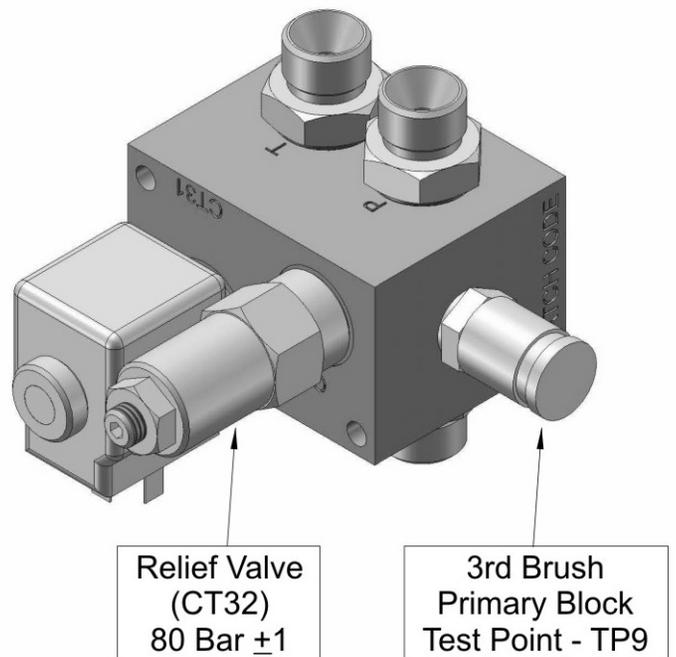
**To Set/Check Brush/Spraybar Relief Valve**

1. Start engine and raise hopper.
2. Engage workmode, set engine speed to 1500 rpm (sweeper) or 1600 rpm (washer).
3. Press Menu button on CANview screen, scroll down to Service Menu and press Enter.
4. Select 'Set Brush/Spraybar Pressure' and press enter. Follow screen prompts. Only adjust valve pressure once ten seconds has elapsed.
5. Adjust relief valve (CT26), if necessary, on front valve block to set pressure to 60 Bar ( $\pm 1$ ) for a sweeper or 65 Bar ( $\pm 1$ ) for a washer. Select 'Set Brush/Spraybar Pressure' on the CANview screen to recheck valve pressure.
6. Disengage work mode.



**3rd Brush Relief Valve**

1. Start engine and raise hopper.
2. Attach lead from pressure gauge to TP9 on 3rd brush primary hydraulic block.
3. Engage workmode, set engine speed to 1500 rpm.
4. Pressure reading should be 80 Bar  $\pm 1$ .
5. Adjust relief valve (CT32), if necessary, on 3rd brush primary hydraulic block to set pressure to 80 Bar  $\pm 1$ .
6. Disengage work mode.

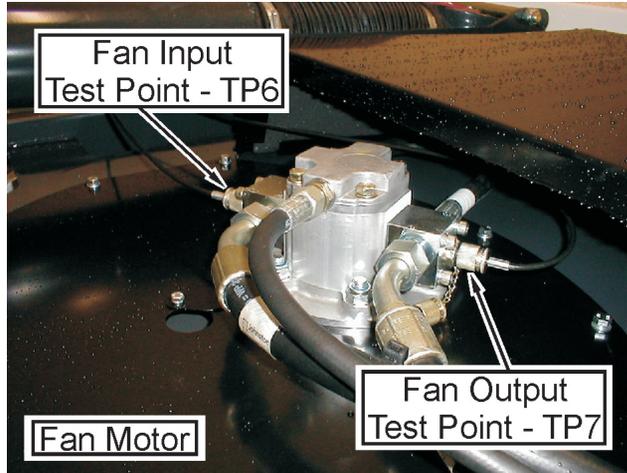


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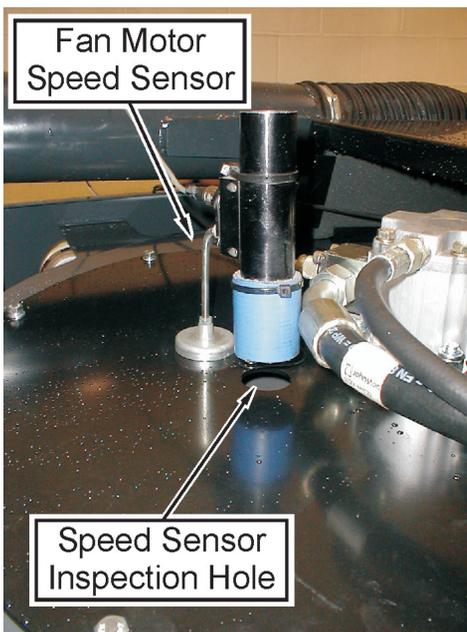
## To Check Fan Motor Pressure & Fan Speed (Sweeper Only)

### Fan Motor Pressures

1. Start engine.
2. Attach lead from pressure gauge to input test point of fan motor block.
3. Check Fan Motor Input pressure, should be between 170 - 190 Bar.
4. Remove lead from input test point and attach to output test point
5. Check Fan Motor Output pressure, should be between 60 - 80 Bar.
6. Disconnect lead from test point and switch off engine.

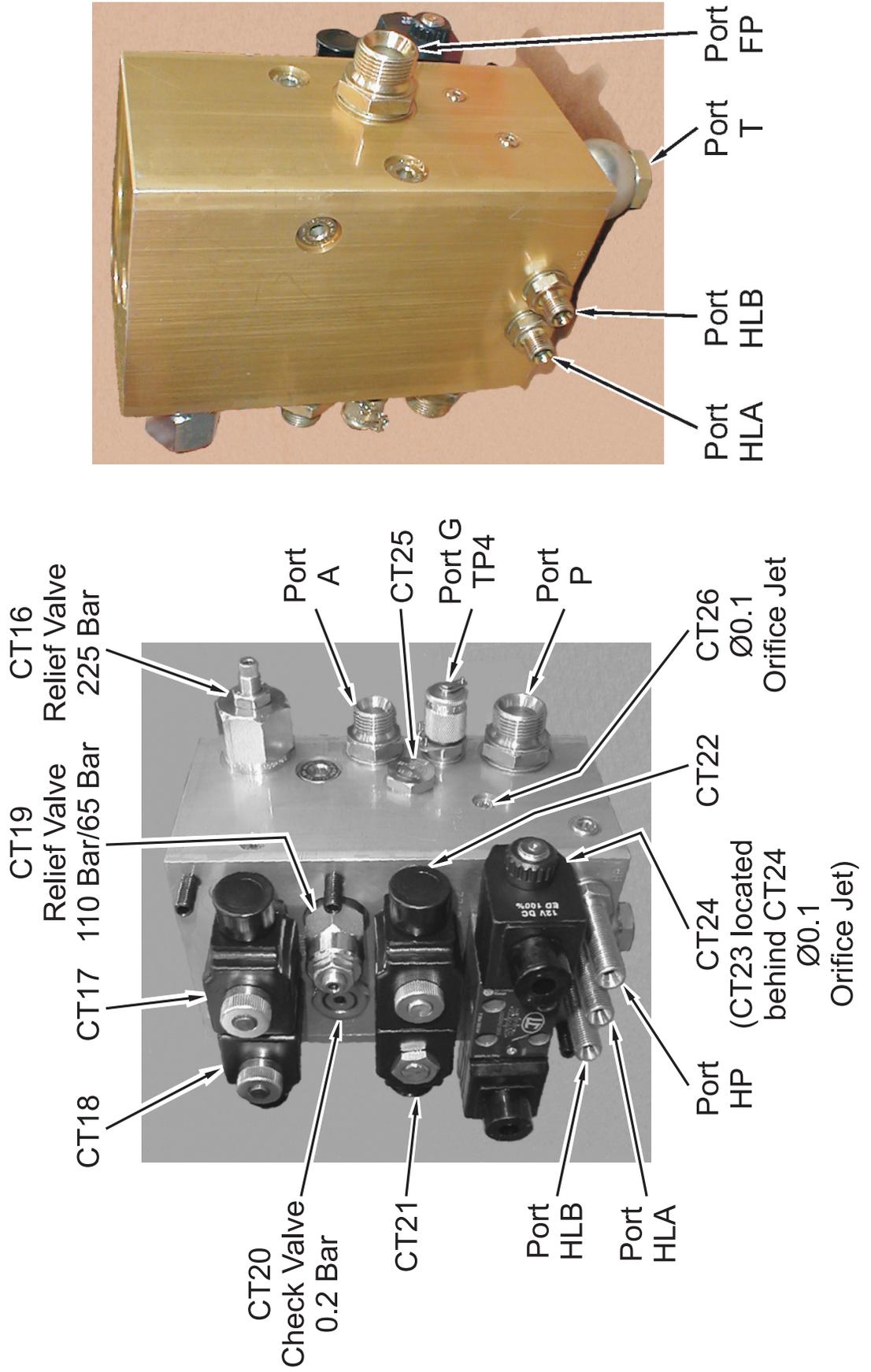


### Fan Speed



1. Start engine.
2. Attach fan speed sensor, optical tachometer or similar device.
3. Check fan speed, should be between 2600 - 2900 rpm.
4. Switch off engine.

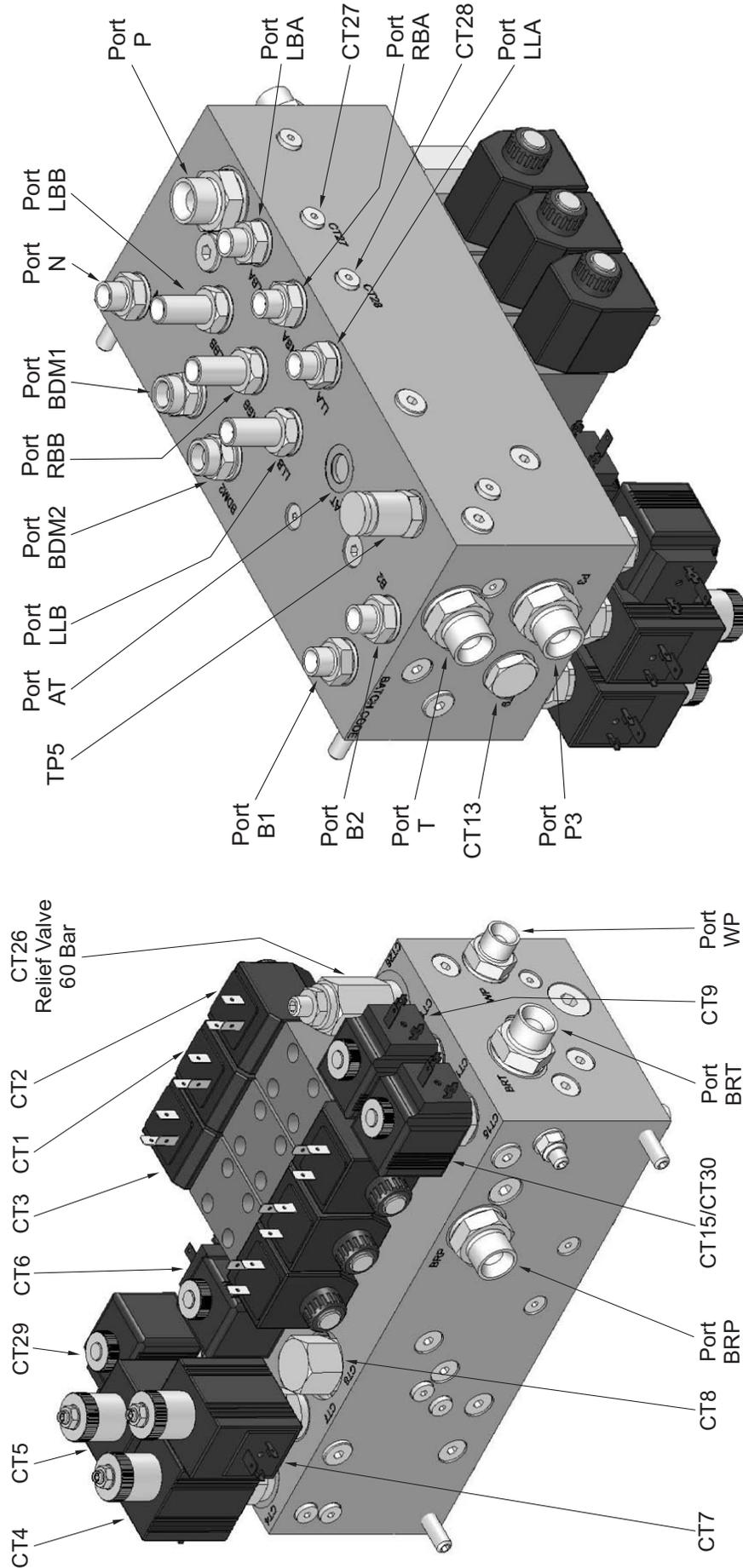
**Hydraulic Control Manifold (Rear Valve Block - Part No. 75755-1)**  
**Valve & Port Identification**



**Sweep Control Manifold (Front Valve Block)**

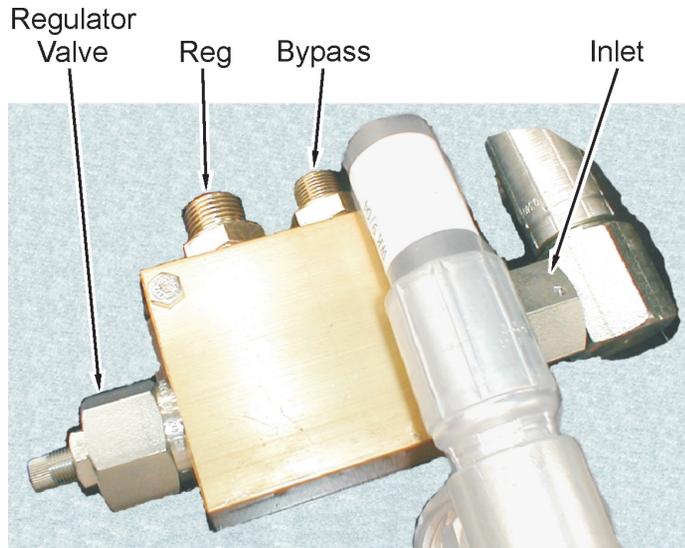
Part No. 722391-1

**Valve & Port Identification**

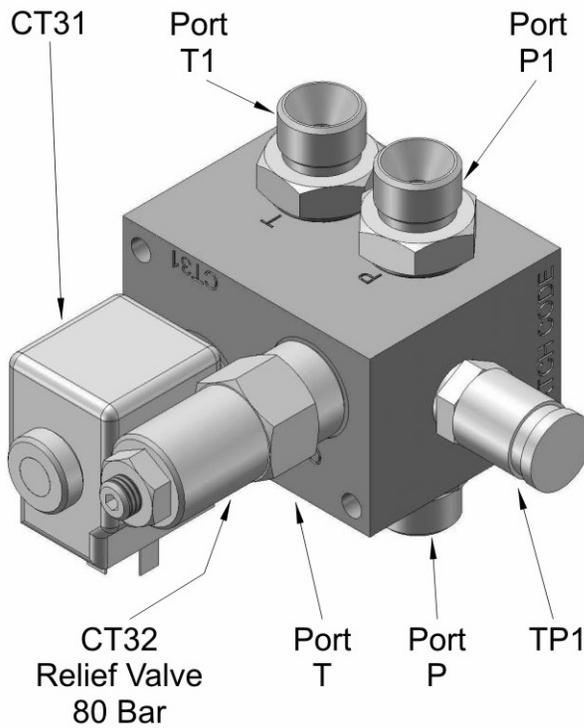


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**Flow Regulator - Valve & Port Identification**  
(Part No. 70625-1)

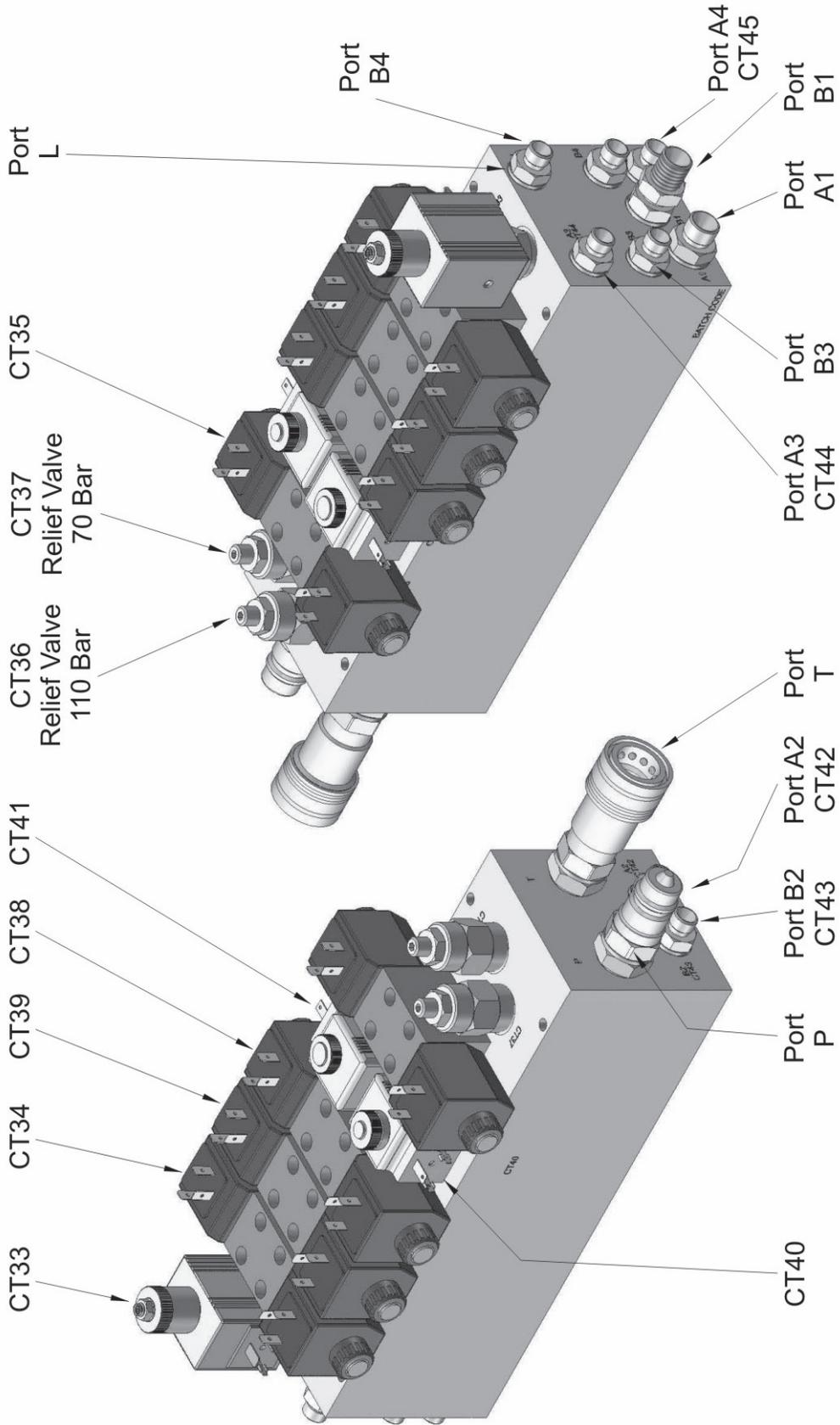


**3rd Brush Primary Block - Valve & Port Identification**  
(Part No. 7005188)



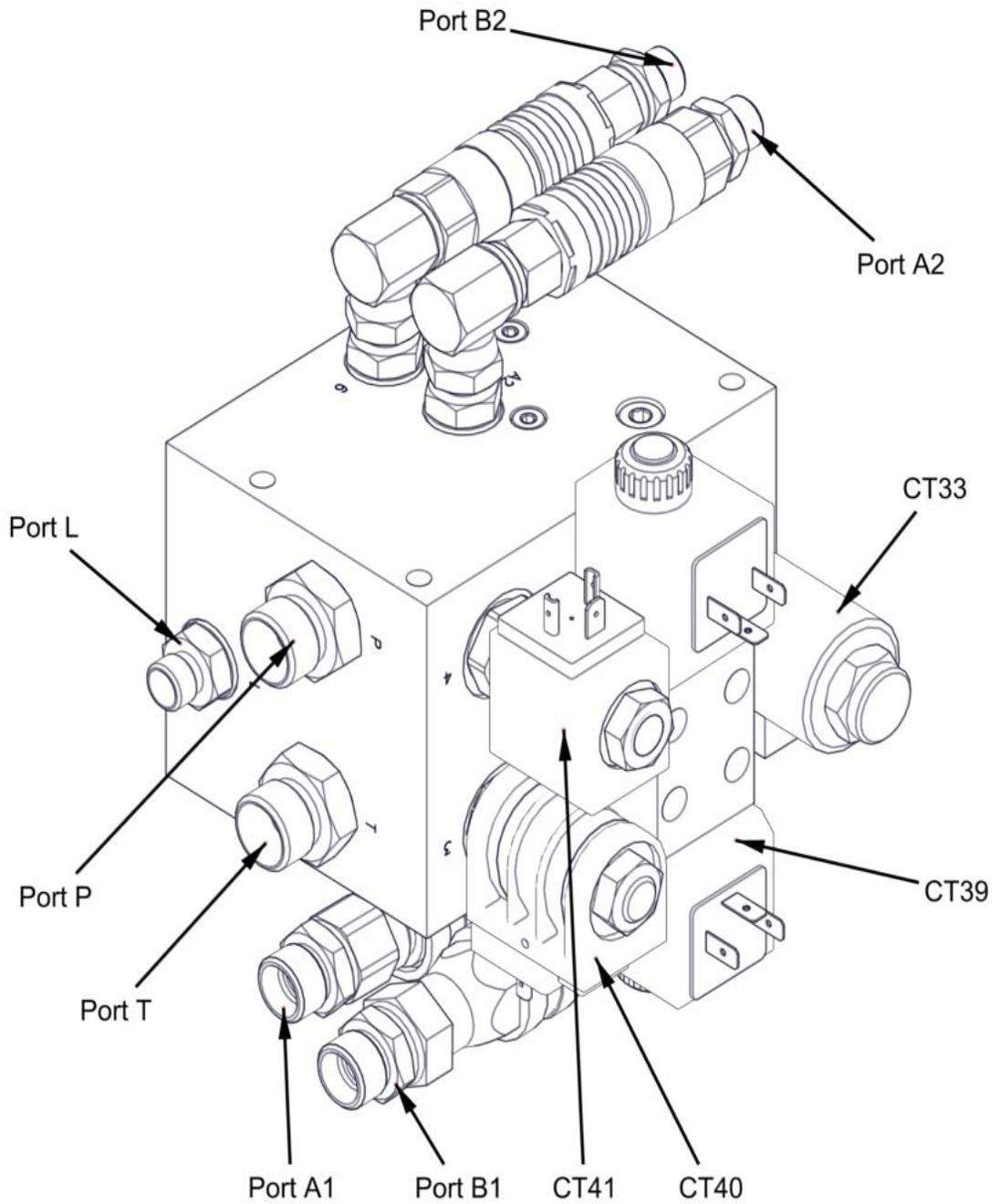
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**3rd Brush Secondary Block - Valve & Port Identification**  
(Part No. 7005371)



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Winter Equipment Block - Valve & Port Identification  
(Part No. 7025914)



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CHAPTER

3

Electrical System

**Table of Contents**

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J-Plex Input/Outputs	3 : 4
How to update control system software	3 : 5
Data capture download	3 : 6

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## Engine Control - CANbus J1939

CAN stands for Controller Area Network. It represents dedicated wiring that connects the control units of a vehicle (ECU), so as to create a structure similar to that of the nervous system. For the C201 sweepers the J1939 CANbus connects the engine ECU to the Tx5 control unit allowing control of engine RPM and other engine data to be exchanged.

The system permits the vehicle's various on-board electronic systems to instantaneously exchange huge amounts of data.

It represents a two-way communication system that is widely used in vehicles, mainly due to the reduction in the number of conductors and the amount of interference.

Information travels according to a specific protocol that defines the dialogue mode.

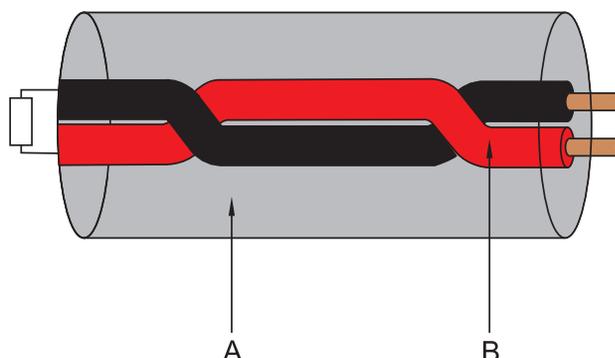
- Information synchronisation.
- Call and answer modes between the various systems.
- Identification and correction of any transmission errors.

### CAN Line Setup

The cable used for the engine 'CAN' line fitted on the vehicle is a twisted pair of cables (B).

It has these characteristics in order to eliminate any electrical disturbance on the signals.

The sheathing (A) is grey in colour.



### CAN Line Efficiency Tests

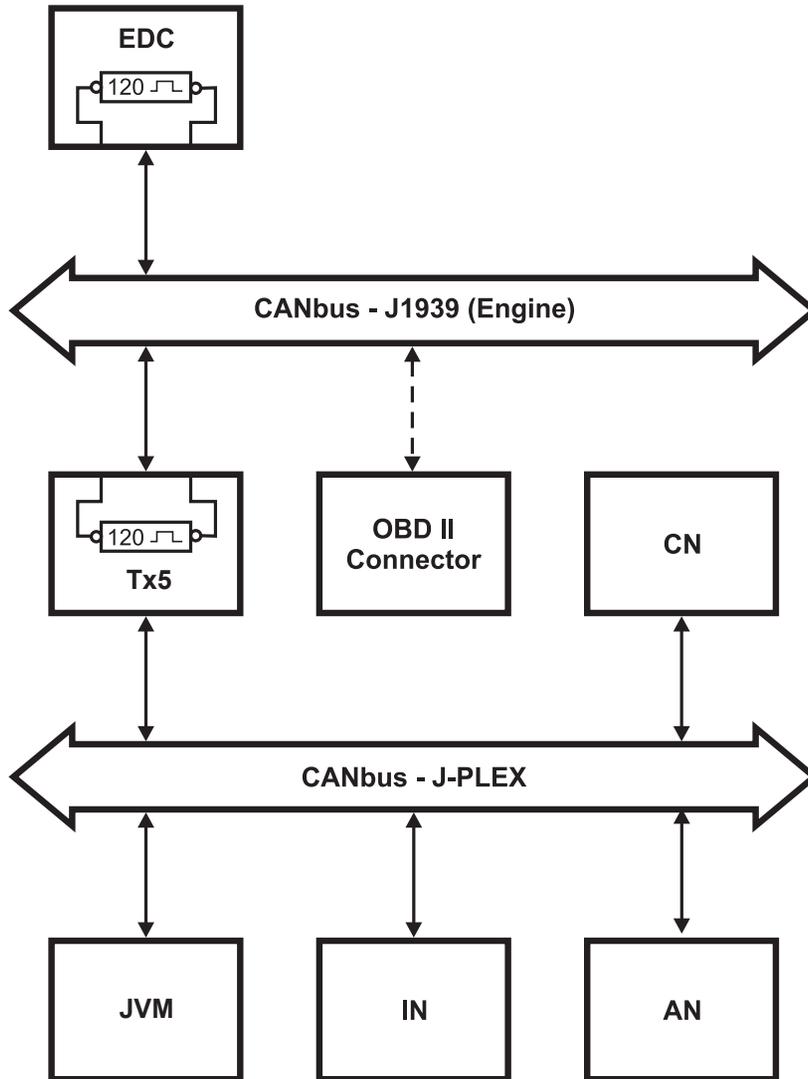
In order to check the state of efficiency of the CAN line on the vehicle, certain measurements must be taken.

In order to take these measurements, connect to pins 6 and 14 of the diagnosis connector and detect the following;

#### Values to be detected during measurements (VBD)

<b>0 Ω</b>	<b>~60 Ω</b>	<b>~120 Ω</b>	<b>0.L.</b>
CAN line short-circuited	CAN line OK	One resistor broken	CAN line interrupted

VDB (Vehicle Data Bus) Communication Line Schematic



List of VDB (Vehicle Data Bus) Control Units

Reference	Description
EDC	Engine Management Control Unit
CAN	Controller Area Network
<b>Tx5</b>	<b>Transmission Controller</b>
OBD	On Board Diagnostics
CN	Chassis Node
<b>JVM</b>	<b>Johnston Visual Module</b>
IN	Internal Control Node
AN	Arm Rest Node

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**For C201 electrical circuits please refer to the following document;**

C201 Electrical Circuits\_7010425\_revD\_BW

**For C201 input / output lists please refer to the following document;**

C201 E5\_T3 IO List\_7032996\_RevA.pdf

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**How to update control system software**

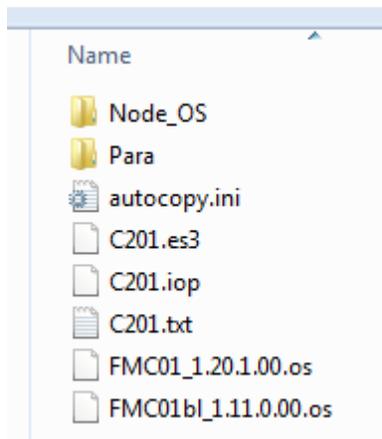
**Step One: Prepare USB Flash Drive**

- 1.1. Download the “C201\_SwPack\_x.zip” from the email onto your PC. The last digit of the file name will indicate the Software Pack Revision level. For example C201\_SwPack\_G.zip = Revision level G.
- 1.2. Unzip the file: “C201\_SwPack\_x.zip”
- 1.3. Erase ALL data contained on the USB Flash drive (Part No: 7022225).



**Figure One: JSL USB Flash Drive**

- 1.4. Add the contents of the folder “C201\_SwPack\_x.zip” to the USB flash drive.
- 1.5. Check to ensure that the USB flash drive file structure is identical to the image shown in Figure Two.



**Note:** The following two files may change when a new software pack is compiled from the versions shown in Figure Two: FMC01\_1.17.1.07.os, JVM4xxbl\_1.09.0.00.

**Figure Two: File Listing On USB Stick**

**Step Two: Software Download**

- 2.1. Ensure the ignition is off.
- 2.2. Carefully open the rubber cover on the front of the JVM to expose the USB port.
- 2.3. Insert the USB flash drive into USB port.
- 2.4. Press and hold buttons F1 & F3 on the display;



- 2.5. Switch on the ignition
- 2.6. Release buttons F1 & F3 when the following text appears;

*“start operating system in STOP mode”*



2.7. Software will now download from the USB flash drive automatically.

Note: Software download can take up to 10 minutes depending on the size of the update.

**\*\*\*\*Never switch off the ignition during the download process\*\*\*\***

2.8. Once the software download is complete the following message will appear;

*“Press any key or touch screen to continue”*

Press any of the JVM buttons to continue.

2.9. The JVM will now reboot.

2.10. Continue to step three.

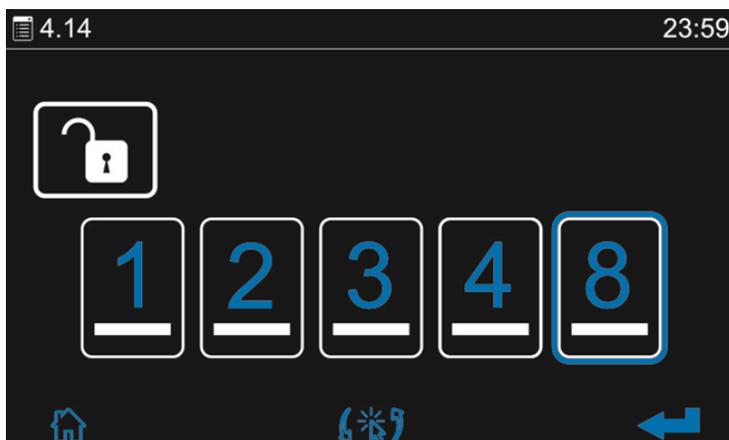
**Step Three: Passcode Entry**

3.1. Press button F3 to access the Main Menu 4.0.



**Figure Three: Menu 4.0 Main Menu**

3.2. Select Menu 4.14 – Security



**Figure Four: Menu 4.14 System Security**

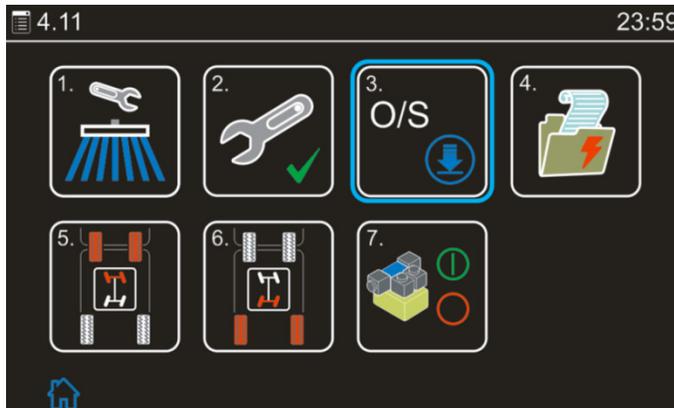
3.3. Enter the “Service” passcode: 88335.

3.4. Press the ‘enter’ key (F4) to complete the passcode entry.

3.5. Exit from the menu.

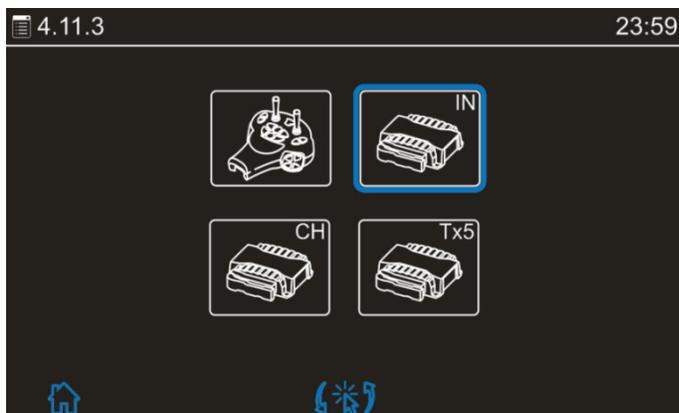
**Step Four: Operating System (OS) Update**

- 4.1. Go to Menu 4.11 – Service, and select option 3, OS Downloads.



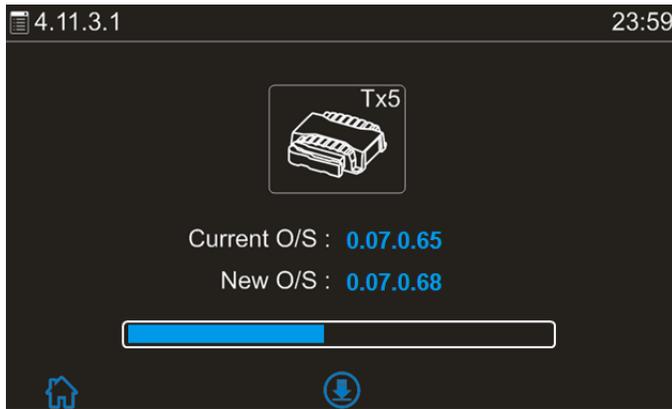
**Figure Five: Menu 4.11 Service**

- 4.2. Move the blue halo and select the Internal Node (IN).



**Figure Six: Menu 4.11.3 OS Downloads**

- 4.3. Compare the “Current OS” version with the “New OS” version numbers. If the OS version numbers are different, then the Node OS must be updated.



**Figure Seven: Menu 4.11.3 Tx5 OS Download**

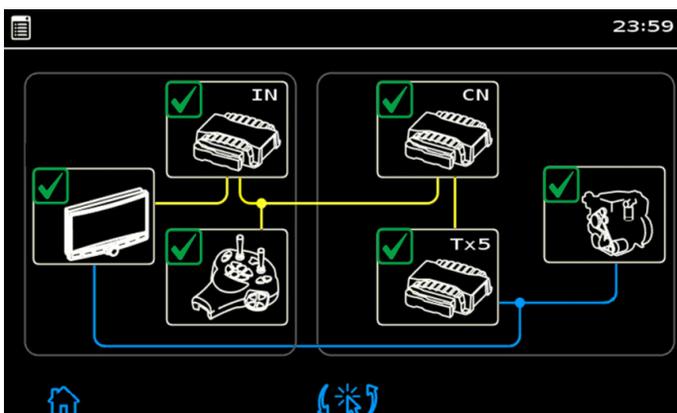
- 4.4. To download the “New OS”, press the centre button on the JVM to start the OS update. The blue bar will indicate the progress of the download.

**\*\*\*\*Never switch off the ignition during the download process\*\*\*\***

- 4.5. Once the green tick appears, the OS download is complete.
- 4.6. Repeat the process for the Chassis Node (CN) and the Tx5 Node.
- 4.7. Once all OS Updates are complete, exit from the Menus and switch off the ignition.
- 4.8. Wait one minute and then switch on the ignition.
- 4.9. Wait a further minute to allow all updates to be processed.
- 4.10. Remove USB stick from the JVM display.

### Step Five: Clear Emergency Codes

- 5.1. Go to Menu 4.2 – CANbus Information.



**Figure Eight: Menu 4.2 CANbus Information**

5.2. Select the Sub Menu for the Internal Node (IN).

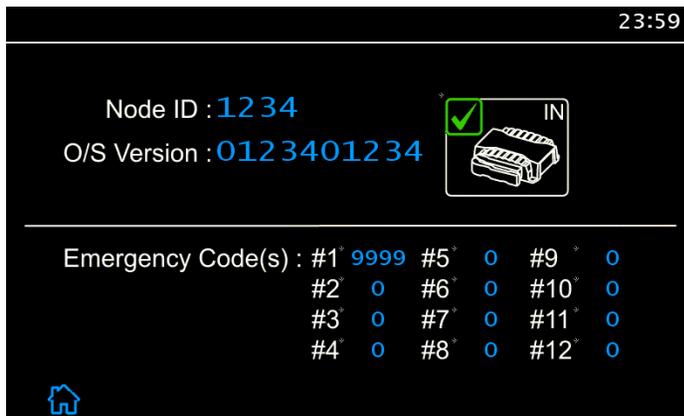


Figure Nine: Menu 4.2.4 Internal Node (IN)

5.3. Press and hold the following buttons for five seconds to clear the codes:

CRUISE CONTROL (On Palm) + JVM BUTTON F4



5.4. Repeat the process for the Chassis Node (CN) and the Transmission Node (TX5).

5.5. Switch off the ignition.

5.6. The JVM software update is now COMPLETE.

## Data Capture Download

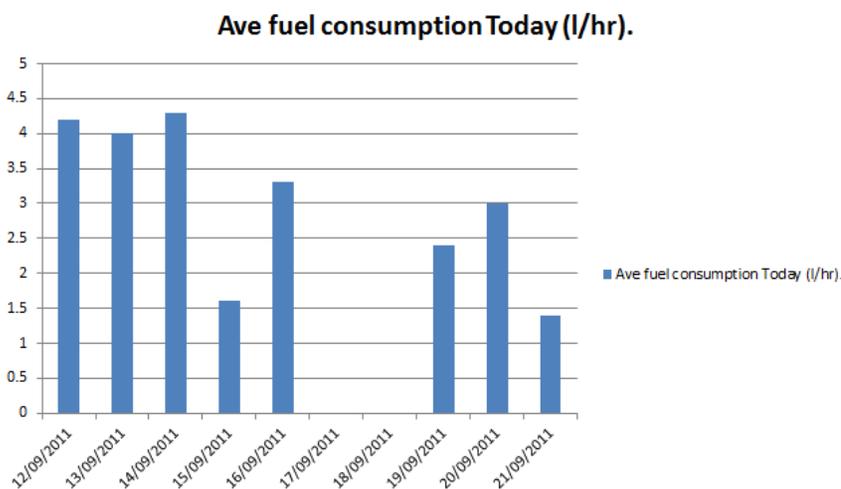
The C201 has a standard feature of 'Data Capture'. Data capture allows the vehicle operator or fleet manager to view or download data logged information directly onto a Johnston USB stick and download onto any PC.

Customer benefits of data capture are;

- Allows fleet managers/operators of C201 machines to monitor how individual C201 machines are operated and identifies which machines are operating efficiently through work mode engine RPM, fuel economy and other data values.
- The data capture values are; Total engine hours; Engine hours today; Total engine hours in work mode; Engine hours in work mode today; Total distance travelled; Distance travelled today; Total distance travelled sweeping; Distance travelled sweeping today; Average workmode RPM; Average workmode RPM today; Average workmode speed; Average workmode speed today; Avg Fuel Consumption to Date; Avg fuel consumption today; Avg workmode fuel consumption to date; Avg workmode fuel consumption today; Hours at last service; Hours until next service.

NOTE : Some data capture values are excluded from the Stage 3a engine choice.

- It allows fleet managers/operators to easily manage servicing. The data capture file records the "Engine Hours At Last Service" and "Engine Hours Until Next Service" allowing quick identification of required servicing by analysis of the data capture files.
- Data capture files can provide a full history of machine operations from servicing requirements to distance travelled on a daily basis.
- Maximum number of data capture records = typical 3000 entries. This equates to over 8 years of daily records.
- Data capture files can be exported to an Excel document and visual results displayed in the format of a graph etc.



CHAPTER

**4**

**Water System**

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To Set Water Flow Rate	4 : 4
To Set/Check Pump Pressure (HP Jetting Option)	4 : 4
Lost Water Spray Circuit	4 : 5

## Maintenance & Adjustment Instructions (refer to Operator's Guide for Additional Information)

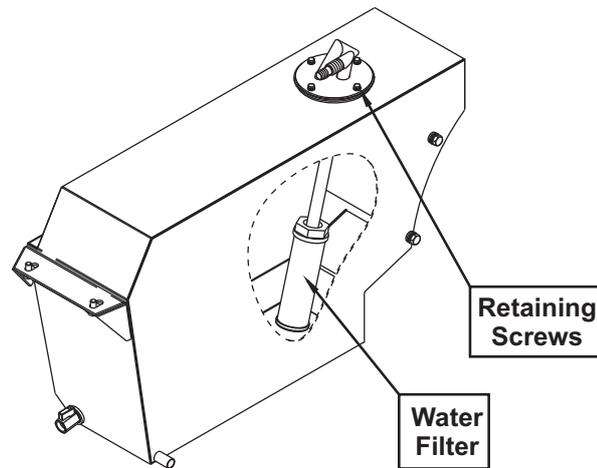
The water system comprises of two circuits:

1. Lost Water System
  - A. Dust suppression for sweeping.
  - B. High Pressure Washer.
2. Recirculation Water System

### Lost Water System

#### Filter

The filter may be cleaned and inspected by removing the nine bolts retaining the suction tube assembly.

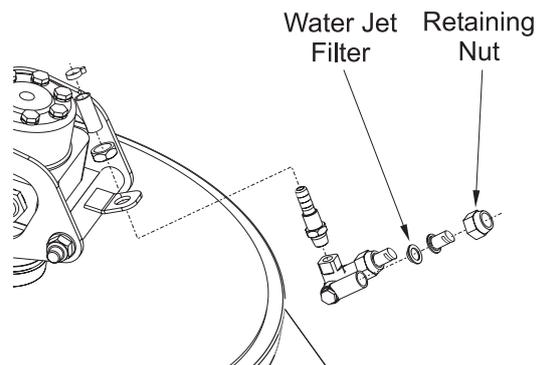


#### Pump

Located under the RH seat, it is controlled by an intergral electrical motor. Normal operating pressure is 3 - 4 Bar.

#### Spray Jets

In order to prevent the water spray jets from blocking, small strainers are fitted behind each jet. If for some reason the jets do become blocked, the strainers and jets can be removed by loosening the nut retaining each jet and cleaning in water.



## Supawash

Supawash is operated using the centre panel mounted rocker switch, ensuring first that, the machine is in neutral and at tickover. Running the engine any faster whilst using the Supawash equipment may cause permanent damage to the motor.

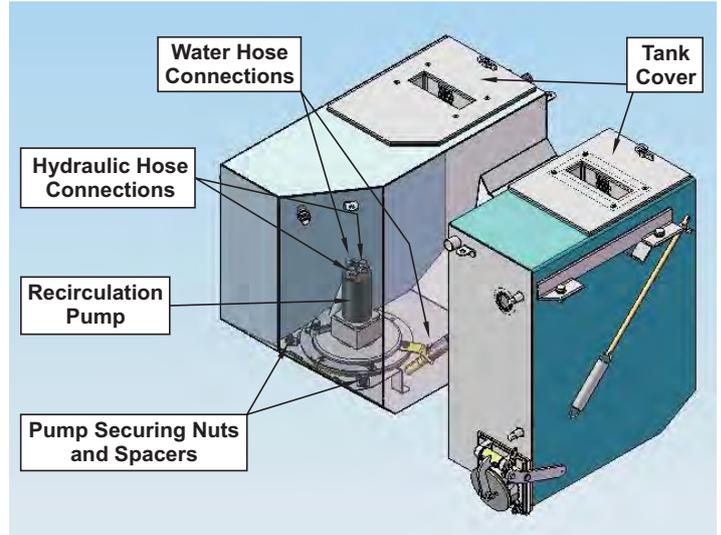
## Recirculation System

### Removal

The recirculation pump is located in the recirculation tank. To remove this the hopper must be raised and the hinged ram props put into position. Remove the recirculation water tank cover and disconnect the water hoses from the pump and the two hydraulic pipes. Keep the hydraulic pipes above the tank level to prevent oil from siphoning from the hydraulic tank or, connect the two pipes together with a 3/8" straight connector. The pump may then be unbolted from the side of the recirculation tank and removed.

### Refitting

The refitting of the recirculation pump is effected in the reverse of removal. Ensure the pump is piped correctly before using the machine.

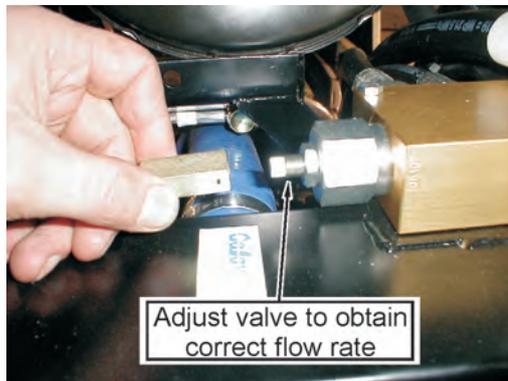
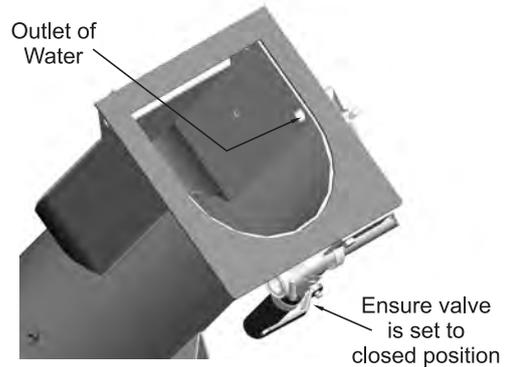


### Flow Regulator Water Pump/Brush Motors

A flow regulator is provided at the rear of the machine to divide the oil from the fan motor to drive the recirculating water pump and brush motors. This is set during the test procedure (see chapter 14) and will only require resetting if replaced. Under no other circumstances should this be tampered with; otherwise damage to the water pump may occur.

### To Set Water Flow Rate

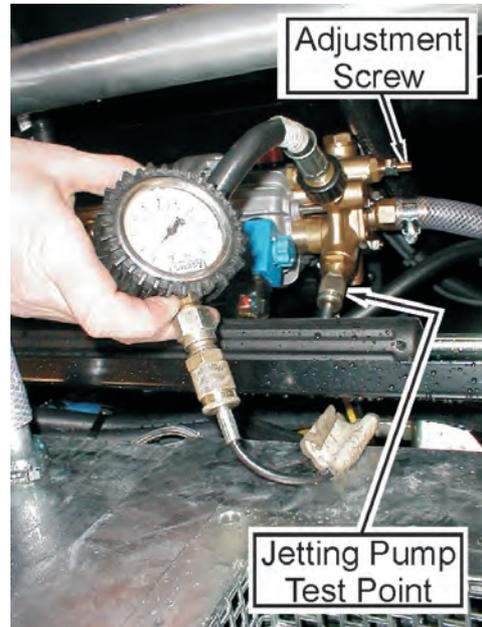
1. Ensure recirculation water tank and lost water tanks are filled.
2. Start engine and engage work mode.
3. Activate green sweep button on arm rest controller, allow machine to settle.
4. With hopper in raised position observe the flow of water falling into the suction tube . Water must be flowing down the centre of the main suction tube.



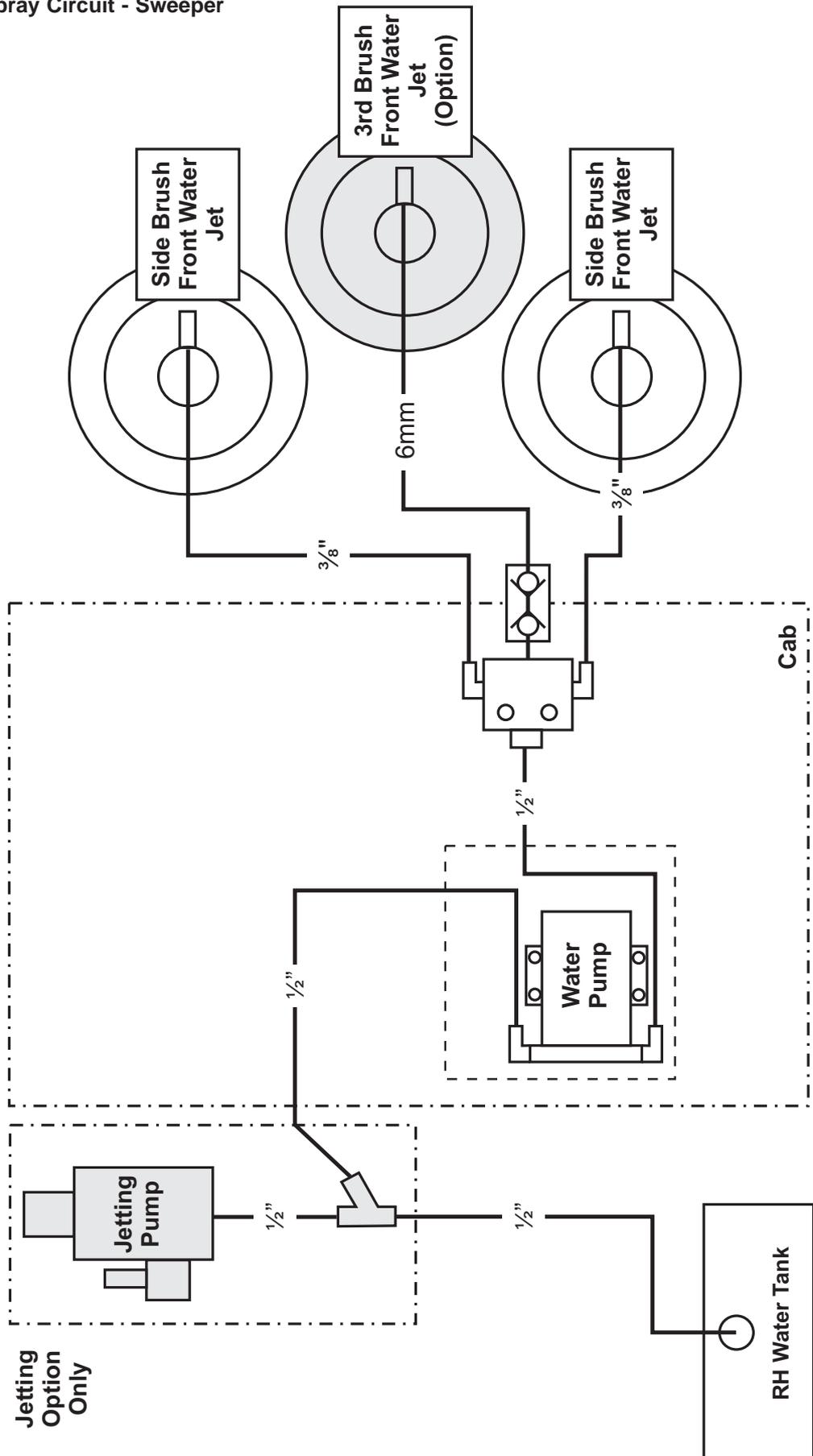
5. Remove cap from flow regulator to access centre screw.
5. Adjust centre screw of flow regulator by undoing lock nut and winding screw in for more flow.
6. Disengage sweep/work mode mode, switch off engine.
7. Refit cap to flow regulator block.

### To Set/Check Pump Pressure (Supawash Option)

1. Remove jetting gun from holster.
2. Attach lead from pressure gauge to test point.
3. Start engine and engage work mode.
4. Activate supawash option using button on centre console.
5. Point jetting gun in a safe direction, pull trigger and note what pressure the gauge goes to. Supawash pressure is set at 1000PSI  $\pm$  20.
6. Adjust pressure using adjuster screw on side of the jetting pump. Once adjustment is complete separate lock nuts and wind them all the way to the base of the adjuster screw to lock it.
7. Return gun to holster and switch off supawash.



Lost Water Spray Circuit - Sweeper



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CHAPTER

5

Wearing Items

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Suction Head Slide	5 : 3
Suction Head Skids/Wheels	5 : 4
Side Brushes	5 : 5
Hopper Entry Duct	5 : 5
Flap Housing	5 : 5



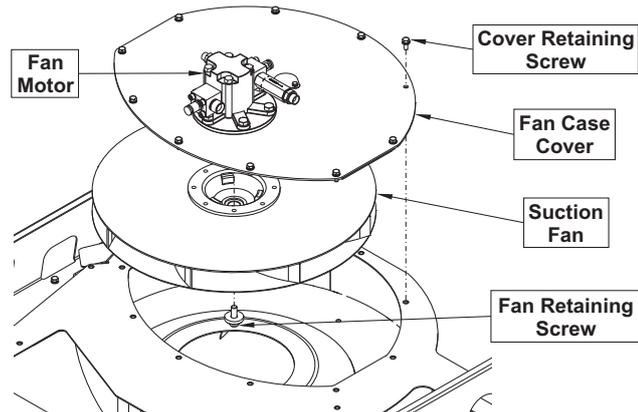
The hinged props located at each hopper ram mounting must be used at all times to prop the hopper when carrying out any inspection, servicing or maintenance work beneath the hopper.

To prevent damage to electrical components, the battery and alternator leads must be disconnected before carrying out any re-work to the electrical system, or before starting electrical welding to any part of the vehicle.

## Suction Fan

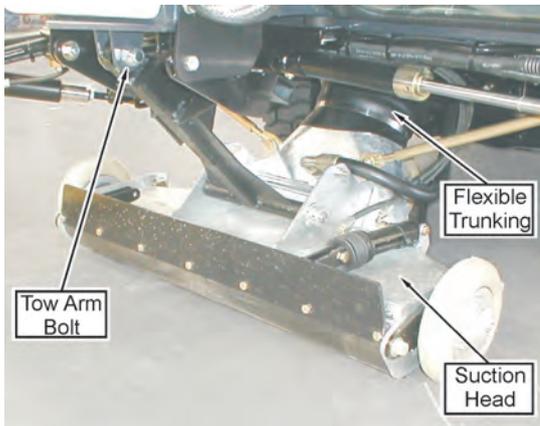
**Removal:** Remove hose connectors from fan motor on roof of hopper, mopping up any spilt oil. Remove the ring of screws holding the fan case cover plate to the fan case and lift out complete fan drive assembly. The fan can then be removed by undoing the retaining screw and pulling clear of the shaft, ensuring the shaft key is not lost.

**Refit:** Lightly smear the fan shaft with grease, refitting is then the reversal of the removal procedure. Torque fan retaining screw to a figure of 200 Nm.



## Suction Head and Flexible Intake Ducting

### Suction Head



**Removal:** The suction head is best removed by first lowering it together with the brushes, which should be positioned to their full outward position. This can be done by stopping the engine with the sweep gear engaged in the work position. The suction head can then be removed by removing the bolt holding the tow arm to the cab and loosening the worm drive hose clip on the flexible trunking.

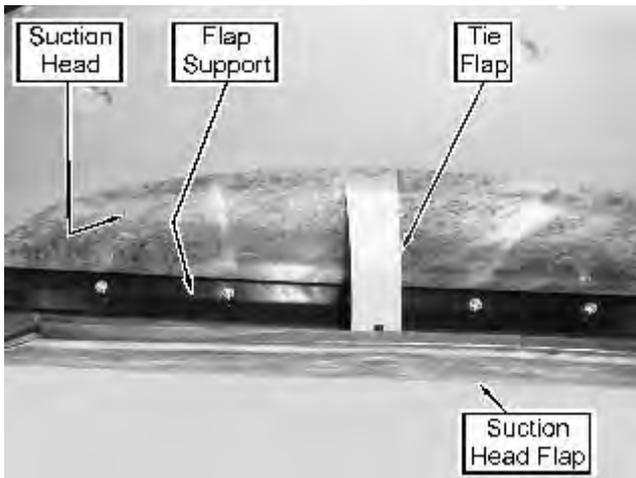
**Refit:** Refitting the suction head is the reverse of the removal procedure. Ensure the trunking is not twisted or rucked and does not foul anything when the nozzle is raised and lowered. Failure to observe this precaution can cause premature wear.

### Flexible Intake Trunking

**Removal:** This trunking is located underneath the cab and connects the suction head to the steel intake duct. Removal is effected by first removing the suction head, (see suction head removal), once the suction head is removed the trunking can be removed by loosening the worm drive hose clip at the lower end of the intake duct.

**Refit:** Loosely fit the worm drive clips to each end of the trunking and refit to the intake tube, securing the worm drive clip at the upper end once positioned. The suction head may then be refitted, (see suction head refitting).

## Suction Head Flap



**Removal:** At the frontal end of the suction head is a large rubber flap which is secured by seven bolts, a clamp plate and flap support. A tie flap is attached at the inner end to control the position of suction head flap, the tie flap is secured by screw fasteners. The purpose of the rubber flap is to produce an effective air stream to collect any swept material. The rubber flap being flexible adjusts automatically to working conditions.

All of these items are easily removed by first removing the suction head, (see suction head removal), and then the tie flap which is secured to the upper panel of the suction head and the inner end of suction head flap. The seven bolts holding the clamp plate and suction head flap to the flap support may then be

released and the flap removed. The flap support may also be removed, if required, by releasing the seven additional bolts holding it to the suction head.

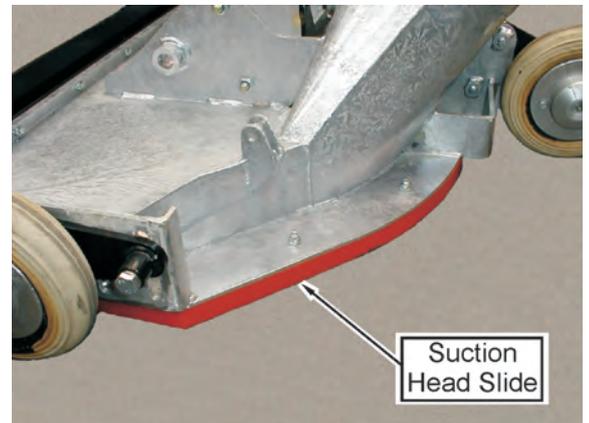
The flap support gives the rubber suction head flap additional resistance to flexing. If the flap support is not fitted a loss of suction performance may result, and therefore the component should be kept in good order.

**Refitting:** Is effected in the reverse of the removal procedure. Care must be taken that all parts are replaced. The suction head should then be refitted, (see suction head refitting).

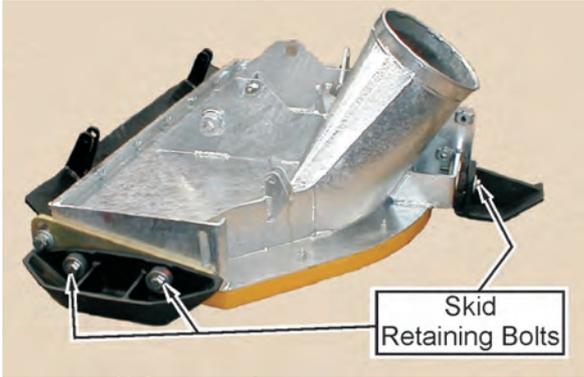
## Suction Head Slide

**Removal:** The suction head slide is located around the rear of the suction head and is manufactured from polypropylene. To remove the slide, the suction head must first be removed from the machine, (see suction head removal). The suction head must be overturned and by releasing the seven countersunk 8mm screws, the slide may be removed.

**Refitting:** This is done by placing the slide on the suction head and re-securing the screws, taking care not to over tighten them, which can have the effect of pulling the screw head through the material.



### Suction Head Skids/Wheels

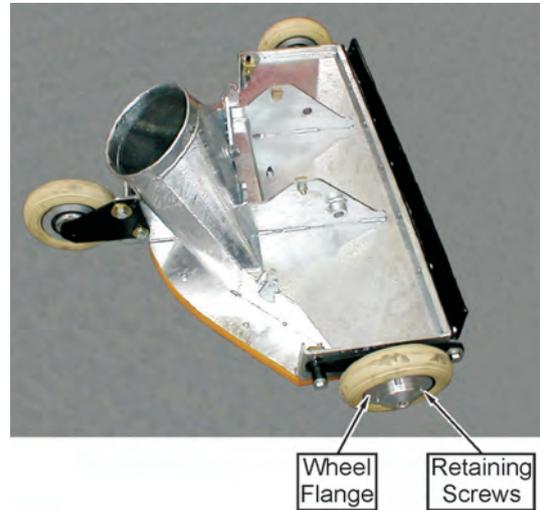


#### Suction Head Skids

There are three suction head skids one at the rear and one either side of the suction head. These can be removed and adjusted without removing the suction head from the machine. Each skid is held on by two nyloc nuts and bolts and the skid is adjusted by releasing the nuts and adjusting in the slots provided.

#### Suction Head Wheels

There are three suction head wheels, one at the rear and one either side of the suction head. The tyres can be removed without removing the suction head from the machine. Each wheel rubber tyre is held on by three retaining screws  $\frac{1}{4}$ " UNC and a wheel flange. By releasing the retaining fixings and flange the tyre may be removed.



When refitting the skids/wheels/tyres make sure they are adjusted so that there is a 5 - 10 mm air gap between the sweeping surface and the suction head slide, see Operator's Guide for further details.

**Side Brushes**



**Removal:** It is preferable to have the brushes in the working position and stationary. This is effected by stopping the engine with the sweep gear engaged. Release the four nuts from the bolts securing the brush stock to the driving plate, remove brush.

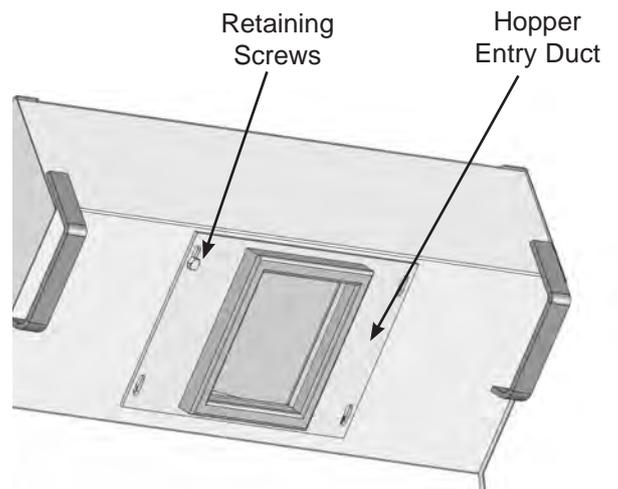
**Refitting:** Refitting of the brush is the reverse of the removal procedure.

See Operator's Guide for details on Brush Settings.

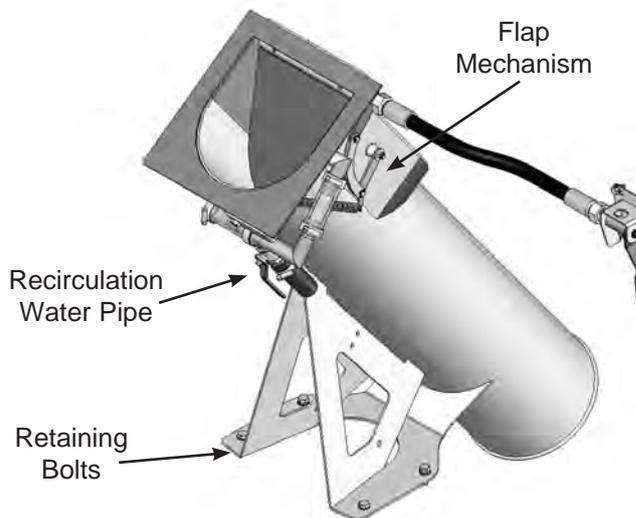
**Entry Duct**

**Removal:** The entry duct is located in the intake to the hopper. To remove the duct the hopper should be in the raised position, with the hopper props in place. The entry duct may then be released by removing the four retaining bolts, and withdrawing the duct.

**Refitting:** Refitting of the entry duct is the reverse of the removal procedure.



**Flap Housing**



**Removal:** The flap housing is located between the flexible intake trunking and the hopper entry duct. To remove the housing the hopper should be raised with the hopper props in place. Remove nozzle trunking as described previously. Disconnect flap operation mechanism. Disconnect recirculation water pipe. Remove four bolts retaining housing to chassis. Lift upwards to remove.

**Refitting:** Refit procedure is the reverse of the removal procedure. Firstly, fit the flap operation mechanism ensuring it is greased and lubricated prior to fitment of the flap housing.

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CHAPTER

6

**Remove & Refit Procedures**

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## Suspension Spring & Damper Unit

1. In order to replace a damper unit, the damper and coil spring assembly needs to be removed from the vehicle.

In the event that the damper to be replaced is at the front of the vehicle, the front of vehicle must be raised such that both front tyres are clear of the ground. This can be achieved by using the bottle jack with the front axle jacking point (if fitted) or a trolley jack under the middle of the front axle.

If a rear damper needs to be replaced, only the tyre of the affected corner of the vehicle needs to be raised clear of the ground. Again this can be achieved with the bottle jack at the rear jacking point or a trolley jack under the relevant rear trailing-arm. It may be deemed desirable to raise the whole of the rear of the vehicle for greater stability. This can be done using a trolley jack under the cross-member between the rear wheels.

2. Place a chassis stand under the vehicle at a suitable point that will carry the vehicle's weight once the jack is removed. Remove the wheel/tyre from the affected corner but leave the jack in place.
3. At the front of the vehicle, a wire rope check strap limits suspension rebound-travel. Undo and remove the M12 nyloc nut from the lower end of the check strap. Discard the nut.

At the rear of the vehicle, a fabricated steel bracket limits suspension rebound-travel. Undo and remove the M10 nyloc nut and long bolt that secures the bracket to the trailing-arm.

4. Undo, remove and discard the M16 nyloc nut that secures the damper assembly's bottom eye to the front axle/rear trailing-arm. Do not attempt to remove the bolt at this stage.
5. Withdraw the jack, leaving the vehicle supported by the chassis stand.
6. Withdraw the M16 bolt from the damper's bottom mounting eye. Remove the 2 locknuts from the top end of the damper and lift off the large washer and upper-top mounting bush. Especially if working on the front of the vehicle, space constraints may dictate that the washer and upper-top bush are left in place and retrieved after the damper is removed. In this case care should be exercised not to dislodge and loose these components. It may prove easier to undo the bottom locknut if the damper assembly is supported from under the vehicle. A trolley jack can be used quite effectively for this purpose.

Extract the damper assembly from the vehicle.

7. Carefully inspect the upper and lower top bush for splits and excessive compression-set damage. Pay particular attention to the lower-top bush around the locating spigot. Renew any damaged bushes.
8. At the lower end of the front damper there is a balljoint inside a rubber boot. Inspect the boot for cuts, tears and perishing and replace if necessary. Any of these failings could result in the ingress of dirt causing premature wear of the balljoint.

Using side-cutters carefully cut the cable tie from the top of the rubber boot. Ease the boot over the bottom mounting bosses.

If the damper is to be refitted the balljoint should be inspected for wear or damage. Closely examine both the internal and external bearing faces for pitting and scoring. The balljoint should be renewed if any damage is evident. It is pressed into the damper's bottom eye and secured by 2 circlips, one either side. To remove the balljoint first remove both circlips, then press the balljoint from the damper's eye using suitably sized tubular spacers. Be sure to press only on the outer part of the bearing.

If the damper is to be renewed remove the mounting bosses so that they can be reused.

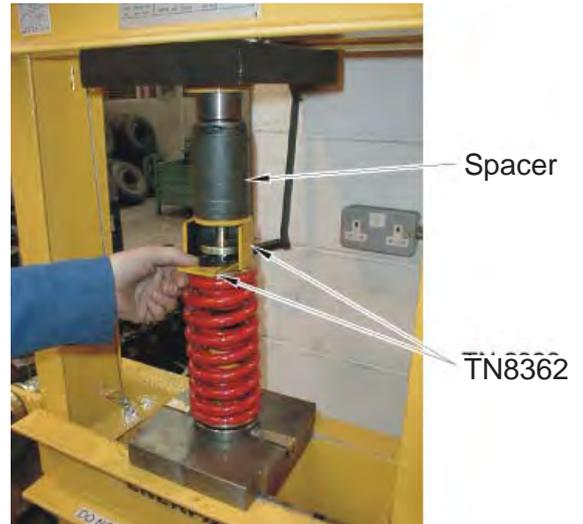
If working on the rear of the vehicle inspect the bottom bush. This is a two-part bush; one part is pressed into the damper's bottom eye from each side. A supporting steel sleeve is then pressed into the middle of the bush.

9. In order to dismantle the damper/coil spring assembly it is necessary to compress the springs in order to relieve the load on the damper and access the locknut that secures the damper top. This will enable the threaded damper top to be unscrewed from the damper shaft.

The easiest way to achieve this is by using a suitably sized hydraulic or pneumatic press, blocks on which to stand the assembly and Johnston special tool TN8362.

Position the blocks on the press bed such that there is sufficient gap between them for the damper lower mounting eye. Stand the damper/coil spring assembly on the blocks such that the damper's bottom spring seat locating ring is against the top of the blocks and the damper's lower mounting eye is between them. Fit TN8362 to the assembly with the underside of the horseshoe section against the top face of the top spring seat and the shaft of the damper top through the hole in the tool. Fit a spacer over the damper top's shaft.

10. Use the press to gently apply force to the special tool via the spacer tube until the fork plate from the special tool can be inserted between the top face of the upper spring seat and the bottom face of the damper top's lock nut (ie: the nut in the centre of the coil springs).
11. Ensure the fork plate is pushed in as far as possible. Release the press and remove the spacer and the loose part of the special tool. Hold the locknut using a thin open-ended spanner and hold the damper top by its machined flats using either a second open-ended spanner or by clamping it in a vice. Unscrew the damper top from the damper. This may require some considerable force, as thread-locking compound will have been used during assembly.



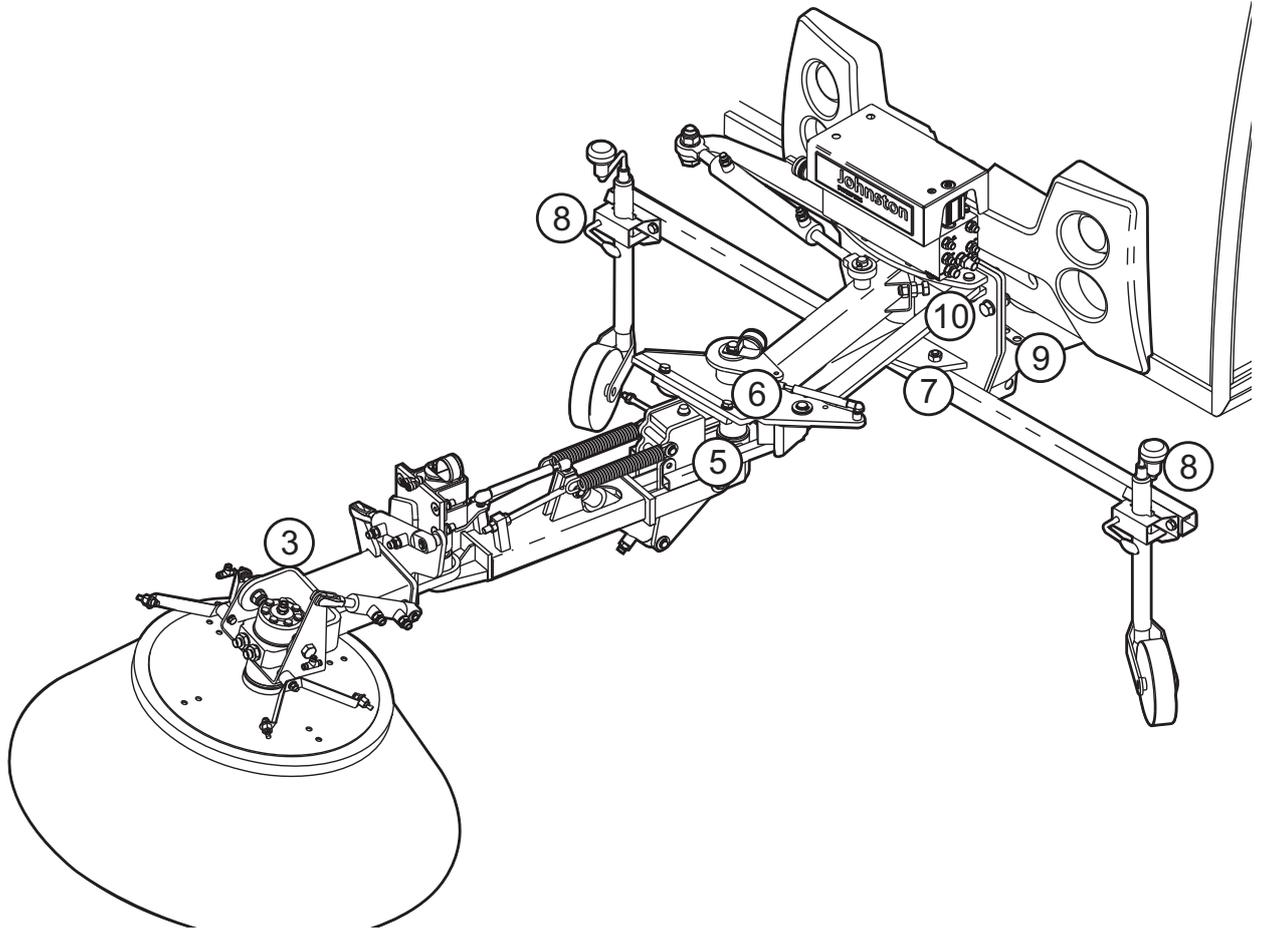
12. Once the damper top has been removed from the assembly, refit the special tool and spacer tube. Position the assembly on the press as before. Again, apply force to the special tool via the spacer tube until the fork plate from the special tool is loose. Remove the fork plate and carefully release the pressure of the press from the springs.
13. The springs and spring seats can now be removed from the damper.

14. Re-assembly is the reverse of the dismantling process. The following points should be noted:

- I. Use only matched sets of springs on any axle. The springs are colour coded; front springs are painted red; rear springs are painted black. It is also ill advised to replace springs individually: the suspension springs can soften with use and age and should always be replaced as an axle set. Failure to do so may result in unpredictable and potentially dangerous handling in, for example, an emergency braking situation.
- II. Ensure that the damper's shaft is fully extended before attempting to assemble the unit.
- III. Ensure that the bump-rubber is in place on the damper-shaft.
- IV. Use a suitable thread-locking compound when securing the damper-shaft to the damper top.
- V. Ensure that the spigots on the upper- and lower-top bushes are correctly located in the mounting hole in the chassis. Tighten the locknuts until the washer is 29mm from the very end of the damper top. Once fully reassembled, briefly road test the vehicle and re-check the upper-top bush. If this bush is not securely located, tighten the locknuts further as necessary.
- VI. The front damper bottom balljoint **MUST NOT BE LUBRICATED**. This is a dry bearing and any form of lubrication can result in the bearing swelling and failing. Ensure that an intact protective boot is fitted and secured to the bottom section of the outside of the damper's body using a cable tie.
- VII. Use new nyloc nuts. This is especially important on the end of the front axle check-strap and the bottom-eye mounting bolts. Torque the bottom mounting bolts to 174Nm.
- VIII. The front axle check straps are set by tightening the M12 nyloc nut on the bottom end of the strap until the adjacent front springs are compressed by a nominal 8mm.
- IX. Ensure that the rear fabricated travel limiter bracket is correctly fitted. Loosely fit the M16 bolt through the trailing arm, damper bottom bush and the bracket with the 10mm holes pointing down. Jack up the trailing arm until the bracket can be swung into place. Fit the M10 bolt and torque it to 40Nm.

### Third Brush Remove & Refit Procedure

The following stages outline the recommended procedure for the safe de-mounting and storage of the third brush equipment.



1. Position vehicle in workshop location where third brush is to be stored; allowing for an adequate working area around the front of the vehicle.
2. Start engine and position side brush arms to their outermost position using joysticks G16/G17.
3. Activate third brush controls on arm controller by pressing switch G14. Using joystick controls G16/G17 move third brush until it is in the fully extended/raised position.
4. Turn off vehicle ignition and remove key (for safety).
5. Slide in brush arm lock and locate in position using M10Cx110 bolt and nyloc nut.
6. Insert two M8Cx50 bolts to lock arm assembly into position.
7. Position third brush support as illustrated using locating bolts and secure using M14C plain nuts.
8. Attach jockey wheels to either end of third brush support. Adjust leg to allow for free movement of wheel and to take load of third brush.
9. Disconnect all third brush hydraulic/water quick release couplings and electrical connections (located on underside of chassis nose-cone). Insert quick release coupling caps for hydraulic/water connections. Insert electrical blanking cap (supplied in tool kit).

10. Remove lower then upper brush arm mounting plate bolts; the third brush assembly will tip forwards slightly once the bolts are fully removed.
11. Pull third brush assembly clear of vehicle. It is advisable to support the fully de-mounted third brush assembly with an axle stand or similar during storage.
12. Start engine; side brushes will return to their parked position automatically.
13. To re-mount the third brush assembly follow the above procedure in reverse. Ensure that the electrical harness connection is fully locked into position when re-connecting.
14. Once the third brush assembly has been refitted; test for correct operation to ensure that any trapped air has been fully purged from the system.

### Setting Four Wheel Alignment (tracking) on a C201 4WS Machine

#### Tools Required:

4 Wheel Laser Alignment Tracking Gauges  
Open ended Spanners: 19mm, 22mm, 27mm.  
6mm Alan Key  
Measuring Tape, Or Locking Pins, depending which method is to be employed.  
BendPak 4 Post Ramp; adjusted to C201 Track Width

#### Safety Equipment Required:

Overalls,  
Eye Protection

#### Method:

Ideally the rear wheel tracking needs to be adjusted both with the hopper down, and from below the vehicle; hence the use of the 4 post ramp for ease and speed of alignment. Note: It is possible to achieve tracking adjustments with the vehicle on the ground; the process is just slower. It is difficult to see the gauges you are trying to adjust settings on without blocking the laser light to the front flags with your body, or having to keep walking around the vehicle.

Ensure the tyre pressures are correct - 5.7 bar (83 psi).

If locking pins are available, ensure these are installed before proceeding. As of 05/08/2011 the side locking pins are not available for use, so proceed with measurement technique outlined below in line 6.

1. Set the ramp to the C200 position as marked on the cross beams. This is achieved by lowering the RH ramp onto the appropriate trolley, or two Pallet trucks, so that the RH ramp is clear of the cross beams. Now, move the ramp to align with the markings on the cross beams - both front and rear to ensure the RH ramp is parallel with the LH Ramp. Now Raise the ramp so that it is supported by the front and rear cross beams and remove the trolley or pallet trucks. Clear these from the white tape marked area before continuing with the procedure.
2. Remove all hubcaps from the vehicle using the 6mm alan key, put aside for re-fitment.
3. Carefully drive the vehicle onto the ramp. The use of a "banksman" is suggested to ensure the front wheels, which have a more narrow track than the rears are safely lined up. Position the vehicle about 300mm BEFORE the centre point of the lift.
4. Place the scuff plates in front of the rear wheels so that the square plate is touching the leading edge of the rear wheels and the pivot disc is central on the plate. It is advised that the square plate has the two upturned corners oriented outwards, i.e. away from the centreline of the vehicle. The reason for this is two-fold; firstly - as a safety measure, in so much as if they are forgotten to be removed before unloading the vehicle from the ramp; no damage is done to either the scuff plates, or the front tyres. Secondly it is possible to see steering angle by making a mark on the pivot disc aligned with the angular scale on the square plates.

5. Drive the vehicle forwards on to the scuff plates placed in front of the rear wheels. Make sure both rear wheels are central on the pivot disc on the scuff plates. The use of workmode is particularly useful here for inching control.
6. If the steering plate at the rear has not been locked with equal steering ram lengths, then these must be set before proceeding further. To achieve this:
  - i. Engage 4WS.
  - ii. Apply input to the handwheel in the cab to get the steering rams to equal lengths.
  - iii. From underneath the vehicle measure the distance from the rear steering ram pivot pin (located on the rear lower cross member of the chassis) to the centre of the ball joint which is connected to the steering plate.
  - iv. Once these are equal - achieved by input to the steering handwheel in the cab - disable 4WS.

**Note:** Until the menu screens are available, which will, through software, turn off the 4WS valves, it MAY be necessary to physically unplug the electrical connection to RS Enable valve located on the bottom of the steering valve block. This is the block connected to the SCU under the cab.

Before proceeding ensure that the vehicle is in 2WS (front wheel steer only)

### **Align the front wheels**

**Note:** There is no adjustment on the front axle, so all aligning is achieved by input to the handwheel in the cab.

1. The Laser gauges should be fitted to the front wheels.
  - i. Loosen the Black plastic locking knob on the side of the tracking gauges.
  - ii. Hook the top of the gauge over the top of the tyre. Note: That it should not fall into the tread groove on the tyre, but be on the outer radius that would contact the ground.
  - iii. Bring the lower pins upto the bottom of the tyre on both front & rear edges of the tyre. This ensures the gauge is located centrally on the wheel.
  - iv. Move the plastic spacer pins that set the spacing out of the gauge onto the innermost part of the slot that they run inside. This should be on the TSR ring, not the main rim of the wheel. This ensures the measurements are accurate.
  - v. Now adjust the position of the gauge so that the spirit level shows it as true horizontal - making sure all the above points stay in position.
  - vi. Once level and positioned correctly as per criteria listed above, turn the black plastic handwheel to lock in position. Support may need to be supplied to the underneath of the gauge whilst tightening to ensure nothing moves.
2. Repeat procedure above for the opposite front wheel.

3. Turn on laser gauges on both sides of the vehicle. A red laser line should now be visible on the scales of both gauges.
4. Confirm you are in Front wheel steer only mode! Now using the handwheel, align the front wheels so that the reading on the gauges is the same. This should be very nearly zero. It is permissible to be upto a reading of 1 Toe In. Any more than this is indicative of the gauges not being correctly fitted to the wheels. In this situation repeat the above gauge installation procedure, then adjust handwheel again.

### Setting the gauges up on the rear wheels for alignment

1. As the front wheels are now straight and parallel to each other, remove the laser gauges from the front, and fit them to the diagonally opposite rear wheel.
2. Using the same procedure outlined above, ensure the gauges are correctly fitted to the rear wheels. Note: Now the scales on the gauges will now be towards the rear of the vehicle. This means that indicated Toe direction is reversed, as such Toe-Out on the gauges becomes Toe-In true to the vehicle and Vice Versa.
3. Fit the additional alignment "Flags" to the front wheels. - these will sit on the tyre bulge. This is OK, as long as the Tyre pressures are correct as stated initially.
4. Raise the ramps to a position where it is possible to comfortably reach up to the steering links and see all gauges. Note: This is usually when the horizontal bar of the gauges are at or slightly below eye level.

### Aligning the rear wheels

1. Using the 19mm & 27mm Open ended spanners, unlock both rear track rods.
2. Examine all Gauge Positions to determine the easiest starting point for adjustment. - This is usually, but not always, determined by the front flag readings. The side with front flag reading that is the furthest away from around 9-11 is the best side to begin adjusting. i.e. if the NSF Flag reading is the furthest out, then start adjusting the NSR track rod. However, If the fronts are matched equal, but the rear side to side measurement is out, then the starting point should be to beginning to bring the rear cross vehicle alignment towards the desired level. Then begin adjustment based front flag position.
3. Start adjustment by rotating one of the rear track rods. The required direction is quickly ascertained by visual check on the scale. Whilst adjustment is carried out observe both the opposite side tracking gauge, and the front flag position.

**Note:** When adjustment is made on one side of the vehicle it also makes a small change, in the opposite direction to the other side.

4. Adjust the track rods in stages:
  - i. Make a change on one rod to around half of the desired change.
  - ii. Now adjust the other track rod for around half the required adjustment
  - iii. Repeat until setting is achieved.
  
5. The Tracking is set when both the front flags display the same number each side (this should be between 9 & 11), and the readings on the rear gauges side to side add up to 14 Toe-out (1.4°). As described previously, when the gauges are fitted to the rear of the vehicle Toe-Out becomes Toe-In & Vice versa.

**Note:** When the side to side gauges read the same colour (blue or green) the numbers display should be added together to calculate combined total toe value. When they display readings in different colours the side with the lower value should be subtracted from the other side. The side with the higher number denotes the direction of Toe. (Reversed when fitted to the rear)

### **An example of Toe Setting calculation**

In an Ideal Condition, the front flags will both display a value of 10, and each side on the rear gauges will display 7 Toe Out. As these are the same colour, you add them together giving 1.4° Toe In (as toe direction is reversed from indicated).

Possibly there may be a reading of 9 on both front flags, and the Rear Left gauge indicates 6 Toe Out, and the Rear Right Gauge indicates 8 Toe Out. Adding these values together gives a total setting of 1.4° Toe-In.

### **Resetting the Sensors**

The Final Thing to do BEFORE moving the vehicle or the steering handwheel in anyway, is to set the sensors to Zero.

The calibration screen on the JVM (menu 4.10.1) will enable you to select and confirm that the front or rear wheels are in the straight ahead position and the calibration will be automatic.

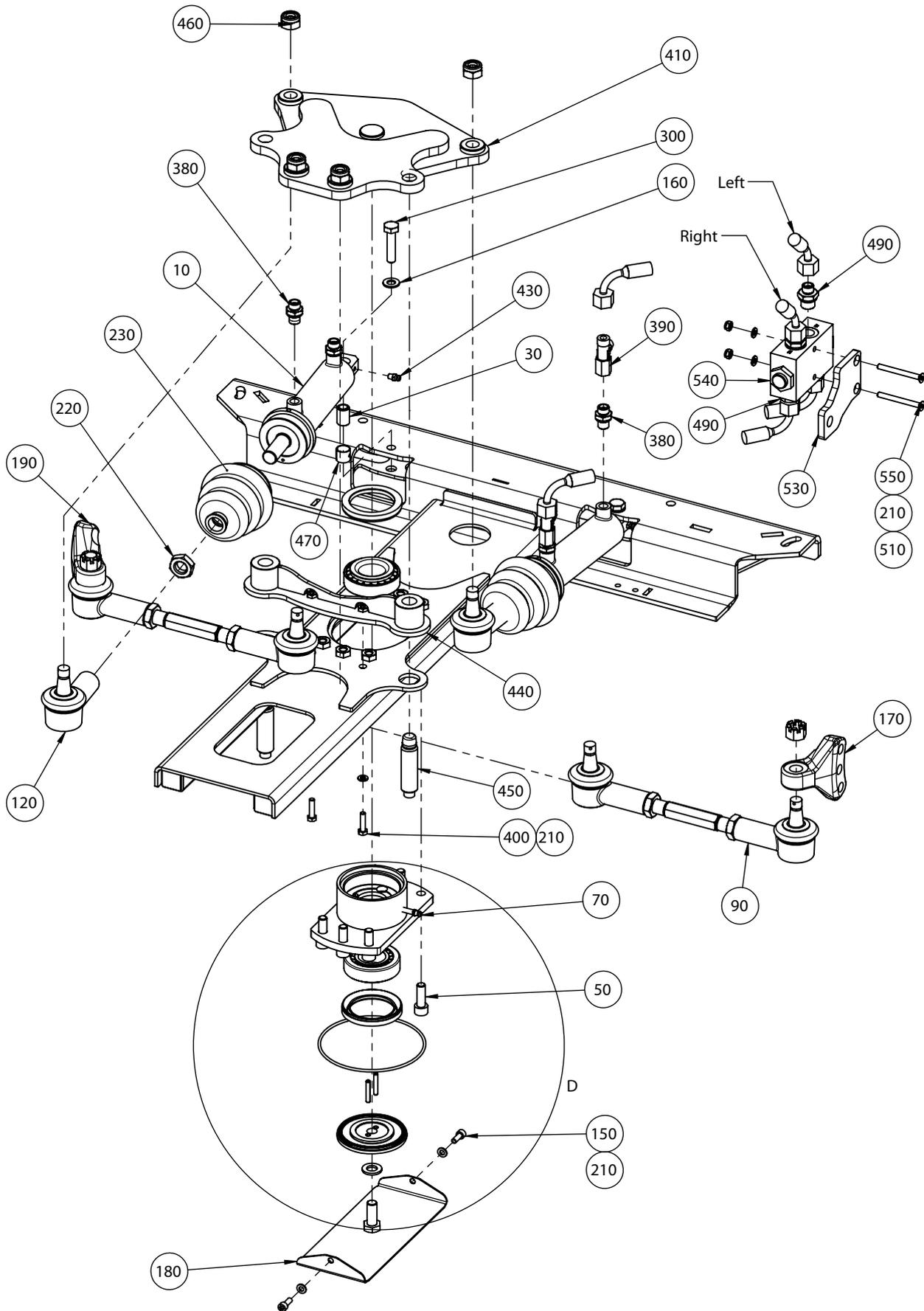
**Assembly Procedure - Bearing System**

1. Using a press, install both bearing races (110) into bearing holder (340).
2. Pack 1 off bearing roller (110) with grease.
3. Push grease seal (350) over greased bearing roller (110)  
Note: Use only Timken parts, the seal will "click" into place with a Timken Bearing. If the seal is not a good fit, it will not work and the bearing must not be used.
4. Fit grease laden bearing roller (110) complete with grease seal (350) into top bearing race.
5. Slide pivot Plate W/Assy (Not Shown In this Drawing) into top bearing.  
Note: The pivot pin must be a tight, but NOT an interference fit. Do not hammer pin into bearing, or remove any material from the pin other than a light cleaning with fine emery cloth.  
Do not remove plating.
6. Invert assembly and place assembly in a vice with pivot plate W/Assy (410) held in soft jaws.
7. Pack second bearing roller (110) with grease.
8. Push grease seal (350) over second bearing roller.  
Note: Use only Timken parts - (see note in step 3).
9. Fit the bearing and seal into the inverted assembly.
10. Grease O-Ring (480) and install into groove in Cover (330)
11. Align the cover plate with the two Ø5 holes in the pivot plate W/Assy
12. Install spiral roll pins (370) to retain cover plate onto shaft of pivot Plate W/Assy (410).  
Ensure pins are flush With Cover (330) otherwise the setting torque value will be inaccurate.
13. Place washer (500) over retaining bolt (320), and using Loctite 243; install finger-tight into pivot pin W/Assy
14. Install grease nipples into bearing case. Use the nipples to grease system whilst oscillating bearing case.
15. Tighten bolt (320) to 40Nm whilst oscillating the bearing case.
16. To complete bearing pre-load; turn bolt (320) through a further 90°.

**Assembly Procedure - Locking Pins & Plate W/Assy - Install when Tracking Vehicle**

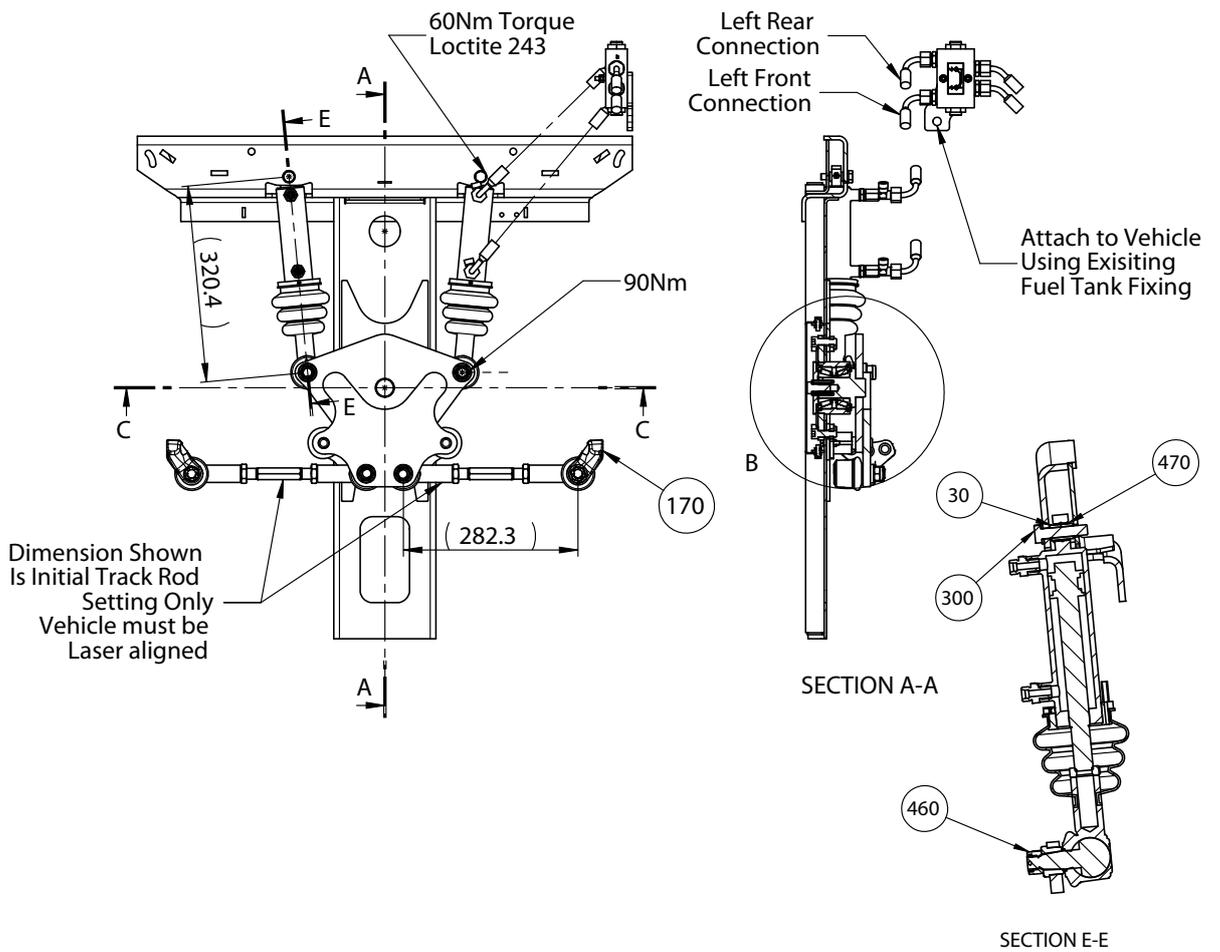
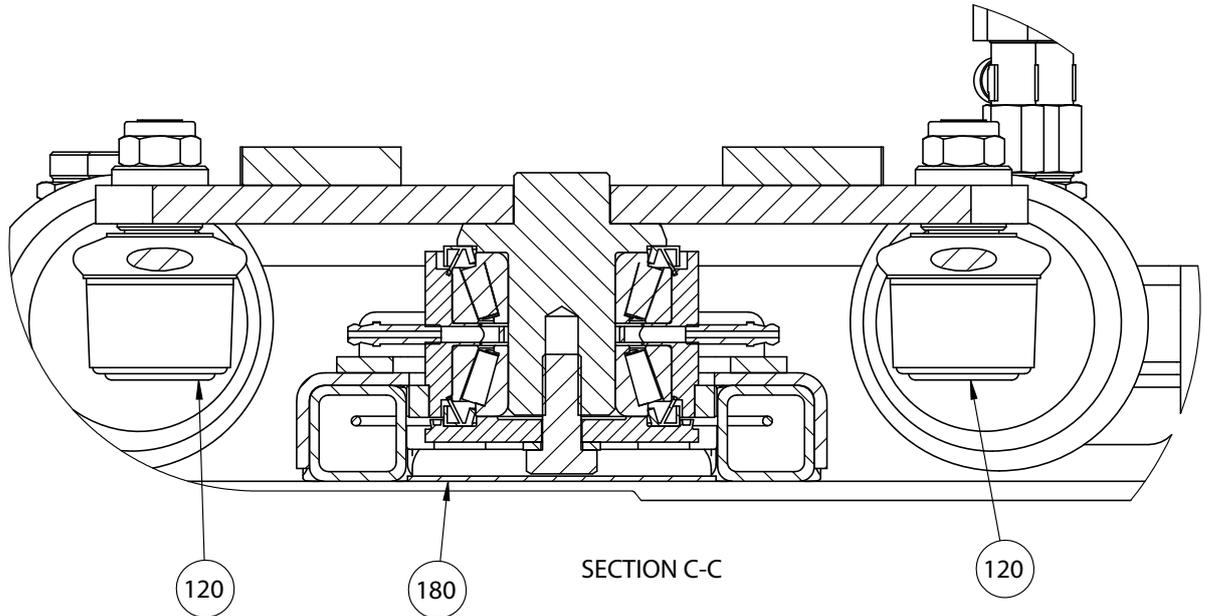
1. Install locking plate (440) with fasteners (400 And 210)
2. Align Pivot Plate W/Assy (410) in the straight ahead position.
3. Install Locking Pins (450) through Locking Plate (440) and Pivot Plate (410).
4. Adjust Steering Cylinder (10) Length (320mm) to suit Plate (410) in straight ahead position before installation

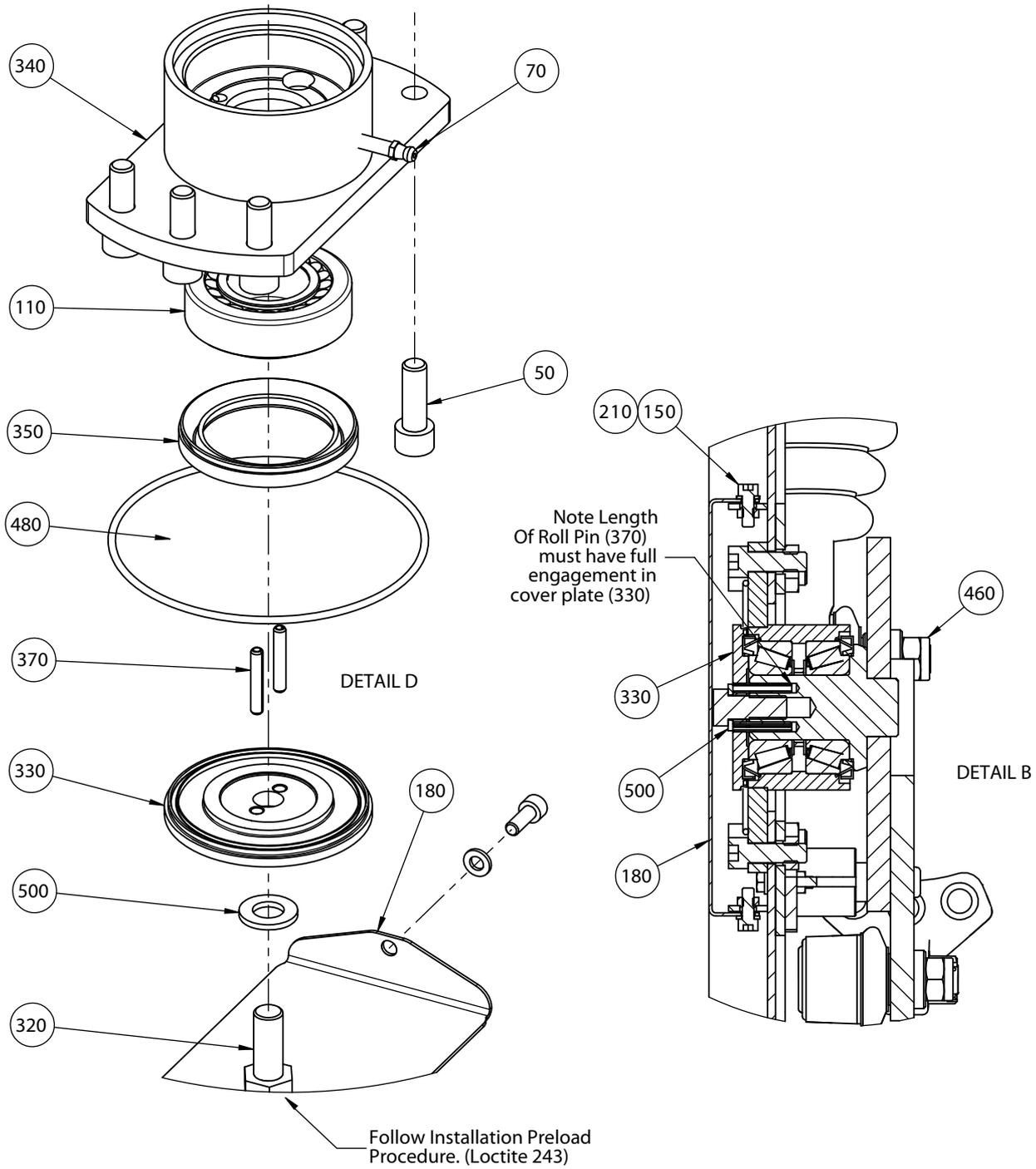
**NOTE: REMOVE LOCKING PINS BEFORE ANY ATTEMPT IS MADE TO ACTUATE REAR STEERING  
- DAMAGE WILL OCCUR**



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### Winter Equipment - Snow Plough/Brush

The following procedure should be carried out in a workshop environment.

Prior to fitment of the snow plough/brush attachment the front hydraulic interface must be fitted.

Firstly remove the front sweeping brushes.

Fit the hydraulic interface to the front mounting plate using 4 off M16x50 set screws, nyloc nuts and flat washers.

Connect the two quick release couplings and connect the 31 pin electrical plug.



The snow plough/brush is now ready to fit onto the interface plate; utilising either mobile or static lifting equipment.

Fit snow plough/brush onto the "A" frame and secure using locating pin, attach slew ram/brush motor hydraulic hoses as required.



The snow plough/brush is now ready for use.

**Winter Equipment - Gritter**

The following procedure should be carried out in a workshop environment.

Fitment of the gritter to the rear of the machine is effected by firstly by aligning the equipment with mounting posts. Once the gritter equipment has been aligned correctly fit top and bottom locating pins.



Once locating pins have been fitted the stand can be removed.

The two hydraulic hoses may then be fitted to the quick-release couplings on the right-hand rear side of the equipment.



The electrical trailer socket can now be fitted to the centre of the machine and clipped into place.

The gritter can now be moved into position and the last two locating pins fitted top and bottom.

The equipment is now ready to for use.



## CHAPTER

## 7

## Fault Diagnosis

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## Engine

### Engine not cranking

- Check that the transmission stalk is in the neutral position.
- Check battery box fuses FE10 & FE11, Tx5 controller.
- Ensure battery has adequate charge to crank engine.
- Ensure brake pedal is depressed fully.
- Check brake pedal switch.

### Engine cranking but not starting

- Check fuel gauge for fuel level.
- Check battery box fuses FE10 & FE11, Tx5 controller.
- Slacken bleed screws on injection pump to check for fuel and the omission of air.
- Check glow plug operation.

## Cab

### JVM inoperative

- Check overhead console fuse B3.

### Handbrake warning buzzer inoperative

- Check handbrake switch at base of handbrake.

### Cab heater inoperative

- Check rear cab fuse A12.
- Check feed at heater switch.
- Check feed and connections to cab heater motor.
- Check earth connection.

### Windscreen wiper/washer inoperative

- Check rear cab fuse A09.
- Check column switch operation.
- Check for feed at wiper motor.
- Inspect wiper motor assembly/mechanism.

### Horn inoperative

- Check rear cab fuse A09.
- Check live feed at horn when switch depressed.
- Check earth point.

**Lights****Brake lamps inoperative**

- Check battery box fuses FE10 & FE11, Tx5 controller.
- Check bulbs.
- Check connections to bulb holder.
- Check wiring and connections to brake lamp switch.

**Side lamps inoperative**

- Check overhead console fuse B1.
- Check bulbs in lamp clusters.

**Indicator lamps inoperative**

- Check steering column fuse C1 for lhd or fuse C2 for rhd vehicles.
- Check bulbs.
- Check wiring to indicator lamps.

**Head lamps dip beam inoperative**

- Check rear cab fuse A08.
- Check feed to headlamp bulbs.

**Beacon inoperative**

- Check rear cab fuse A13.
- Check feed at beacon.
- Check switch operation.
- Check drive band condition.

**Work lamps inoperative**

- Check rear cab fuse A10.
- Check feeds to work lamps.
- Check switch operation.



### Brushes

#### Brush arm water sprays inoperative

- Check earthing point at rear of cab.
- Check water pump relay K007.
- Check rear cab fuse A04, internal control node.

#### Brushes bounce when operated

- Check brush plates for damage, replace if bent.
- Check for excessive wear in brush arm linkage.

#### Brushes do not sweep effectively

- Check brush angles are correct.
- Check brush balance is set correctly, i.e; brush is touching the ground.
- Check brush overlaps the nozzle opening.
- Check brush speed.

#### Excessive brush wear

- Check brush balance is not too heavy.
- Check earth connection on powathrust pedal (i.e; bad earth).

### Suction Nozzle/System

#### No pick up performance

- Ensure nozzle duct blanking plate is not activated for wanderhose.
- Check hopper door is shut correctly.
- Suction nozzle or trunking is not blocked or restricted by debris.
- Hopper full, discharge load and clean out.

#### Poor pick up performance

- Remove and clean hopper mesh screens, ensure that ducting to the mesh is clean.
- Check suction nozzle slide ground clearance, 5mm.
- Check suction nozzle trunking and hopper inlet duct for wear, replace if necessary.
- Check suction nozzle flap, flap support and tie.
- Check condition of all hopper seals, replace if necessary.
- Ensure fan impeller is clean and not blocked.
- Check wanderhose is correctly stowed, not holed or worn allowing air to be drawn through.
- Check recirculating water pump operates and is not seized.

**Water System****Clean water system inoperative**

- Ensure sufficient water is in tanks and pump is primed.
- Check filter behind jet is not blocked.
- Check and clean water spray pump suction filter, if blocked.
- Check electrical feed to pump.

**Recirculating water system inoperative**

- Check pipe to inlet duct is not blocked.
- Ensure recirculating tank cover mesh filter is clean.
- Check water pump impeller is not seized.
- Ensure recirculating screens to the front and sides of the hopper sludge drainage channels are clean.

**High pressure washer inoperative**

- Check drive selection is in neutral.
- Check machine is not in work mode.
- Check switch illuminates when pressed.
- Check feed to valve on pump.

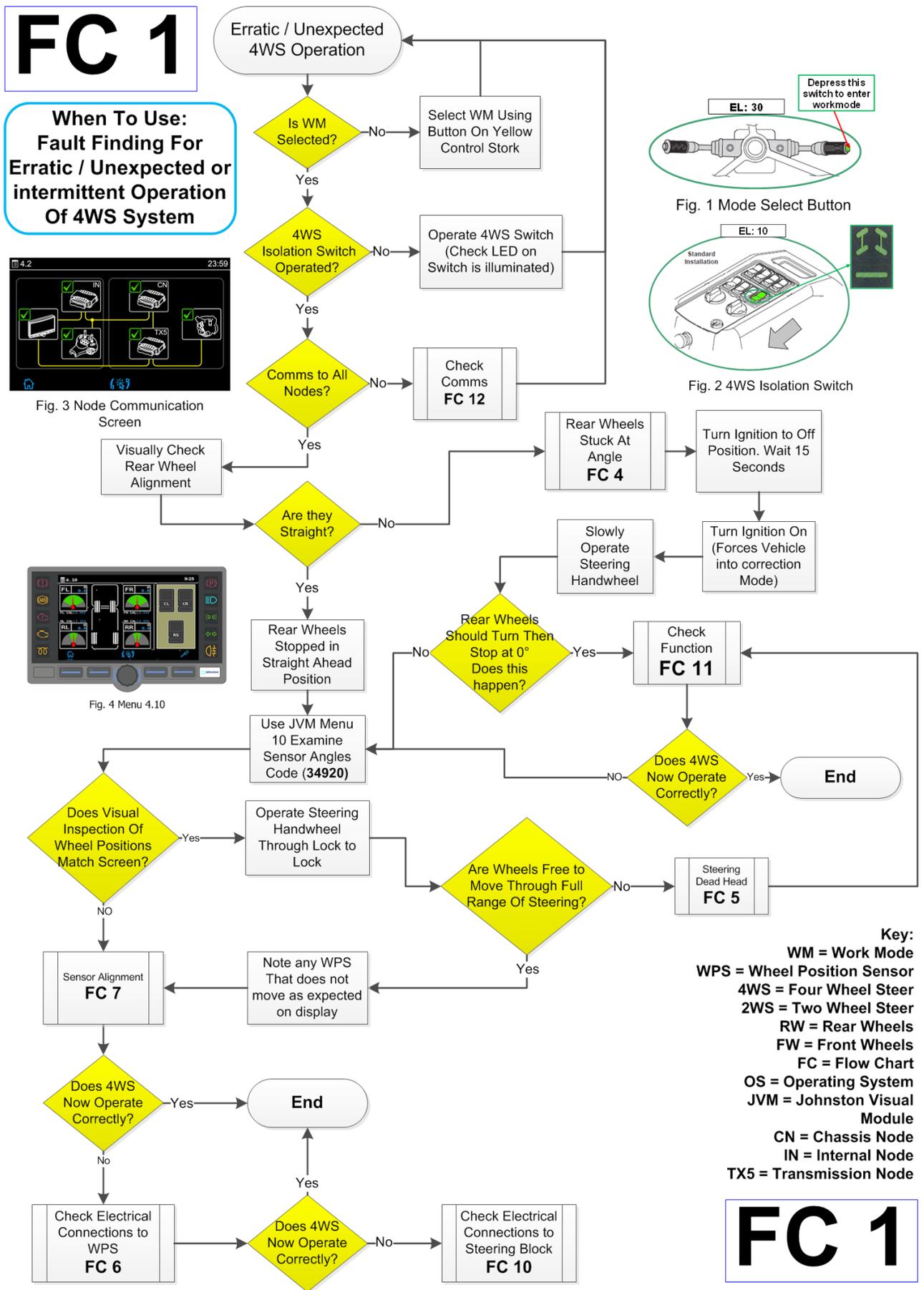
**No water pressure**

- Check pump inlet for air leaks.



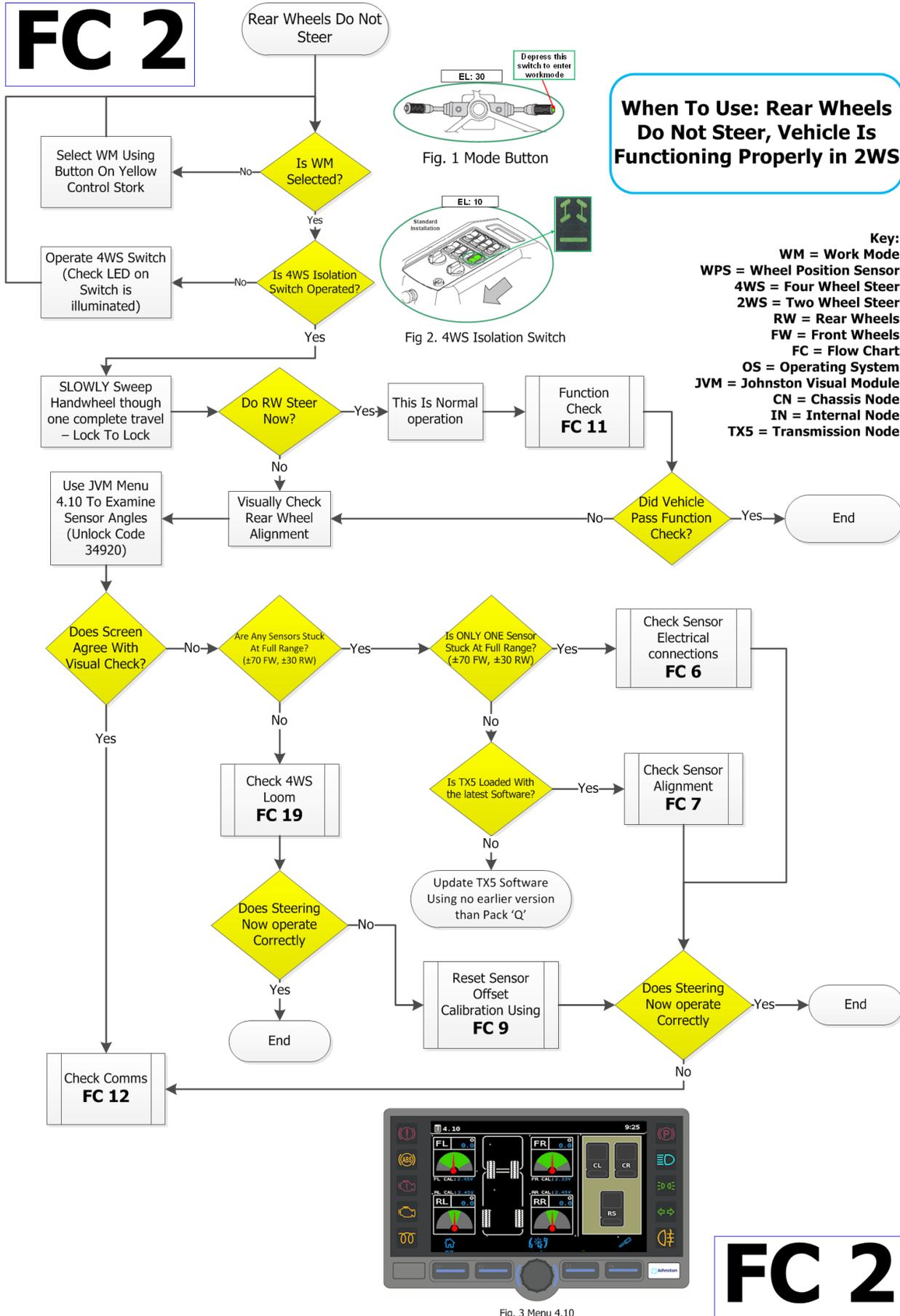
The following series of charts are intended as a fault finding guide for the C201 4WS system. It covers all known faults, and conditions that may arise throughout the operation of a C201 4WS vehicle. It also contains information on how to test the full functionality of the vehicle and the criteria required to achieve reliable and correct operation of the system. Flow charts 14, 15 & 16 are non-diagnostic flow charts and are included to help the support technician understand the operation of the system.

If unsure on how to proceed with fault finding, i.e. unsure on what the problem actually is, Flow Chart 1 is the place to start. This will direct the technician to the correct flow chart to use at the correct time.



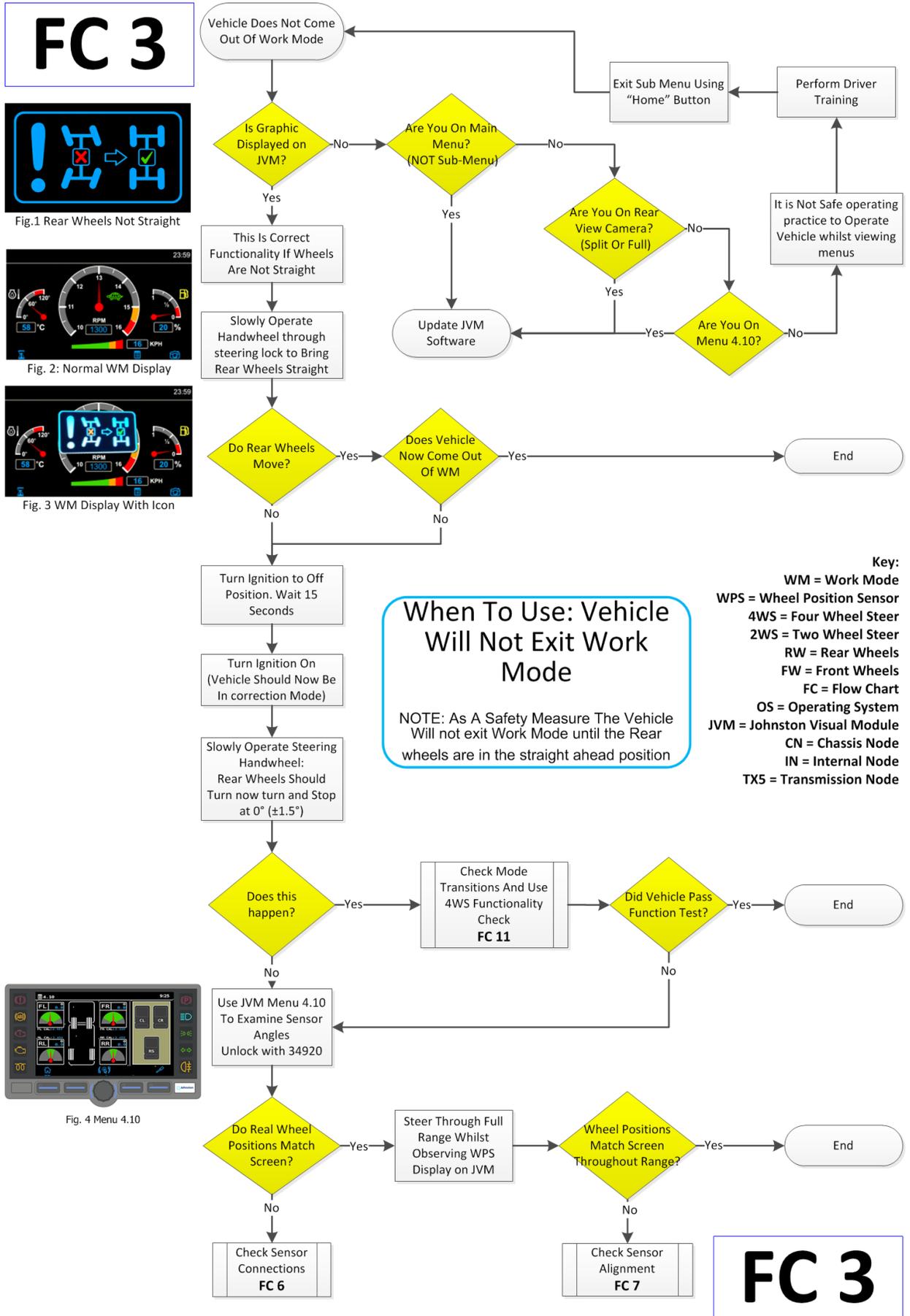
Flow Chart 1: Fault Finding for Erratic / Unexpected or intermittent Operation Of 4WS System

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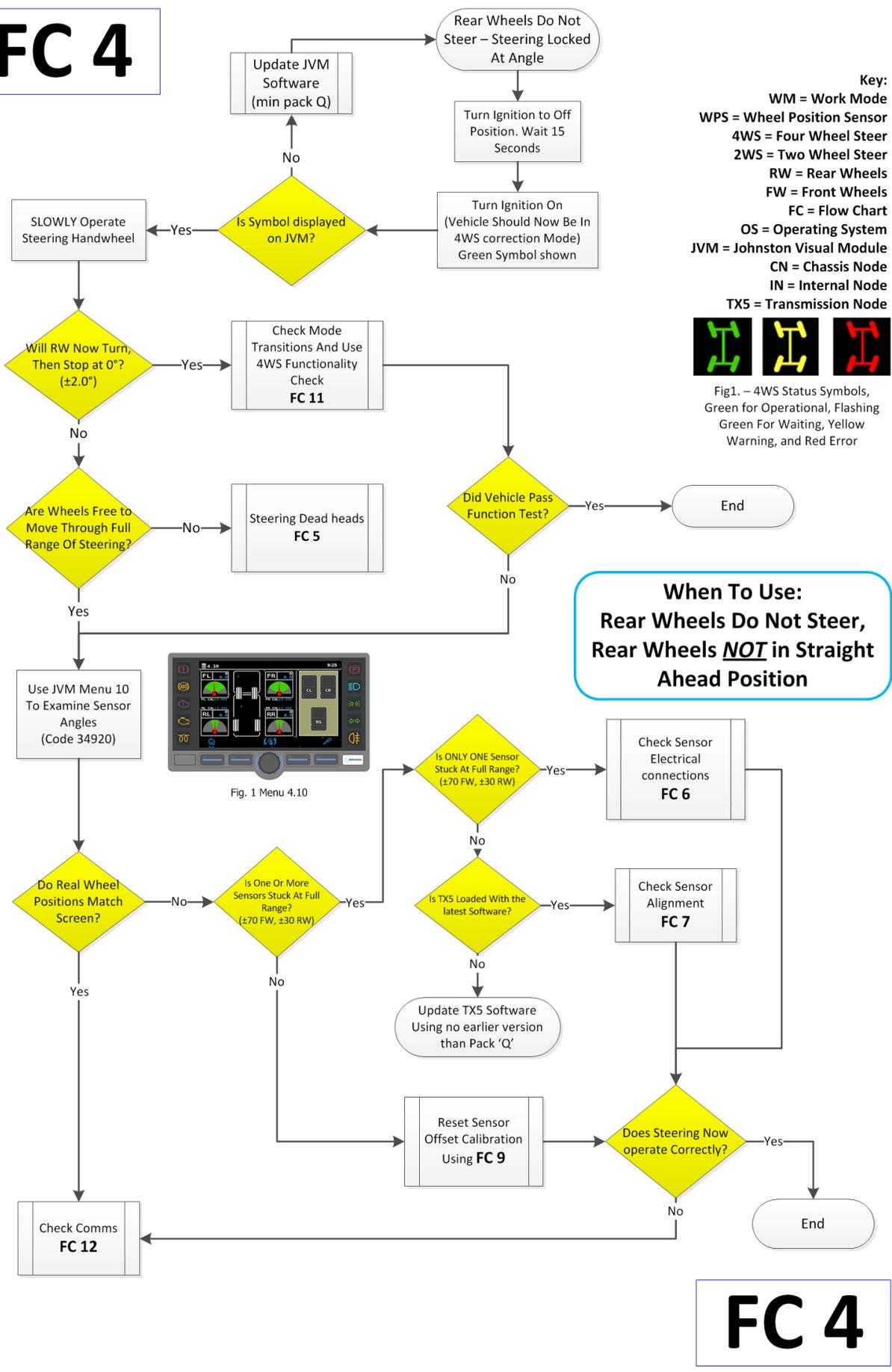
Flow Chart 2: Rear Wheels Do Not Steer, Vehicle Is Functioning Properly in 2WS



Flow Chart 3: Vehicle Will Not Exit Work Mode

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**FC 4**



**Key:**  
 WM = Work Mode  
 WPS = Wheel Position Sensor  
 4WS = Four Wheel Steer  
 2WS = Two Wheel Steer  
 RW = Rear Wheels  
 FW = Front Wheels  
 FC = Flow Chart  
 OS = Operating System  
 JVM = Johnston Visual Module  
 CN = Chassis Node  
 IN = Internal Node  
 TX5 = Transmission Node

Fig1. - 4WS Status Symbols, Green for Operational, Flashing Green For Warning, Yellow Warning, and Red Error

**When To Use:**  
 Rear Wheels Do Not Steer,  
 Rear Wheels NOT in Straight Ahead Position

**FC 4**

Flow Chart 4: Rear Wheels Do Not Steer, Rear Wheels NOT in Straight Ahead Position

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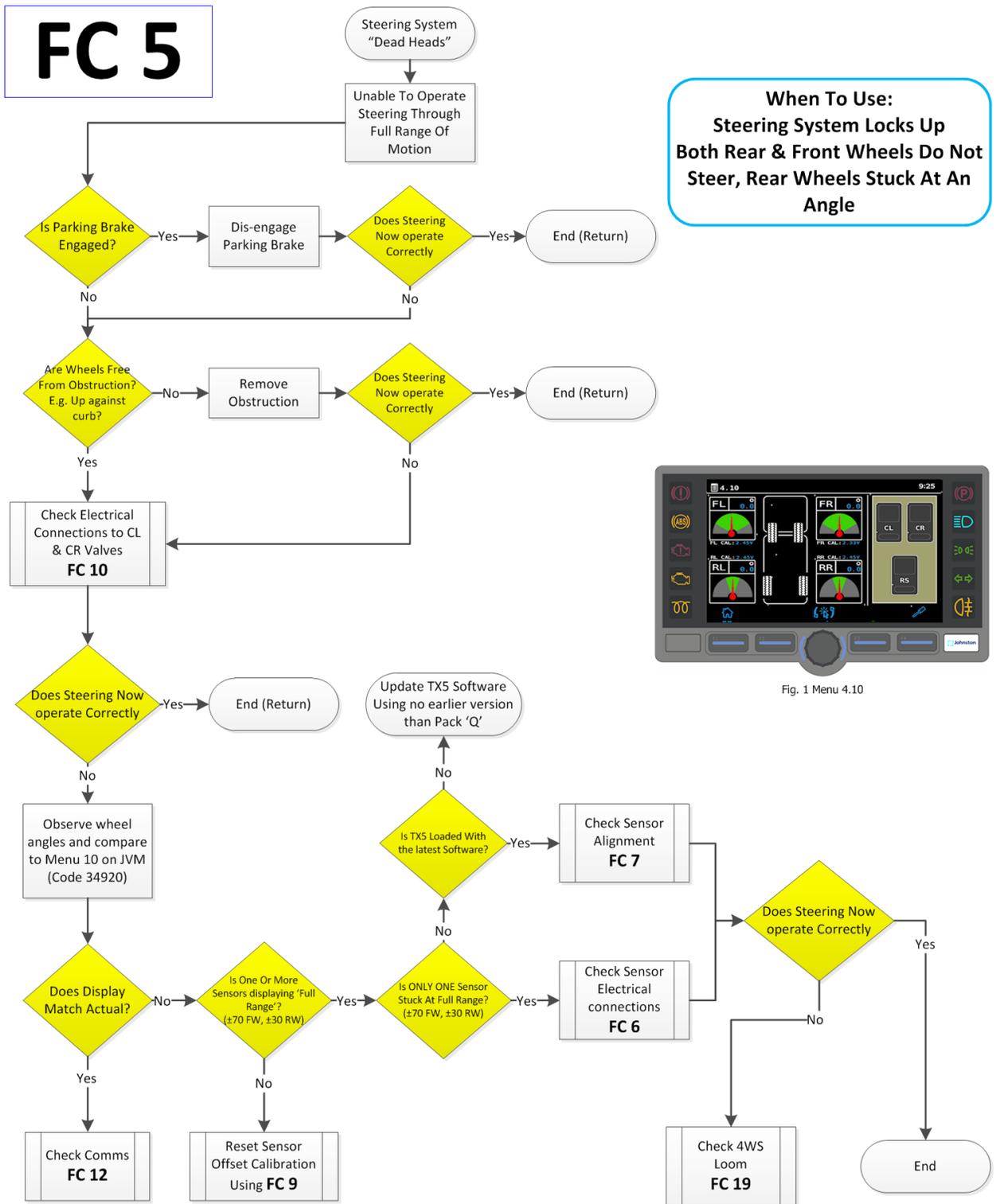


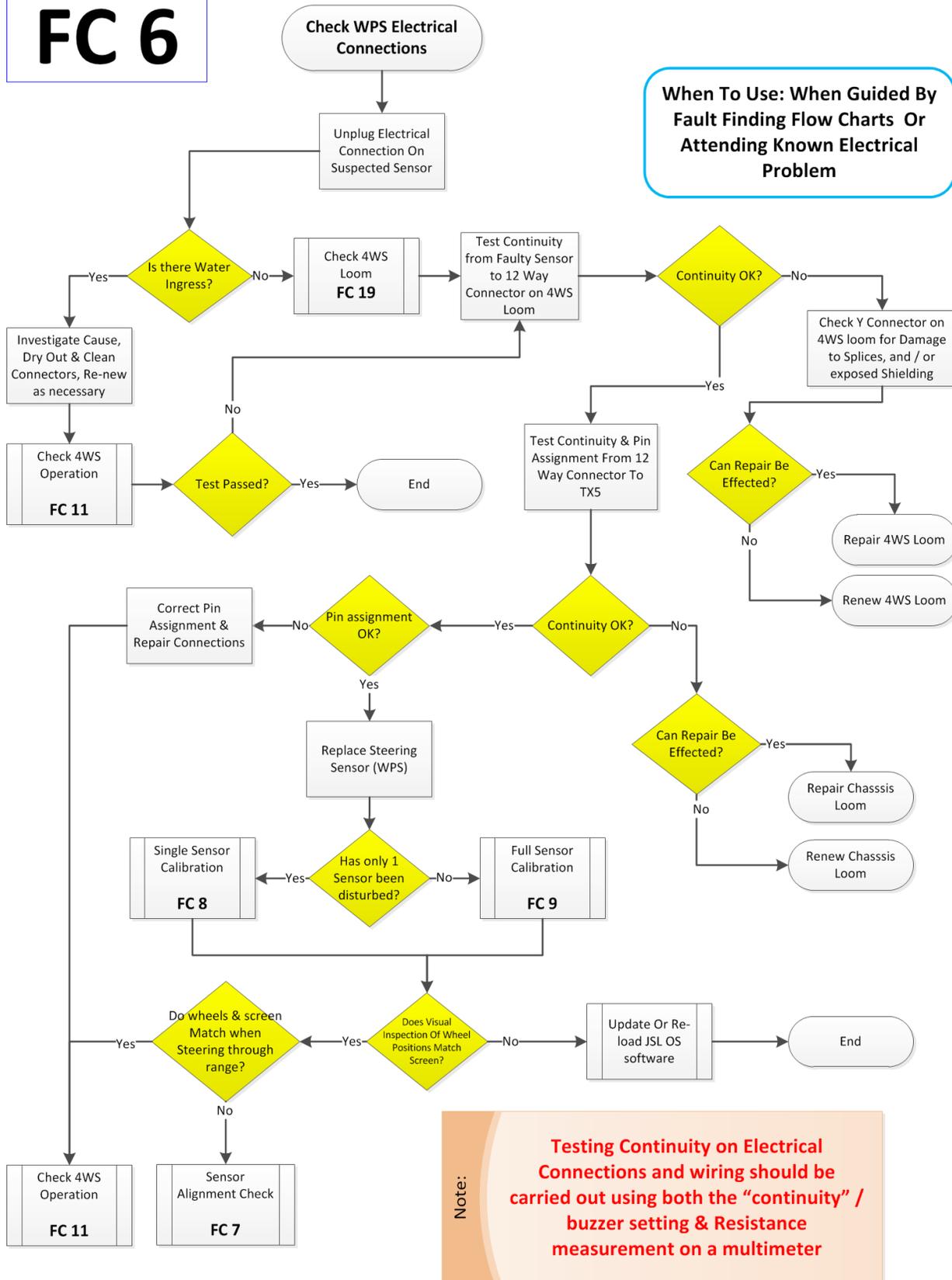
Fig. 1 Menu 4.10

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# FC 5

Flow Chart 5: Steering System Locks Up: Both Rear & Front Wheels Do Not Steer

**FC 6**



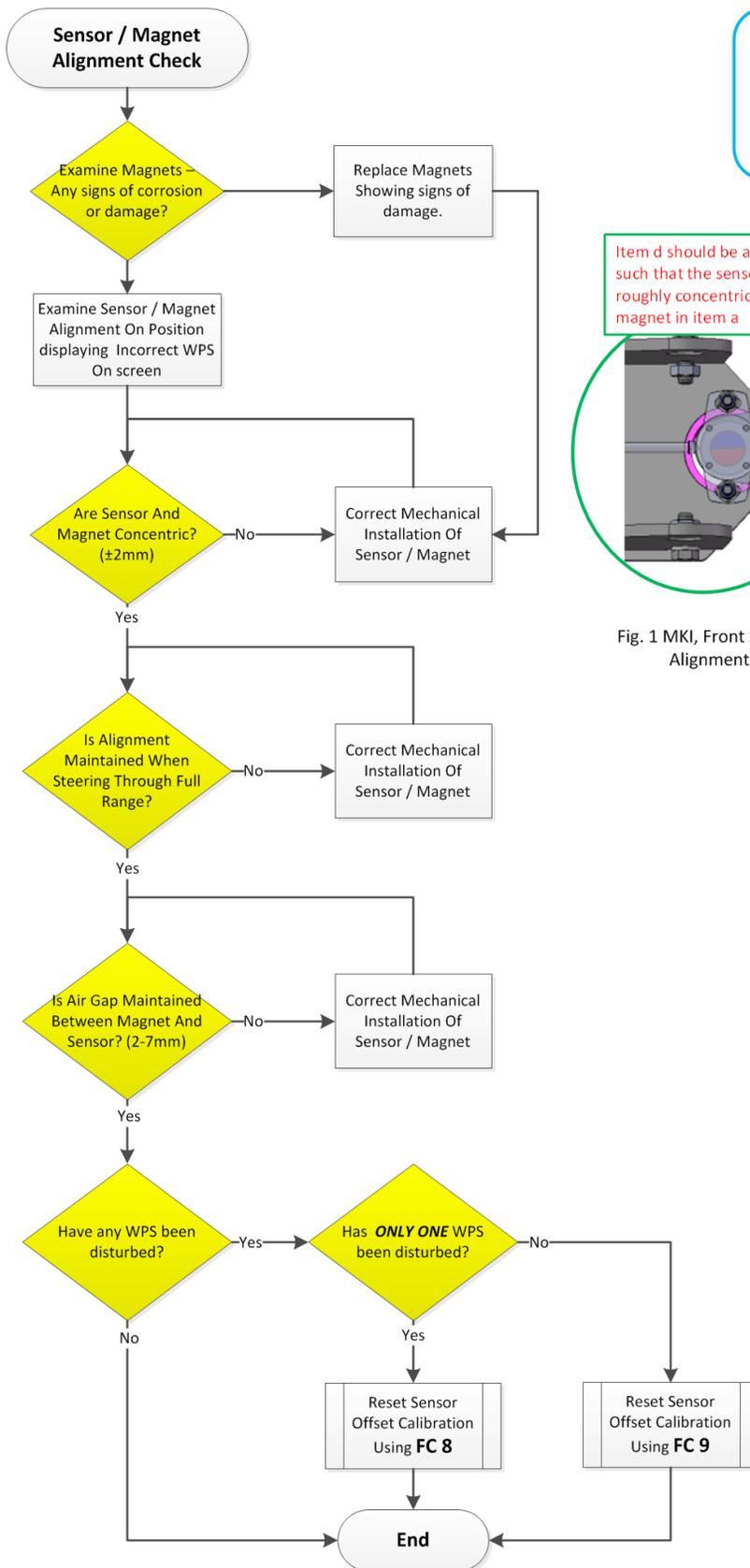
**FC 6**

Flow Chart 6: Wheel Position Sensor Electrical connections

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# FC 7

## Sensor / Magnet Alignment Check



**When To Use:**  
 When Directed by Fault Finding, Or whenever a sensor is replaced or disturbed, Or Calibration Voltage is outside the range 2.2V – 2.8V

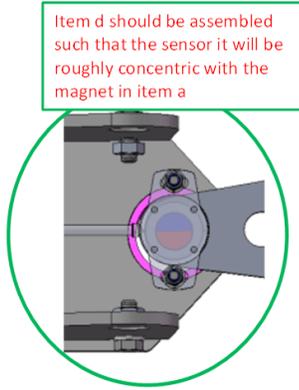


Fig. 1 MKI, Front Sensor Alignment

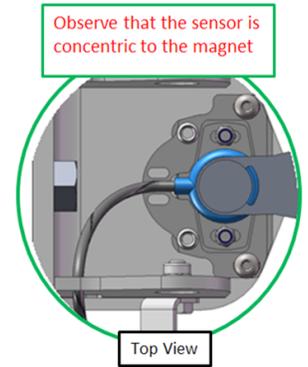


Fig. 2 MKII, Front Sensor Alignment

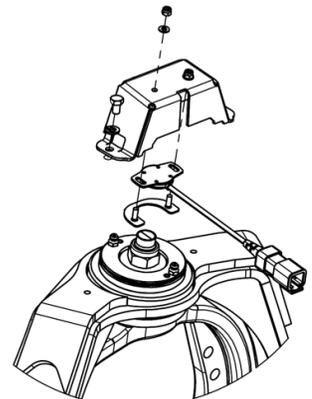


Fig. 3 Rear Sensor Alignment

- Key:**
- WM = Work Mode
  - WPS = Wheel Position Sensor
  - 4WS = Four Wheel Steer
  - 2WS = Two Wheel Steer
  - RW = Rear Wheels
  - FW = Front Wheels
  - FC = Flow Chart
  - OS = Operating System
  - JVM = Johnston Visual Module
  - CN = Chassis Node
  - IN = Internal Node
  - TX5 = Transmission Node

# FC 7

Flow Chart 7: Sensor / Magnet Alignment Check

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**FC 8**

**When To Use:**  
**Single Sensor Calibration:**  
 When ONLY ONE sensor Has been moved / replaced and Tracking is NOT Required

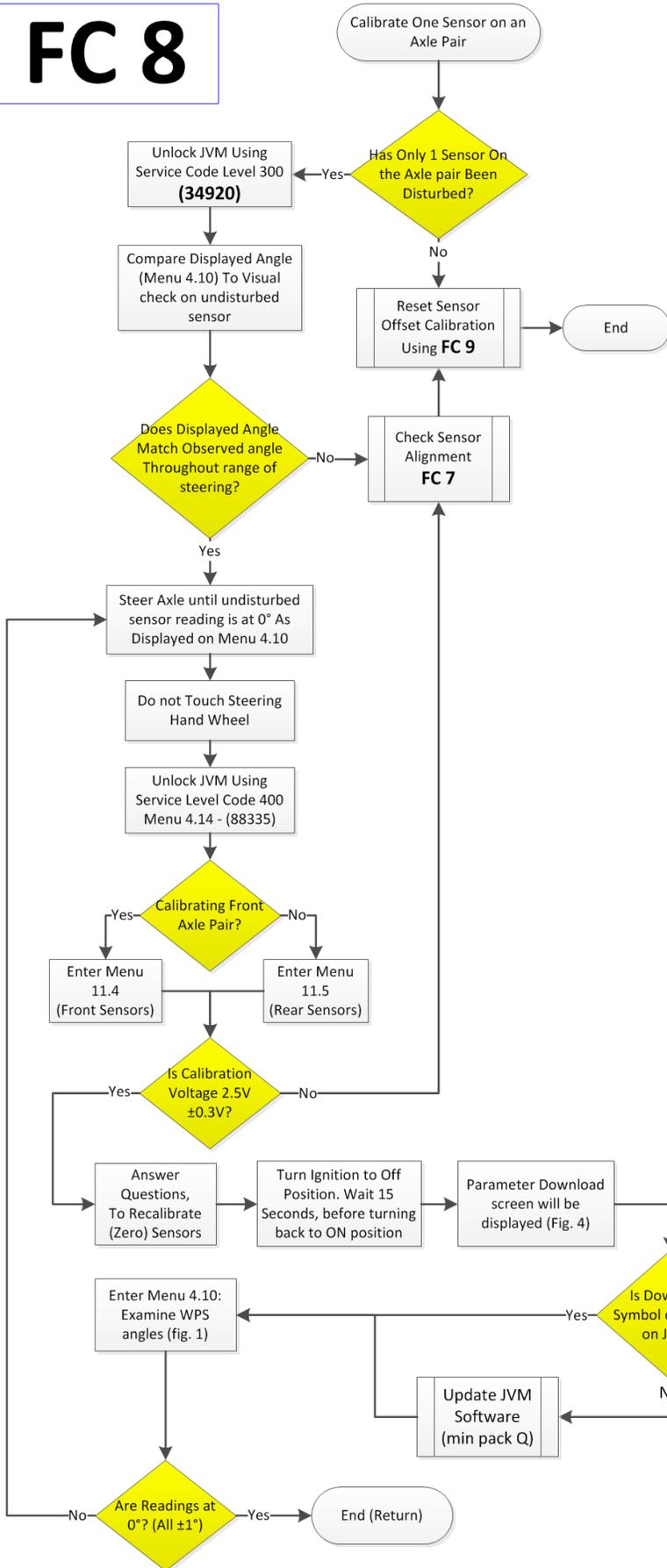


Fig. 1 Menu 4.10 – Wheel Angle Display



Fig. 2 Unlock Menu 14

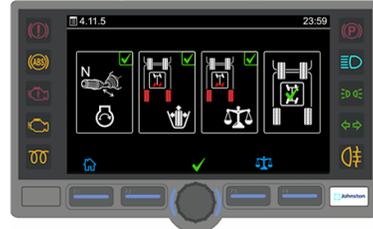


Fig. 3 Rear Wheel Calibration Screen

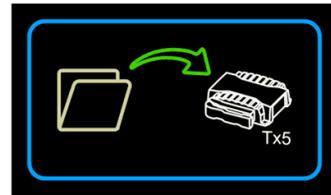


Fig. 4 Parameter Download Screen

- Key:**
- WM = Work Mode
  - WPS = Wheel Position Sensor
  - 4WS = Four Wheel Steer
  - 2WS = Two Wheel Steer
  - RW = Rear Wheels
  - FW = Front Wheels
  - FC = Flow Chart
  - OS = Operating System
  - JVM = Johnston Visual Module
  - CN = Chassis Node
  - IN = Internal Node
  - TX5 = Transmission Node

**FC 8**

Flow Chart 8: Calibrate One Sensor on an Axle Pair

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# FC 9

**When To Use:**  
Calibrate Sensors When Two Or More Sensors Have been Disturbed OR Wheel Alignment / Tracking Required

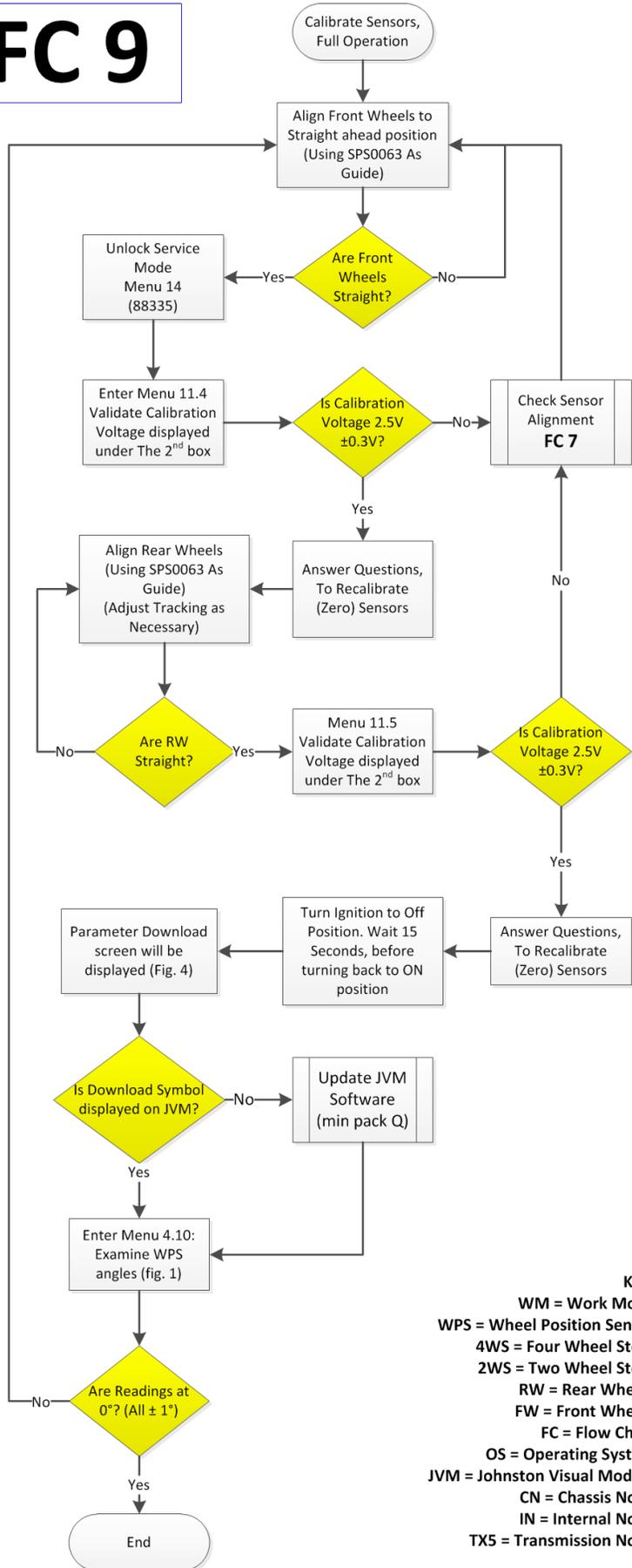


Fig. 1 Menu 4.10 - Wheel Angle Display



Fig. 2 Unlock Menu 14



Fig. 3 Rear Wheel Calibration Screen

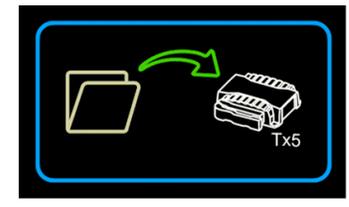


Fig. 4 Parameter Download Screen

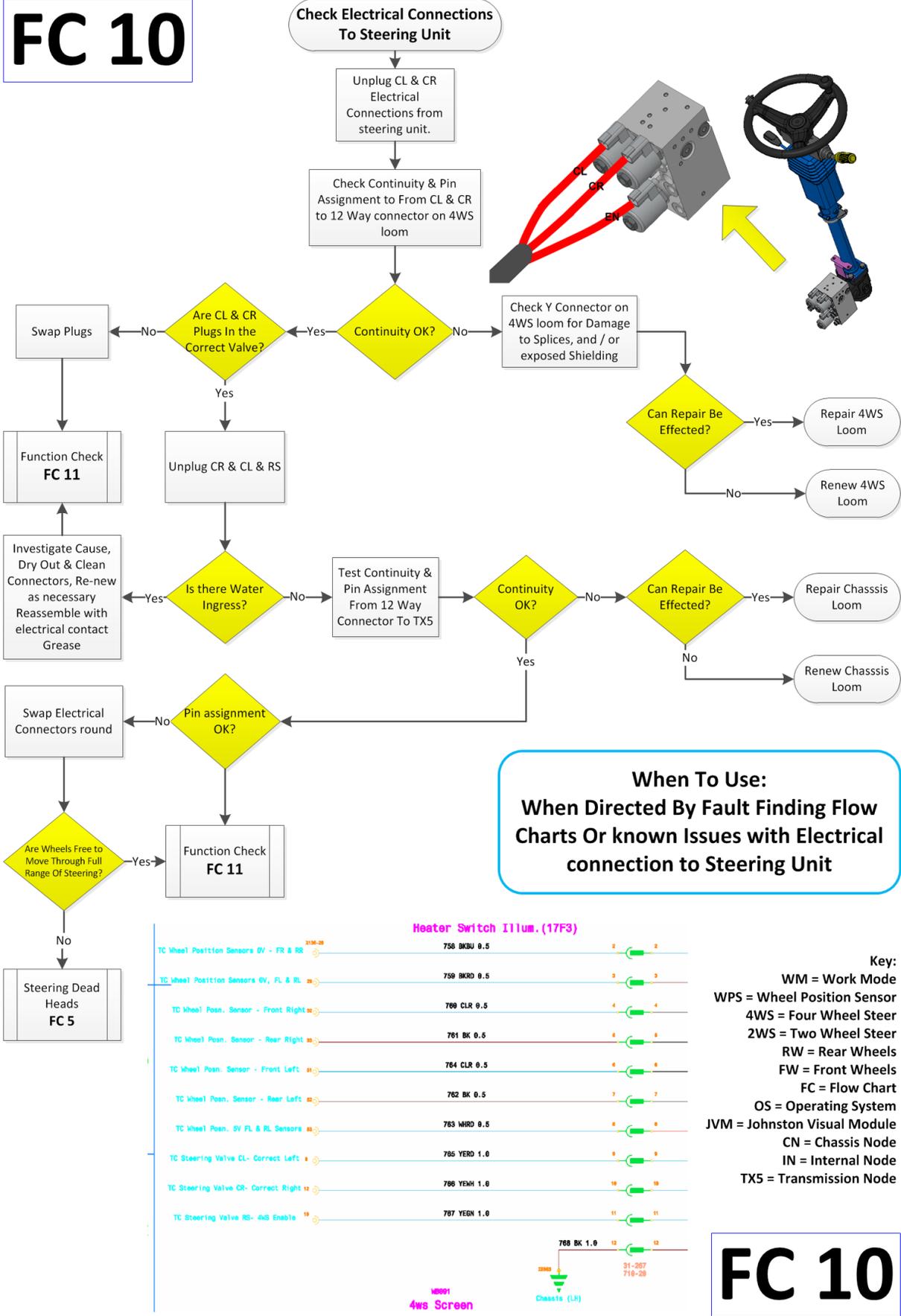
- Key:**  
 WM = Work Mode  
 WPS = Wheel Position Sensor  
 4WS = Four Wheel Steer  
 2WS = Two Wheel Steer  
 RW = Rear Wheels  
 FW = Front Wheels  
 FC = Flow Chart  
 OS = Operating System  
 JVM = Johnston Visual Module  
 CN = Chassis Node  
 IN = Internal Node  
 TX5 = Transmission Node

# FC 9

Flow Chart 9: Calibrate Sensors, Full Operation

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**FC 10**



**FC 10**

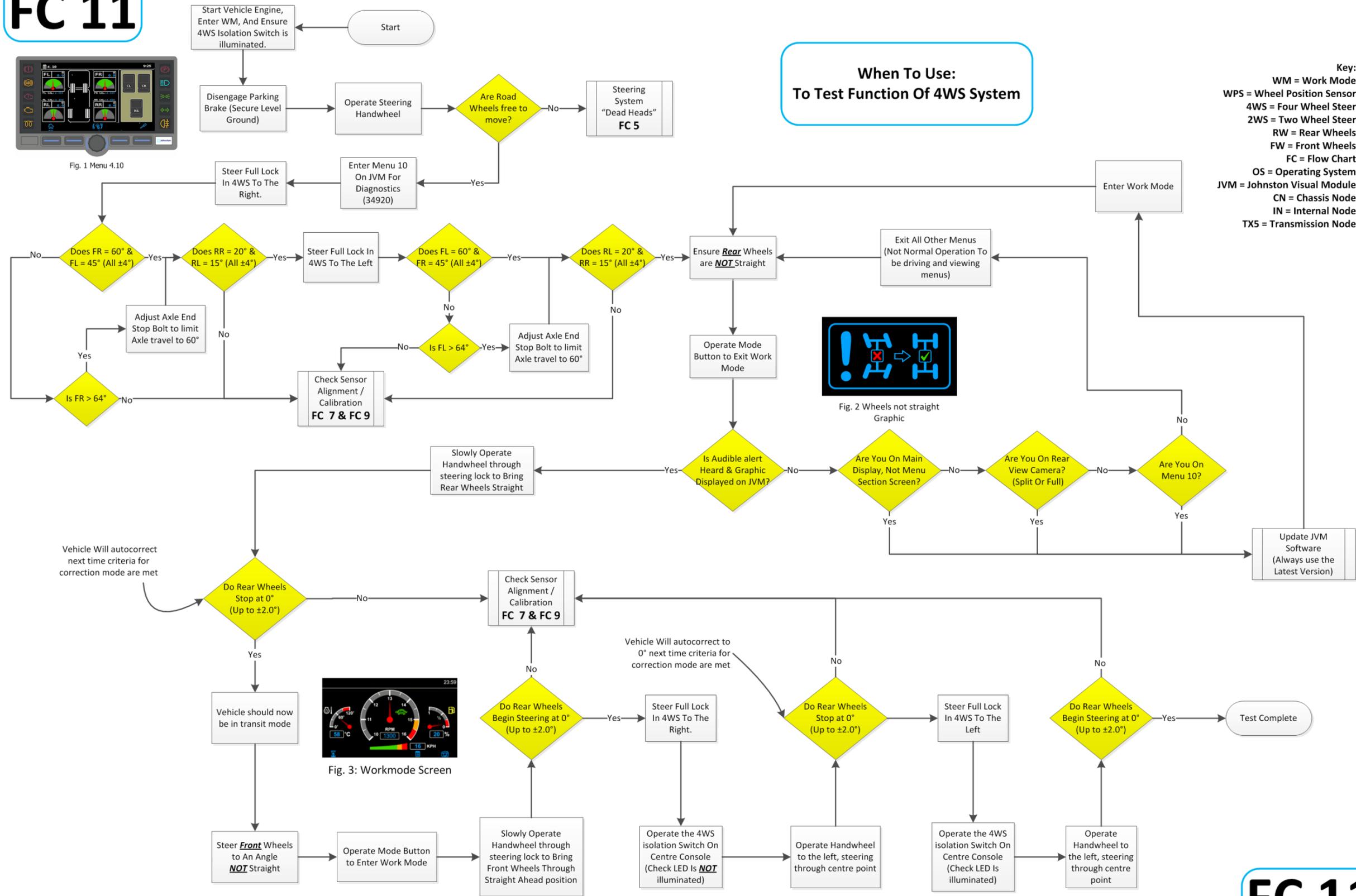
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Flow Chart 10: Check Electrical Connections to Steering Unit

# FC 11

**When To Use:  
To Test Function Of 4WS System**

- Key:**  
 WM = Work Mode  
 WPS = Wheel Position Sensor  
 4WS = Four Wheel Steer  
 2WS = Two Wheel Steer  
 RW = Rear Wheels  
 FW = Front Wheels  
 FC = Flow Chart  
 OS = Operating System  
 JVM = Johnston Visual Module  
 CN = Chassis Node  
 IN = Internal Node  
 TX5 = Transmission Node



Flow Chart 11: Test Function of 4WS System

# FC 11

# FC 12

## Node Comms Check Flow Chart

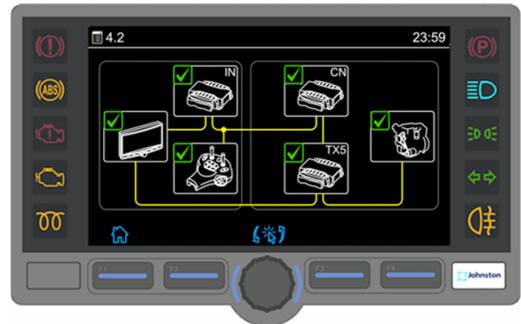
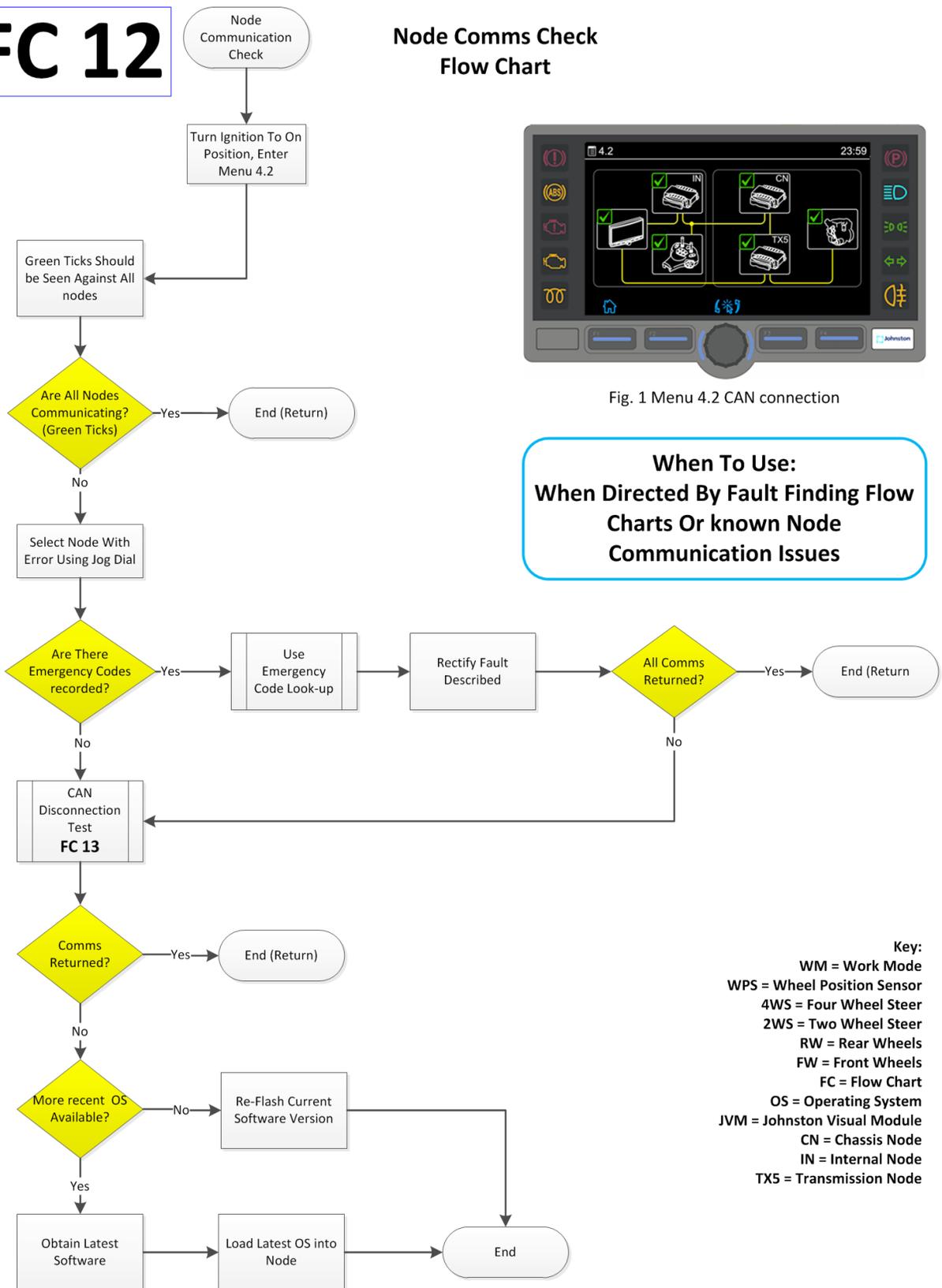


Fig. 1 Menu 4.2 CAN connection

**When To Use:**  
When Directed By Fault Finding Flow Charts Or known Node Communication Issues

- Key:
- WM = Work Mode
  - WPS = Wheel Position Sensor
  - 4WS = Four Wheel Steer
  - 2WS = Two Wheel Steer
  - RW = Rear Wheels
  - FW = Front Wheels
  - FC = Flow Chart
  - OS = Operating System
  - JVM = Johnston Visual Module
  - CN = Chassis Node
  - IN = Internal Node
  - TX5 = Transmission Node

# FC 12

Flow Chart 12: Node Communication Check

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**FC 13**

**When To Use:**  
As Directed By Flow Charts Or  
When Known Communication  
Issues have occurred

- Key:
- WM = Work Mode
  - WPS = Wheel Position Sensor
  - 4WS = Four Wheel Steer
  - 2WS = Two Wheel Steer
  - RW = Rear Wheels
  - FW = Front Wheels
  - FC = Flow Chart
  - OS = Operating System
  - JVM = Johnston Visual Module
  - CN = Chassis Node
  - IN = Internal Node
  - AN = Arm Rest Node
  - TX5 = Transmission Node

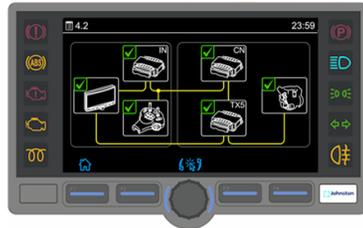
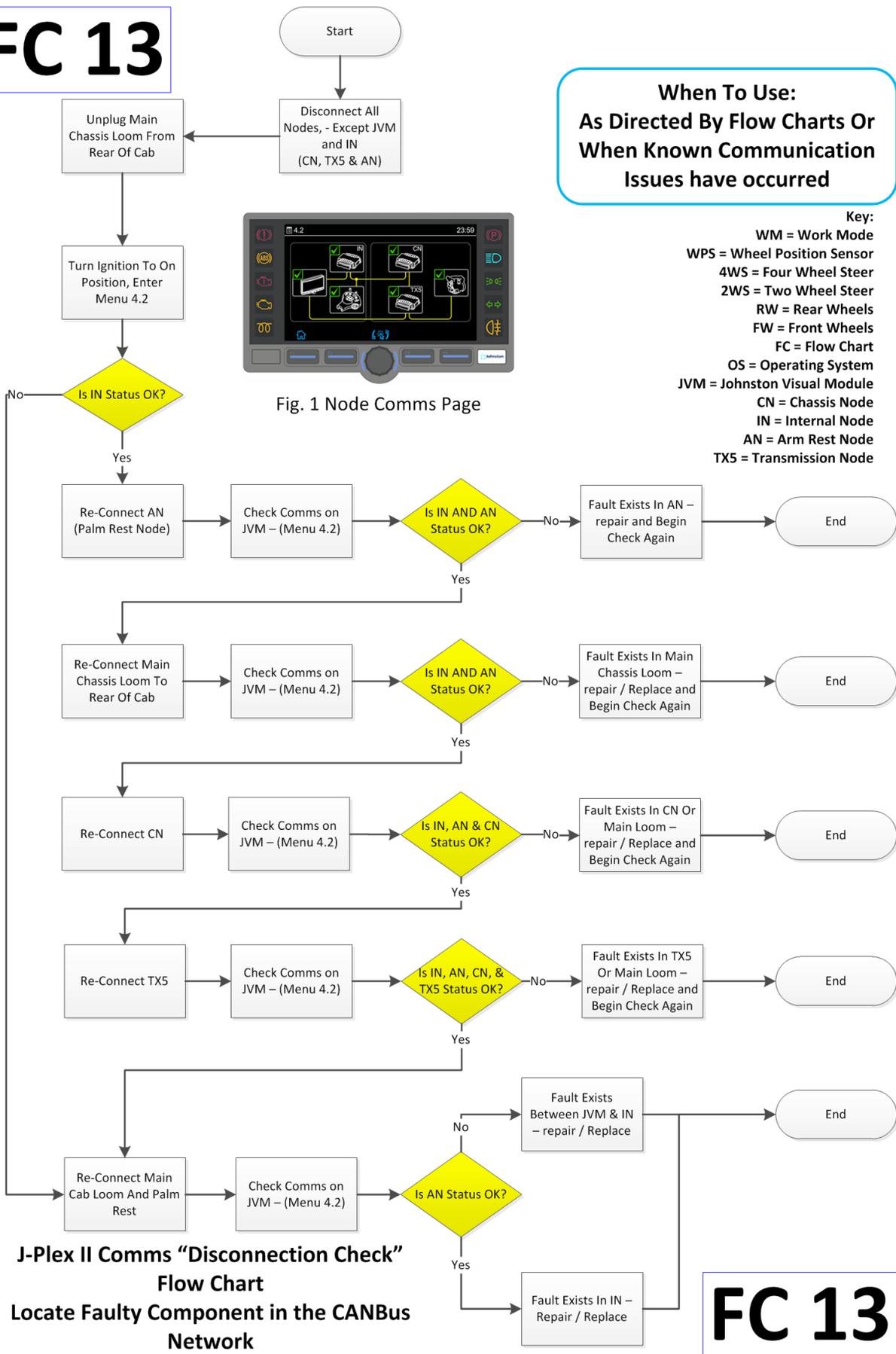


Fig. 1 Node Comms Page

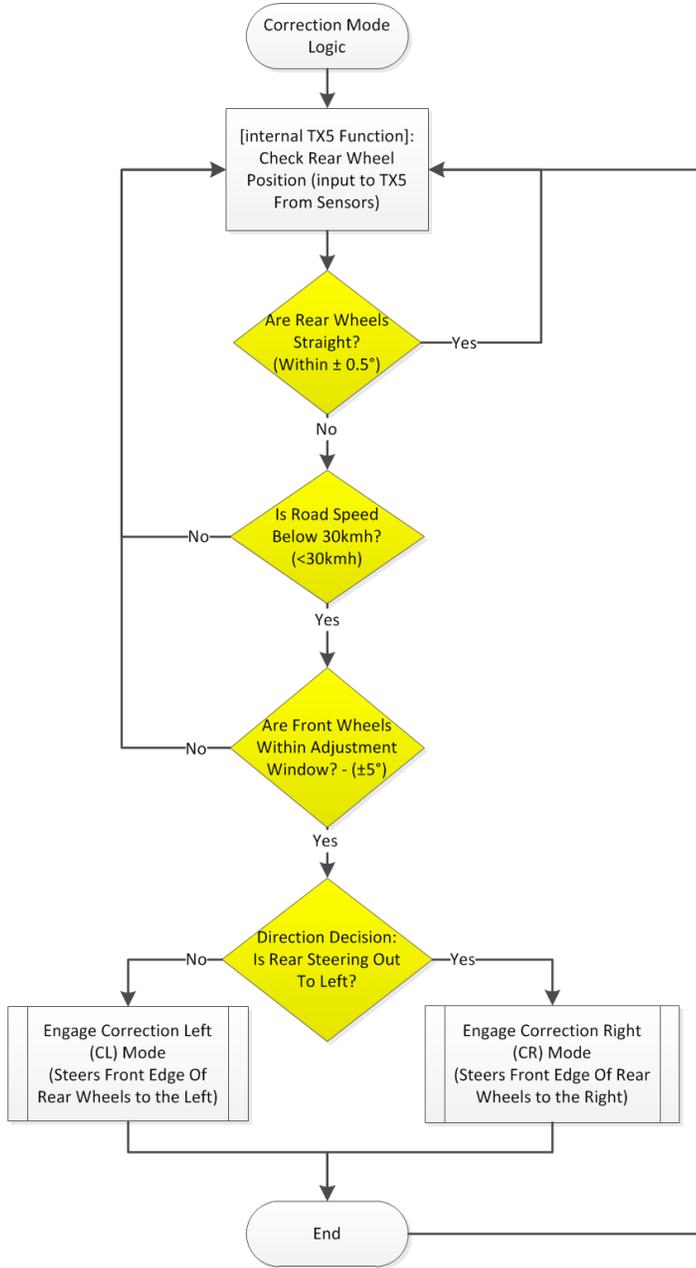


**J-Plex II Comms "Disconnection Check" Flow Chart**  
Locate Faulty Component in the CANBus Network

**FC 13**

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# FC 14



**When To Use:**  
Non-Diagnostic Flow Chart.  
Supplied to Spread  
Understanding Of how  
Control Systems Operate

**Algorithm Of Automatic  
Correction Mode Carried  
Out By TX5 During 2WS  
Operation**

- Key:
- WM = Work Mode
  - WPS = Wheel Position Sensor
  - 4WS = Four Wheel Steer
  - 2WS = Two Wheel Steer
  - RW = Rear Wheels
  - FW = Front Wheels
  - FC = Flow Chart
  - OS = Operating System
  - JVM = Johnston Visual Module
  - CN = Chassis Node
  - IN = Internal Node
  - TX5 = Transmission Node

# FC 14

Flow Chart 14: Correction Mode Logic

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# FC 15

## Control Algorithm For Function Of 4WS System (Carried Out By TX5)

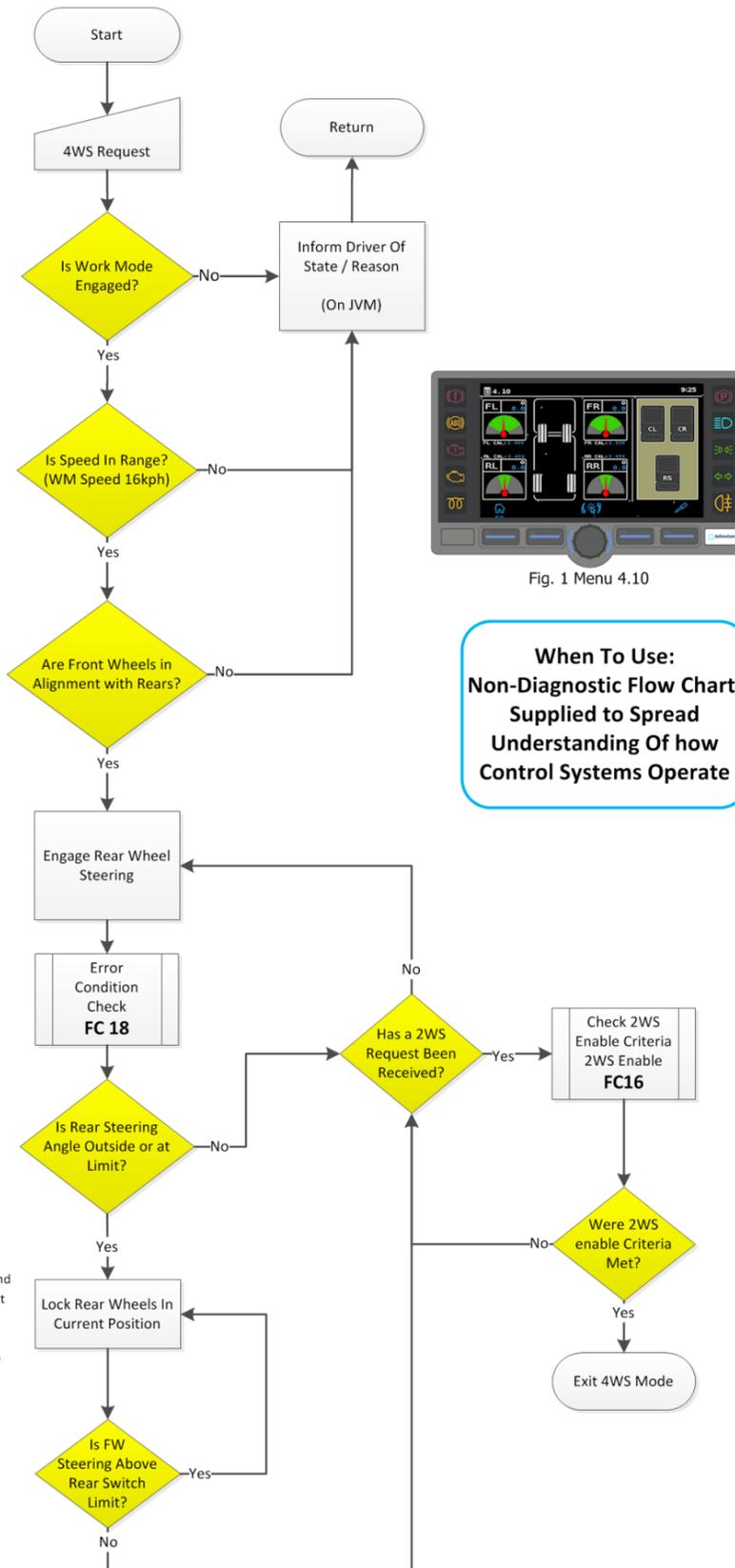
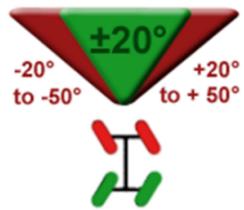


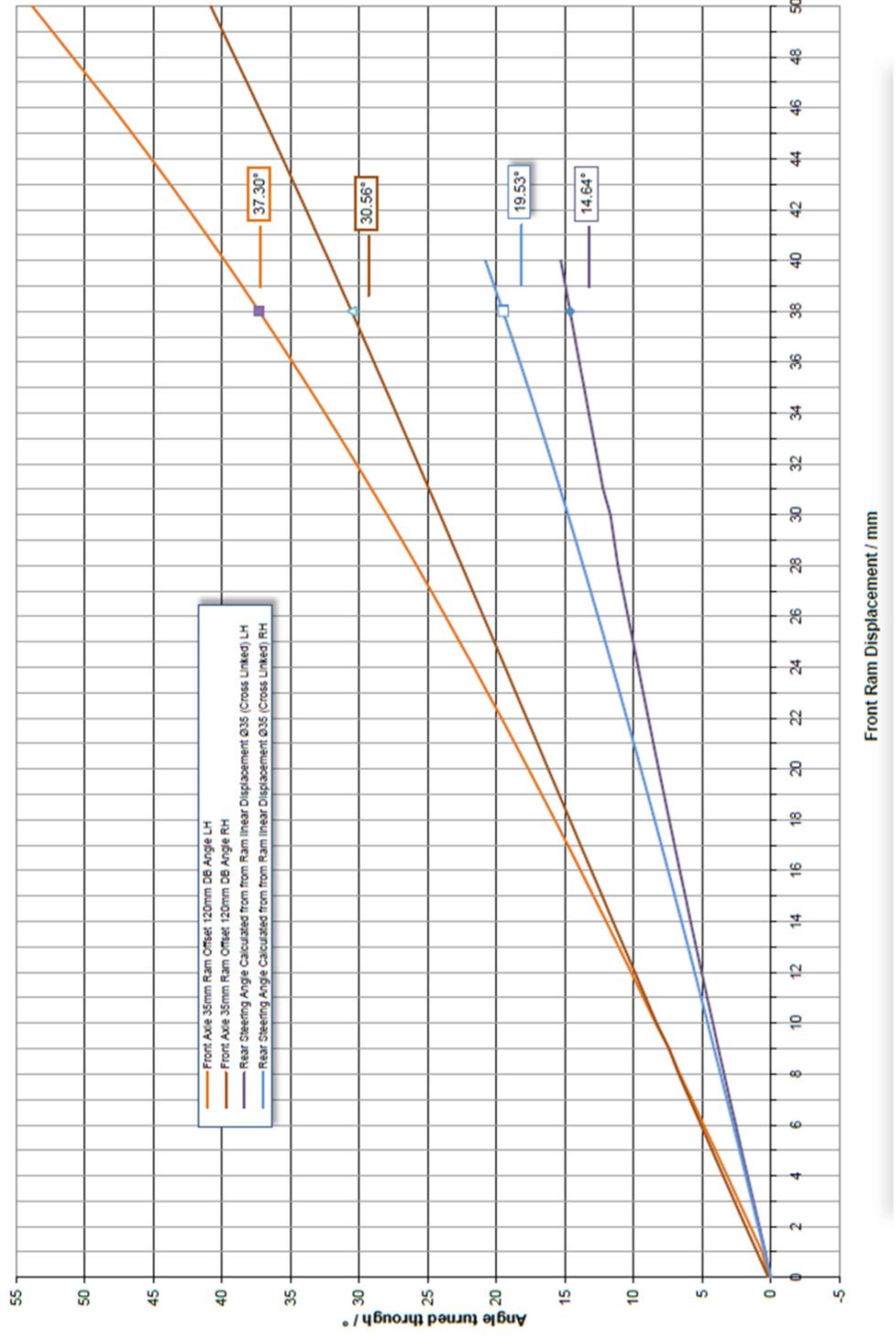
Fig. 1 Menu 4.10

**When To Use:**  
Non-Diagnostic Flow Chart.  
Supplied to Spread  
Understanding Of how  
Control Systems Operate



The rear wheels steer in the opposite direction and in proportion to the front wheels, then stop once they reach circa 20°, the front wheels continue to steer to their maximum limit

## Graphical representation of Front and Rear Steering Angles achieved whilst Turning Right, Production Build Specification



# FC 15

Flow Chart 15: 4WS Enable Logic

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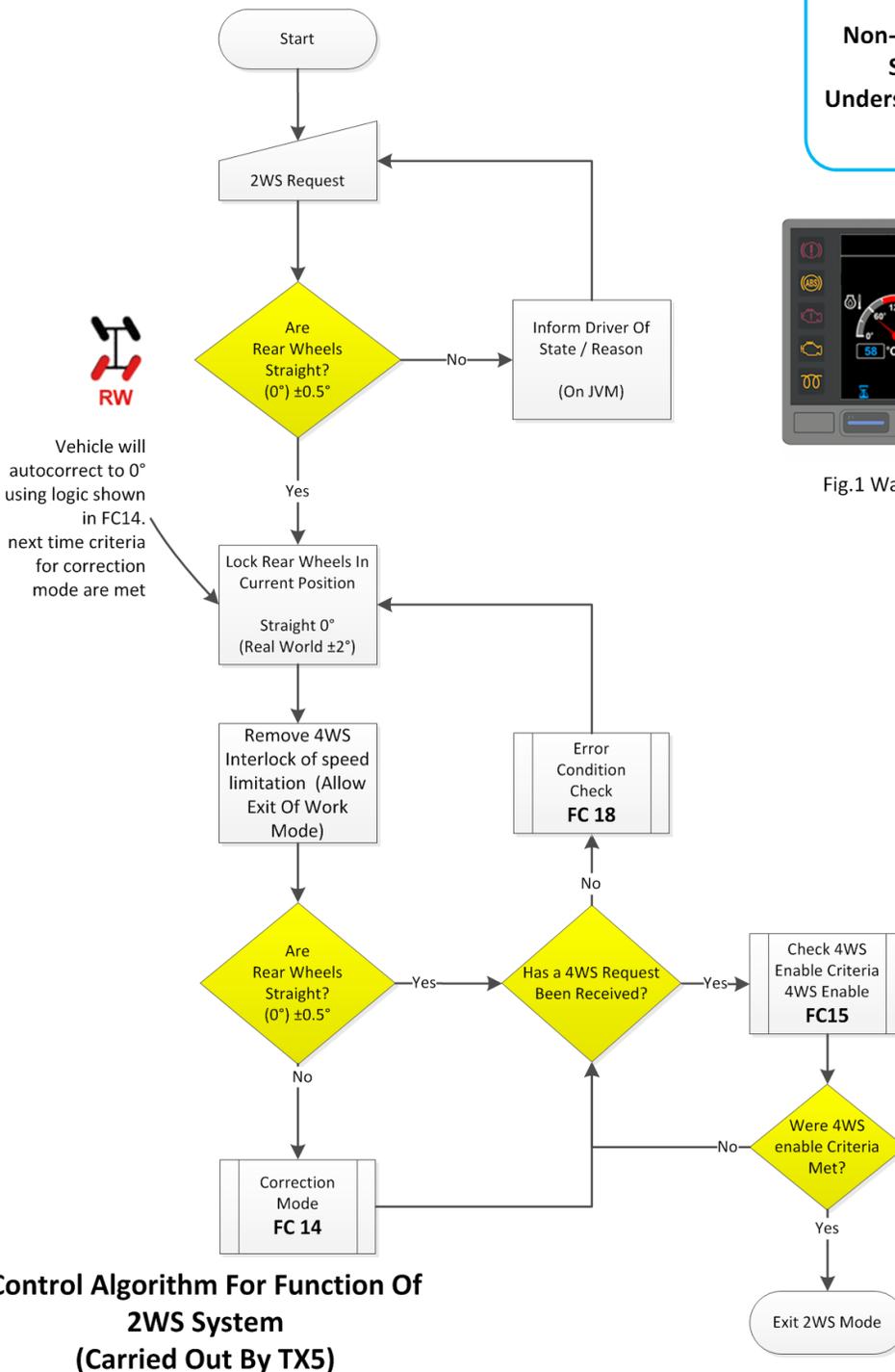
# FC 16

**When To Use:**  
Non-Diagnostic Flow Chart.  
Supplied to Spread  
Understanding Of how Control  
Systems Operate



Fig.1 Warning Icon on exiting WM

- Key:**
- WM = Work Mode
  - WPS = Wheel Position Sensor
  - 4WS = Four Wheel Steer
  - 2WS = Two Wheel Steer
  - RW = Rear Wheels
  - FW = Front Wheels
  - FC = Flow Chart
  - OS = Operating System
  - JVM = Johnston Visual Module
  - CN = Chassis Node
  - IN = Internal Node
  - TX5 = Transmission Node

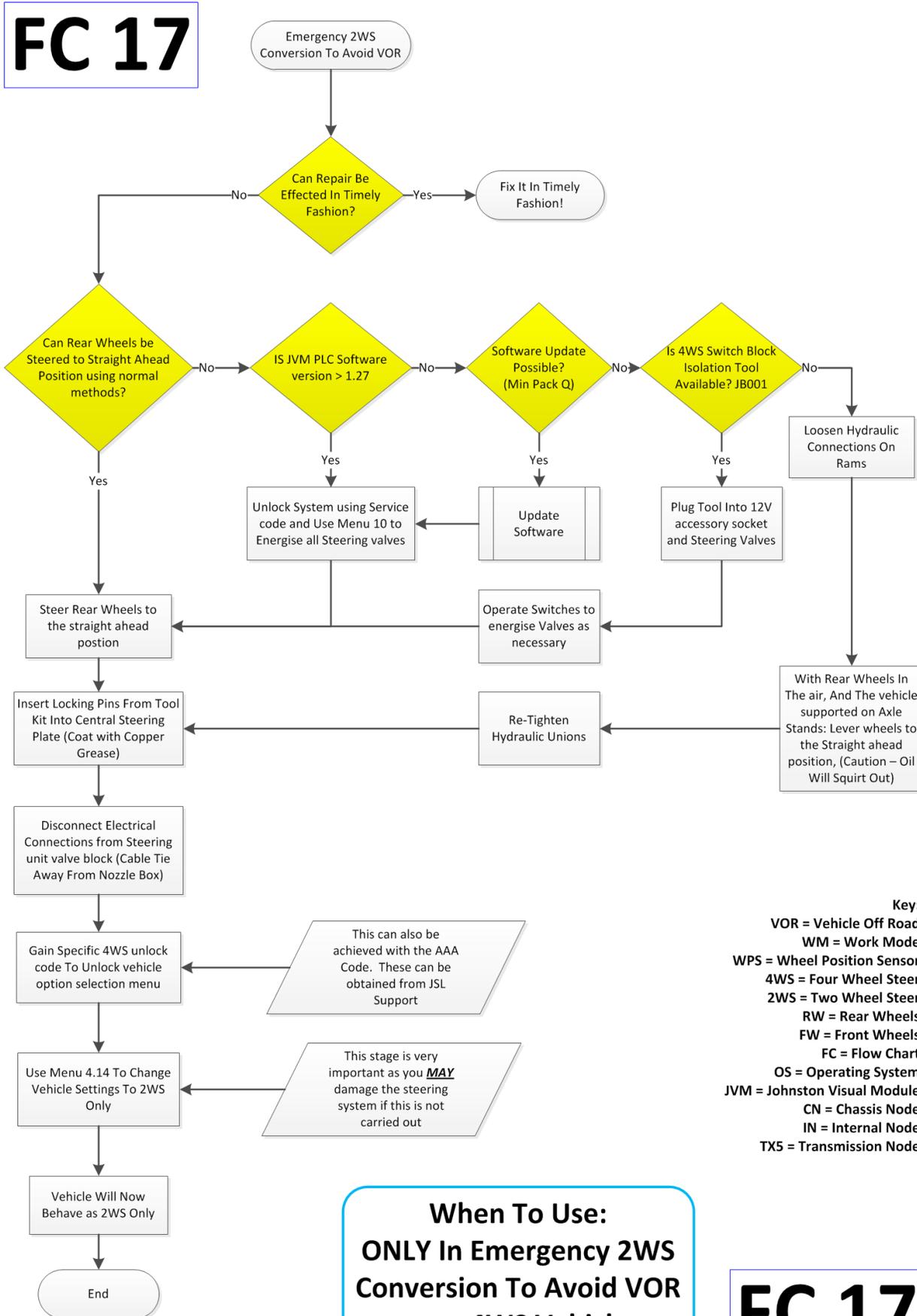


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# FC 16

Flow Chart 16: 2WS Enable Logic

**FC 17**



**Key:**  
 VOR = Vehicle Off Road  
 WM = Work Mode  
 WPS = Wheel Position Sensor  
 4WS = Four Wheel Steer  
 2WS = Two Wheel Steer  
 RW = Rear Wheels  
 FW = Front Wheels  
 FC = Flow Chart  
 OS = Operating System  
 JVM = Johnston Visual Module  
 CN = Chassis Node  
 IN = Internal Node  
 TX5 = Transmission Node

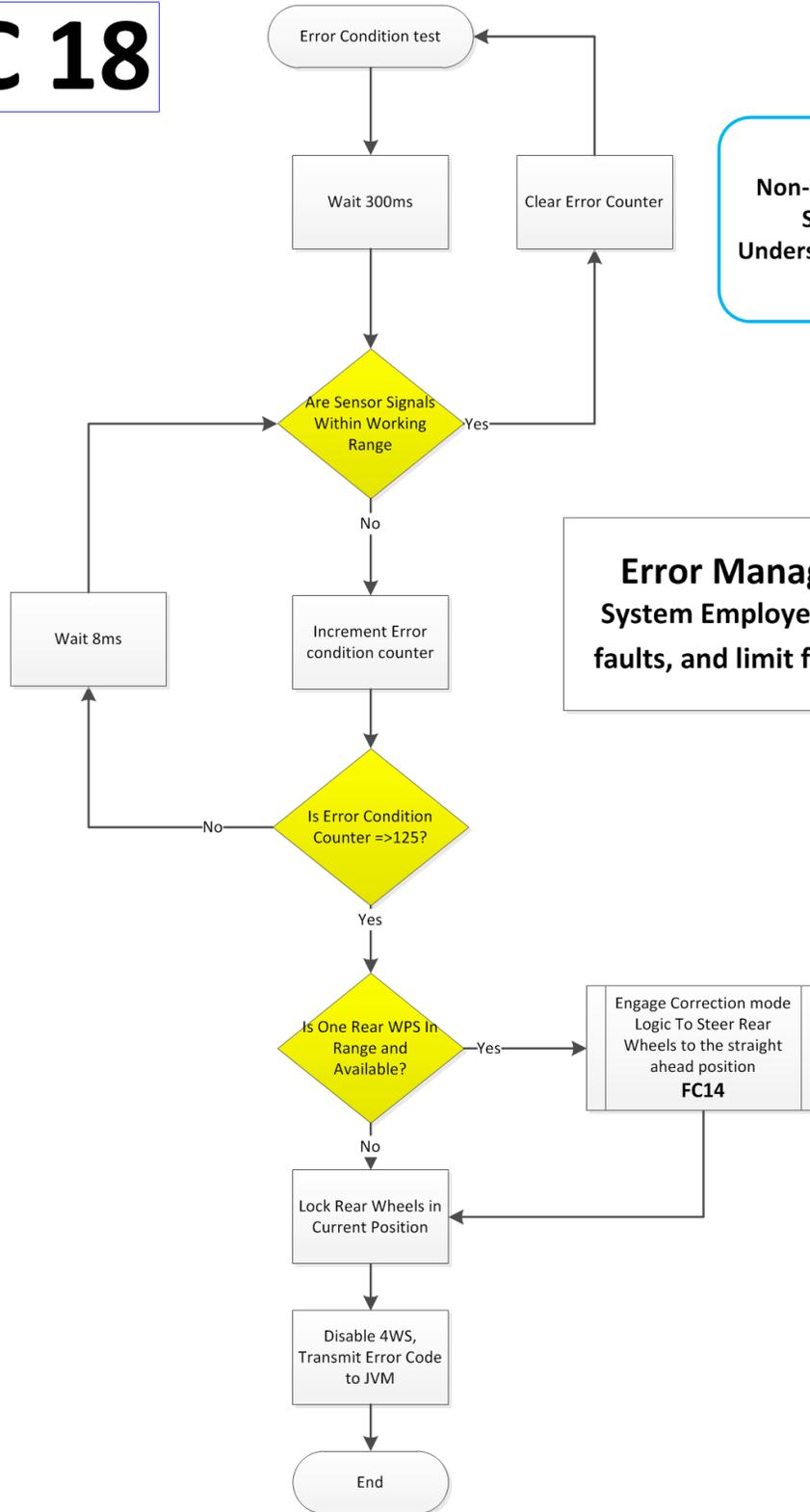
**When To Use:**  
**ONLY In Emergency 2WS Conversion To Avoid VOR on a 4WS Vehicle**

**FC 17**

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Flow Chart 17: Emergency 2WS Conversion to Avoid VOR

**FC 18**



**When To Use:**  
Non-Diagnostic Flow Chart.  
Supplied to Spread  
Understanding Of how Control  
Systems Operate

**Error Management Logic:**  
System Employed by TX5 to test for  
faults, and limit false positive results

- Key:
- WM = Work Mode
  - WPS = Wheel Position Sensor
  - 4WS = Four Wheel Steer
  - 2WS = Two Wheel Steer
  - RW = Rear Wheels
  - FW = Front Wheels
  - FC = Flow Chart
  - OS = Operating System
  - JVM = Johnston Visual Module
  - CN = Chassis Node
  - IN = Internal Node
  - TX5 = Transmission Node

**FC 18**

Flow Chart 18: Error Management Logic

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# FC 19



Fig. 1 Menu 4.10

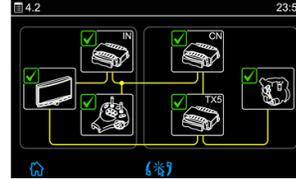
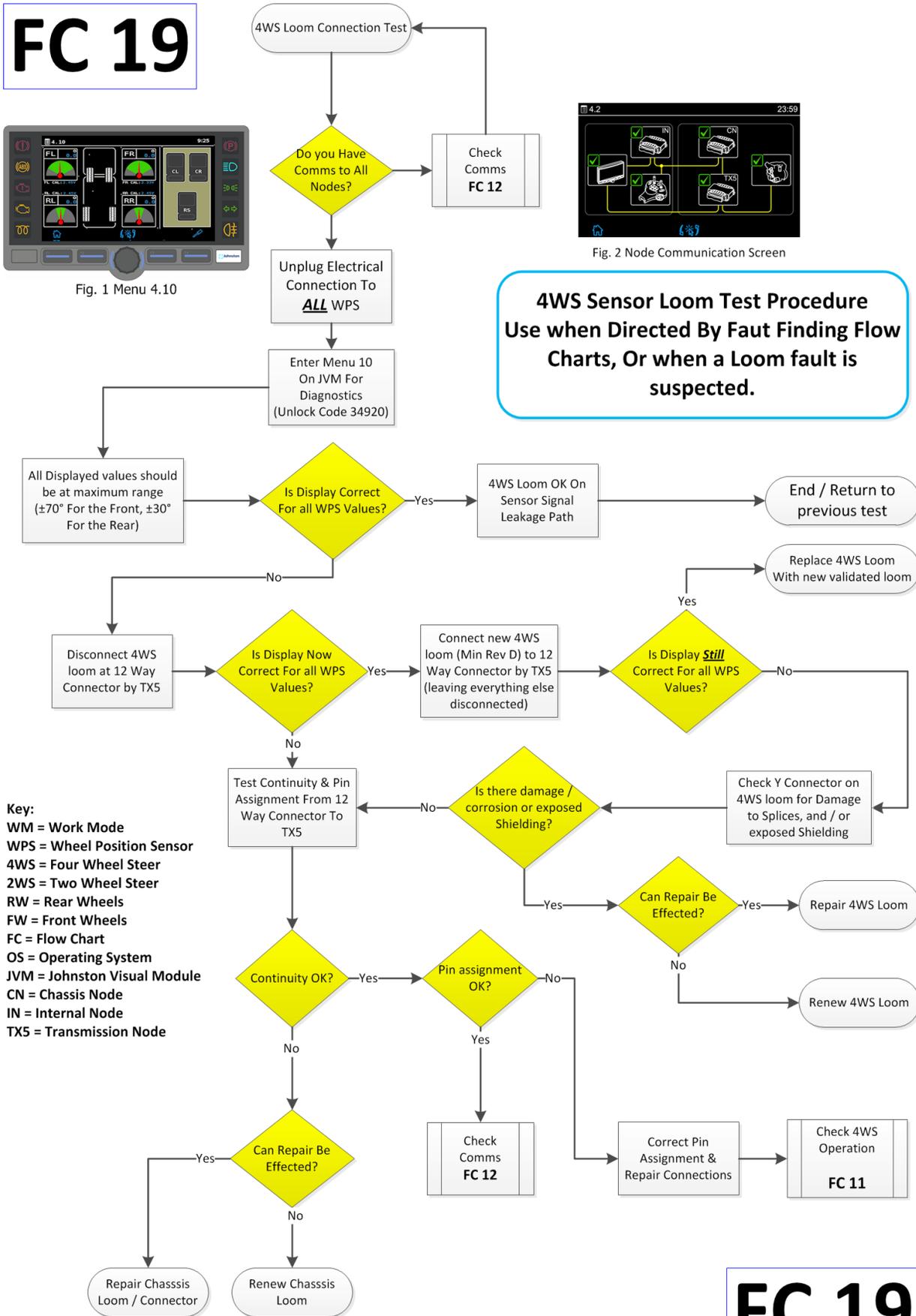


Fig. 2 Node Communication Screen

**4WS Sensor Loom Test Procedure**  
 Use when Directed By Fault Finding Flow Charts, Or when a Loom fault is suspected.



**Key:**  
 WM = Work Mode  
 WPS = Wheel Position Sensor  
 4WS = Four Wheel Steer  
 2WS = Two Wheel Steer  
 RW = Rear Wheels  
 FW = Front Wheels  
 FC = Flow Chart  
 OS = Operating System  
 JVM = Johnston Visual Module  
 CN = Chassis Node  
 IN = Internal Node  
 TX5 = Transmission Node

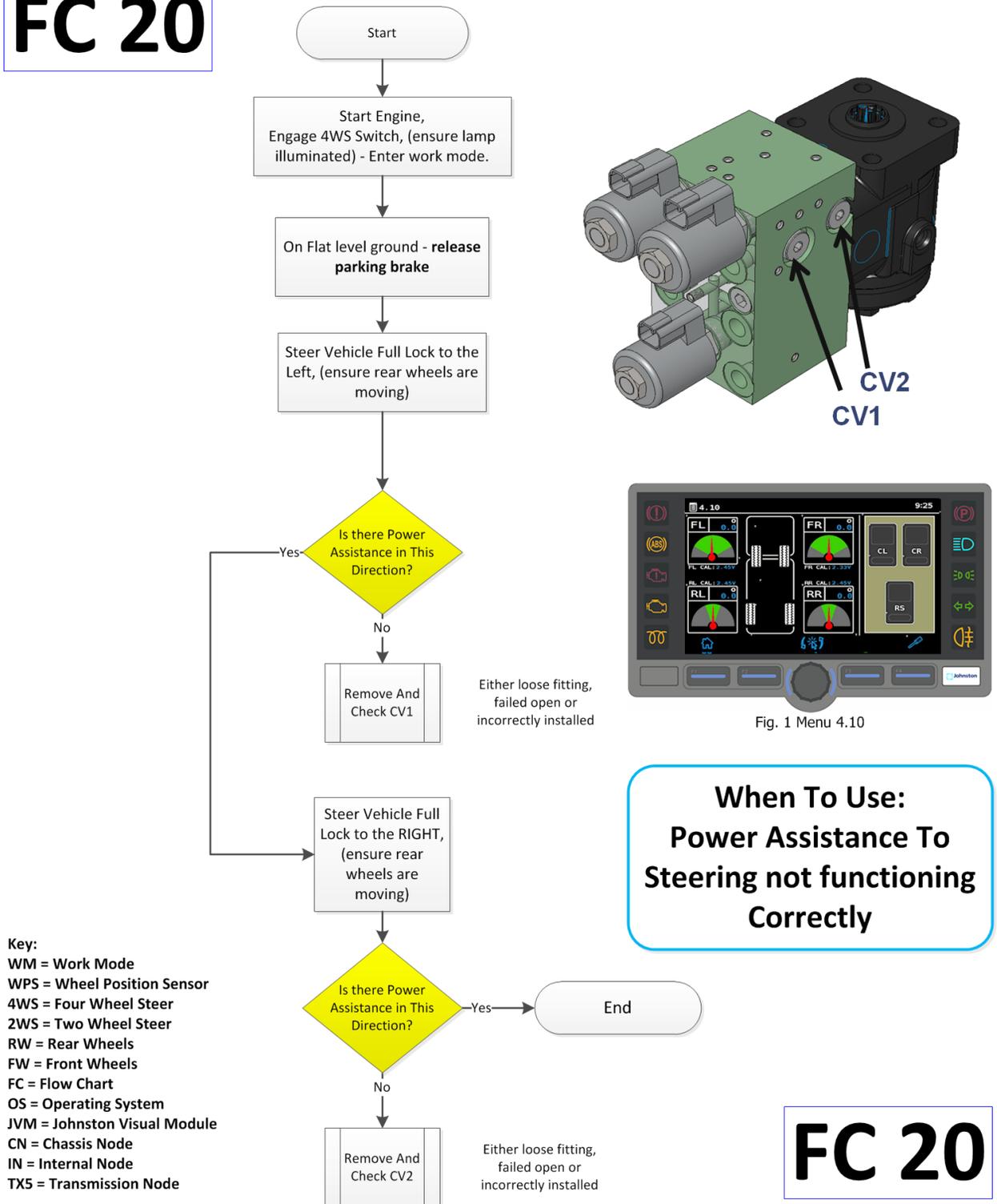
# FC 19

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Flow Chart 19: 4WS Loom Connection Test

**FC 20**

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Flow Chart 20: Power Assistance to Steering not functioning correctly



**CHAPTER**

**8**

**Service Tools**

**Table of Contents**

<b>Section</b>	<b>Page</b>
Service Tools	8 : 2

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The following tools are available through our Spares Network

<b>Tool No.</b>	<b>Description</b>	<b>Function</b>
437/3	Pressure Gauge Set	Used to measure hydraulic and water pressures.
437/4	Optical Tachometer	Used to measure fan rpm.
437/7	0.55 Litres/min Flow Gauge	Used to measure hydraulic flows.
437/8	Impulse Adaptor	Connects to 437/4 to measure engine speeds from fuel injection pipes.
7012202	Tensioner - Gimbal Bearing	For applying correct torque setting to gimbal bearing 140 Nm (103 lb.ft) - 4WS only.

CHAPTER

**9**

**Health and Safety**

**Introduction**

The information presented in this chapter does not infer that there are hazards associated with the Johnston sweepers. It is given as a guide to general precautions that should be exercised in the course of their maintenance work.

Whilst every effort has been made to ensure completeness of this document, owners and operators of Johnston sweepers are reminded of their responsibilities to comply with all relevant legislation including Risk/COSHH Assessments and Approved Codes of Practice.

## Health and Safety Precautions

The information presented in this section does not infer there are any particular hazards associated with these machines. It is given as a guide to the general precautions that should be taken in any workshop environment when working on machines of this nature in the course of their maintenance.



### **Safety symbol:**

The universal symbol is used throughout this manual to indicate information which is essential for health and safety of all operating personnel.

Refer to all state, district/company, or council Health and Safety Regulations and follow the procedures laid down.

The repair and maintenance of machinery such as this can involve physical hazards or other risks to health. This section lists some of these hazards and the precautions necessary to avoid them.

The list is only general but all other operations, procedures and the handling of materials should be carried out in accordance with the requirement of health and safety laws, which is the responsibility of the Owner/Operator/Maintainer.



### **Anti Freeze:**

Anti-freeze may be absorbed through the skin in toxic or harmful quantities. If swallowed, seek medical attention immediately. Some types, i.e., isopropanol, ethylene glycol and methanol are flammable.



### **Batteries:**

Gases released during charging are explosive. Never use naked flames or allow sparks near charging or recently charged batteries.



### **Disconnection:**

Disconnect the negative battery lead from battery first. The positive cable must always be disconnected last.

### **Reconnection:**

Always reconnect the positive battery cable first.

### **Jump-starting and use of auxiliary (booster) batteries:**

Do not jump-start maintenance free batteries if in a deeply discharged state as internal short circuits may occur.

If a maintenance free battery is found to be in a deeply discharged state, it is essential to remove the battery and recharge off the vehicle. Jump-starting will not enable the vehicles own charging system to initiate the charging process.

**Jump starting procedure:**

Always follow this procedure when connecting a booster battery.

Take care not to cause sparking which could ignite hydrogen gas being given off by the batteries.

1. Apply the park brake, turn off ignition, lights and other electrical loads.
2. If the slave battery is mounted on another vehicle, ensure that the vehicles are not touching.
3. Ensure that the donor battery voltage is compatible with the vehicle battery.
4. Ensure that adequate ventilation is available to the vehicle and slave batteries.
5. Connect positive terminal of the donor battery group to positive terminal of the discharged battery group.
6. Connect negative terminal or slave battery group to chassis earth of the discharged battery group.
7. Attempt to start the casualty vehicle.
8. Once the vehicle has started, remove the negative lead from the chassis and then the slave battery.
9. Remove positive lead from discharged chassis and then the donor chassis.

If the vehicle will not start with a booster battery, contact your local Johnston Service Network.



**Chemical materials:**

Chemical materials such as solvents, sealers, adhesive, paints, resin foams, battery acids, anti-freezes, brake fluids, oils and grease should always be used with caution and stored and handled with care.

Chemical materials may be toxic, harmful, corrosive, irritant or highly flammable and give rise to hazardous fumes and dust.

Always consult the appropriate safety standards for handling such materials.



Typical biohazard symbol



Typical radioactive material symbol



Typical poison symbol



Always use appropriate protective clothing

**Reminders**

## Chemical materials

- DO** remove chemical materials from the skin and clothing as soon as practical after soiling. Change heavily soiled clothing and have it cleaned.
- DO** carefully read and observe hazard and precaution warnings given on hazardous material containers and in any accompanying leaflets, posters or other instructions. Hazardous material health and safety data can be obtained from manufacturers.
- DO** organise work practices and use protective clothing to avoid soiling of the skin and eyes; breathing vapours, aerosols, dust, and fumes; inadequate container labelling; fire and explosive hazards.
- DO** wash before job breaks, before eating, smoking, drinking or using toilet facilities when handling chemical materials.
- DO** keep work areas clean, uncluttered and free of spills.
  
- DO NOT** mix chemical materials except in accordance with the manufacturer's instructions. Some chemicals can form other toxic or harmful substances; give off toxic or harmful fumes; be explosive when mixed together.
- DO NOT** spray chemical materials, particularly those based on solvents, in confined spaces; for example, when people are inside a vehicle.
- DO NOT** apply heat or flame to chemical materials, except under the manufacturer's instructions. Some are highly flammable and some may release toxic or harmful fumes.
- DO NOT** leave containers open. Fumes given off can build up to toxic, harmful or explosive concentrations. Some fumes are heavier than air and will accumulate in confined areas, pits, etc.
- DO NOT** transfer chemical materials to unlabelled containers.
- DO NOT** clean hands or clothing with chemical materials. Chemicals, particularly solvents and fuels will dry the skin and may cause irritation with dermatitis. Some can be absorbed through the skin in toxic or harmful quantities.



**Dusts:**

Powder, dusts or clouds may be irritant, harmful or toxic. Avoid breathing dusts from powdery chemical materials or those arising from dry abrasion operations. Wear respiratory protection in accordance with the requirement of the Health and Safety Acts.



**Electric shocks:**

When working on electrical systems, remove watches, bracelets and rings as these can conduct electricity and cause shorts and/or burns.

Electric shocks can result from the use of faulty electrical equipment or from the misuse of equipment even in good condition.

Ensure that electrical equipment is maintained in good condition and frequently inspected and tested.

Ensure that flexes, cables, plugs and sockets are not frayed, kinked, cut, cracked or otherwise damaged.

Ensure that electrical equipment is protected by the correct rated fuse and if used outside an earth-leakage circuit breaker is used.

Never misuse electrical equipment and never use equipment that is in any way faulty. The results could be fatal.

Use reduced voltage equipment (110 or 24 volt) for inspection and working lights where possible.

Ensure that the cables of mobile electrical equipment cannot be trapped and damaged such as in a vehicle hoist, trolley jacks, etc.

Use air operated mobile equipment where possible in preference to electrical equipment.



**Exhaust fumes:**

These contain asphyxiating, harmful and toxic chemicals and particles such as carbon oxides, nitrogen oxides, aldehydes, leads and aromatic hydrocarbons.

Engines should only be run under conditions of adequate extraction or general ventilation and not in confined spaces.

**NB :** Catalyst exhausts/silencers can run at extremely high temperatures.



**Fire and welding:**

Observe strict fire safety when storing and handling flammable materials or solvents, particularly near electrical equipment or welding processes.

Disconnect battery, microprocessors, etc. before commencing welding. Failure to observe this could cause failure of components.

Ensure before using electrical or welding equipment that there is no fire hazard present.

Have a suitable fire extinguisher available when using welding or heating equipment.

Special precautions must be taken before any welding or cutting takes place on vessels which have contained combustible materials, e.g. fuel tanks.

The sound insulation foam used on the equipment must be removed if any welding is to be carried out in that area of the machine.

**First aid:**

It is desirable for someone in the workshop to be trained in the first aid procedures. Splashes or particles in the eye should be flushed with clean water for at least ten minutes and medical attention sought. Soiled skin should be washed with soap and water. Inhalation affected individuals should be removed to fresh air immediately. If hazardous material has been swallowed or if the effects of exposure to hazardous materials persist, consult a doctor with information (label) on material used. Do not induce vomiting (unless indicated by the manufacturer).

**High-pressure air and lubrication equipment:**

Always keep high-pressure equipment in good condition and regularly maintained, particularly at joints and unions.

Never direct a high (or low) pressure nozzle at the skin as the fluid may penetrate to the underlying tissue, etc, and cause serious and potentially fatal injury.

**Oils and greases:**

Prolonged and repeated contact with mineral oil may result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. Gross and prolonged contact, especially with used engine oil, which contains potentially harmful contaminants, may cause skin cancer.



Where there is a risk of eye contact, e.g., by splashing, eye protection should be worn, for example, chemical goggles or face shields; in addition, an eyewash facility should be provided.

Adequate means of skin protection and washing facilities should be provided.

Repeated or prolonged skin contact should be avoided by wearing protective clothing, including impervious gloves where practical. Particular care should be taken with used oils and greases containing lead.

First Aid treatment should be obtained immediately for open cuts and wounds.

Apply barrier cream before each work period to help when removing oil from the skin.

Use proprietary hand cleaners only if they can be removed from the skin using water.

Overalls must be cleaned regularly. Discard clothing that cannot be cleaned and footwear that has become impregnated.

In the event of a skin condition occurring consult a doctor and tell him/her that your work involves using oil.

### **Solvents:**

Solvents such as acetone, white spirit, toluene, xylene and trichloroethane are flammable.



Avoid splashes to the skin, eyes and clothing. Wear protective gloves, goggles and clothing.



When using solvents ensure good ventilation; avoid breathing fumes, vapours, spray-mists and keep containers tightly sealed. Do not use in confined spaces. When spraying materials containing solvents, for example paints, adhesives or coatings, use extraction ventilation or personal respiratory protection in the absence of adequate general ventilation.

Do not apply heat or flame except under specific and detailed manufacturer's instructions.



### **Suspended loads:**

Never work under an unsupported, suspended or raised load. For example, jacked up vehicle, raised tipper body, suspended engine, etc.

Always ensure that lifting equipment e.g., jacks, hoists, axle stands, slings, etc are adequate and suitable for the job, in good condition and regularly maintained.

**NEVER** improvise lifting tackle. **ALWAYS** ensure body props and/or axle stands are used when working under bodies or chassis.



### **Workshop tools and equipment:**

Only use tools and equipment for their intended purposes.

Never overload equipment such as hoists, jacks, axles stands or lifting slings. Damage caused by overloading is not always immediately apparent and may result in a fatal failure the next time the equipment is used.

Never use damaged or defective tools or equipment.

Always wear suitable eye protection when using grinding, chiselling or air guns.



Always wear a suitable breathing mask when using sand blasting equipment, working with asbestos based materials (such as brake linings) or using spraying equipment.

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