



USER MANUAL

Titan PT600 – User Manual

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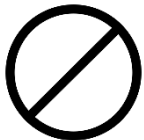


Manual Coverage

This manual is intended exclusively for **Titan PT600 Tow Truck** with manufacture year of 2025 (MY2025). It provides instructions, guidelines, and specifications specific to this equipment and should not be used for any other products.

Using this manual for equipment other than those listed may result in incorrect operation, improper maintenance, or potential safety hazards.

Reading This Manual

Read and understand this manual thoroughly before using the equipment to ensure safe and proper use. Failure to follow the instructions may result in damage or injury.

	WARNING Explains something that, if not obeyed, could cause death or injury to people.
	NOTICE Explains something that, if not obeyed, could cause damage or a malfunction in the equipment.
	DO NOT Means “Do not”, “Do not do this” or “Do not let this happen”
	IMPORTANT NOTE Helpful information
	PART/S INVOLVED Contains information about the part/s.

It is not the intention of Avro GSE to teach drivers how to drive a vehicle, this manual is to provide an operator with the ability to identify and familiarize themselves with the vehicle so that they can perform their daily duties with confidence.

All people operating this vehicle require prior authorization and training from their company.

Pictures in this manual may be different to actual vehicle. They are used as a guide to identify specific components.

Table of Contents

Manual Coverage.....	3
Reading This Manual.....	4
Table of Contents	5
Introduction.....	10
SPECIFICATIONS & FEATURES.....	11
Vehicle Mass and Dimensions	11
Engine Details Overview	12
Engine Coolant Schematic	13
Transmission Overview.....	14
Driveshafts Overview – Wing Bearing / C-Positive.....	16
Axles Overview.....	17
Wheels and Tires.....	17
Steering Overview	18
Brake System Overview	18
Hydraulic System Overview	19
Electrical System Overview.....	19
Chassis & Cabin Overview	19
Towing Features	19
Warranty	20
OPERATING THE EQUIPMENT	21
Operator Controls	21
Foot Controls.....	21
Hand Controls	23
Transmission Shift Control Lever	24
Park Brake	24
Driver Seat Controls	27
Digital Display	28
Warnings and Faults.....	31
System Pressure	32
Maintenance Page	33
Settings Transducer	34

Titan PT600 – User Manual

Deutz Screen	34
Switches & Indicators	35
Spicer Transmission Display Module (TDM).....	35
Battery Isolation Switch	38
Operator's Instructions	39
Pre-operational Check.....	39
Engine Start.....	39
Steering Controls.....	40
Moving Off	40
Engine Shutdown	40
Towing the Tractor	40
Braking the Vehicle	41
General Vehicle Shutdown.....	41
Preparing for Aircraft Movement Operations.....	41
EQUIPMENT MAINTENANCE.....	43
Before Starting Service	43
Recommended Lubricants and Fluids.....	44
Service Intervals.....	45
Engine Oil	45
Oil Level.....	45
Oil Change Intervals	46
Using Lubricating Oil Analysis	47
Axle Components	48
General Details.....	48
Axle Overhaul.....	49
Propeller Shafts – Bearing Cap Construction	50
General Information.....	50
Lubrication Propeller Shafts.....	50
Service Check for Propeller Shaft Component Wear	50
Removing Propeller Shaft.....	51
Installing Propeller Shaft	51
Propeller Shaft Overhaul	51
Disassembling Propeller Shaft.....	51

Titan PT600 – User Manual

Assembling Propeller Shaft	52
Inspecting Propeller Shaft Component for Wear	52
Transmission – ZF 6WG 210	53
General Information.....	53
Removal and Installation	53
Disconnection of the Transmission from the Engine	53
Removal of Flex Plate Assembly from Engine Crankshaft.....	54
Installation of Flex Plate Assembly	54
Installation of Transmission to Engine.....	54
Transmission Overhaul.....	54
Air Inlet Equipment – Filter Assembly.....	55
Maintenance Checks	55
Replacing the Filter Element.....	55
Exhaust System	56
Cooling System	56
Checking Coolant Level.....	56
Radiator Fan.....	57
Monthly Maintenance	57
Radiator Assembly Removal	58
Cooling System Overhaul	58
Wheel Assemblies	59
Tightening Wheel Nuts.....	59
Tire Wear	59
Checking Tire Pressure	59
Hydraulic System	60
Steering.....	61
Steering Faults and Adjustments.....	62
Procedure to Correct Steering Track	64
Braking.....	65
Parking Brakes	65
Service Brakes	66
Jacking Cylinders	67
After Completing Work:	67

Titan PT600 – User Manual

Reservoir and Ancillary Equipment.....	68
Components in Hydraulic System	68
Hydraulic Changes.....	70
Oil Change.....	70
Preventive Maintenance.....	70
Replacement of Return Line Filter Element	70
Cleanliness	70
Hydraulics System – Maintenance	71
General Hydraulic System Check.....	71
Replacement of Return Line Filter Element	72
Fan Drive Assembly	72
Fan Drive Maintenance.....	72
Fuel Reservoir	73
Fuel Reservoir Cleaning.....	74
Fuel Filters.....	74
Fuel Reservoir Preventative Maintenance.....	75
Battery and Battery Box.....	75
Battery Connection.....	75
Battery Fluid Level	75
Battery Preventative Maintenance.....	76
Tow Hitches.....	76
Diesel Fuel Oils.....	76
Fuel Mixing Considerations	76
ASTM Diesel Fuel Specifications	77
Service Intervals.....	78
Daily Maintenance Inspection	80
Spare Parts List	81
HYDRAULIC SYSTEM DIAGRAM.....	82
ELECTRICAL SYSTEM AND CIRCUITS DIAGRAMS	84
APPENDICES.....	113
Torque Reference Table.....	113
Standard Conversion Table	114
Pressure And Torque Conversion Table	115
Torque Specification	116

Titan PT600 – User Manual

Notes..... 117

Contact Us 118

Introduction

The Titan PT600 Tow Tractor is built for push-out and towing operations of aircraft up to 300,000 kg*.

It runs on a 4-cylinder Deutz TCD 4.1 L4 diesel engine with a 6WG190 powershift transmission (six forward, three reverse speeds). A torque converter and flex plate ensure smooth gear shifts. The gearbox connects to the front and rear Kessler drive steer axles via two prop shafts.

The spacious cabin offers optional air conditioning. The driver's seat is on the left, with a passenger seat and seat belts. The design ensures excellent visibility.

Maintenance is easy with hinged doors, hatches, and lightweight covers.

The vehicle has hydraulic braking and steering, both functional in emergencies. The hydraulic steering system supports three modes:

- 4WS (Four-Wheel Steer) – Better maneuverability.
- 2WS (Two-Wheel Steer) – Front wheels steer only.
- CRAB Steer – All wheels turn in the same direction for sideways movement.

Braking is hydraulic, with a DC emergency pump and accumulators for backup.

SPECIFICATIONS & FEATURES

Vehicle Mass and Dimensions

Overall Length	7750mm (CRS Tow Pins)
Overall Height	2060mm (Cabin)
Overall Width	2700mm
Ground Clearance	300mm
Wheelbase	3900mm
Track	2302mm
Outside Turning Radius	4300mm
Nominal Gross Mass	40-ton

Titan PT600 – User Manual

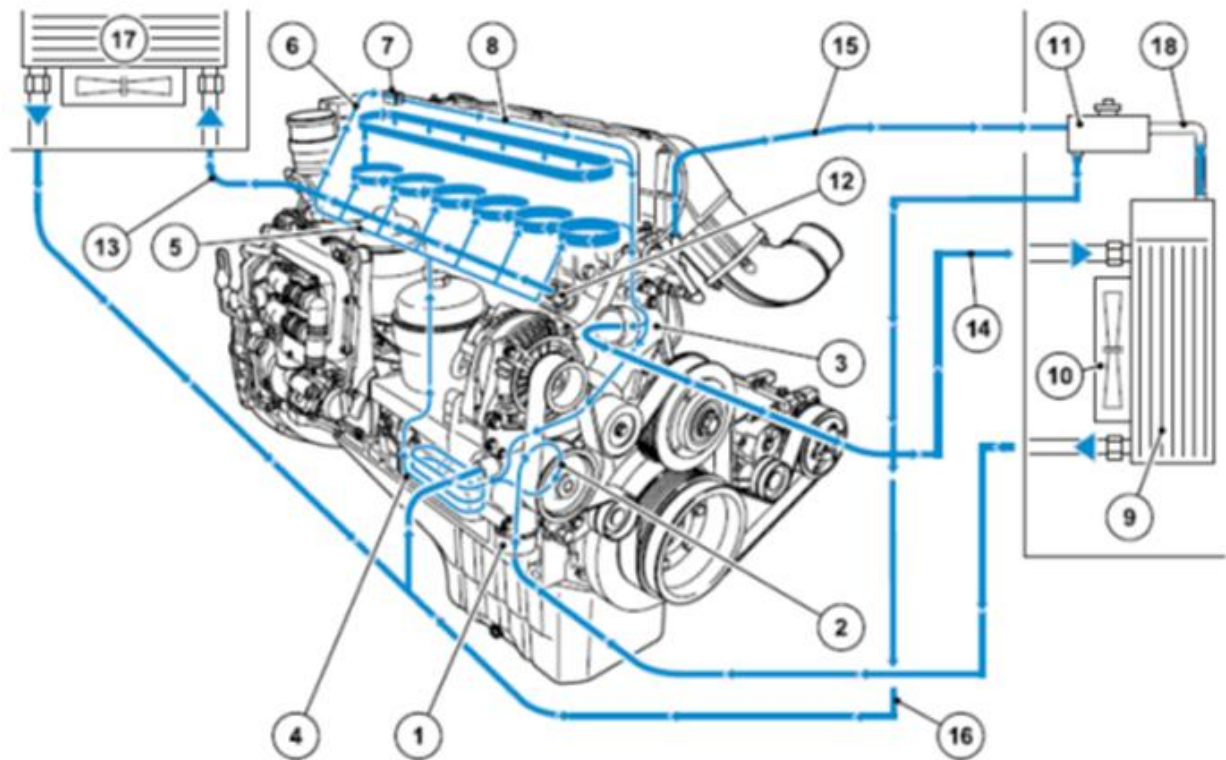
Engine Details Overview

Deutz TCD 4.1 cylinder, 4-Stroke, liquid cooled diesel engine with EMR 4 (electronics)

Capacity	4.038 liters
Bore & Stroke	101mm x 126mm
Rated Power	190kW @ 2300rpm
Torque	1050Nm @ 1500rpm
Alternator	24V DC
Fuel Injection System	Electronic Common Rail
Engine Lubrication System	Crankshaft driven gear pump system incorporates an oil cooler and full flow replaceable element type filter.
Oil Capacity	11.5 liter
Oil Type	15w40 or equivalent

Titan PT600 – User Manual

Engine Coolant Schematic



1. Coolant inlet to engine
2. Coolant pump
3. Thermostat
4. Lube oil cooler
5. Cylinder pipe/head cooling
6. Coolant Supply for EGR cooling (optional)
7. Engine brake cooling (optional)
8. Return line to the thermostat (optional)
9. Heat exchanger (optional)
10. Fan (by customer)
11. Compensation tank
12. Cab heater connection
13. Coolant supply flow to the cab heating
14. Engine outlet to the cooler
15. Engine ventilation to compensation tank
16. Compensation line from the compensation tank to the coolant pump
17. Cab heating (optional)
18. Cooler breather

Titan PT600 – User Manual

Transmission Overview

ZF 6WG210 series power shift transmission. Gear selection by floor mount electronic control type.

The Shift Selector is situated to the right of the driving position on a pedestal mounted to the floor.

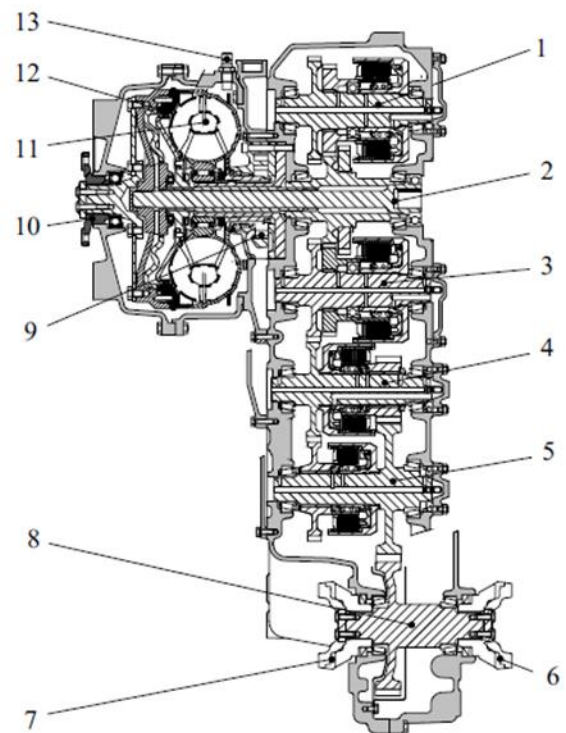
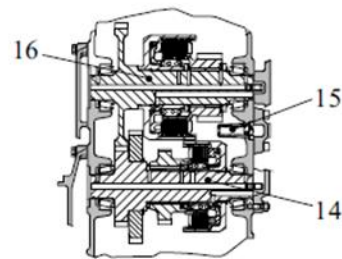
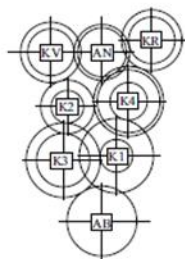
Number of Forward Gears	6	
Number of Reverse Gears	3	
Ratio of Gears	First	5.562 : 1
	Second	3.615 : 1
	Third	2.255 : 1
	Fourth	1.466 : 1
	Fifth	0.842 : 1
	Sixth	0.613 : 1
	Reverse	5.274 : 1
		2.138 : 1
		0.894 : 1
Oil Capacity	27 liters	
Oil Type	Dextron 3	

LAYOUT 6 WG-210

TABLE-1

- 1 = Clutch shaft „KR“
- 2 = Power take-off, coaxial, engine-dependent
- 3 = Clutch shaft „KV“
- 4 = Clutch shaft „K2“
- 5 = Clutch shaft „K3“
- 6 = Output flange - rear side
- 7 = Output flange - converter side
- 8 = Output shaft "AB"
- 9 = Transmission pump
- 10 = Input flange - input through universal shaft "AN"
- 11 = Converter
- 12 = WK (converter clutch)
- 13 = Inductive transmitter for engine speed
- 14 = Clutch shaft „K4“
- 15 = Converter safety valve
- 16 = Clutch shaft „K1“

GEARBOX DIAGRAM



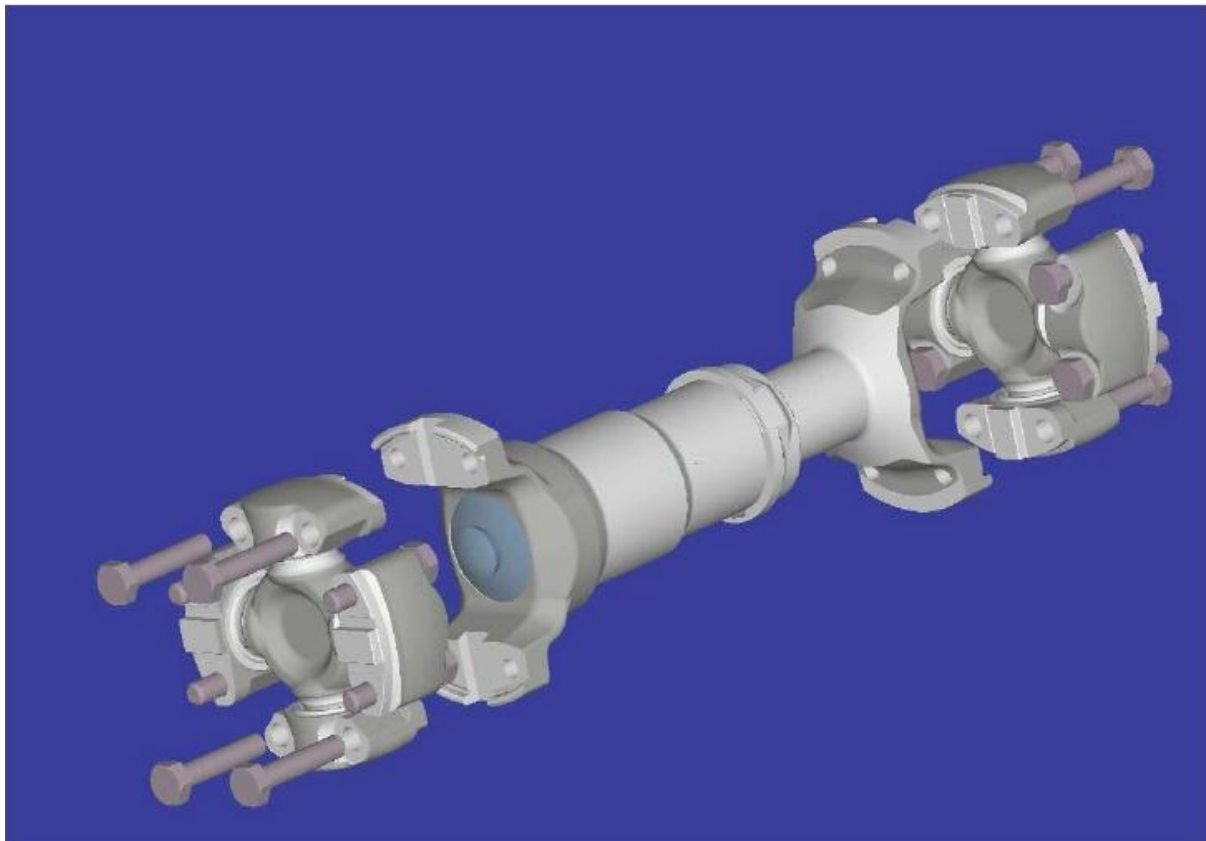
Driveshafts Overview – Wing Bearing / C-Positive

Spicer Italcardano driveshafts are designed for efficient torque transfer through a mechanical drive, using keys positioned on the bearing blocks. These keys fit precisely into corresponding slots machined on the connecting yokes.

This design offers significant advantages, especially in applications with continuous load variations or shock loads.

The direct connection of bearing blocks to output flanges provides several key benefits:

- High flexibility for various applications
- Ideal for short application lengths
- Reduced joint working angles for improved efficiency
- Quick disassembly with just four bolts per side
- Easy maintenance – U-joint kits can be replaced without removing the entire shaft



Titan PT600 – User Manual

Axles Overview

Model	Kessler LT81PL489	
Manufacturer	Kessler – Germany	
Front Axles	P/N: DRG # 82.9375.3 Drive steer (Fixed) axle with single reduction hypoid gear and differential	
Rear Axles	P/N: DRG # 82.9375.3 Drive Steer (Pivot) axle with single reduction hypoid gear and differential	
Axle Reduction Ratio	6.23 : 1	
Oil Capacity (approx.)	Hubs (all four)	8 liters
	Differential (two)	16.6 liters

Wheels and Tires

Tires	Four, 385/65 R22.5, 22 ply
Wheel (Rim)	11.25 inch
Tire Pressure	9.5 Bar (135psi)

Steering Overview

System Control	Fully managed by Eaton screen and ECU.
Steering Modes	<ul style="list-style-type: none"> - 2WS (Two-Wheel Steer): Front wheels only - 4WS (Four-Wheel Steer): All wheels turn for better maneuverability - Crab Steer: All wheels turn in the same direction
Power Source	Hydraulically powered by Eaton vane pump, directly coupled to the rear of the ZF 6WG190 transmission.
Steering Control	Three-spoke steering wheel connected to a hydraulic orbital unit that controls the steering cylinders on both front and rear axles.
Rear Steering	Hydraulically powered, mirroring front-wheel movements in 4WS and Crab Steer modes for precise control.

Brake System Overview

Service Brakes	Under normal operating conditions, hydraulic oil powers the heavy-duty wet disc brakes (internal on each axle). Pressure is provided by the engine-driven hydraulic pump and controlled via the brake pedal.
	If the engine fails, pressure is supplied by accumulator-stored energy, allowing at least 15 brake pedal depressions for a safe stop. Alternatively, the DC pump can be switched on to restore hydraulic pressure for braking.
Parking Brake	<p>Spring Applied Hydraulic Release (SAHR) system, controlled by a switch on the driver's console.</p> <ul style="list-style-type: none"> - Turn left → Park brake releases (indicator off on Eaton Display). - Turn right → Park brake applies (indicator on Eaton Display).

Titan PT600 – User Manual

Hydraulic System Overview

Power Source	62cc Eaton piston pump and 1 gear pump, directly connected to the rear of the ZF 6WG210 transmission.
Oil Circulation	Hydraulic oil is drawn from the main tank (located on the right-hand side of the engine bay) and circulated through various valves and cylinders.
Hydraulic Circuits	<ol style="list-style-type: none"> 1. Steering 2. Braking
Pump System	Two close-coupled spline driven pumps
Emergency System	<ol style="list-style-type: none"> 1. Emergency braking 2. Emergency park brake release

Electrical System Overview

System Voltage	24V DC powered by alternator
Battery	Two 12V DC Batteries in Series Connection

Chassis & Cabin Overview

Chassis and Main Frame	All steel, welded construction with bolted covers.
CAB Cabin	Lightweight composite material
Cabin Feature	Can be elevated via hydraulic cylinder for 360 degrees of vision.
Access	Hinged and fully removable
Windows	Laminated safety glass (except for sliding door glass)
Driver's Position	Left Hand Side (LHS) with mounted seat, steering wheel, and instrument console.
Passenger Seat	Dual fixed seat on the Right Hand Side (RHS) with seat belts for both seats.

Towing Features




Tow Hitch	Available in front and rear of the vehicle
Lock	Available in front and rear hitch to hold the pin firmly.

Warranty

This equipment is covered by a limited warranty against defects in materials and workmanship under normal use and service. Unauthorized modifications, improper use, or failure to follow maintenance guidelines may void the warranty.

Please contact Avro GSE for a full copy of the warranty policy.

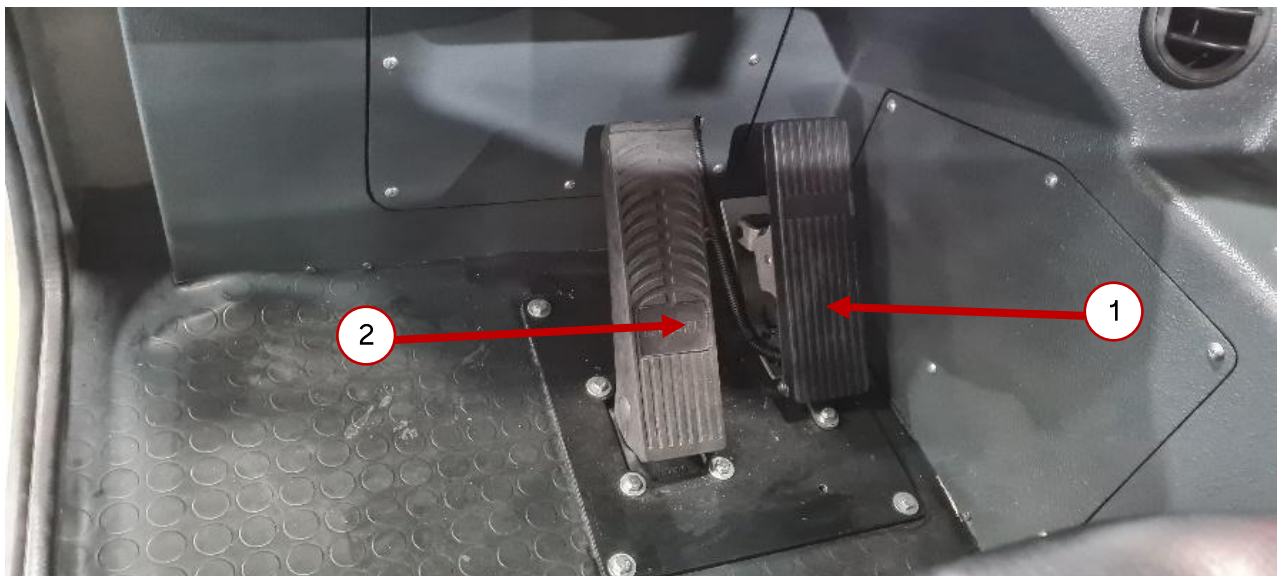
OPERATING THE EQUIPMENT

-  **Stay Aware of the Surroundings:** Watch for other GSE vehicles, personnel, and aircraft.
-  **Prior and Post-Use Inspection:** Perform a visual inspection on the equipment, ensuring all bolts, connections, tires, brakes, and structural components are secure, intact, and free from damage or excessive wear. Report any issues to maintenance before operation.
-  **Do not** leave the cart unattended without engaging the brakes.
Do not exceed the maximum carrying capacity of the cart to avoid tipping and mechanical failure.

Operator Controls

The controls are strategically positioned for easy operation and are categorized into two groups: foot controls and hand controls.

Foot Controls



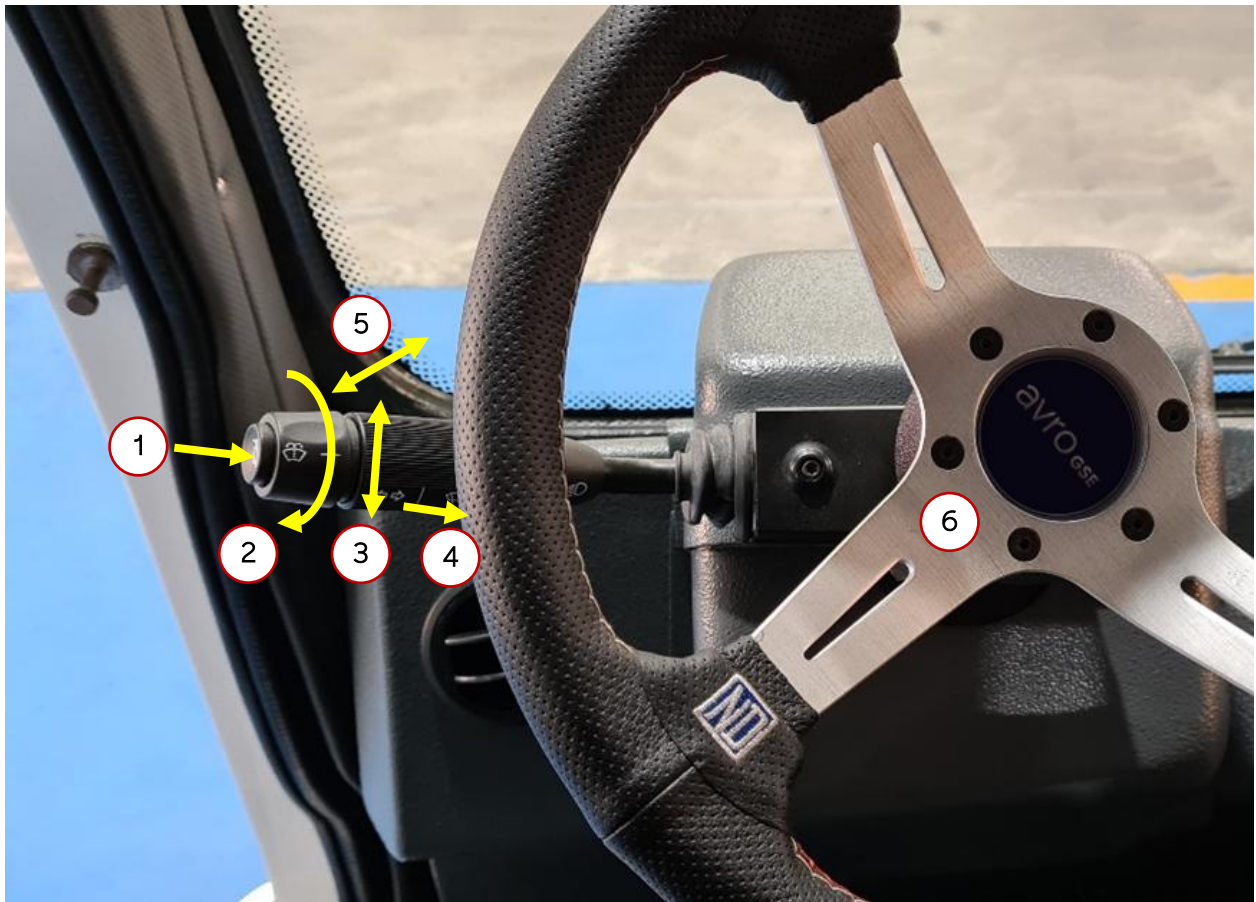
1. Accelerator Pedal

The accelerator pedal, located on the floor to the far right of the steering wheel, controls engine speed via an electrical CAN (Controller Area Network) system. It must remain in the idle position when starting the engine.

2. Brake Pedal

The brake pedal, located slightly to the left of the accelerator, controls the service brakes through a hydraulic power valve. Applied braking pedal pressure is proportional to braking force, meaning increased pressure results in stronger braking.

- Normal Operation: Hydraulic oil from an engine-driven pump (via transmission PTO) powers the heavy-duty wet disc brakes.
- Engine Failure Backup: Accumulators provide backup pressure, allowing approximately 25 brake applications to safely stop the vehicle. Steering becomes harder but remains functional due to the orbital pump effect. A DC pump can be activated to restore hydraulic pressure, ensuring both braking and steering remain operational.

Hand Controls

i Pictures may be generic and may not match the actual

1. **Horn Button** – Press the button at the end of the column stalk switch to activate the horn.
2. **Windscreen Washer** – Twist and hold the lever to spray washer fluid onto the windscreen.
3. **Turn Indicator Lights** – Push the lever up to signal a right turn and down for a left turn. Manually return the lever to neutral position after completing the turn.
4. **Windscreen Wiper** – Slide the lever to the right to activate the wipers.
5. **Headlight** – Push the stalk forward to turn on the headlights. Push it further to activate the high beam.
6. **Steering Wheel** – Used to control the direction of the tractor. It operates the hydraulic power assisted steering valve (steering Orbital).

Transmission Shift Control Lever

Shift lever must be in center position before starting the tractor.

The shift lever is positioned to the right of the driver's seat and is used to select gears, offering four forward and three reverse options.

To change gears, the following conditions must be met:

- The engine must be running at normal idle speed.
- The vehicle must be at a complete stop, with the service brake engaged. (Note: The direction cannot be changed from forward to reverse while in motion.)
- The park brake must be released.

To select a gear, move the shift lever forward, then left or right, depending on the desired direction of travel. The selected gear (forward only) and direction will be displayed on both the Eaton screen and the Spicer screen on the dashboard. When the reverse is engaged, the reversing camera will activate and display on the Eaton screen.

Park Brake

The park brake is SAHR (Spring Applied Hydraulic Release) and is operated via the switch on the driver's console, located to the right of the steering wheel assembly.

Titan PT600 – User Manual

The Park Brake is controlled by a switch (1) mounted on the driver's console to the right of the steering wheel. The light on EATON screen (2) will be illuminated if the park brake is applied.



❗ **Park Brake Usage:** Do not engage the park brake while the vehicle is in motion, except in extreme emergencies. Doing so can cause severe driveline damage, which is not covered under warranty. Always ensure the tractor is at a complete stop before applying the park brake.

❗ **Safety Reminder:** Chock the Tractor when not in use.

When the engine is running, both park and service brake accumulators are being charged via the system vane pumps.

Under Normal operation, the hydraulic system pressure will operate both service and park brakes including the steering.


Upon shutting down the engine (either by turning the key to the off position or due to engine failure), the accumulators will retain pressure for the service brake as described above. However, the park brake accumulator will gradually bleed down its internal pressure, releasing pressure from the park brake caliper springs and allowing the park brake to apply pressure to the disc. This is a failsafe system, meaning that if all power is lost, the park brake will automatically apply. Additionally, if the operator forgets to apply the park brake via the switch on the driver's console, it will still be engaged. All operators should be aware of the park brake function.


Titan PT600 – User Manual

This feature means that there is a limited time before the park brake is fully applied in the event of a hydraulic failure while the vehicle is at speed. It is essential that the service brake be applied immediately if a loss of hydraulic and electrical power occurs, to prevent the park brake from fully applying before the vehicle has come to a safe stop.

If the engine is inoperable but has electric (24 Volt) supply still operating, the park brake can only be applied with the switch on the driver's console. If the park brake needs to be released, use the following procedure:

1. Turn the ignition to the on position.
2. Press the DC pump switch and hold via the rocker switch in the cabin on the driver's console (symbol looks like a steering wheel).
3. Turn the park brake switch to the off position and wait for the indicator light to extinguish (on the Eaton Display).

 The DC pump supplies hydraulic oil to the entire hydraulic system in an emergency if the engine fails or becomes unserviceable. The DC pump is set with a timer and will operate for only 1.5 to 2 minutes before it needs to be reset via the switch. Do not turn off the ignition until repositioning is completed.

 Do not tow or move the vehicle more than 100 meters with drive shafts connected as severe damage will occur to the transmission. See transmission manual for details.

Titan PT600 – User Manual

Driver Seat Controls

- Fore and Aft Movement – Adjusted using a grab bar at the front base of the seat.
- Seat Tilt – Controlled by a lever on the right-hand side of the seat.
- Backrest Angle – Adjusted via a yellow knob on the left-hand side of the seat.
- Passenger (PAX) Seat Options – Available as either a single-seat or a bench accommodating two passengers on the right side of the cabin. The electrical panel is located beneath the PAX seat and can be accessed by removing the lock pin and flipping the seat forward.
- Seat belts can be fitted on request.

Digital Display

The tractor is equipped with an EATON digital display, and switches. This Electronic Display Module (EDM) serves as a digital dashboard which has several functions.



1. Speedometer – Indicates the road speed of the tractor in kilometers per hour (km/h).
2. Fuel Gauge – Indicates the volume of fuel available in tank.

Steering Mode Selection on Display

3. 2-Wheel Steering (2WS) – Press to select 2-Wheel Steering mode.
4. 4-Wheel Steering (4WS) – Press to select 4-Wheel Steering mode.
5. Crab Steering – Press to select Crab Steering mode.

Steering Position Bar

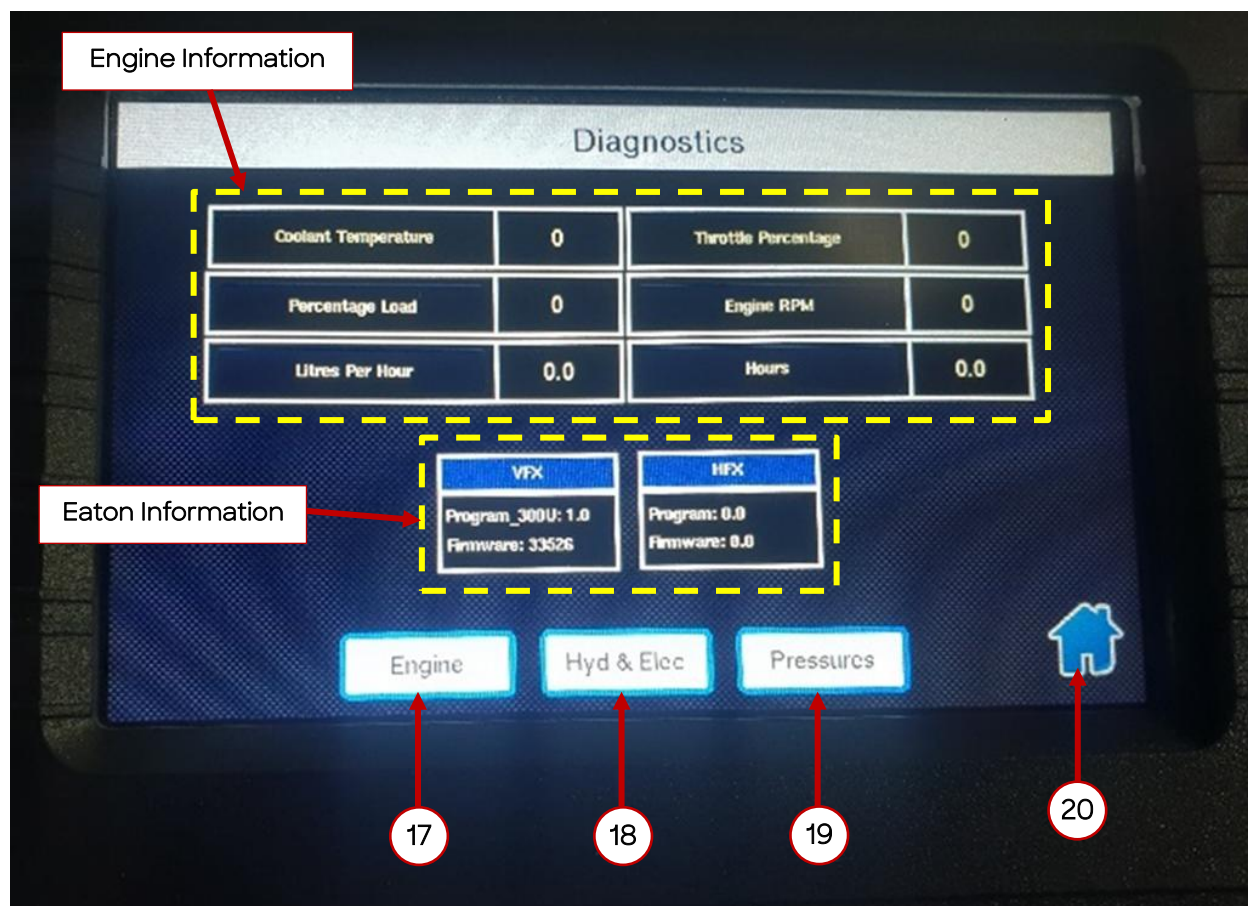
6. Front Axle Position Bar – Indicates the direction and position of the front wheels.
7. Rear Axle Position Bar – Indicates the direction and position of the rear wheels.



- 8. Park Brake – Park brake status indicator.
- 9. Selected Gear – Indicates the tractor direction and gear selected.
- 10. Engine Hours – Indicates the running hours of the tractor.
- 11. Hydraulic Pressure – Indicates the system hydraulic pressure.
- 12. Battery Status – Indicates real time battery voltage.
- 13. System Failure – Shows when a system failure is detected.
- 14. Transmission Temperature – Indicates real time transmission temperature in Celsius unit.



- 15. Diagnostic and Faults Page – Press the button or the icon on the screen to access the diagnostics page.
- 16. Maintenance Page – Press the button of the icon on the screen to access the maintenance log in page.

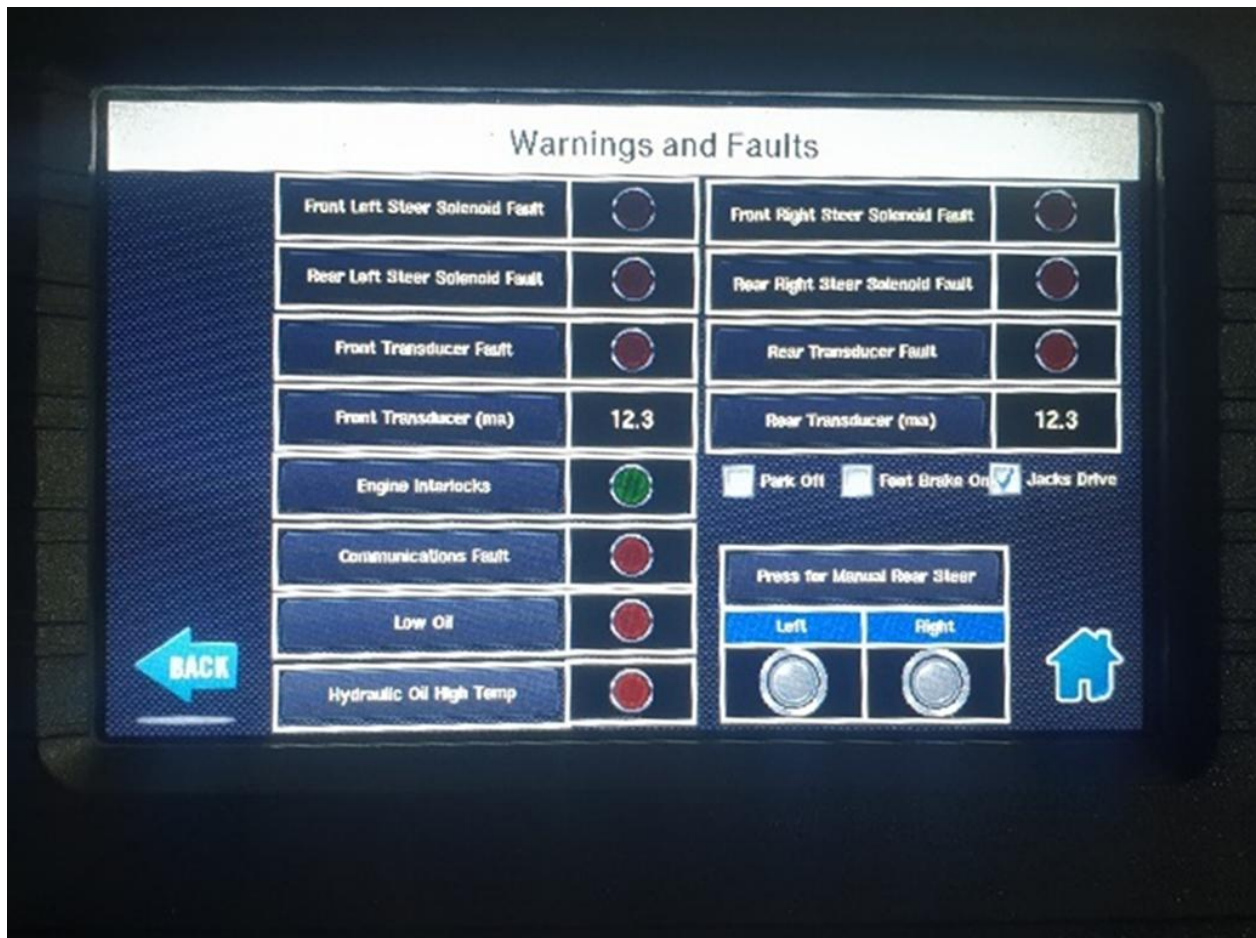


- 17. Engine – Press to enter the diagnostics page showing engine information.
- 18. Hydraulic & Electrical – Press to enter the diagnostics page showing hydraulic and electrical system information.
- 19. Pressure – Press to gather information about various system pressure.
- 20. Home – Press to go back to the EDM main page.

Diagnostics

Engine Information – this section contains information about the engine's Coolant Temperature, Engine Load, Fuel Consumption, Throttle Percentage, Engine RPM and Running Hours.

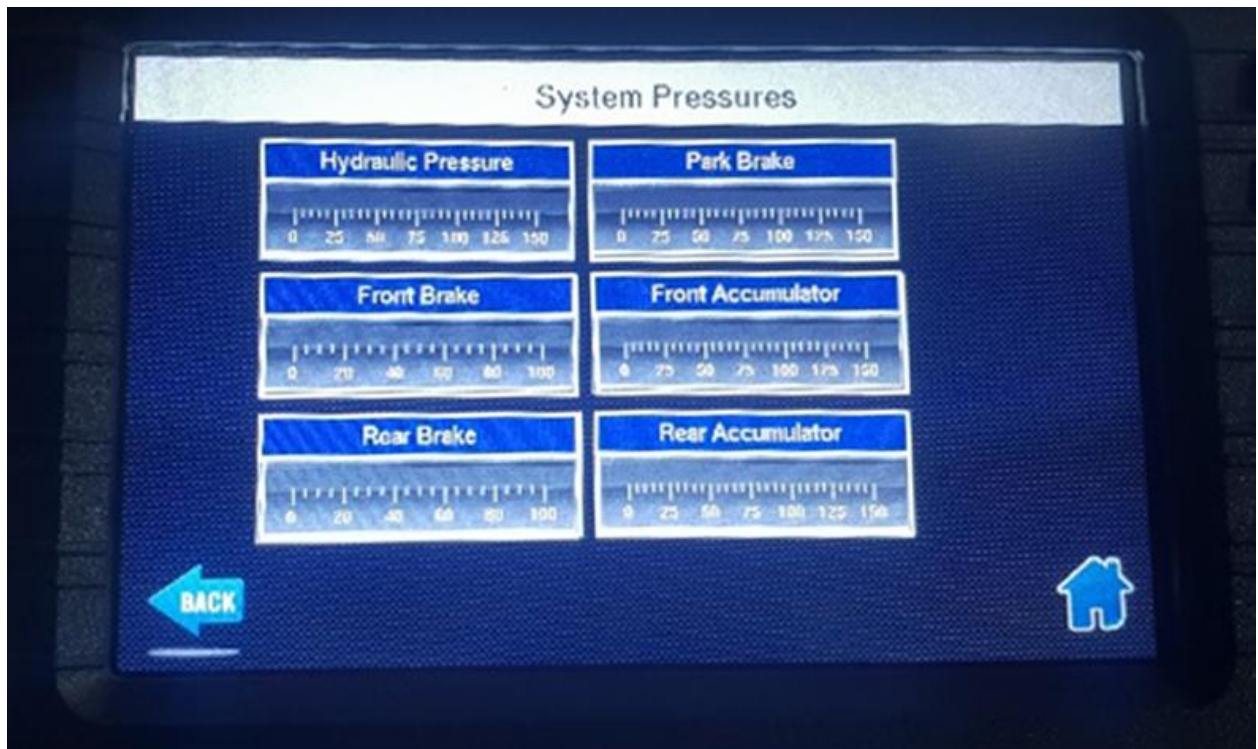
Eaton Information – this section contains details for the versions of VFX (Eaton Display) and HFX (Eaton ECU) which are useful when requesting replacement parts.



Warnings and Faults

This screen displays the status of:

- Hydraulic solenoid faults
- Steering transducer faults
- Engine/transmission interlock states
- Communication faults
- Low hydraulic oil level
- Hydraulic oil temperature
- Rear steering manual override



System Pressure

This screen hydraulic system pressures. The information displayed removes the requirement for connecting test equipment to the unit when diagnosing possible pressure related issues.



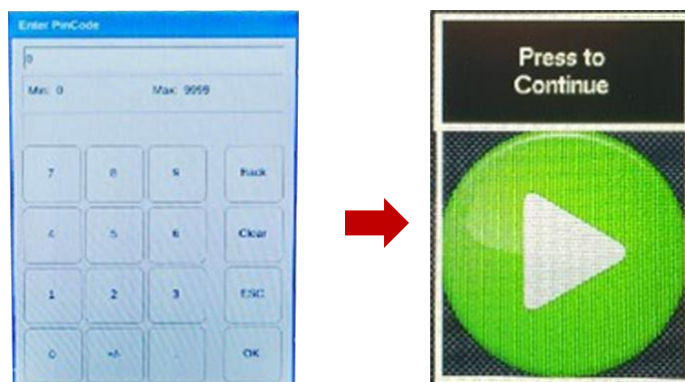
Maintenance Login

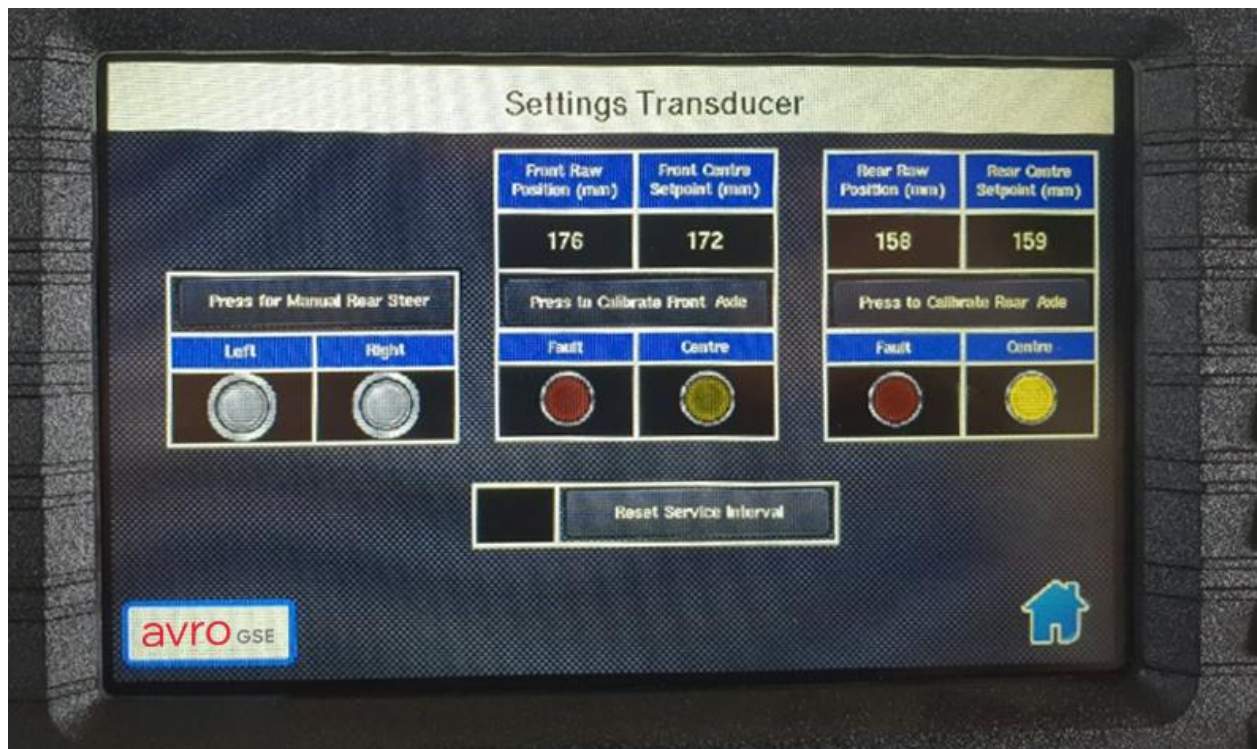
From this screen various functions can be accessed:

- General maintenance login
- Set screen brightness
- Set time and date
- Customer access login
- Avro login
- Home button returns to main screen

Maintenance Login Procedure

1. Select “Press to Login”, on the “Enter Pin Code” page select “Clear”, enter the code “1234” and select “OK”.
2. The next screen displays a green arrow icon, press to continue.





Settings Transducer

This screen allows a certified maintenance technician to recalibrate the steering sensors for correct tracking of the steering. “Reset Service Interval” is selected after maintenance has been performed to reset the service interval. Home button returns to main screen.



Deutz Screen

The Deutz digital display screen is located on the side wall just below the dashboard. This screen provides the maintenance team with useful information regarding faults and general condition of the engine and its emissions related components.



Switches & Indicators











Spicer Transmission Display Module (TDM)










The TDM displays current gear selection and any current faults.

Press and hold “M” for three seconds to enter diagnostic mode where codes and data can be accessed.

	<p>HEADLIGHT SWITCH</p> <p>This is a three-position rocker switch:</p> <ol style="list-style-type: none">1. Off2. Park Lights3. Main Beam <p>The green headlight symbol illuminates when the switch is in position two or three.</p>
	<p>HAZARD LIGHTS SWITCH</p> <p>This is an On-OFF rocker switch. In the ON position the amber side indicators intermittently flash, along with a lamp mounted within the switch which illuminates the orange symbol.</p>

Titan PT600 – User Manual

	BEACON SWITCH This is an On-OFF rocker switch. In the ON position it operates the beacon on the roof, along with the lamp mounted within the switch which illuminates the orange symbol.
	HIGH BEAM INDICATOR When the column mounted signal switch is in the forward position the high beam headlights are activated. The blue indicator illuminates when the headlights are on high beam.
	WORK LAMP SWITCH This is an On-OFF rocker switch, in the ON position the work lamp is activated. The green indicator illuminates when the work lamp is activated.
	TOW PIN LAMP SWITCH This is an On-Off rocker switch, in the ON position the tow pin lamps are activated front and rear. The green indicator illuminates when the work lamps are activated.
	IGNITION SWITCH This switch is key operated and has three positions, OFF, ON and START. Turning the key all the way counterclockwise to "OFF" will shut down the engine and power off all systems. Turning the key clockwise to "ON" will supply power to all systems. Turn the key clockwise past the "ON" position, spring resistance will be encountered, turning the key against the resistance activates the starter motor. Once the engine has started release the key and it will return to the "ON" position.
	LOW OIL PRESSURE INDICATOR LAMP This red indicator lamp will illuminate when the engine oil pressure is low and needs to be corrected before the machine can be put into service.
	TURN INDICATORS "ON" INDICATOR LAMP This green indicator lamp flashes when the turn indicators are functioning.
	CHECK TRANSMISSION INDICATOR LAMP This indicator lamp flashes when a fault occurs on the transmission. Diagnostics can be performed using the EDM

	ENGINE FAULT INDICATOR LAMP This indicator lamp will flash when a fault occurs on the engine. Diagnostics can be performed using the EDM
	ENGINE TEMP INDICATOR LAMP This indicator lamp will illuminate when OVER TEMP occurs. Diagnostics can be performed using the EDM.
	REAR WINDOW DEFOG SWITCH This is an On-Off rocker switch and must be switched off when not in use.
	REAR WINDSCREEN WIPER SWITCH This is an On-Off rocker switch and must be switched off when not in use.
	DC PUMP SWITCH This is an On-Off rocker switch and must be switched off when not in use. The switch and DC pump are protected by a timer that only allows the DC pump to operate for 1-1.5 minutes at a time. To reset the timer the switch must be switched off and then back on again.  Do not operate the DC pump continuously as this will cause severe damage to the DC pump and will not be covered under warranty.
	INTERIOR LIGHT SWITCH This is an On-Off rocker switch and must be switched off when not in use.
	MIRROR ADJUSTMENT SWITCH This switch controls the adjustment of the rear-view mirrors. Position the arrow to the left or right selecting which mirror to adjust then move the button in the direction required.
	COOLANT BYPASS VALVE SWITCH This is an On-Off rocker switch and must be switched off when not in use. It opens the valve that allows heated engine coolant to flow through the heater core in the cabin.

Titan PT600 – User Manual

Battery Isolation Switch

The control switch is located on the right-hand side of the vehicle.

To activate switch turn:

- Clockwise – On
- Anti-clockwise – Off

Only when the lever is in the OFF position can the lever be removed.



- The switch should be turned off when the vehicle is left in parked position for any extended periods or when any maintenance is going to be performed.
- Keep the Battery Isolation Switch on while the engine is running.
- Switch off Battery Isolation Switch when charging batteries.
- When welding on the tractor, switch off the Battery Isolation Switch and disconnect the batteries, engine and transmission ECU's and the Eaton Screen.
- Do not immediately turn off the Battery Isolation Switch after shutting down the engine. This is required for the ECUs to power down correctly.

Operator's Instructions

The AVRO PT600 Pushback Tractor is an easy vehicle to drive. It requires no specialized driver techniques as the vehicle and its controls are conventional automotive in their operation and response. However, it must always be remembered that it is a heavy and powerful vehicle, and any misjudgment by the operator can lead to severe damage to aircraft, ground service equipment, buildings, or personnel.

Before operating the tractor ensure that the daily service/check procedures have been carried out. These procedures are listed in the Maintenance Intervals Section of this manual.

Pre-operational Check

Do operational safety check or check as per organization's local requirements and rules:

- Check for visible damage and leaks around the tractor and on the ground beneath the tractor.
- Check cabin for cleanliness.
- Check logbook for reported issues from previous operator if available.
- If there are any issues report immediately to maintenance supervisor.

Engine Start

1. Turn the battery isolator on.
2. Turn ignition to the ON position.
3. Apply service brake.
4. Ensure gear shifter is in Neutral position.
5. Turn the ignition switch key for the engine to the ON position. (Eaton Display module will take approx. 1.5 minutes to boot up). Turn the key to the start position to crank the engine. The engine should fire within a couple of revolutions. Do not attempt to crank the engine over for more than a few seconds as the starter motor can be severely damaged by doing so.
6. As soon as the engine starts, release the key from the start position. Do not turn the ignition key off and immediately back on. Wait a few seconds before attempting to start vehicle again. Failure to follow this procedure may cause severe damage to the starter motor.
7. Check that all gauges are operating in their normal operating ranges as per the OEM tech manuals in this manual.
8. After a cold start the engine should be allowed to idle for five minutes so that it can warm up to operating temperature and establish an oil film on all working surfaces.

Titan PT600 – User Manual

Steering Controls

The tractor is equipped with power assisted steering and only minimal effort is required to turn the steering wheel from lock to lock while the vehicle is in motion.

Approximately 4.5 – 5 turns of the steering wheel are required to move the wheels from lock to lock.

To further assist the driver when maneuvering the vehicle while at stationary or low speed, there is no need to accelerate the engine. The system is designed to operate effectively at idle.

Moving Off

1. Start the engine in accordance with the Engine Start procedure above.
2. If the vehicle is to be operated at night, switch on the lights that are to be illuminated.
3. Check that the fuel gauge indicates sufficient fuel available for the duration of operation.
4. Apply the service brakes.
5. Release the Park Brake.
6. Select a suitable gear for the load condition and direction that applies for the vehicle to travel.
7. Release the service brakes and depress the accelerator pedal sufficiently to allow the vehicle to get under way smoothly.

Engine Shutdown

1. Ensure that the park brake is on.
2. Select Neutral Gear.
3. Allow the engine to idle for an additional thirty (30) seconds.
4. Turn the ignition switch to its OFF position.
5. Chock the wheels.
6. Turn the battery isolator off after approx. 2 min allowing the ECU to power down correctly.

Towing the Tractor

Before pushing or towing, the tractor the driveline must be disconnected. The tractor cannot be started when pushing or towing it.



Maximum allowable push or tow is 20 meters.



Failure to disconnect the driveline before pushing or towing can cause serious transmission damage.

Titan PT600 – User Manual

Braking the Vehicle

Always apply the service brakes progressively to ensure a smooth stop, especially when towing aircraft or cargo dollies.

Always allow plenty of distance when braking to a complete stop, especially when approaching or towing aircraft.

General Vehicle Shutdown

When the vehicle has completed an operation period, or if it is to be left unattended for any length of time, the following procedures should be complied with:

1. Select the NEUTRAL gear.
2. Apply the parking brakes
3. Chock the wheels.
4. Shut the engine down by turning the key to the off position.
5. Remove the ignition key from its switch.
6. Turn battery isolator to off position. (Remember to wait a few minutes before completing this function.)
7. At the end of an operational period, the driver is to inform the vehicle's maintenance crew of any malfunctions that may have occurred during that period and ensure that the vehicle's ignition keys, and battery isolation switch handle are left with the person in charge of the vehicle's operation.

Preparing for Aircraft Movement Operations

The vehicle can be used for Pushback operations on various narrow bodied sized aircraft connected to either the front or rear hitch points. For towing operations, it is recommended that the rear hitch point be used for both tractor performance and operator safety.

 Pushback operators are specially trained to do pushouts and tows.

Before proceeding with Pushback operations ensure that compliance is made with IATA AHM 631.

Basic lights and accessories:

- Two Headlight sets - 2 front
- Four Flashing Turn Indicator Lamps (Amber) - 2 front, 2 rear
- Two Taillights (Red) 2 rear
- Two Brake Lights (Red) 2 rear
- Two Reversing Lights 2 rear
- Two Emergency Stop Buttons - one in the front cabin, one on the rear of the tractor
- One Amber beacon Lamp
- 1 x Horn 1 front
- 1 x Reversing Siren 1 rear

Titan PT600 – User Manual

- 2 x Floodlights (1 Front, 1 Rear)
- 2 x tow pin lights (1 front 1Rear)
- All gauges and warning lights are in the driver's cabin.

The Driver's Station is equipped with the following:

- One (1) - EATON Display, providing:
 - Tachometer
 - Km (distance travelled)
 - Transmission oil temperature
 - Voltage (24V)
 - Engine coolant temperature
 - Steering Mode selection (4WS, 2WS and Crab modes)
 - Steering position indicator
 - Engine Hrs.
 - Gear selected and direction moved

This screen is used for diagnostics and technical information

- One (1) Steering Column Stalk Switch - which contains:
 - Turn indicator lights lever
 - Headlight high beam on/off and flash
 - Wind screen wiper function 2 speed with intermittent
 - Wind screen washer
 - One (1) - Horn
- One (1) - Park brake on off switch
- One (1) - Park Brake ON Indicator (Eaton Screen)
- One (1) - High Beam Indicator (Eaton Screen)
- One (1) - Turning Indicators ON Indicator (Eaton Screen) and dashboard
- One (1) - Headlights Switch - OFF - PARK - ON
- One (1) - Floodlights Switch
- One (1) - Hazards Lights Switch
- One (1) - DANA Transmission Gearshift Selector (Right side of driver)
- One (1)- Ignition Switch
- Two (2) - Emergency Stop Push Button.



The Emergency Stop Push Button is to be used only in an emergency. Do not use it to shut down the tractor in lieu of the ignition key.

EQUIPMENT MAINTENANCE

Before Starting Service

Prepare lubricants and parts as per OEM requirements per service quick reference below:

Engine (TCD 4.1)

- Oil capacity: 26 – 26.5 liters with filter
- Oil type: 15w40D or equivalent

Transmission (DANA T32000)

- Oil capacity: 15 liters, please follow instructions in DANA service manual
- Oil type: Dextron III

Axles (DANA 212)

- Oil capacity: 8 liters (center differential section)
- Oil capacity: 5 liters (reduction hub each)
- Oil type: SAE 90

Check the hours on vehicle to ensure that correct service is carried out. Check with users / operators for any issues that they have encountered during the use of the vehicle. Check logbook if available for any comments or complaints from users.

Refer to appropriate OEM workshop manuals (engine, axles, and transmissions) for correct process or procedures all available in this manual.

All figures / numbers mentioned here are only for reference and actual manuals should be referred to for correct details.

The figures stated here for the maintenance intervals are the number of elapsed operational hours, which will be registered by the vehicle's engine hour-meter. It is emphasized that these procedures and intervals should always be adhered to, otherwise warranties covering the vehicle and its components will be void.

Should the operators of the vehicle wish to change any maintenance interval or procedures, Avro GSE should be contacted for verification of the proposed change.

For the complete description of the lubricants and fluids, reference should be made to the specific texts of the various OEM manuals incorporated in this manual.

All maintenance operations serve only as a guide. For specific requirements, refer to the OEM manuals within this manual.

Only qualified personnel (mechanics and electricians) should be allowed to work on this equipment at the discretion of the vehicle owner with clear understanding that

Titan PT600 – User Manual

incorrect procedures or processes are used by unqualified persons could result in warranty being revoked by Avro GSE and or its suppliers.

Ensure all services are carried out on flat surfaces and that all local and workshop rules are strictly adhered to. The correct tool for the job at hand should always be used.

Ensure the cleanliness of the area where work is being performed.

Always take special care when working with hydraulic and electrical systems. Ensure that batteries are electrically disconnected, and hydraulic accumulators are discharged.

Refer to relevant sections for workshop and parts manual of major components. (Engine, Transmission, Axles)


Special care should be taken when disconnecting electrical plugs to avoid pulling wires from their receptacles.

Use appropriate lifts, hoists and slings to avoid damage to equipment and to avoid injury or death when working with heavy components such as engines, transmissions, and axles.

Recommended Lubricants and Fluids

Refer to the Lubricants that are listed in the OEM's texts within this manual. OEMs of the major components (engine Deutz, transmission ZF and axles Kessler) are used in the manufacturing of this product.

Avro GSE therefore recommends that customers use lubricants with the same specifications to maintain warranties and obtain the maximum service life for the tractor and its components.

 To ensure trouble-free operation and long life of all components of the tractor; follow the service and lubrication schedule.

Any equivalent grade lubricant from another recognized supplier may be used, providing the manufacturer can guarantee it is an entirely suitable equivalent in every respect, and that the responsibility for satisfactory operation is accepted by them.

This tractor should be maintained and serviced mechanically, hydraulically and electrically, lubricated and adjusted only by experienced qualified tradespeople.

Titan PT600 – User Manual

Service Intervals

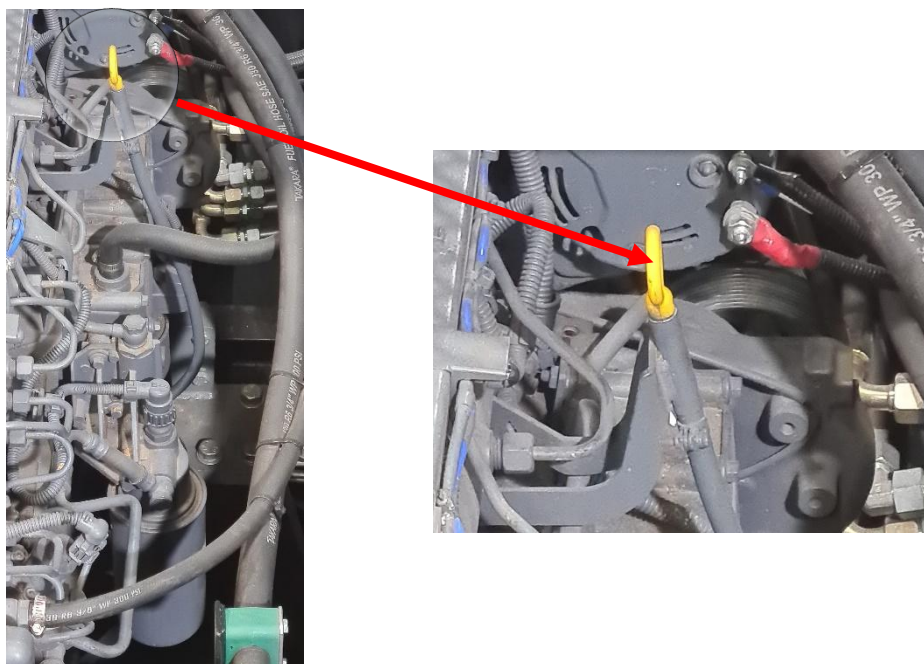
Engine Oil

- Specification: 15w40D or equivalent
- Capacity: 23.5–26L (with filter) see Deutz Manual

The engine oil should be checked using a dip stick to confirm correct level after filling.

Oil Level

The dip stick is located on the right-hand side of the engine beneath the front top cover.



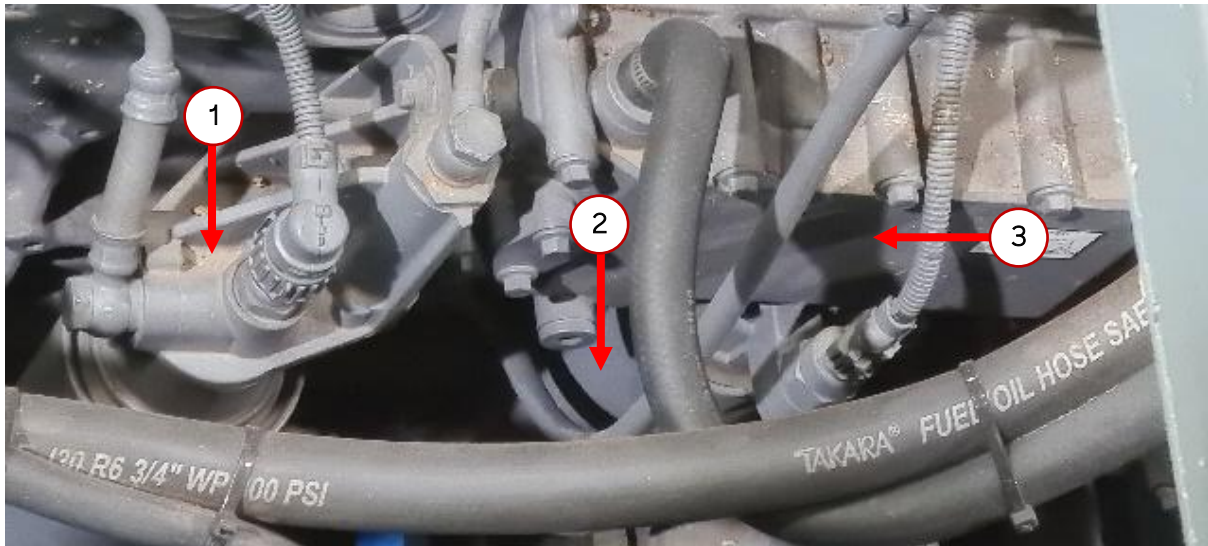
Check the Lubricating Oil Level with the engine stopped. If the engine has just been in operation, wait approximately twenty (20) minutes to allow the oil to drain back to the oil pan (sump). Add the correct grade of oil, as required, to maintain the correct level on the Dipstick.

 Do not overfill this can cause serious damage to the engine.

Titan PT600 – User Manual

Oil Change Intervals

The engine oil filter is located on the right-hand side of the engine in front of the fuel filter.



1. Fuel Filter
2. Oil Filter
3. Oil Cooler

Refer to service schedule for replacement.

During use, Engine Lubricating Oil undergoes deterioration from combustion by-products and contamination.

For this reason, and if the engine is subject to heavy loading, regular oil drain intervals are necessary. These intervals vary in length depending upon engine operation, fuel quality, sulfur content, and lubricant quality.

! Under no circumstances should the engine OEM drain intervals be exceeded. Do not mix types, brands, or grades of engine oil.

Refer to the Deutz TCD 2013 Service manual, for more details on engine preventive maintenance

i Recommended oil change interval for PT600 tow tractor is 500 service hours.


Titan PT600 – User Manual


Using Lubricating Oil Analysis

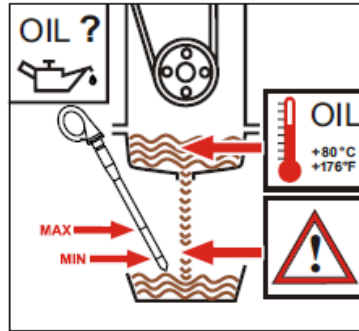
Using a lubricating oil analysis program is recommended for the monitoring of crankcase oil in all engines.

Oil analysis indicates the condition of the engine, not the lubricating oil. It should not be used to extend oil drain intervals


Regulations for working on the lubricating oil system


 Do not work when the engine is running! Smoking and naked lights prohibited! Be careful of hot lubricating oil. Danger of scalding!

 Pay attention to utmost cleanliness when working on the lubricating oil system. Clean the area around the components concerned carefully. Blow damp parts dry with compressed air. Observe the safety regulations and national specifications for handling lube oils. Dispose of leaking lubricating oil and filter elements properly. Do not allow used oil to seep away into the ground. Perform a trial run after all work. Pay attention to tightness and lubricating oil pressure and then check the engine oil level. In case of fuels containing more than 1% sulphur, contact your corresponding DEUTZ partner.



Checking the lubricating oil level

 Low lubricating oil level and overfilling lead to engine damage. The lubricating oil level may only be checked with the engine in a horizontal position and switched off. If the engine is warm, switch off the engine and check the lubricating oil level after 5 minutes. If the engine is cold you can check it immediately.

 Be careful of hot lubricating oil. Danger of scalding!

- Pull out the lubricating oil dipstick and wipe off with a lint-free, clean cloth.
- Insert the lubricating oil dipstick as far as it will go.
- Extract the lubricating oil dipstick and read off the oil level.

- The oil level must always be between the MIN and MAX marks! Top up to the MAX mark if necessary.

Changing the lubricating oil

- Warm up the engine (lubricating oil temperature > 80 °C).
- Ensure that the engine or vehicle is in a level position.
- Switch off the engine.
- Place a collecting receptacle underneath the lube oil drain screw.
- Unscrew the lube oil drain screw, drain oil.
- Fit a new sealing ring to the lube oil drain screw, insert and tighten. (tightening torque 100 Nm).
- Pour in lube oil.
 - Quality/viscosity data.
 - Filling volume (65).
- Warm up the engine (lubricating oil temperature > 80 °C).
- Ensure that the engine or vehicle is in a level position.
- Check lubricating oil level, if necessary top up.

Titan PT600 – User Manual

Axle Components

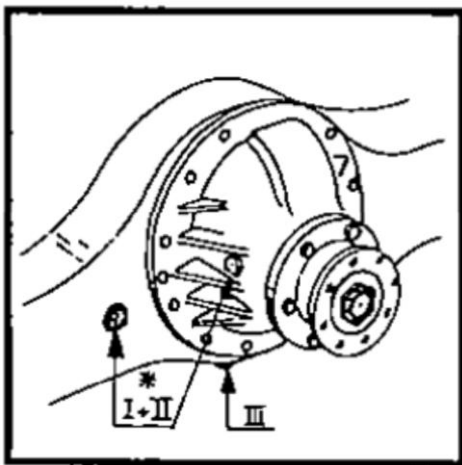
Please refer to the Kessler Service manual for all details on axle component preventative maintenance, including general lubrication instructions, lubrication points, specifications & intervals.



Avro GSE will not be responsible for any mechanical failure if the incorrect grade of oil is used in any components requiring oil or lubrication.

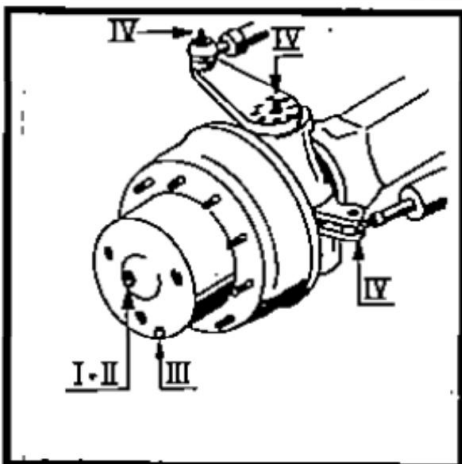
General DetailsLubrication Points

The binding lubrication points must be according to the installation drawing of the axle.



Single Drive Assembly

- The position is dependent from the respective axle version.



Hub assembly with planetary gear drive

The axles fitted to this vehicle are drive steer hypoid differential units where the drive from the Transmission output flanges provides power through the propeller shafts that is applied to the axle input flanges and through to the planetary gear final drive hubs to the road wheels. (Refer to Kessler manual).

Both these components have their own separate lubrication. The front axle differential is provided with filler plugs which act as an oil level indicator also, refer to Kessler manual for location.

Titan PT600 – User Manual



Please ensure the tractor is stationary, the engine is turned off, the park brake is on, and the wheels are chocked. Batteries should be isolated prior to any checks being performed. The front axle is fixed mount to the chassis and the rear axle is pivot mount to the chassis.

Safety Recommendations

Prior to doing any maintenance on the axles (front and rear), the vehicle should be raised from its wheels and supported on suitable stands that will prevent it from falling or moving while axle maintenance is taking place. The wheels should be demounted from the hubs.

Maintenance can also be carried out over a suitable in ground pit, if available.

1. Pump the brake pedal or use the blow down valves to bleed all the oil pressure from the accumulator.
2. Check the hydraulic lines from the brake cylinders on the axles, including the input pinion park brake for wear and leaks.
3. Check the hydraulic lines to the steering cylinders for wear and leaks.
4. Check all grease points on the axle.
5. Drain the differential oil (front & rear). Refer to Kessler manual for procedure.
6. Check the propeller shaft bolts on the differential input flange and the transmission output flange.
7. Check all the axle mounting bolts are secure and nuts are torqued (600 Nm).
8. Check axle housing for cracks and leaks.
9. Ensure that all hoses, pipes, and grease lines are securely clamped and positioned out of the way so as not to obstruct the rotation of the wheels.
10. Replace oil with recommended oil type.
11. Check the operation and adjustments of the steering orbital and braking systems by starting the engine and operating the system. Adjust as necessary. Refer to the appropriate section of this manual for adjustment procedures.
12. Ensure that the axle's lubricating oil levels are correct.
13. Install wheels onto wheel hubs.



Axle Overhaul

For overhaul of axle, refer to authorized Kessler Dealer or to Avro GSE.

Propeller Shafts – Bearing Cap Construction

General Information

There are two propeller shafts fitted to this unit. They fitted between the transmission and the front and rear axle differentials.

-  Please ensure that the tractor is stationary, the engine is turned off, and the wheels are chocked on both sides before attempting to perform any maintenance on the propeller(drive) shafts.
-  Never use high pressure washer to remove grease from universal or slip joints.

Lubrication Propeller Shafts

1. Wipe the grease nipples which are located on the universal joint journals and slip joints, clean and ensure that the nipple sealing ball recess is free from old grease and dirt.
2. With a hand grease gun inject grease into the journal of the universals via the grease nipples until fresh grease appears around the bearing seals of every journal.
3. Wipe the purged grease from the universal.
4. With a hand-operated grease gun inject grease into the slip joints via the grease nipples until fresh grease appears around the shaft at the edge of the dust cap on the slip joint.
5. Wipe the purged grease from around the slip dust cap and grease nipple.

Service Check for Propeller Shaft Component Wear

1. Hold the companion flange half of a universal joint stationary and attempt to rotate the other half about its axis in each direction. No movement should be felt.
2. Repeat this procedure for each universal joint.
3. Hold the yoke half of the slip stationery and attempt to rotate the slip joint stub shaft about its axis in each direction. Only a small amount of movement is acceptable.
4. Hold the slip joint yoke around the body of the joint and attempt to move it back and for the across the axis of the propeller shaft. No movement should be detectable.
5. Should the detected movement is more than that which was described, the propeller shaft should be removed and overhauled.

Titan PT600 – User Manual

Removing Propeller Shaft

1. Take suitable precautions to prevent the vehicle from moving and to prevent the engine from starting.
2. Remove the fasteners that retain the propeller shaft flange yokes to their mating companion flanges.
3. Remove the propeller shaft from the vehicle.

Installing Propeller Shaft

1. Ensure that the propeller shaft slip joint is restrained at the “fully closed” position so that it cannot accidentally slide out and damage the slip yoke dust cap while the propeller shaft is being installed.
2. Install the slip jointed half of the propeller shaft into position between the driver and driven companion flanges.
3. Ensure that all nuts and bolts that are replaced with new ones are grade 10 minimum with spring washer torque to 81Nm. (Should be fine thread).

Propeller Shaft Overhaul

It is recommended that the propeller shafts are overhauled by a qualified tradesperson or refer to Avro GSE.

Disassembling Propeller Shaft

1. Unscrew the dust cap fitted to the end of the slip yoke and slide the propeller shaft apart.
2. Bend the tabs on the locking strips down and remove the bearing cap fasteners on the universal joint which is to be disassembled.
3. Remove the locking strips and bearing caps from the journal bearings.
4. Bend up the tabs on the locking straps to lock the fasteners.
5. With the bearing caps removed, the journal can be displaced so that the journal bearings are pushed out of the yokes sufficiently to be removed. Remove the journal bearings.
6. Remove the journal and separate the joint.
7. Thoroughly wash the journal and yokes clean with a solvent, wipe the parts dry with clean cloth.
8. Remove the seal, seal washer and dust cap from the slip joint stub shaft. Thoroughly wash the slip yoke and the slip stub and shaft splines clear with a solvent. Wipe the parts dry with clean cloth.
9. Remove the split pin from the nut that retains the support bearing companion flange, then remove the nut and its washer and slide the flange of the splined end of the propeller shaft.
10. Remove the support bearing from the propeller shaft.

Titan PT600 – User Manual

Assembling Propeller Shaft

1. Position a universal joint journal in a flange yoke and lift a bearing assembly complete with seal, etc., into a bearing bore of the flange yoke and over a trunnion of the journal.
2. Support the journal and bearing assembly in position and fit the other bearing assembly.
3. Install the bearing caps, locking straps and fasteners, check that the bearing cap keys are engaged into the slots in the bearing assemblies and then tighten the fasteners securely.
4. Repeat this procedure to assemble the slip joint yoke to the journal.
5. Repeat this procedure to assemble the tubular shaft universal joint journal.
6. Apply a film of recommended grease to the spline surfaces on both halves of the slip joint.
7. Ensure that the drive shaft is phased correctly, if not done correctly it may cause severe vibration or even damage to the drive shaft.
8. Install the dust cap and steel washer onto the slip stub shaft and then install the slip yoke assembly onto the slip shaft with the arrows aligned. This is important as it aligns the trunnions.
9. Lubricate the universal joints and slip joint in accordance with procedures.

Inspecting Propeller Shaft Component for Wear

1. Lightly clamp the tubular half of the propeller shaft horizontally in a vice, taking care not to deform the drive tube of shafts with this type of construction.
2. Check with a dial gauge, the radial end play of the universal joints. This must not exceed 0.010" (0.25mm).
3. Check with a dial gauge the circumferential play of the universal joints. This must not exceed 0.010" (0.25mm).
4. Checking for the axial run out of the propeller shaft must be carried out with specialized equipment. The maximum shaft run out between centers is 0.010" (0.25mm) and 0.005" (0.12mm) on the stub shaft neck.
5. Parts which are defective or at all suspects must be discarded and replacements obtained.

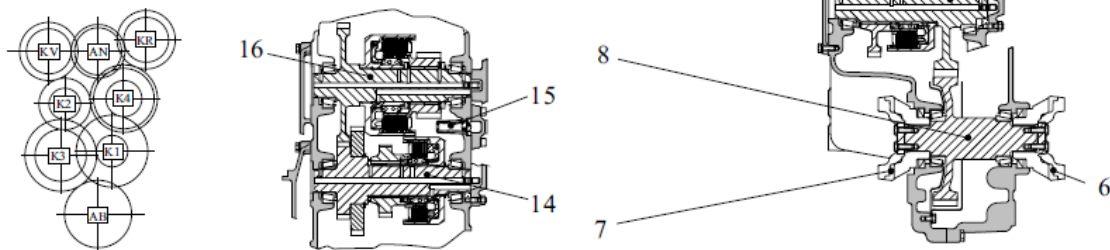
Transmission – ZF 6WG 210

LAYOUT 6 WG-210

TABLE-1

- 1 = Clutch shaft „KR“
- 2 = Power take-off, coaxial, engine-dependent
- 3 = Clutch shaft „KV“
- 4 = Clutch shaft „K2“
- 5 = Clutch shaft „K3“
- 6 = Output flange - rear side
- 7 = Output flange - converter side
- 8 = Output shaft "AB"
- 9 = Transmission pump
- 10 = Input flange - input through universal shaft "AN"
- 11 = Converter
- 12 = WK (converter clutch)
- 13 = Inductive transmitter for engine speed
- 14 = Clutch shaft „K4“
- 15 = Converter safety valve
- 16 = Clutch shaft „K1“

GEARBOX DIAGRAM



General Information

The transmission assembly is mounted directly to the engine within the engine bay. It is fitted with a 'stick shift' upshift and downshift controller.

Refer to ZF Manual for complete details.

- ⚠ Ensure that the tractor is stationary, the engine is turned off, and the wheels are chocked on both sides when performing any maintenance on this tractor.

Removal and Installation

The transmission cannot be removed from the vehicle on its own. It must be removed with the engine as an assembly. The engine, transmission and hydraulic system can be removed as one as it is all mounted to a modular frame.

- ⚠ All safety recommendations must be observed and followed.

Disconnection of the Transmission from the Engine

1. Support the engine and transmission assembly to facilitate the removal of the transmission.
2. Remove the large plug fitted to the engine flywheel housing.
3. Rotate the engine flywheel **clockwise only** until one of the bolts securing the flex disk drive plate to the flywheel is adjacent to the plug hole in the flywheel (bell) housing.

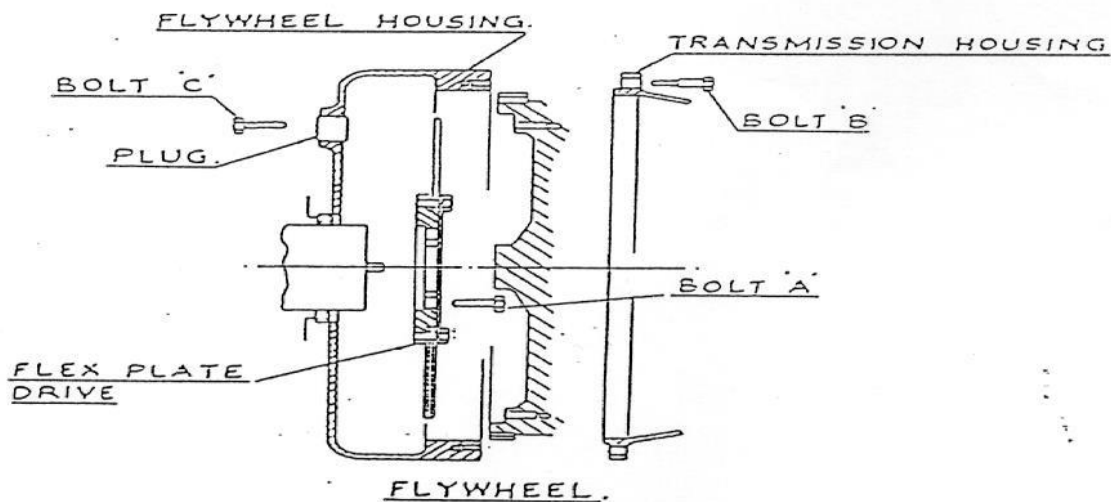
- ⚠ Never rotate the engine counterclockwise during disassembly or assembly of transmission as this will result in major damage to engine components.

Titan PT600 – User Manual

4. Remove the bolts and repeat this procedure until all bolts are removed.
5. Ensure that the engine is properly supported so that when the transmission is separated from the flywheel housing, the engine will not fall. Attach a chain hoist and suitable lifting sling to the transmission and then separate the transmission from the engine.

Removal of Flex Plate Assembly from Engine Crankshaft

1. Remove the fasteners which secure the flex plate hub to the engine crankshaft.
2. Remove flex plate assembly from engine crankshaft.

**Installation of Flex Plate Assembly**

1. Ensure engine crankshaft mounting diameters are free from burs and surface imperfections.
2. Install the flex plate assembly.
3. Install flex plate fasteners and tighten securely.

Installation of Transmission to Engine

- ⚠ Never use old fasteners, always replace such with new ones and the same spec (minimum Grade 10 bolts).

The procedure for installing the transmission to the engine is in the reverse order for its removal with attention given to the following points:

1. Ensure that the fasteners securing the transmission to the engine flywheel housing are tightened to correct torque as per engine manufacture.
2. Ensure that the (BOLTS) fasteners used to secure the flex plate to the transmission converter housing are securely tightened to the correct torque as per engine manufacture.

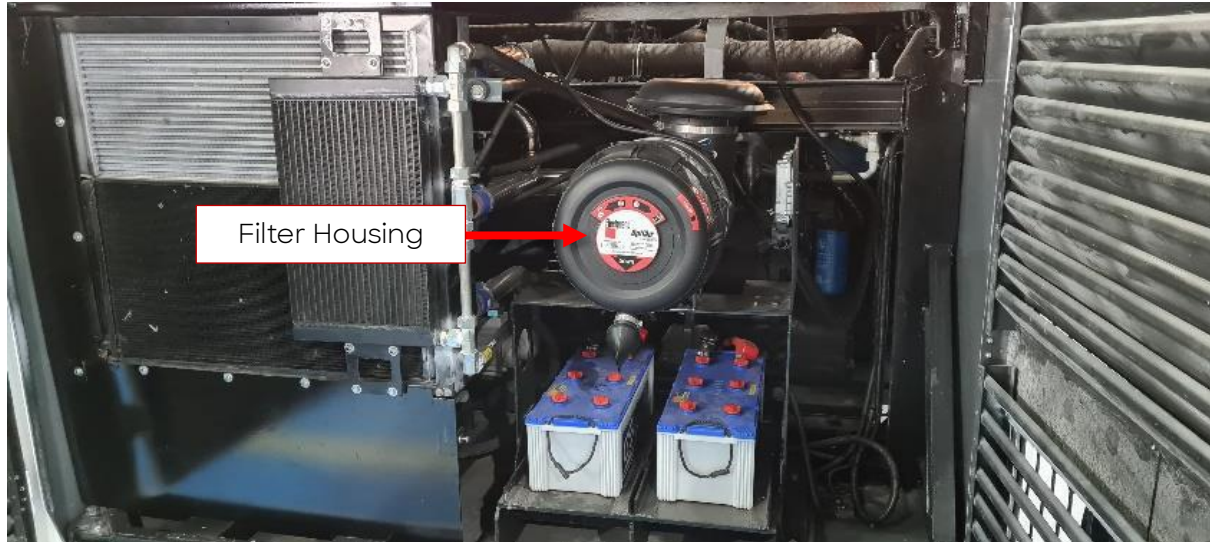
Transmission Overhaul

For overhaul of transmission, refer to authorized DANA Dealer or to Avro GSE.

Air Inlet Equipment – Filter Assembly

The vehicle's engine is provided with 2 Air Filters (Primary and Secondary).

Both filters are housed in the filter housing on the left-hand side behind the door above the batteries.



Maintenance Checks

1. Check that all rubber hoses and boots are free from defects (holes and cracks).
2. Check all clamps are secure and undamaged.
3. Check for leaks and seal accordingly.

Replacing the Filter Element

1. Remove air filter end cover.
2. Remove filter elements and replace according to PM schedule. If conditions are extremely dusty, filters should be inspected and changed more regularly.
3. Wipe the inside of filter housing with clean rag, removing all dust and dirt prior to installing the new elements.
4. Inspect outside of housing, all clamps, rubber hoses to ensure no cracks or damage is visible and all joints are airtight.

Exhaust System

The exhaust system of the vehicle consists of a muffler mounted on the right-hand side of the vehicle behind the engine bay side door to the left of the hydraulic tank. The muffler is connected by clamps to a single tailpipe that protrudes through the floor.

Check Exhaust Assembly

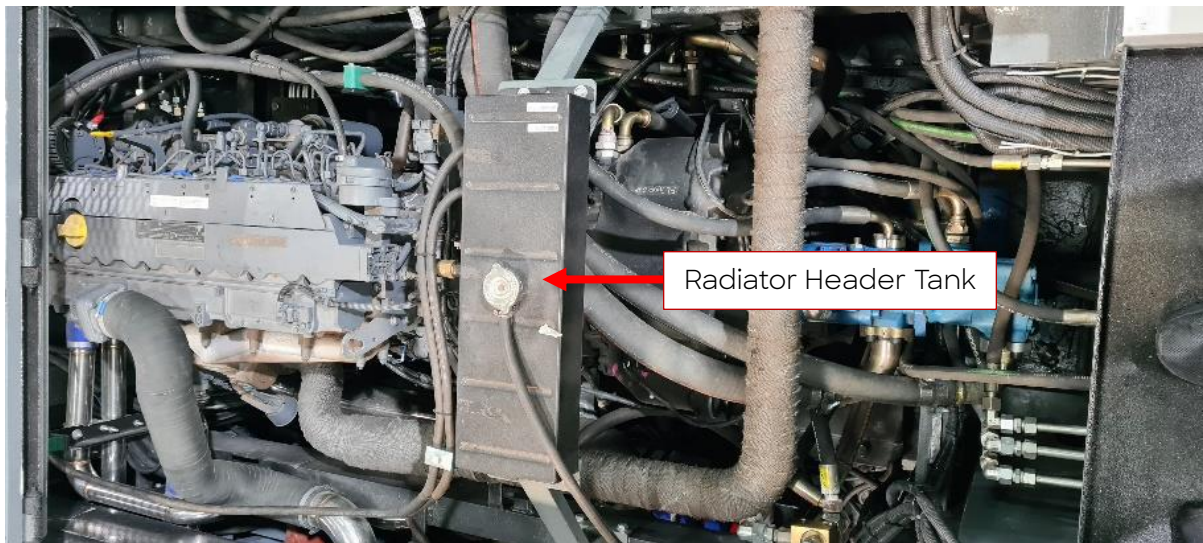
1. Ensure all parts are cool NOT hot.
2. Check all clamps and joints on the exhaust system for leaks and damage.



Exhaust system can reach temperatures more than 500deg. C.

Cooling System

The engine cooling system is a radiator assembly to the left of engine assembly in the engine bay. There is also a “transmission oil” heat exchanger which is integral with the engine oil cooling system, a hydraulic oil cooler and where fitted an A/C condenser.



Checking Coolant Level



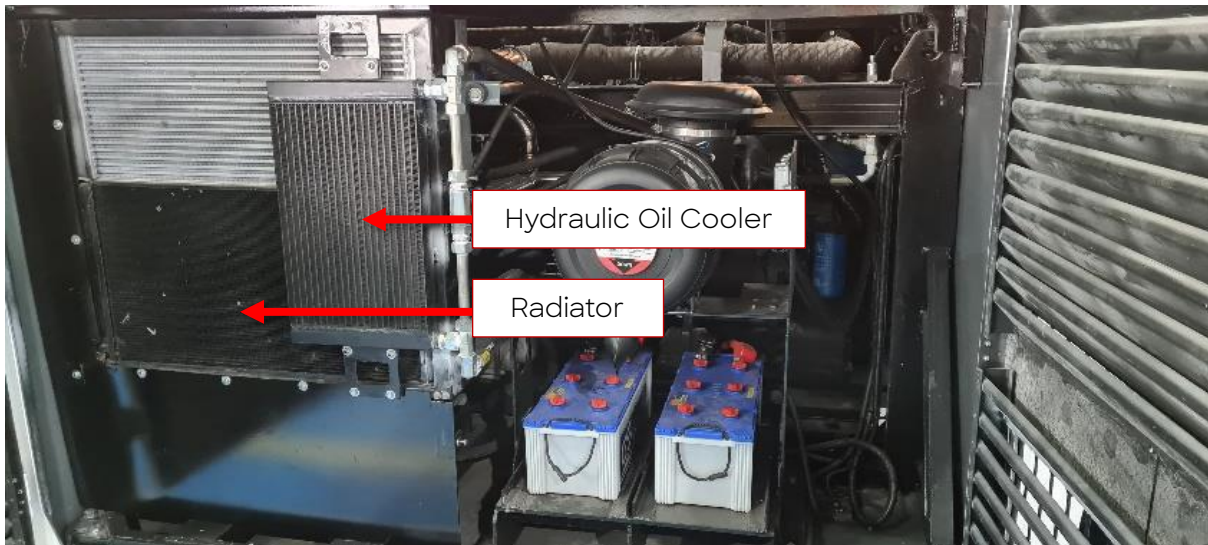
If the engine is still hot from operating, steam may be vented from under the filler cap and may cause severe injury. Eye protection should be worn when filling the radiator.

Always check the coolant level and top up if necessary.

Refer to Deutz engine manual for recommended coolants and top up procedures.

Titan PT600 – User Manual

Radiator Fan



Secure all loose clothing and hair when working around moving parts or machinery.

The Fan Drive Assembly consists of a fan assembly and a hub driven by a hydraulic motor and pump arrangement. The fan will turn as soon as the engine is started and is of the suction type – meaning, it draws air from the left side of the tractor through the radiator, charge-air cooler, and auxiliary coolers. The hydraulic oil cooler is in front of main radiator assembly and on the left-hand side behind the maintenance door.

Monthly Maintenance

1. Secure the fan tightly to the fan hub and the hub to the output shaft.
2. Ensure that the fan cowling does not show signs of fatigue or damage. If there is, repair or replace immediately to avoid costly repairs and downtime.
3. Check hydraulic oil cooler electric fan operation.
4. Clean radiator cores regularly with medium pressure washer.



Never use high pressure washer in cleaning as this may damage radiator aluminum core.

Titan PT600 – User Manual

Radiator Assembly Removal

If the engine is still hot from operating, steam may be vented from under the filler cap and may cause severe injury.

1. Remove the radiator filler cap and open all draincocks to drain the cooling system.
2. Check the fan for operation and damage.
3. Check all hose clamps and hoses for damage and leaks. Replace if required.
4. Check and clean radiator cooling fins.
5. Flush radiator.
6. Replace coolant with correct mixture of water and Deutz Inhibitor “anti-freeze”.
7. Run engine and recheck coolant level.

**Cooling System Overhaul**

For the procedures and information related to the overhaul of the cooling system, contact Avro GSE.

Wheel Assemblies

The wheel assemblies used on the tractor are composed of conventional wheels and tires designed fit for purpose. However, tires may vary depending on brand.

Tightening Wheel Nuts

⚠ Ensure that the tractor is stationary, the engine is turned off and the park brake is on before making any adjustments.

The correct torque value is at 600 Nm. All wheel nuts should be tightened to identical value.

⚠ Pre-Cautionary:

When the tractor is new, the wheel nuts should be re-torqued after 8 hours of operation. Subsequently, it is recommended that all wheel nuts be re-torqued weekly for the first month. After this period, wheel nuts should be checked for the correct torque value monthly.

It is recommended to lift each end of the tractor sequentially, raising it to a point where most of the tractor's weight is off the wheels and tires, while ensuring the tires remain just in contact with ground.

Tire Wear

To help reduce unnecessary wear of the tires, it is recommended by Avro GSE and the tire manufacturers to rotate the tires from SIDE to SIDE and from front to back every 500 to 600 hours. This will help reduce “HEEL and TOE” and possible “SCOLLOPING” wear and prolong tire life.



Checking Tire Pressure

The tire pressure should be checked prior to each operational period where practical, or whenever it is suspected that the tire pressures are incorrect. Check Tire Tread and Walls weekly. Report all tire concerns to the respective maintenance department immediately.

Tire pressure: 135 psi (9.5 bar)

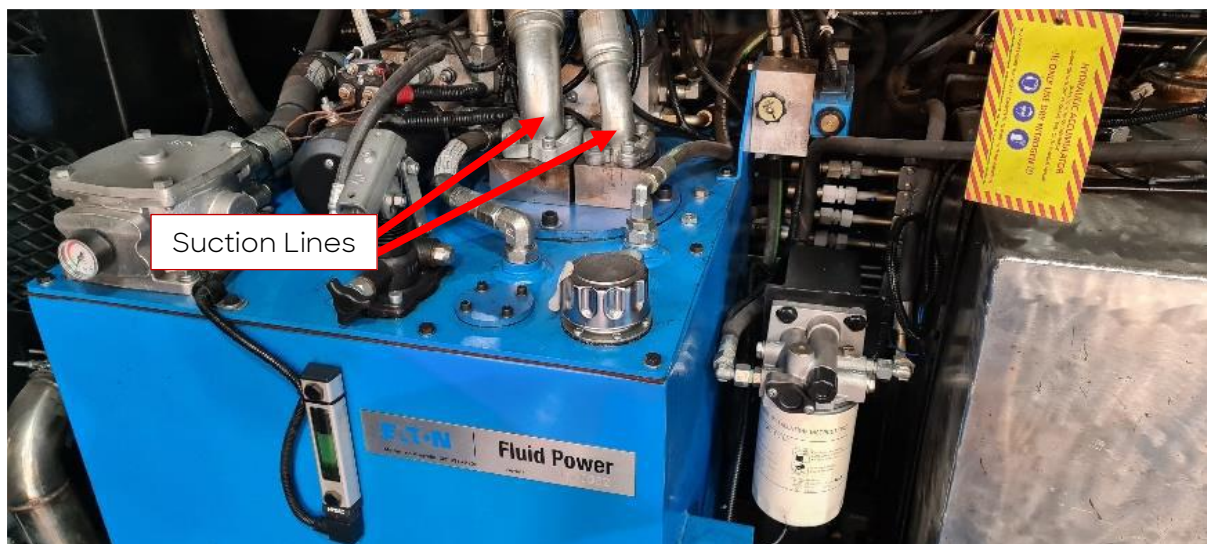
Hydraulic System

The vehicle's steering and braking systems are all hydraulically powered. They are divided into 4 major sections:

1. Steering
2. Braking
3. Cabin Lift
4. Jacking

Fluid requirements for these systems are provided by variable displacement pump and vane pump directly coupled to the Transmission's PTO drive. The pumps are fed from the oil reservoir by individual "flooded type" suction lines. The pumps provide maximum system pressure as required to ensure effortless operation. System relief provides safety from any hydraulic pressure overload.

⚠ Always ensure that the hydraulic tank supplying the suction hoses has sufficient oil to supply the hydraulic system after servicing. Severe damage will occur to the pump if pumps run dry.



Two main hydraulic oil suction lines positioned top of hydraulic tank on the left side of the engine frame module.

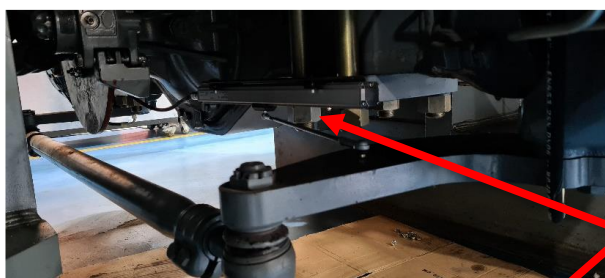
ⓘ For more detailed information, please refer to OEM's Hydraulic manual.

Steering

Vehicle steering is achieved by turning the steering wheel and passing oil through the steering orbital valve (located under the steering column under the covers front left inside the cabin) to the separate hydraulic cylinders on each side of the front and rear axles.



Typical position of steering cylinders front and rear axles







Position of linear transducers for both front and rear axles.



The steering is controlled via 2 linear transducers positioned on the left-hand side of each axle. The movement of the front axle is mimicked by the rear axle via the Eaton electronic control system and screen.

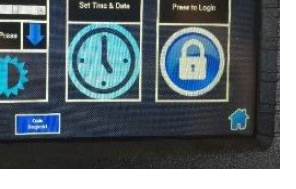
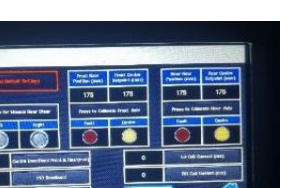
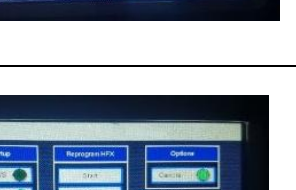
Steering Faults and Adjustments

If at any time the steering is not tracking straight, or the rear has moved out of alignment for some reason, follow the following procedure to correct the wheel alignment.

	<p>Select maintenance log in page. Maintenance log in page can be selected via either the button or touch screen.</p>
	<p>From this screen, various functions can be accessed. General maintenance log in. Set the time, date and screen brightness. Code Request: For this function AVRO provides access code. AVRO needs to be contacted. AVRO level login. Home button back to main screen.</p>
	<p>From the maintenance log in page, Select press to login. Enter the code 1234 in the pin code screen. Press OK. The screen will show an icon with a green arrow, press to Continue.</p>
	<p>This screen allows the maintenance team to: Recalibrate the steering transducers if the wheels are not tracking in a straight line. Bring the rear wheels online if there is a fault with the 4 steering wheels. Press Home to return to main screen.</p>

Titan PT600 – User Manual

For more advanced functions, it is necessary to log on to the Code Request page. A code is provided by Avro GSE upon request. These pages enable the maintenance team to perform additional tasks, such as program updates (special tools, including cables, are required and can be purchased separately).

	<p>Select login request</p> <p>From the maintenance log in page, select 'CODE REQUEST' login. A pin code screen will appear.</p> <p>Press 'Clear', then enter the code provided by Avro GSE. Once done, press 'OK'.</p>
	<p>This screen allows the maintenance team to perform the same functions as previous with additional functions provided for trouble shooting.</p>
	<p>Page 2 allows the maintenance team to:</p> <ul style="list-style-type: none"> Update program if required via special tool cable. Set preferred start-up of steering 4 WS or 2 WS (Crab not recommended at start up). Camera on/off if installed. Allows to override interlock in cases of emergency.

Titan PT600 – User Manual

Procedure to Correct Steering Track



This will take two personnel to do correctly. This can be done by one person with clear vision of both front and rear wheels.

1. Position the front wheels in the center via the steering wheel. Check using a straight edge or string line confirming that the wheels are in the straight ahead/parallel with the tractor chassis or body.
2. Once confirmed the wheels are straight or parallel, press the calibrate front axle button (2), on the right the yellow light will illuminate.
3. For positioning the rear wheels, use the manual steer buttons (1) to set the rear wheels straight. The left and right buttons will move the wheels in the direction of correction required. Check by using a straight edge or string line same as for the front to confirm wheels are straight/parallel to the chassis.
4. Once confirmed, it is straight/parallel press the calibrate rear axle button (3), on the right the yellow light will illuminate.
5. Press the home button, shut down and reboot, the tracking should be functioning correctly now.

Braking

The vehicle has a closed-circuit hydraulic system operated via the service brake pedal which in turn provides pressure to the 4 sets of brake calipers (2 per wheel).



Parking Brakes

Park brake is activated via an on/off. Return to the center switch (1) on the dash mounted on the driver's console to the right of the steering wheel. It is a hydraulic release spring applied self-adjusting system incorporated on the front axle. The light on EATON screen (2) will illuminate if the park brake is applied. It also forms part of the transmission interlocking system.

i Gear cannot be selected if park brake is applied.



! Do not apply park brake while tractor in motion. This will result in severe mechanical failure in the driveline and will not be covered by warranty.



Position of Park brake caliper on both axles.

Titan PT600 – User Manual

Service Brakes

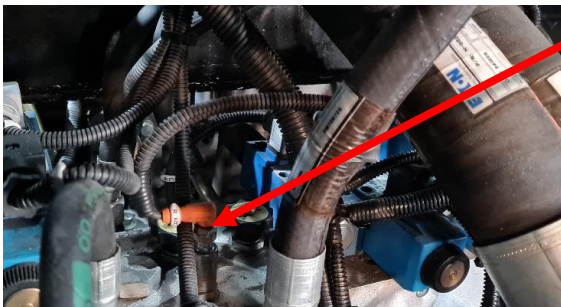
There are 4 Dry type caliper discs operated from the foot brake valve and pedal. A pressure Switch is used to activate the vehicle's stop lights as well as the interlocking system for the transmission gear selector.



Service Brake Pedal




Brake Valve below plate

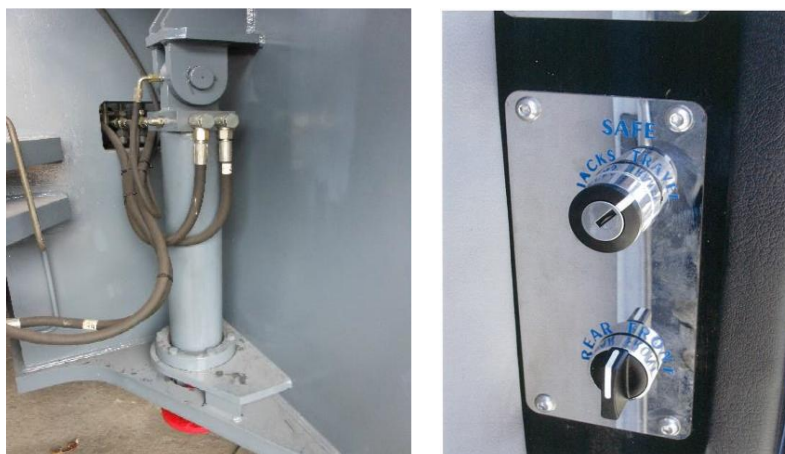


Service brake pressure transducers located on hydraulic power pack

Jacking Cylinders

The tractor is equipped with 4 hydraulic jacking cylinders attached to the chassis inside the 4-wheel arches. The jacks are operated via the switches on the right-hand side of the electrical box drawn in the cabin. The jacking cylinders work in pairs when they are actuated 2 front or 2 rear.

-  All 4 cylinders cannot be extended at the same site for safety reasons the tractor can also not engage gear if cylinders are extended.




The top switch is a keyed switch with three positions: “JACKS,” “SAFE,” and “TRAVEL.”

- “JACKS”: Enables activation of the front or rear jacks using the bottom switch in the desired direction.
- “SAFE”: Prevents jack movement when in the down position, ensuring safety.
- “TRAVEL”: Used when the tractor is ready for normal operation. The key should be removed in this position.

-  The key must be removed when in the “TRAVEL” position to prevent unauthorized or accidental changes.

Ensure the wheels are properly chocked on the opposite side of the jack-up point.

-  Use suitable supports to bear the weight of the tractor before working underneath.

After Completing Work:

1. Remove all tools and obstacles from under the tractor.
2. Start the tractor.
3. Turn the key to “TRAVEL” mode—the jacks will retract automatically.
4. Remove the key and store it in designated location.
5. The tractor is now ready for normal operation.

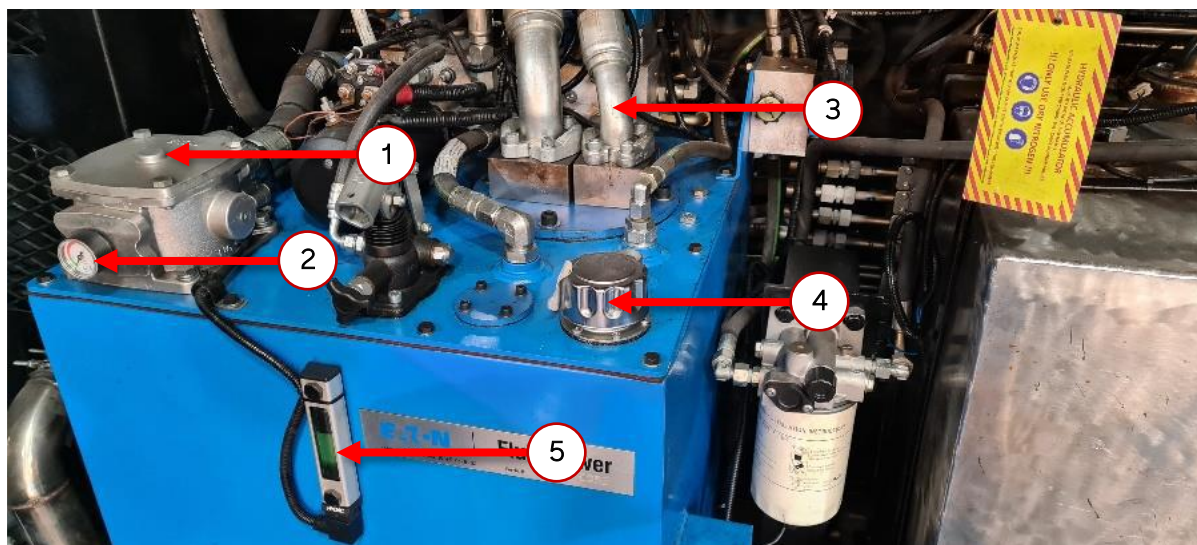
Reservoir and Ancillary Equipment

The hydraulic reservoir is mounted on the right side of the engine bay behind the access doors and holds approximately 150 liters of oil. The reservoir is equipped with a sight level gauge and temperature sensor oil temp should not exceed 70 deg. C.

Access to the reservoir is via 2 doors located at the left-hand side of the tractor. Filling is done via the filler-breather located on the top right-hand side of the hydraulic reservoir.

- ❗ If oil is not clear in the sight glass and it appears to look milky it will require immediate change as in this condition it is contaminated with water or some other liquid substance and will cause serious damage to the hydraulic pump and valves.
- i A plugged outlet is provided for reservoir draining. This is located on the bottom right-hand side of the tank directly below the tank temp sensor.

Components in Hydraulic System



1. Return Line Filter – is positioned so that all valve return functions flow through the filter before returning to the reservoir. The only exception to this is that the brake circuit has its own dedicated return to ensure that part of the circuit is not subject to possible tank-line back pressure surges.
2. Filter Condition Indicator – shows the status of the filter.
3. Main Manifold – The main manifold distributes the oil flow to the required areas of use, as and when it is required by the different components in the system. The system pressures and pressures to the brake system are monitored and can be seen on the Eaton display. This is very useful when diagnosing basic hydraulic faults that require messy gauges to be fitted.
4. Hydraulic Oil Filler Cap – The filler cap is positioned on the top left side of the hydraulic reservoir; it has an integral strainer to remove any large foreign debris

Titan PT600 – User Manual

that may be accidentally introduced while filling/topping up oil. It also acts as a breather to prevent any pressure build-up in the tank.

5. Sight Glass Oil Level Indicator – indicates oil level and has a warning low level sensor. It provides a warning in the cabin to the operator (hydraulic warning light will illuminate if the oil level is low.) the operator must report this to his supervisor immediately and report it to the maintenance team.




High Hydraulic Temperature Sensor:
Located on the side of the hydraulic tank and provides warning if the hydraulic temperature exceeds 70 deg. C.



DC Pump:
An electric powered hydraulic pump that is used in the event of an emergency e.g. failure of main hydraulic pumps (engine driven), Engine failure or any other scenario that may occur that requires hydraulic power.



Main Hydraulic Pump:
The system uses a variable displacement vane pump to supply fluid to the hydraulic system under normal operating conditions. The pump is directly coupled to the transmission's PTO drives and is fed from the oil reservoir through individual flooded suction lines to ensure consistent fluid supply. It is self-compensating, automatically adjusting its output to match system demand. Refer to the Hydraulic Drawing in this manual for system operating pressures.

 Only qualified hydraulic technicians that understand hydraulic systems and drawings should be allowed to set system pressures. Ensure that mixture of oils is never used in this hydraulic system.

Under normal working conditions, the “life” expectancy of the hydraulic oil supplied by Avro GSE in the Tractor is very high. However, it is recommended that the hydraulic oil be inspected for both quality and quantity at least once every calendar month.

Hydraulic Changes

The grade of Hydraulic Oil used in the Hydraulic System is a vital factor in influencing the hydraulic system performance and ensures freedom from frequent and unnecessary servicing.

Oil Change

Under normal operating conditions, it is automatically filtered and should be periodically tested to ensure suitability, the oil may be retained in service for up to two years, especially if the oil temperature remains below 70° C and is kept free of contaminants.

If the system operates under adverse conditions the oil must be changed more regularly.

When doing periodic maintenance, drain the hydraulic reservoir by using the drain plug. It is then advisable to flush the entire system pumps, cylinders, pressure lines etc. With a specified flushing oil, drain the system free of flushing oil, and replace the oil filters associated with the hydraulic system.

At this point, fill the Hydraulic Reservoir and the entire system with new, clean, filtered Hydraulic Oil. Fill to the correct level and bleed the system free of trapped air.



Eye protection should be worn when draining or filling hydraulic system.

Preventive Maintenance

- Oil level must be checked daily. Top up if necessary.
- Filler breather cap to be kept secured and clean.
- Ensure there are no leaks from the reservoir, pumps, cylinders or pressure lines.

Replacement of Return Line Filter Element

The return line filter is fitted with a filter condition indicator. Replace filter element if the indicator is in the Amber or Red section of the Condition Gauge or at the bi-annual hydraulic oil change. This indicator is located on the filter housing.

Cleanliness

Since most of the parts in this system have precision finished surfaces working together, it is a proven fact that contamination from acid, water, grit, metal particles etc. in the oil will inevitably cause damage that will require repairs. Use new clean oil only, handle all oil in clean containers and pour oil into the hydraulic system through a clean 10-micron filter. Even new oil should be filtered. Keep containers adequately capped or sealed when not in use, to prevent water contamination.

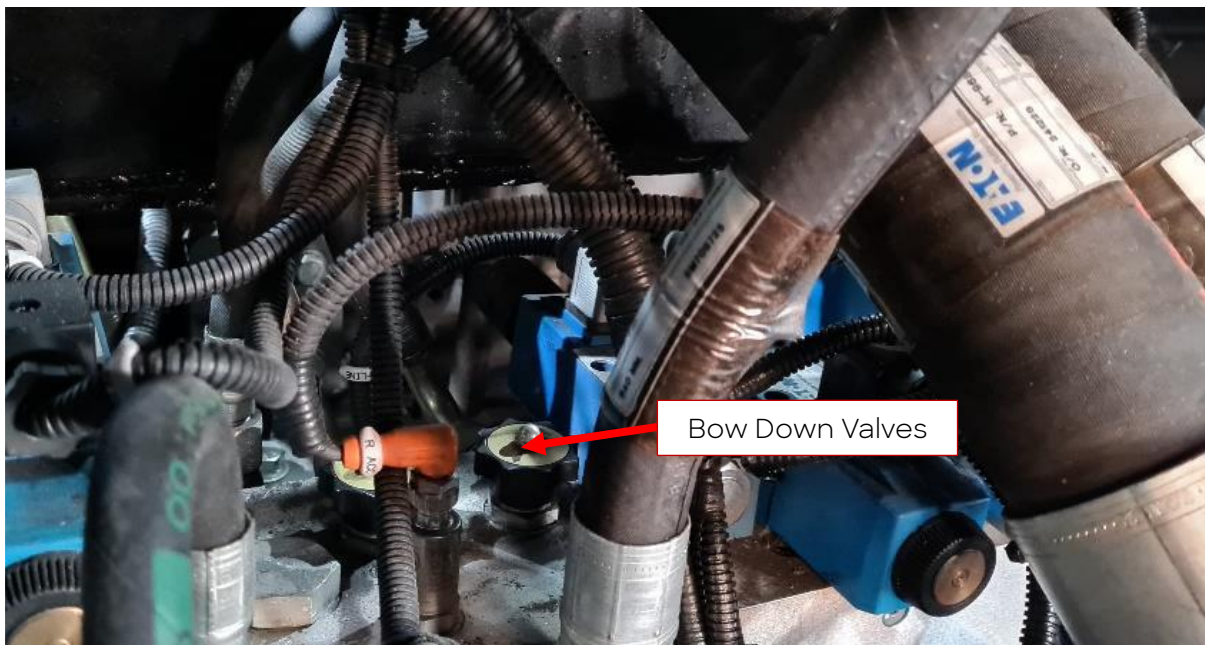
Hydraulics System – Maintenance

Any maintenance on the vehicle hydraulic components must be done with the engine shut down and the Park Brake is applied, and the vehicle chocked. Should the pumps need removing for servicing, the Suction Gate Valves (where installed) must be closed before removing any hoses.

❗ Remember to OPEN these valves upon re-assembly, as failure to do this, and running the pumps without oil supply, will damage them almost instantly.

Before removing any Solenoid Valve for servicing, it is a good practice to manually energize each solenoid a few times to ensure that any residual pressure is released to tank.

Any work on the braking circuit will require the main accumulator to be bled off via applying the brake pedal several times or by opening the blow down valves on the main manifold block.



❗ When performing maintenance, ensure the following:

- Clean hands
- Clean oil
- Clean container

General Hydraulic System Check

1. Check all hydraulic hoses for any signs of leakage or damage. Replace any hose that is faulty.
2. Check for oil leaks at all valves and fittings. Take note of the parking area for signs of leakage on the ground and report to maintenance staff immediately.

Titan PT600 – User Manual

3. Check the Hydraulic cooler for damage and clogging. Clean regularly to avoid over temp of hydraulic system.
4. Confirm hydraulic temperature transducer not damaged.
5. Test manual park brake release regularly to ensure correct operation.

Replacement of Return Line Filter Element

The return line filter is fitted with a filter condition indicator. Replace the filter elements if the indicator is in the Amber or Red section of the Condition Gauge or at the bi-annual hydraulic oil change. This indicator is located on the filter housing above the filter element.

Fan Drive Assembly

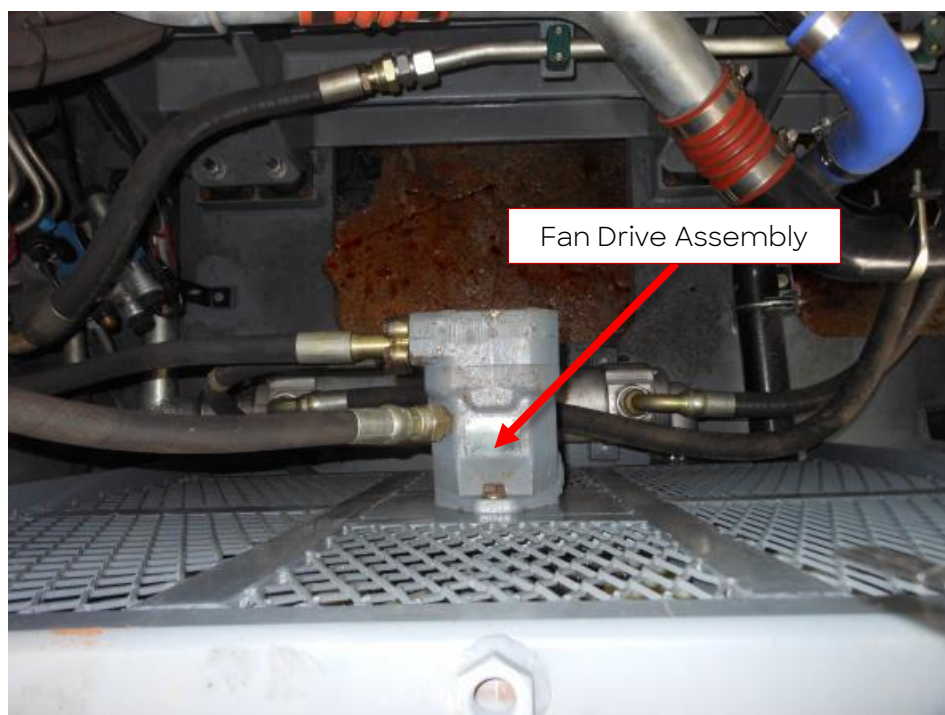
The Fan Drive Assembly consists of a fan assembly and a hub, which are driven by a hydraulic motor assembly. The fan begins operating as soon as the engine starts and the hydraulic pump is engaged. A separate 45cc/rev gear-type hydraulic pump is mounted specifically to drive the hydraulic fan motor.

The fan is a suction-type fan, drawing in cool, fresh air from outside the radiator and expelling it through the engine bay top covers (grilles).

Fan Drive Maintenance

On a monthly basis, check:

1. That the fan is secured tightly to the fan hub and the hub to the output shaft.
2. That the fan motor is secure.





Fuel Reservoir

The fuel reservoir is mounted on the right side of the engine bay, behind the hydraulic tank, and has a capacity of approximately 200 liters. The reservoir is equipped with a fuel level sender, which provides readings on a fuel gauge located on the EDM on the right side of the driver's console. Fueling is done on the right side of the tractor, with the filler located on the exterior wall. Always replace the filler cap after refueling and avoid overfilling. Only filtered fuel should be added.



A suitable filler Breather Cap is fitted to the top of the Reservoir and must be always kept clean.

-  A plugged outlet is provided at the base of the Reservoir for draining fuel at the bottom of the tank when required.
-  Check the fuel gauge at the start of each shift to ensure that the fuel does not run out, preventing being stranded during the shift.



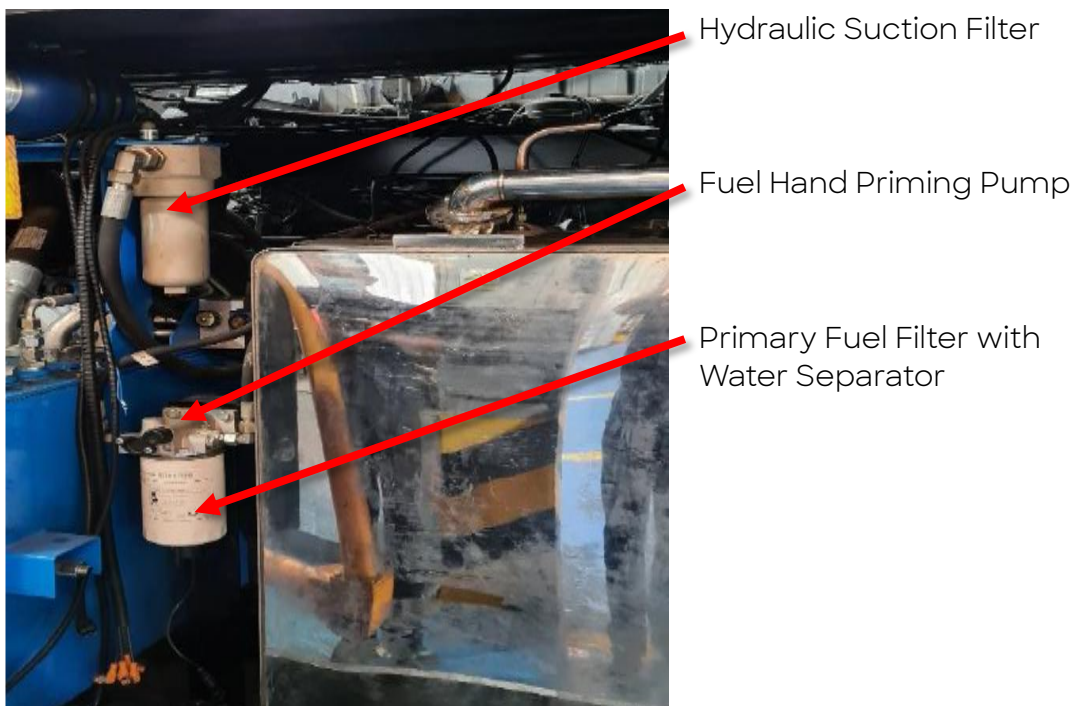
⚠ Always visually check the fuel gauge, as it is the only protection against running out of fuel. When in doubt, fill up the Fuel Reservoir/tank.

Fuel Reservoir Cleaning

Over time, if the interior of the Reservoir becomes fouled, or the fuel may be contaminated, it is necessary to drain the entire system, clean the interior of the reservoir and replace the filter/s located on the left side of engine.

After draining and cleaning check that the drain plug is securely replaced in the base of the Fuel Reservoir prior re- filling the entire fuel system.

Fuel Filters



Titan PT600 – User Manual



Eye protection should be worn when draining or filling fuel lines or reservoir.

Fuel Reservoir Preventative Maintenance

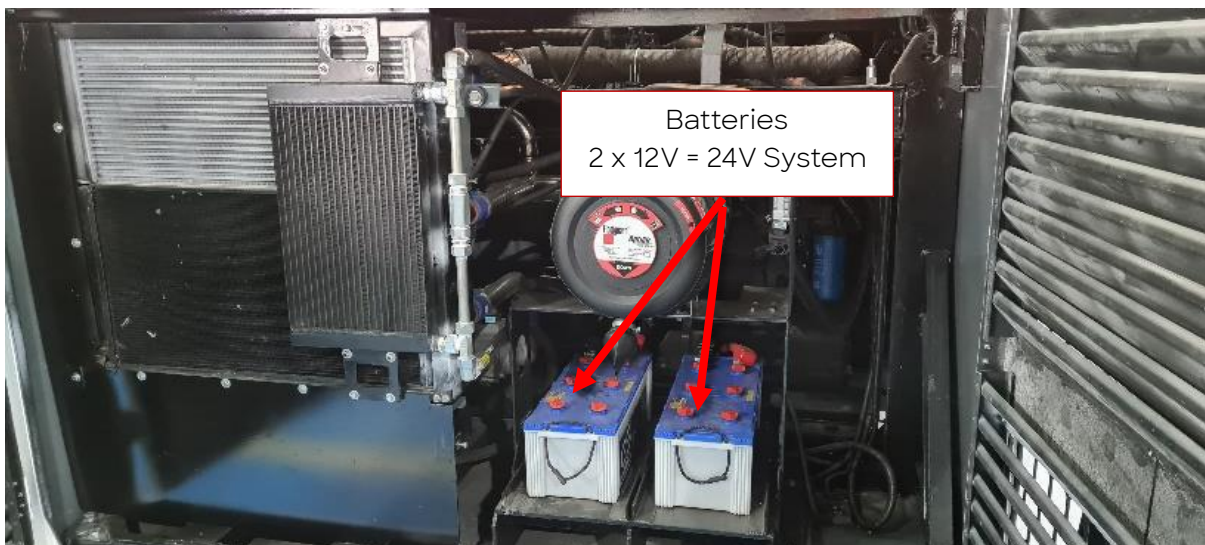
1. Fuel Level should be checked at the start of each shift. Top up if necessary.
2. Filler Cap to be kept secured.
3. Air Vent to be kept clean.
4. Ensure there are no leaks from the reservoir, fuel pump or feed lines.

Fuel lines are to be inspected annually and must be replaced immediately if:

- The cover appears to be abnormal (cracking)
- There is any fluid leakage
- The fittings are damaged
- The hoses are damaged
- The metal reinforcement is showing (visible)
- Use only compatible hoses and fittings

Battery and Battery Box

The batteries for this Tractor are accessible from left hand side by opening the door. The battery is secured with a Clamp Bar which is manually secured by use of wing nuts.

**Battery Connection**

Applicable cables should be secured to the battery terminals ensuring correct connection and polarity.

Battery Fluid Level

Check the fluid level in all cells of all batteries where applicable.

Ensure the fluid level just covers the top of each vertical plate where applicable.

Only top up the batteries with distilled water where applicable.

Titan PT600 – User Manual



Eye protection should be worn when filling or servicing batteries.

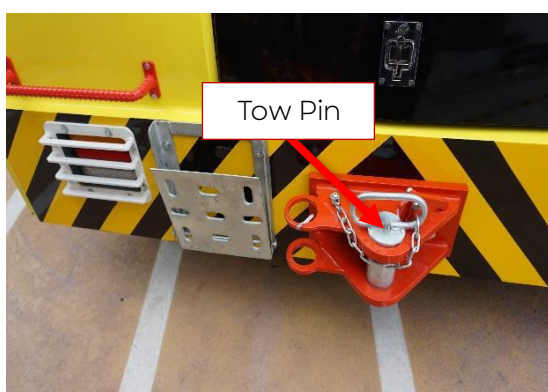
Battery Preventative Maintenance

1. Ensure the battery is secured in its cradle.
2. Check the fluid level in each cell (If not maintenance free type).
3. Check for correct terminal connection.

Tow Hitches

The vehicle is fitted with bolted-on single or double (where requested by customer) level tow hitches with stepped diameter tow pins. It is recommended that they be checked every six months for any abnormal wear & tear and replaced whenever necessary.

With both tow pins in place, ensure that the safety latch locks the towing pins. To unlock them ensure that they are easily unlocked by just lifting the latch.


**Diesel Fuel Oils**

The quality of fuel used for high-speed engine operation is a very important factor in obtaining satisfactory engine performance, long engine life, and acceptable exhaust emission levels.

-  The tractor is shipped with an empty fuel tank. Refer to the ASTM diesel fuel specifications table for recommended fuel standards.

Fuel Mixing Considerations

Very small amounts of Isopropyl Alcohol (Isopropanol) may be used to preclude fuel line freeze-up in winter months. No more than two (2) liters of Isopropyl Alcohol should be added to 570 liters of diesel fuel for adequate protection.

-  Gasohol and/or gasoline should **never** be added to diesel fuel due to the fire and explosive hazards of mixing and burning such blends. The use of turbine fuel JP4, a gasoline/diesel fuel blend, is also **not** recommended.

Using fuel that contains drained lubricating oil can result in premature ring wear, valve burning and injector problems. Mixing drain oil with diesel fuel is **not** recommended.

ASTM Diesel Fuel Specifications

Specification or Classification Grade NATO CODE	VV-F-800 DF-2		VV-F -800 DF-1	ASTM D-975 1-D	ASTM D-975 2-D	VV-F -800 DF-A (F56)	MIL-T -5264 JP-5 (F44)	MIL-T -83133 JP-8 (F34)
	CONUS	CONUS (F54)						
Flash C Point Min F	52 125	56 133	38 100	38 100	52 125	60 140	38 100	38 100
Carbon Residue (10% residuum) mass % max.	0.35	0.20	0.15	0.15	0.35	0.10	NS	NS
Accelerated Stability Total Insoluble (mg/100mL)	1.5	1.5	1.5	NS	NS	1.5	NS	NS
Water & Sediment % by vol max.	--	--	--	0.05	0.05	0.01	--	--
Particulate mg/Lmax	10	10	10	--	10	1.0	1.0	1.0
Appearance, Visual	C&B	C&B	C&B	NS	--	C&B	C&B	C&B
Ash % by wt max.	0.01	0.02	0.01	0.01	0.01	0.01	--	--
Distillation Temp 10% Recovered C Min. F 90% Recovered C Min. F Max. C F End Point Max C F	NS -- 338 640 370 698	NS -- 357 675 370 698	NS -- 288 550 330 626	NS -- 288 550 --	NS 282 540 338 640 --	NS -- 288 554 300 572	400 205 -- 243 470 300 572	400 205 -- -- 300 572
Viscosity Kinematic cSt @40 C Min. Max.	20 C 1.9 4.1	1.8 9.5	1.3 2.9	1.3 2.4	1.9 4.1	-20 C 1.1 2.4	-20 C -- 8.5	-- 8.0
Sulphur mass % Max	0.50	0.70	0.50	0.50	0.50	0.25	0.40	0.30
Cetane No. Min.	45.0	45.0	40.0	40.0	40.0	40.0	Report	Report
Specific Gravity Kg/L @ 15 C	REPORT	REPORT	REPORT	NS	NS	NS	0.788 0.845	0.775 0.840
Cloud Point Max C	--	--	--	--	--	-51	-46 Fz	-47 Fz

NS = Not Specified C&B = Clear & Bright Fz = Freeze Temperature

-- Specified property ref to specification for details.

Titan PT600 – User Manual

Service Intervals

OPERATION	FREQUENCY (HOURS)									
	DAILY	50	100	250	500	750	1000		Min. 1 yr	Min. 1 in 2 yr
Check Engine Oil	φ				φ					
Clean Dry Air Cleaner	φ				φ					
Check Coolant Mixture Level	φ				φ					
Check Radiator for Blockages & Debris	φ									
Check Fuel Level	φ									
Check Tire Inflation Pressure	φ									
Check Hydraulic Oil Level	φ									
Check Battery Electrolyte Level	φ									
Check Operation of Lights	φ									
Check Tire Condition, Tread & Walls	φ									
Check Towing Attachments	φ									
Vee-Belt Check	φ	φ			φ				φ	
Check Differential Level		φ			φ					
Check Planetary Hub Level		φ			φ					
Check Wheel nuts for Tightness	φ	φ								
Bolt Tightening - Axle					φ					
Check Tightness of Fuel Lines					φ					
Greasing - Under Normal Use					φ					
Check Radiator Hoses					φ					
Change Fuel Filter /water trap	φ				φ		φ			
Change Engine Oil					φ		φ			
Change Oil Filter					φ		φ			
Check Injector Settings							φ			
Change Air Cleaner Cartridge					φ		φ			

Titan PT600 – User Manual

OPERATION	FREQUENCY (HOURS)										
	DAILY	50	100	150	200	500	1000	2000	5000	Min. 1 yr	Min. 1 in 2 yr
Change Differential Oil							φ				
Change Planetary Oil							φ				
Adjustment of Park (Safety) Brake (Check every service)						φ	φ				
Change External Transmission Oil Filter						φ	φ				φ
Change Hydraulic Return Filter							φ			φ	
Change Coolant Mixture							φ				φ
Clean Fuel Tank							φ				
Change Fan Belt							φ			φ	
Check Turbo Unit							φ				φ

Transmission: Dana T32000 power shift

Engine: Deutz TCD 4.1 L4

Axles: Dana 223

Daily Maintenance Inspection

The following items must be checked before the operation of the PT600 Tow Vehicle daily. Refer to the AVRO Daily Maintenance Manual for a more detailed explanation of the following items.

Tick the following items once completed.

- ☐ **Engine Oil Quantity.** Inspect the engine oil quantity level via the engine oil dipstick by placing the vehicle on a flat, level surface. Pull the dipstick out and wipe clean then re-insert the dipstick into its housing. Remove the dipstick, hold it horizontal and check to see if the oil level is between the minimum and maximum levels on the dipstick.
- ☐ **Fuel Lines and Fuel Tank.** Perform a visual inspection of the fuel lines and the fuel tank to ensure there are no fuel leaks evident
- ☐ **AdBlue Tank – Check AdBlue tank daily.** When topping up tank use extreme caution as the liquid is highly corrosive. (T4 ONLY)
- ☐ **Cooling System.** Check to see if the cooling system has sufficient coolant. Ensure the engine is not hot and gently touch the top of the radiator cap to ensure the radiator and its coolant is not too hot to open the cap. Remove the radiator cap and check to see if the fluid level is within 50mm from the top of the filler neck.
- ☐ **Turbocharger.** Inspect the turbocharger mounting, intake and exhaust ducting for leaks.
- ☐ **Transmission Oil Level.** Check the transmission oil quantity level using the following procedure.
Inspect the transmission oil quantity level via the transmission oil dipstick by placing the vehicle on a flat, level surface with engine and transmission oil at normal operating temperature and park brake applied. Pull the dipstick out and wipe it clean then re-insert the dipstick into its housing. Remove the dipstick, hold it horizontally and check to see if the oil level is between the minimum and maximum levels on the dipstick.
- ☐ **Visual Inspection and Walkaround.** Carry out a visual inspection of the entire vehicle checking for the following items:
Body – look for damage, severe rust and metal cracking
Windscreens, windows and mirrors – look for cracks, breaks and damaged rubber
Lights – Ensure all lights are not broken and are functioning correctly
Fluid leakage – oil, fuel, coolant and hydraulic fluid. Ensure there are no fluid leaks evident on the ground
Wheels – ensure all wheel mounting bolts and tie rod ends are installed and do not show signs of loosening
Tires – inspect the tires for bulging, blistering, large cuts and wear. Visually check the tire for sufficient inflation if in doubt check with pressure gauge

Inspector Name:	
Date and Time of Inspection:	
Any additional remarks:	
Signature	

Spare Parts List

DESCRIPTION	PART NUMBER
CABIN	
Door Latch L/H (Right Hand Door)	GA172304067
Door Latch R/H (Left Hand Door)	GA172304070
Door Handle External C/W Keys	GA403004097
Door Strap	GA323004136
Ignition Switch	GA403004002-S
Work Light	GA152304543
Tow Pin Light	GA152304543
Interior Cabin Light	GA273004108
Switch 3 POS	GA152304488
Light Switch 2 POS	GA152304486
Column Stalk Switch Front	GA152304472-S
FILTERS	
Air Filter	GA552304190
Air Filter Safety	GA552304191
Oil Filter (Engine)	GA552304188
Fuel Filter with Water Separator	GA513004105

Contact Avro GSE for spare parts ordering and inquiries:



Main:

1 833 220 2810



General Inquiries:

info@avrogse.com

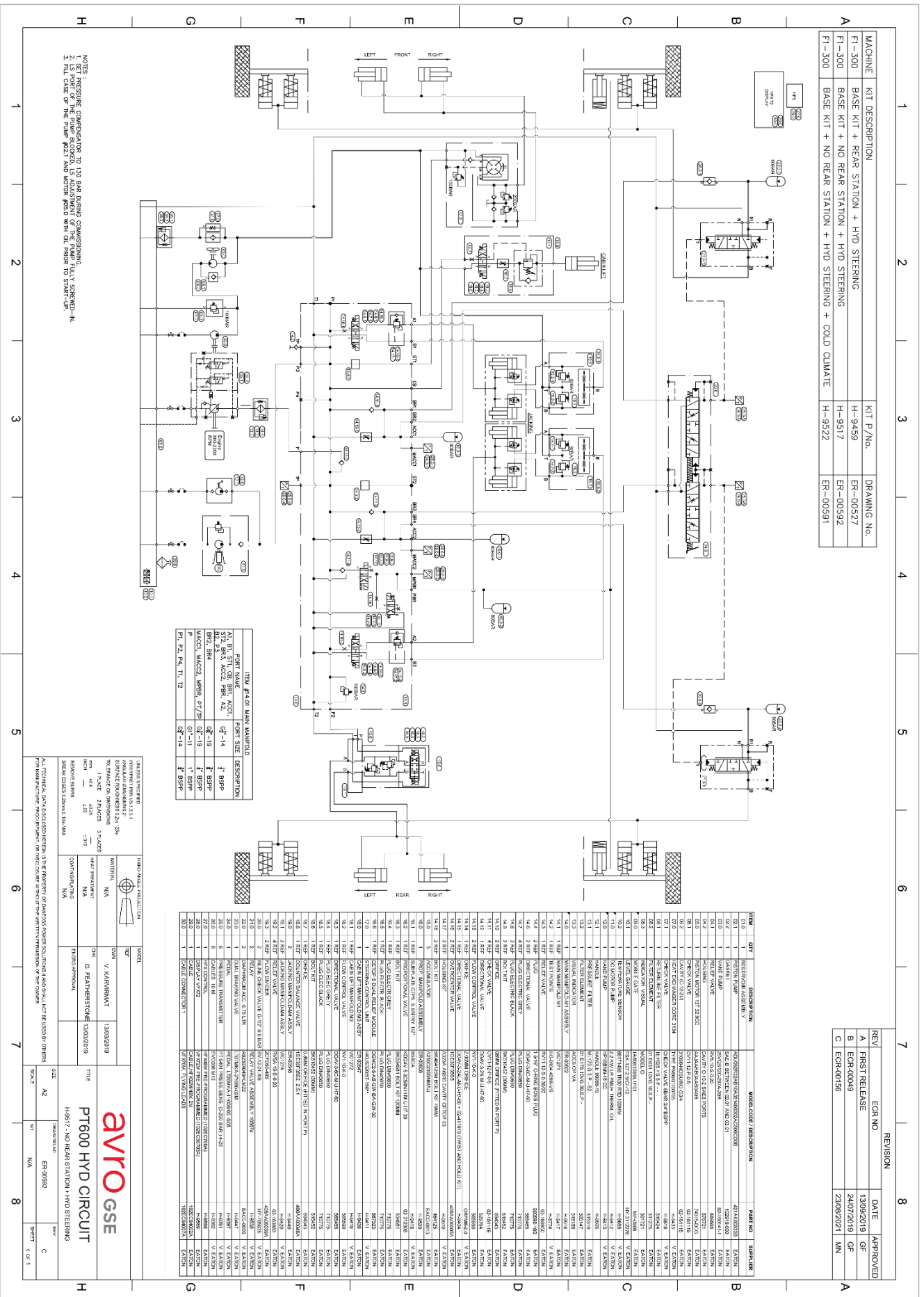
Parts Inquiries:

parts@avrogse.com

HYDRAULIC SYSTEM DIAGRAM

This section contains detailed hydraulic system diagram and connections for reference during operation, maintenance, and troubleshooting.

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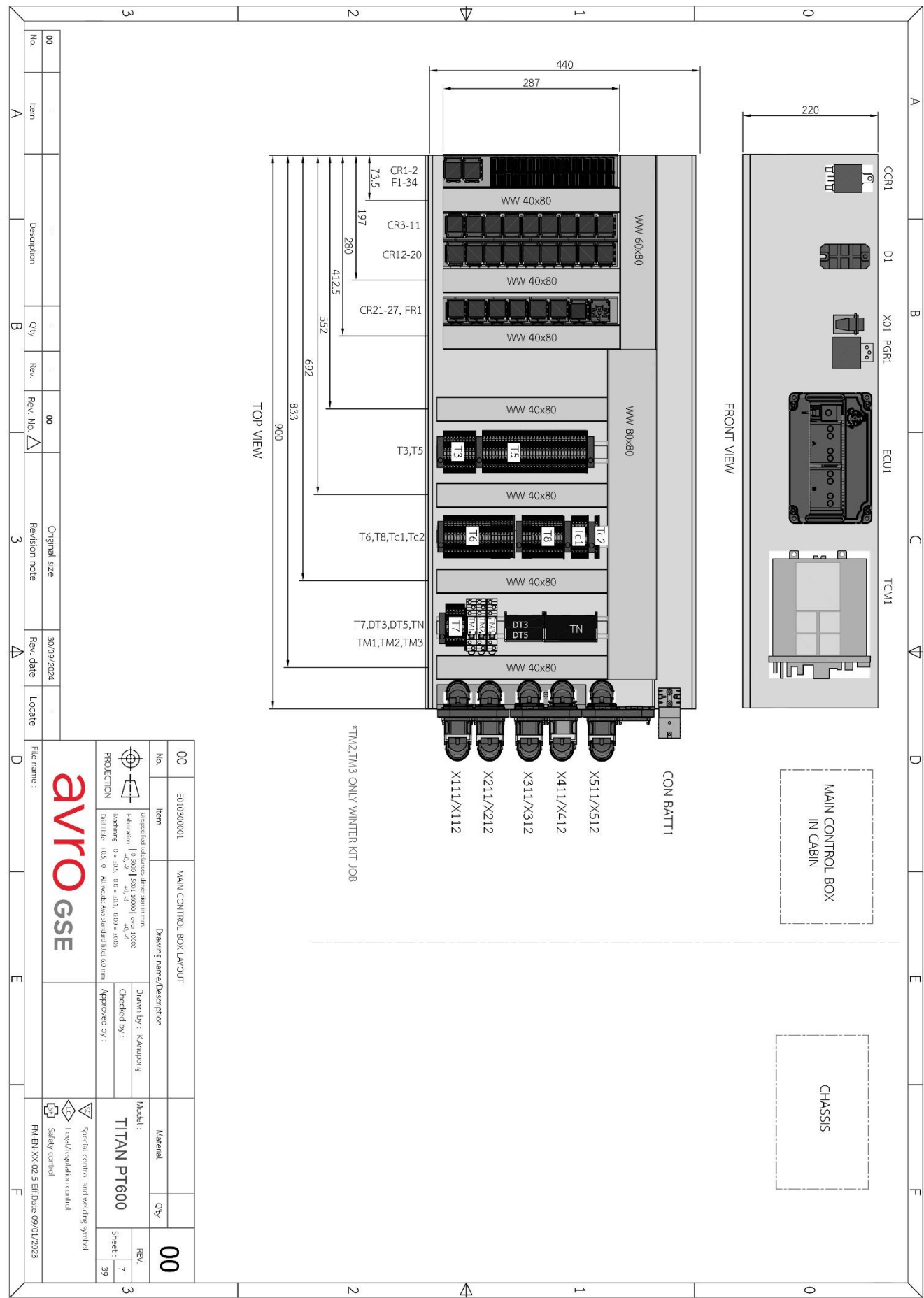


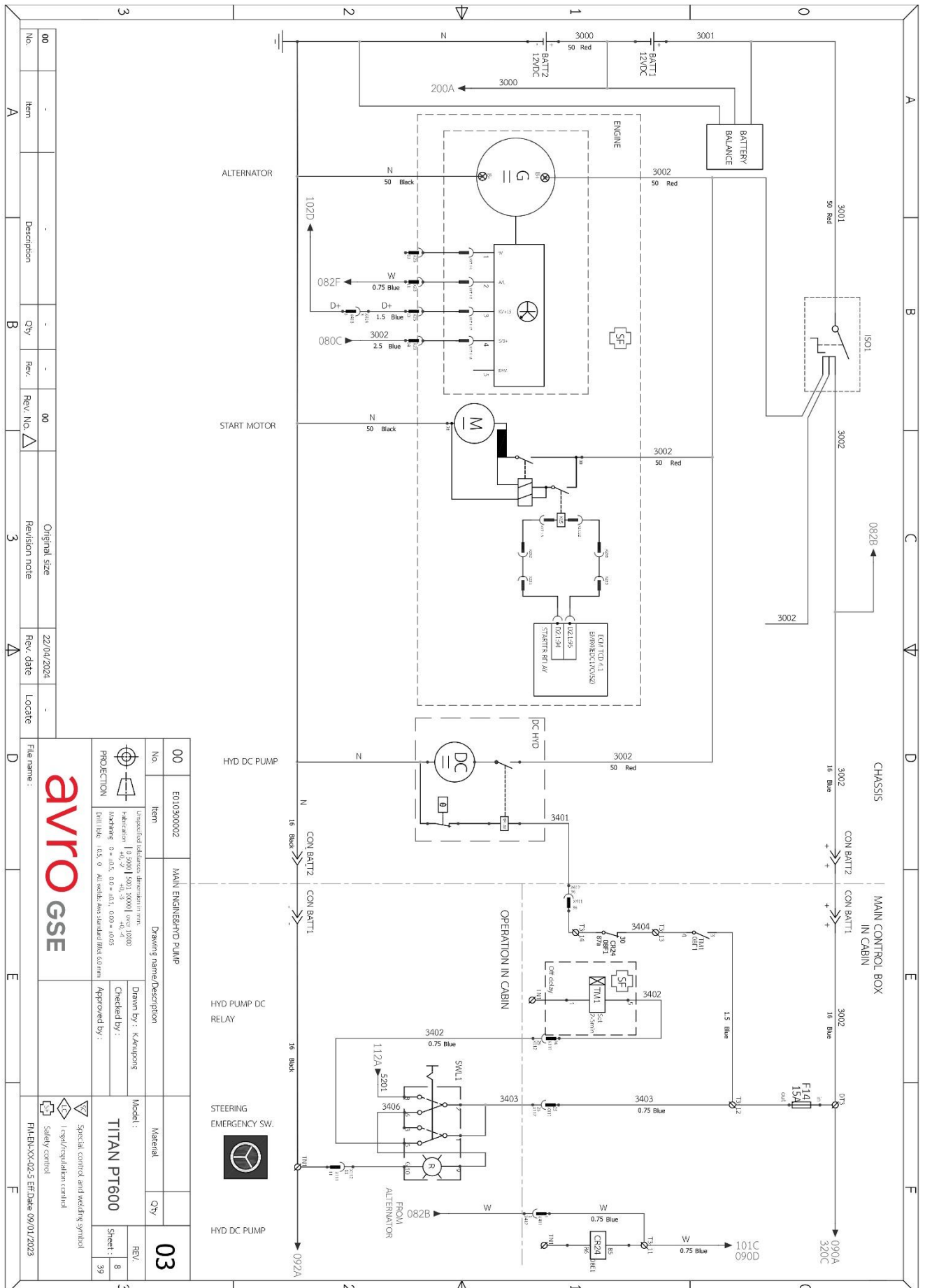
ELECTRICAL SYSTEM AND CIRCUITS DIAGRAMS

This section includes detailed diagrams of the electrical system and circuits, showing component connections, wiring paths, and power distribution for troubleshooting and maintenance.

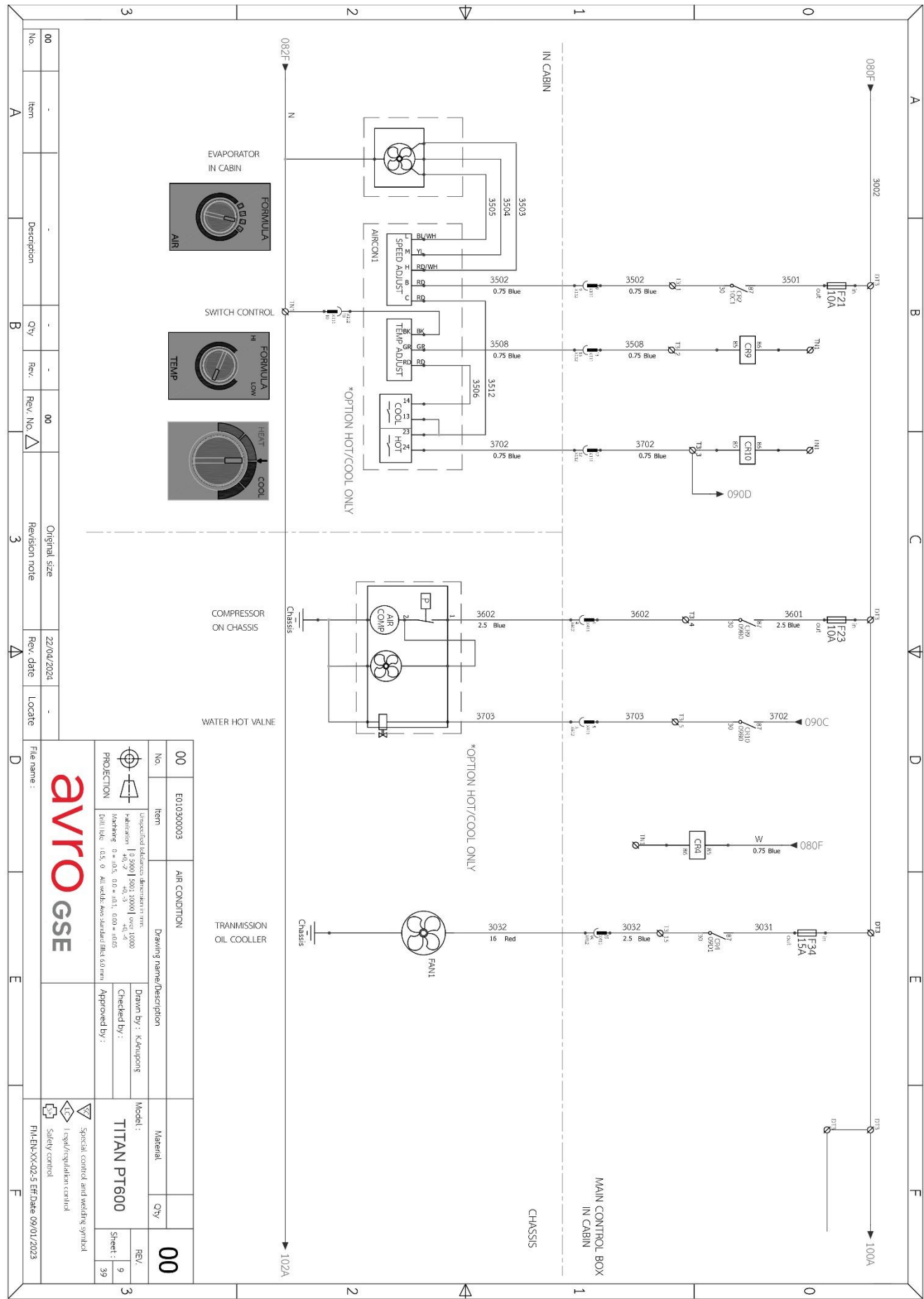
A										B										C										D										E										F																													
0										1										2										3										4										5										6																			
SYMBOL										ABBREVIATION										DESCRIPTION										SPECIFICATION										SYMBOL										ABBREVIATION										DESCRIPTION										SPECIFICATION									
										CON BATT										DC CONNECTOR										CON BATT 24VDC 50A																				BC										BEACON LIGHT										24VDC 128MAF									
										ISO										ISOLATOR SWITCH										HELLA 24VDC 250A																				WL										WORK LIGHT										24VDC 18W									
										BATT										BATTERY										GS DIN L14-MF 12VDC																				TL										TOW LIGHT										24VDC 18W									
										CON										PIN CON FEMALE										CONNECTOR F 24VDC Size 2.8																				SOL										SOLENOID VALVE B										VALVE -B 24VDC									
										CON										PIN CON MALE										CONNECTOR M 24VDC Size 2.8																				SOL										SOLENOID VALVE A										VALVE -A 24VDC									
										F										FUSE										FUSE HOLDER 10,15,25A RED BLUE WHITE																				PSW										PRESSURE SWITCH										24VDC									
										CR, CCR										RELAY										24VDC 20A, 100A																				LSR										LEVEL SENSOR EATON										24VDC									
										T										TERMINAL										12-24V																				SW										SWITCH PARK BREAK										24VDC									
										CR, CCR										COIL RELAY										24VDC 20AMP																				LT										LINEAR TRANSDUCER										Transducer 24 VDC									
										EMER										EMERGENCY PB										24VDC																				DC-DC										DC CONVERTER										24 TO 12VDC 4-20mA									
										KEY										KEY START SWITCH										EPINA ST 24VDC																				L										WARNING LIGHT										24VDC									
										SWL										ROCKER SWITCH 2 POSITION										24VDC																				COM AIR										CONTROL AIR-CON SWITCH										24VDC									
										HL										HEAD LIGHT										24VDC 45W																				CL										CABIN INTERIOR LIGHT										24VDC									
										L										LAMP										24VDC																				TM										TIMER RELAY										OMRON 24VDC									
										FR										FLASHER RELAY										24VDC 10-170W																				MM										WIPER MOTOR										24VDC									
										D										DIODE MODULE										OMRON 24VDC																				PSR										PULSE GENERATOR RELAY										24VDC									
										CST										COLUMB STALK SW CONTROL HEADLIGHT										24VDC																				WP										WASH PUMP										24VDC									
										BZ										BUZZER										MISUNO 24VDC																				HORN										HELLA AUTOMOTIVE AIR HORN										24VDC									
										DC HYD										HYD PACK EATON										24VDC																				PS										PRESSURE ANALOG										24VDC									
00										E000000006										COMPONENT LISTS										00										00										00										00																			
No.										Item										Drawing name/Description										Material										Qty										REV										REV																			
PROJECTION										1:0.5000 5000:100000 1000:																																																																					

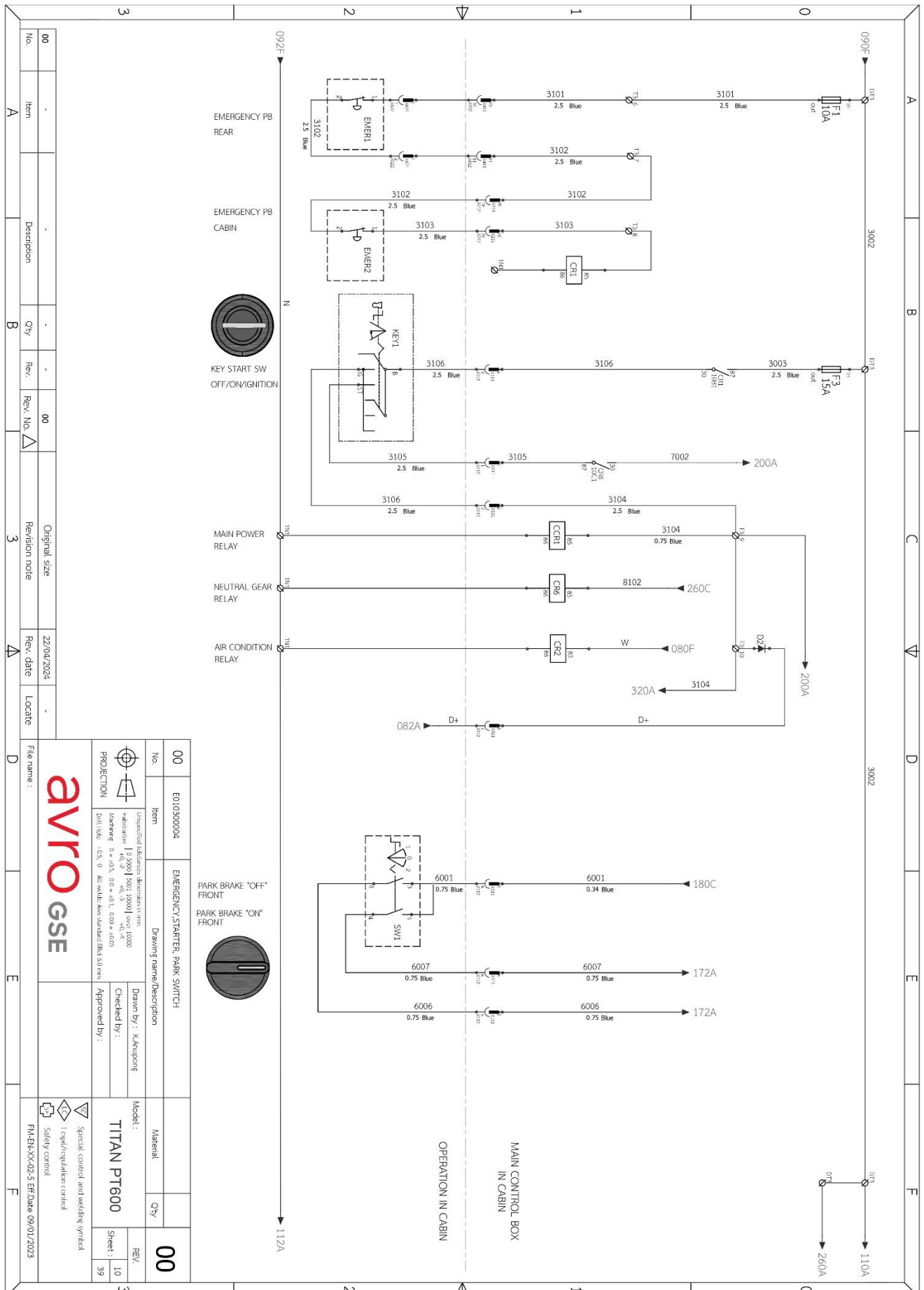
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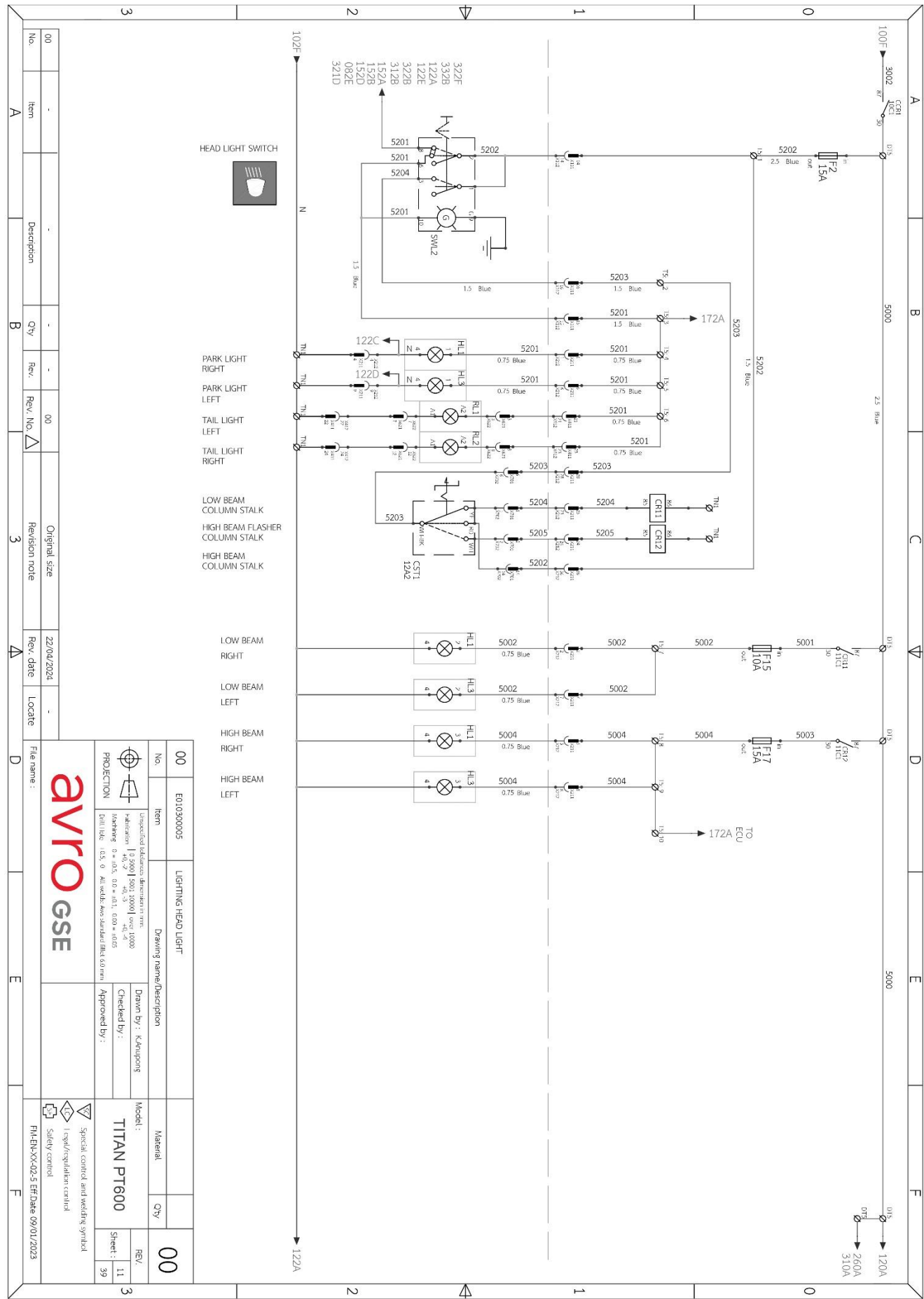


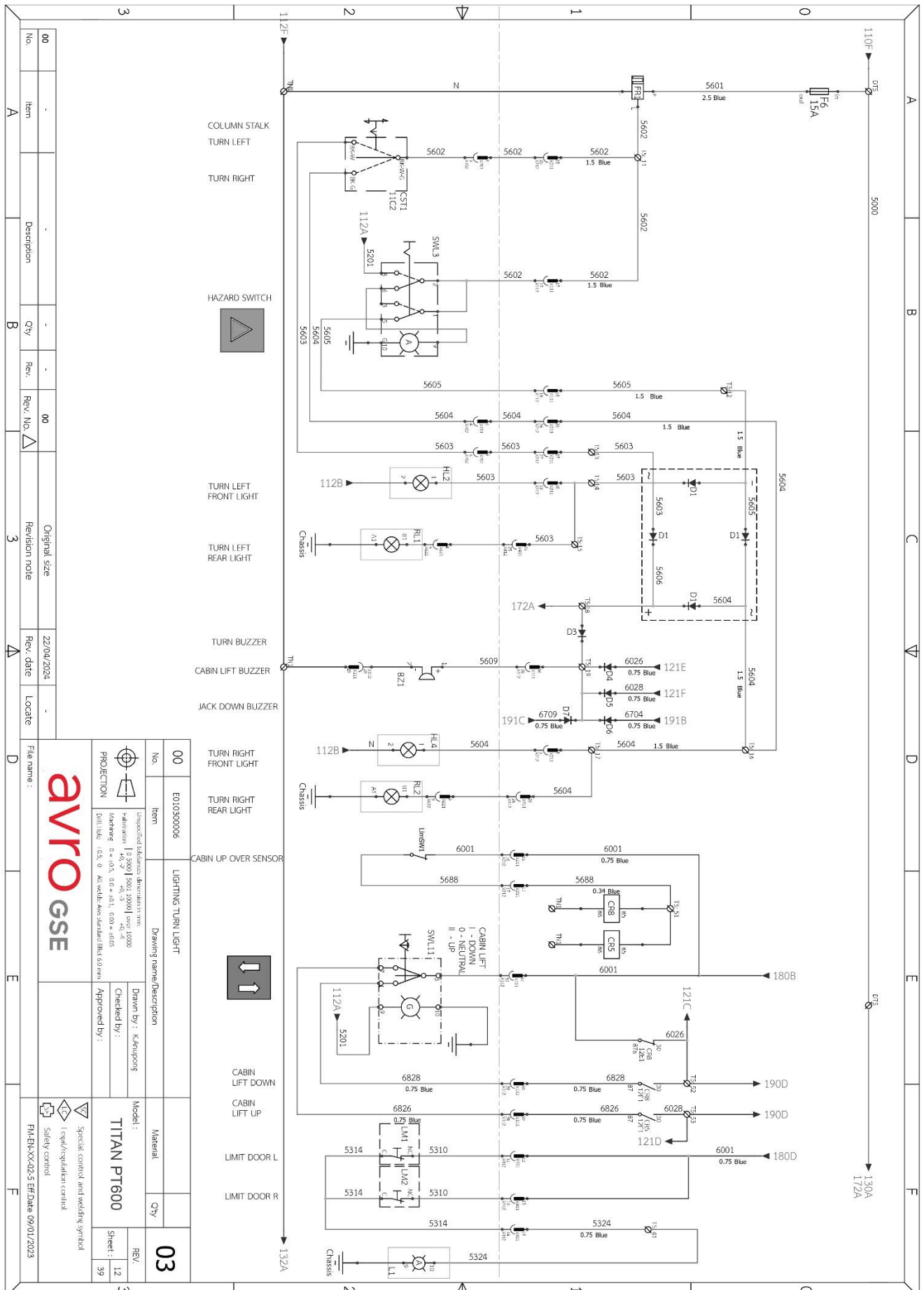
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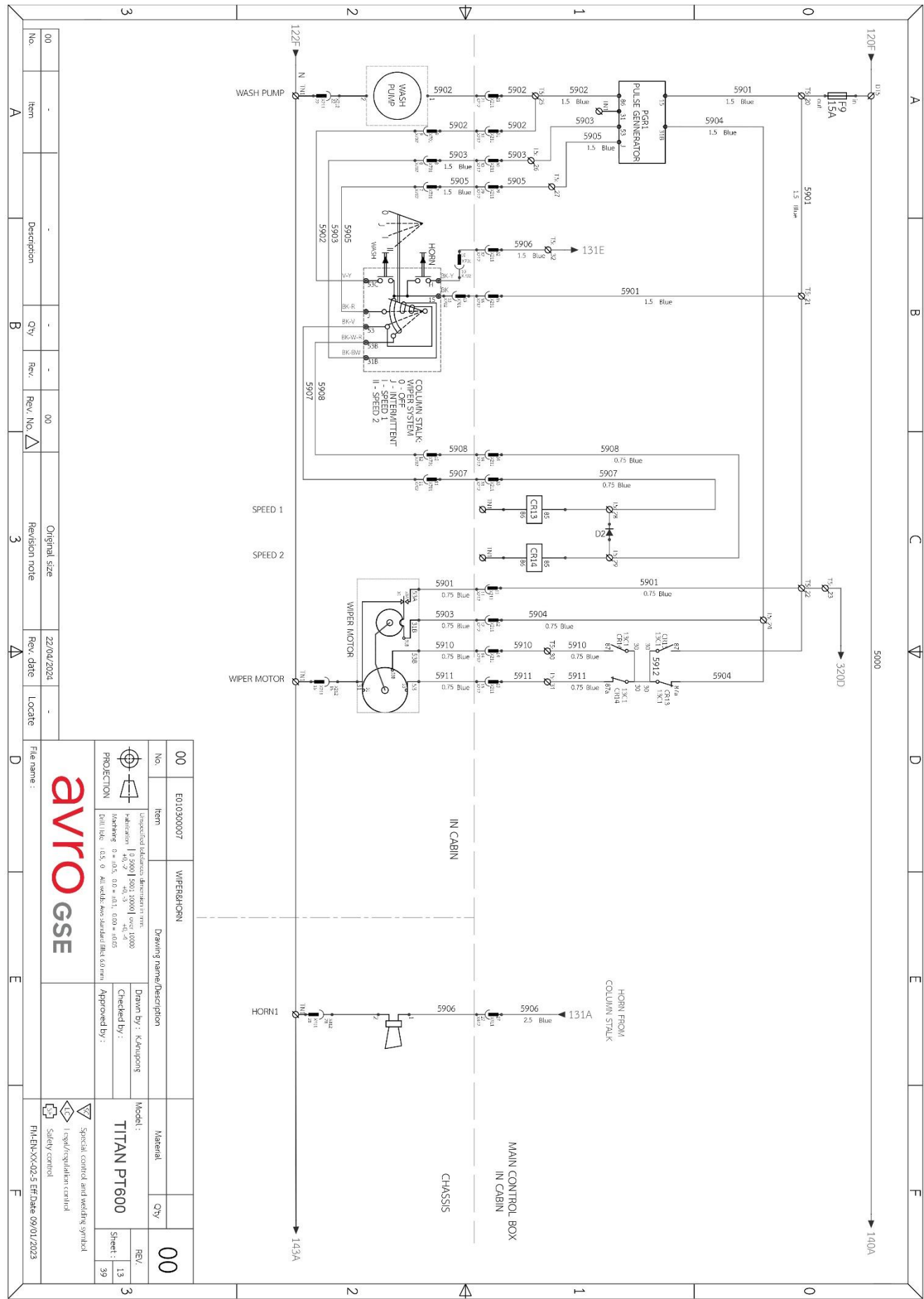


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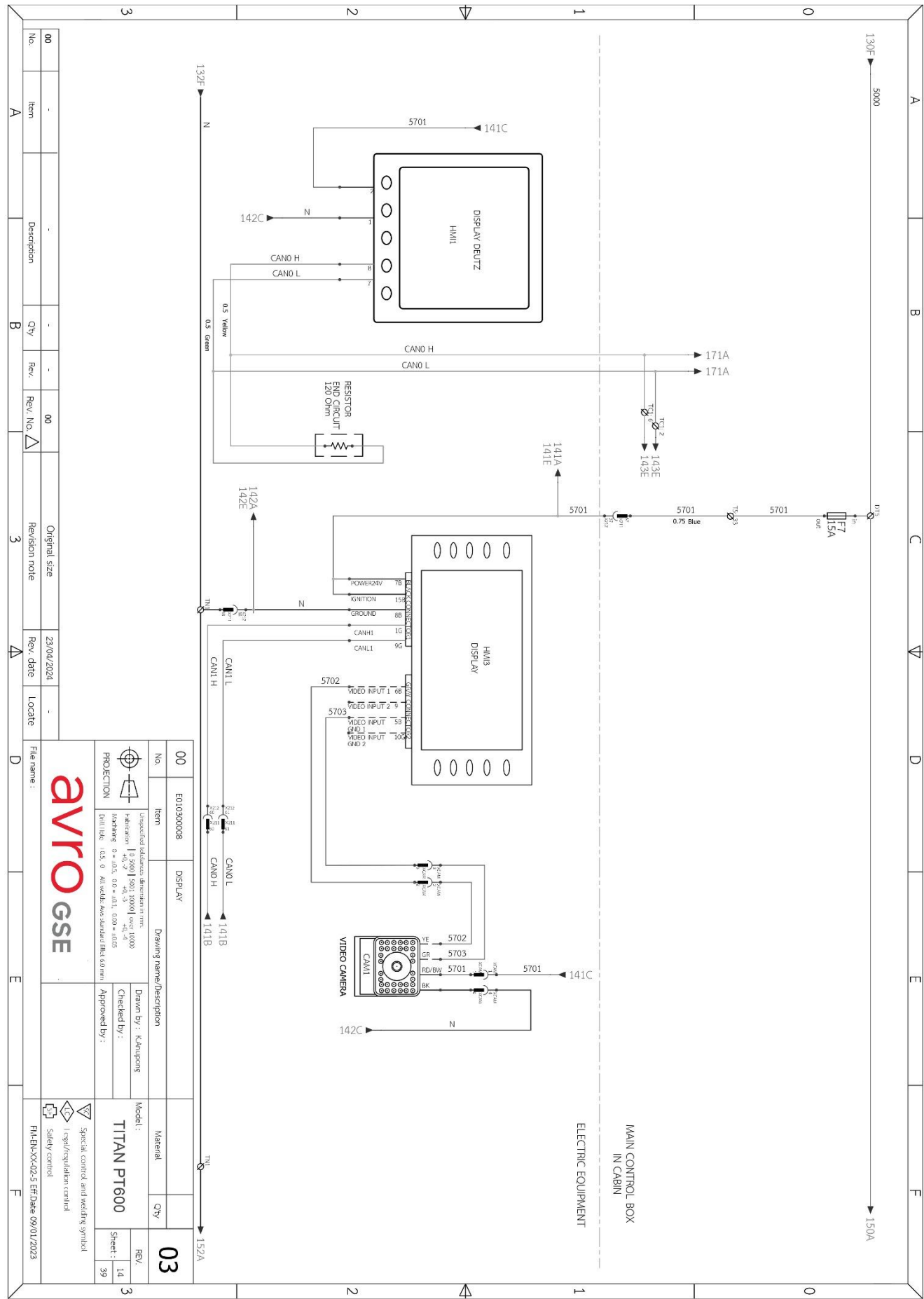




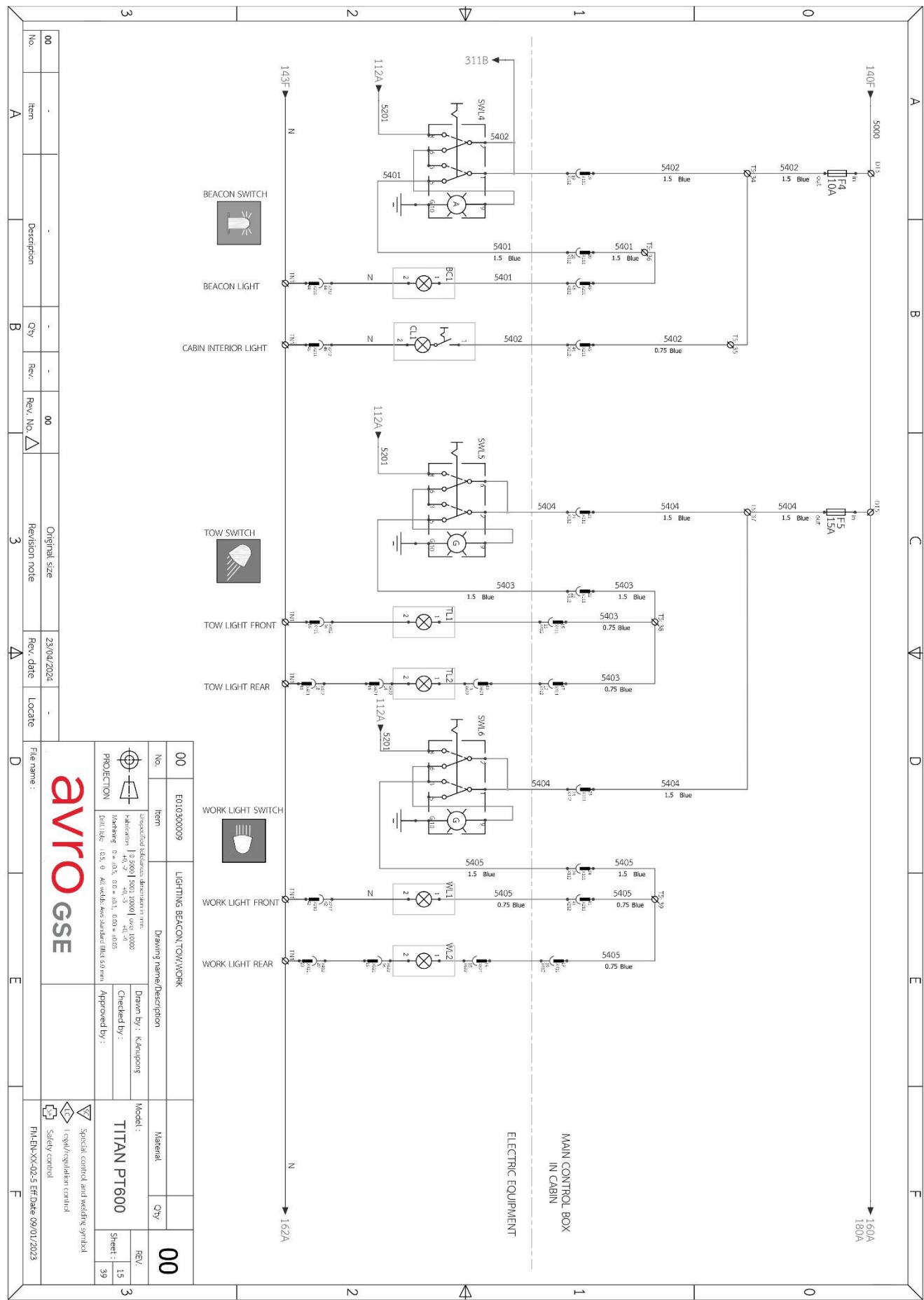
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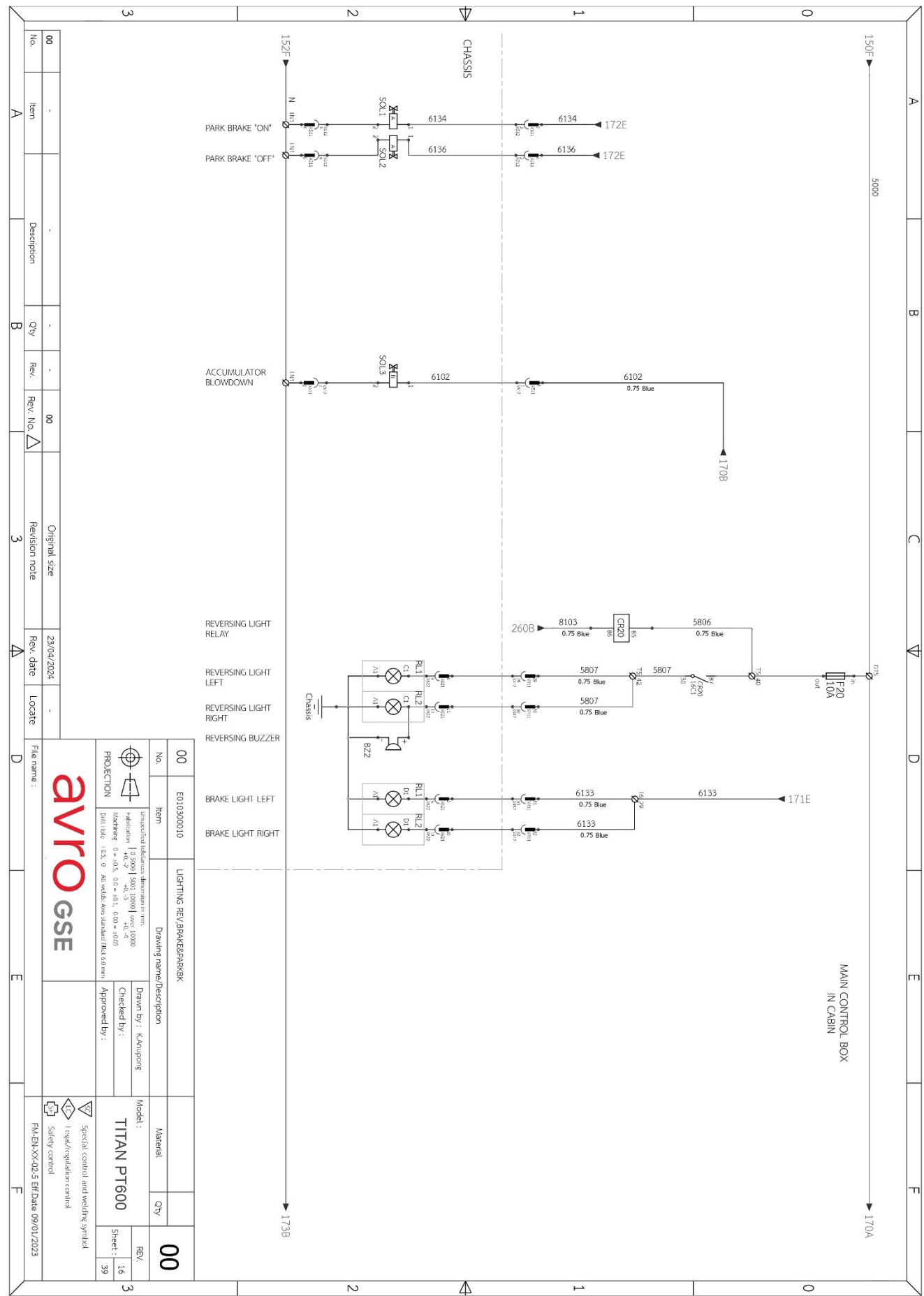
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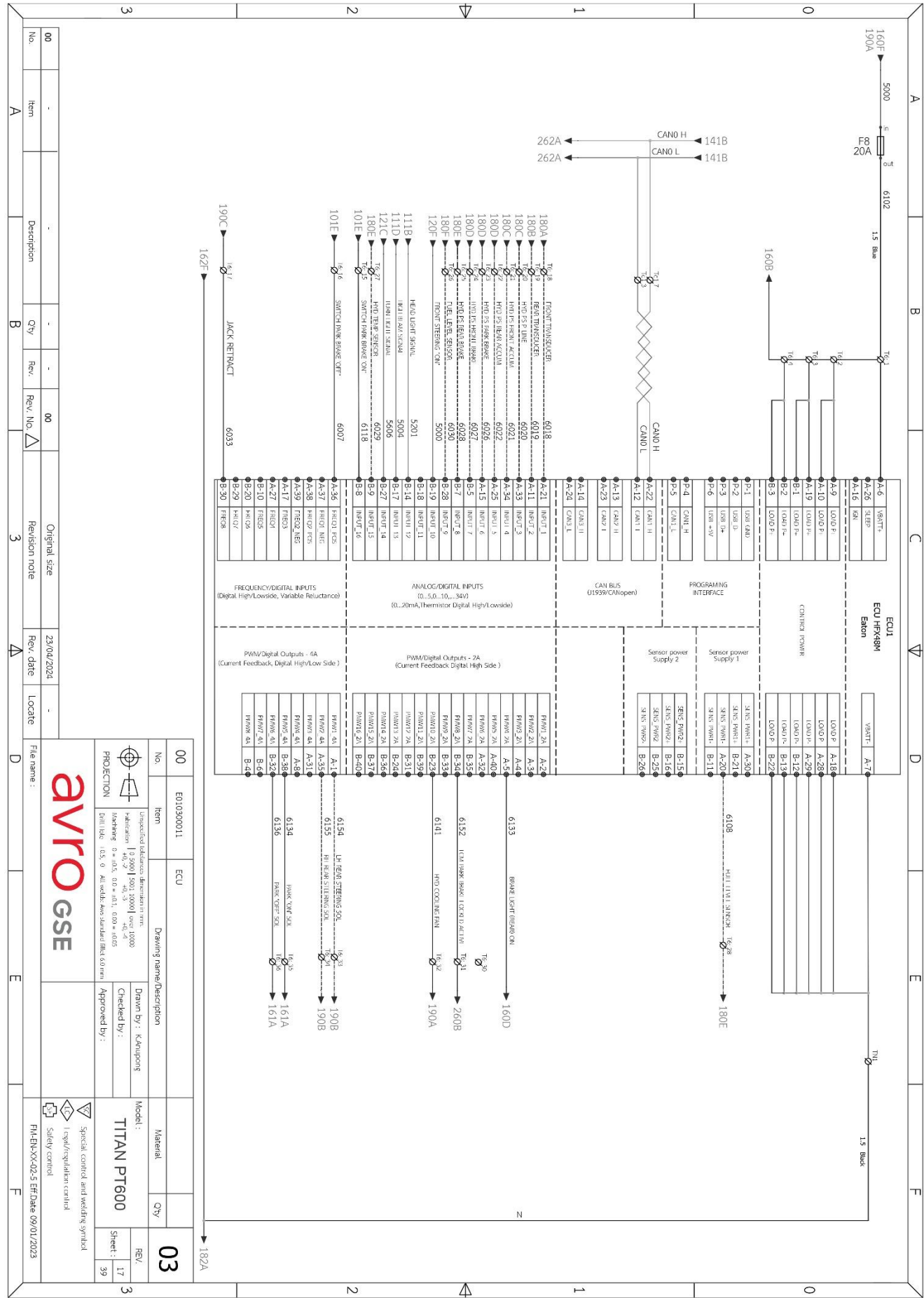
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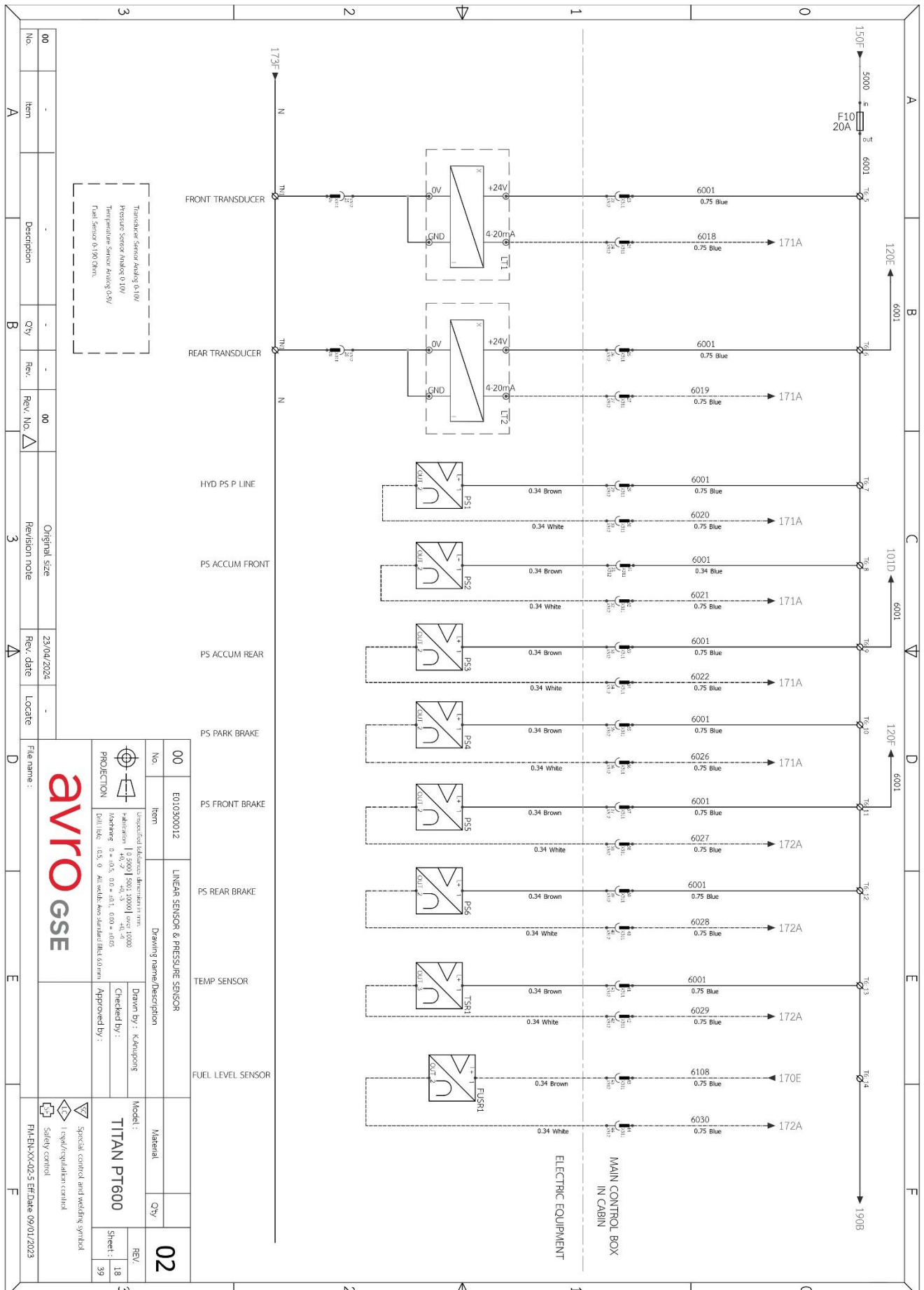


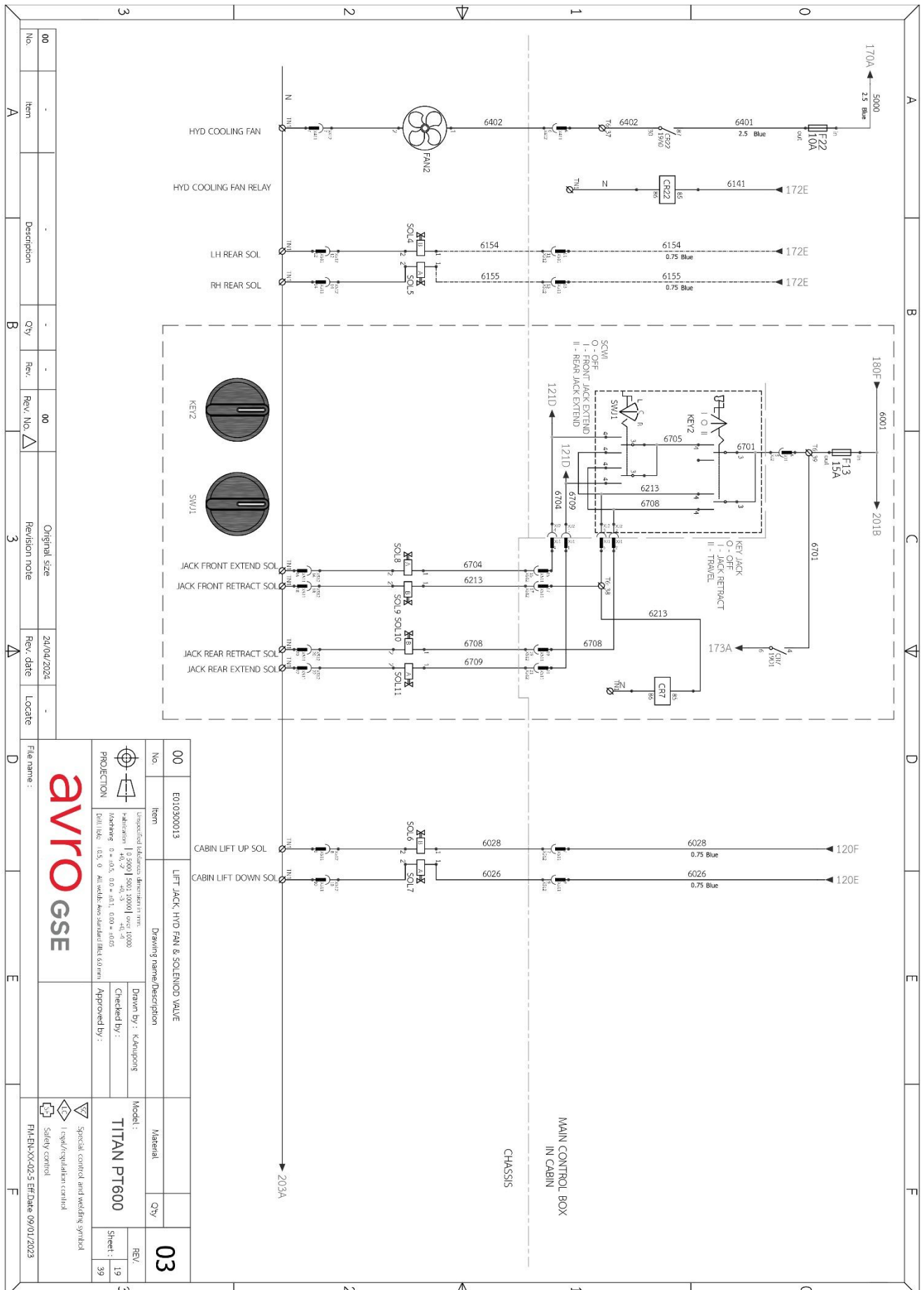
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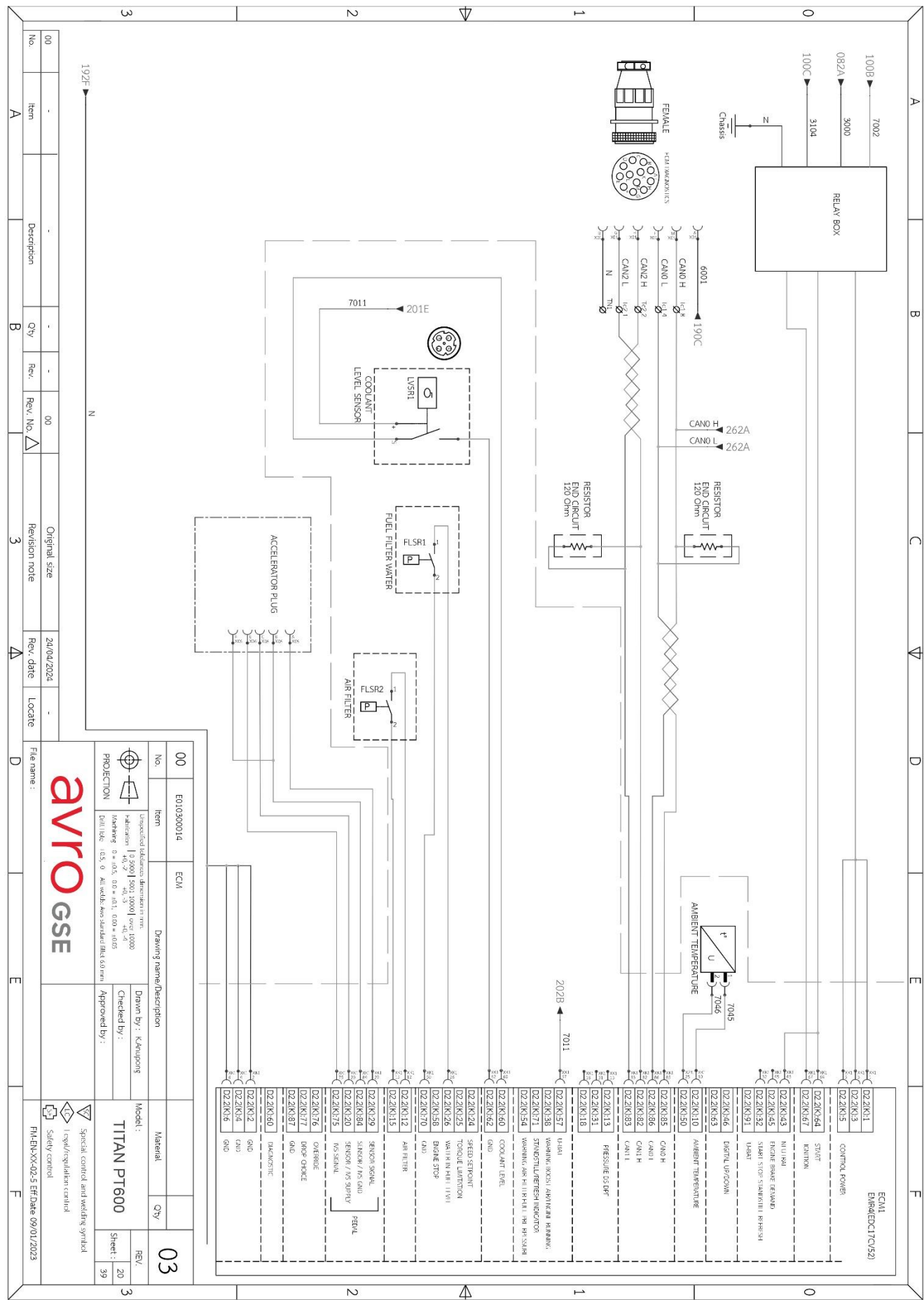
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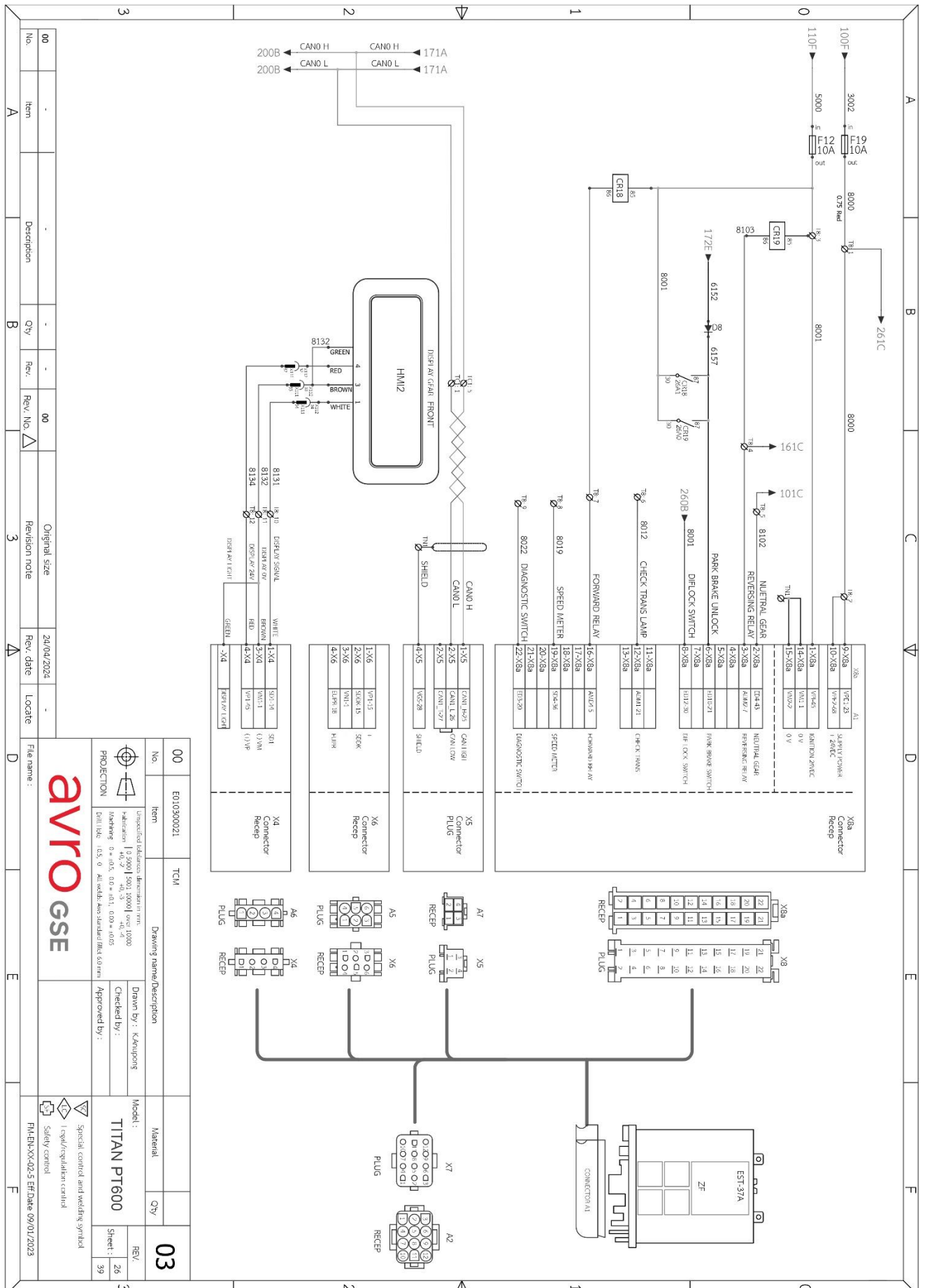


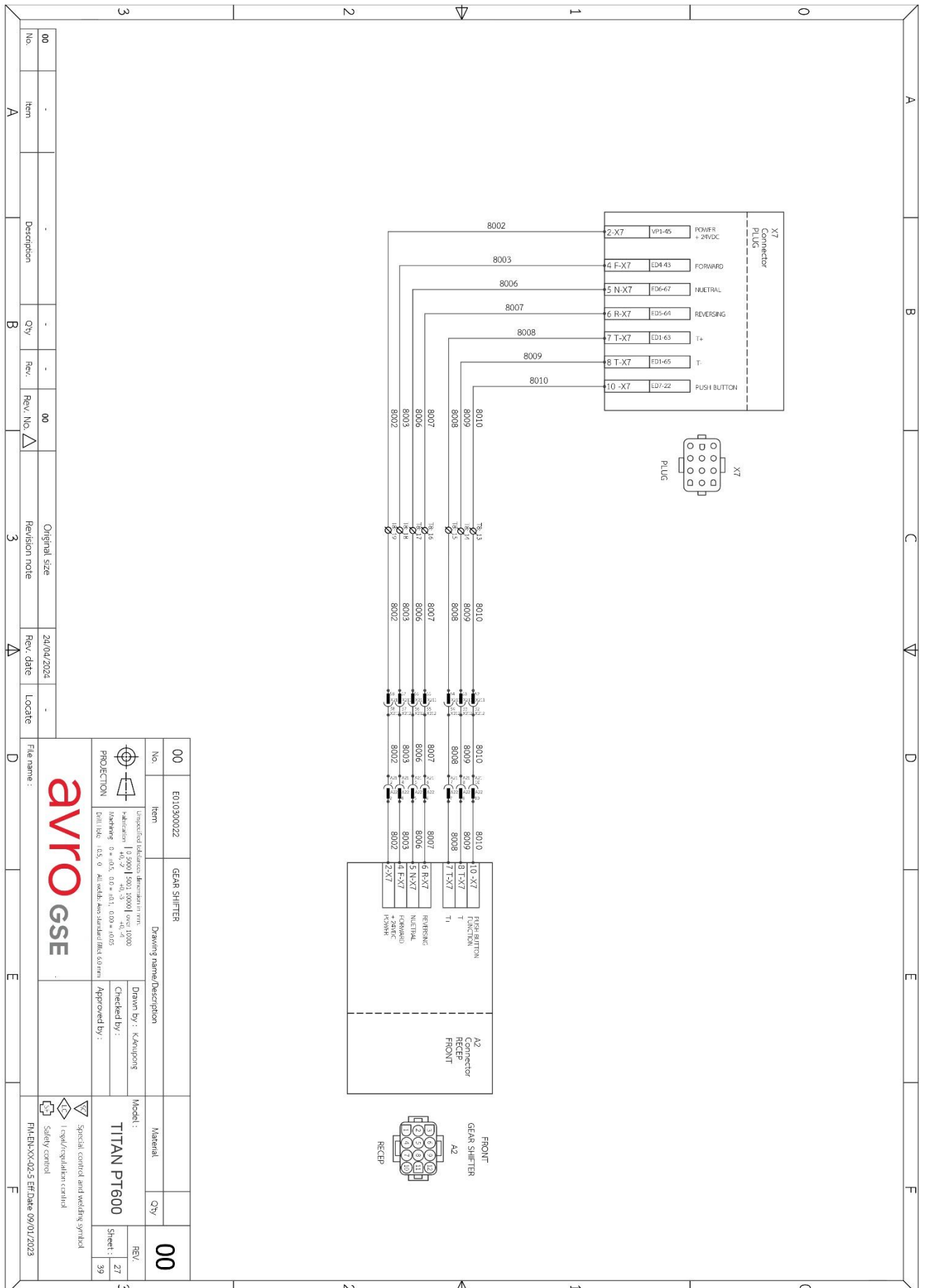




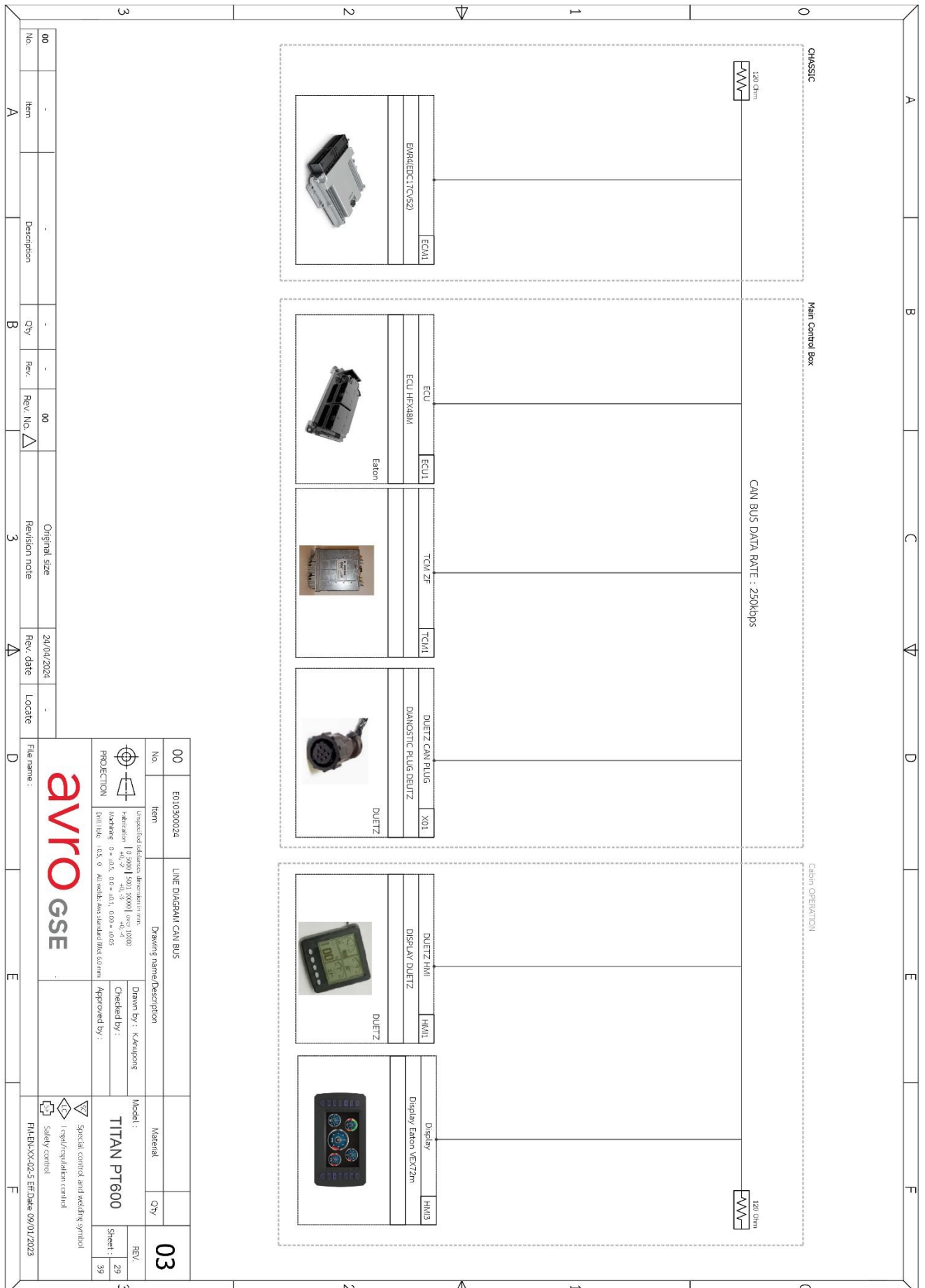
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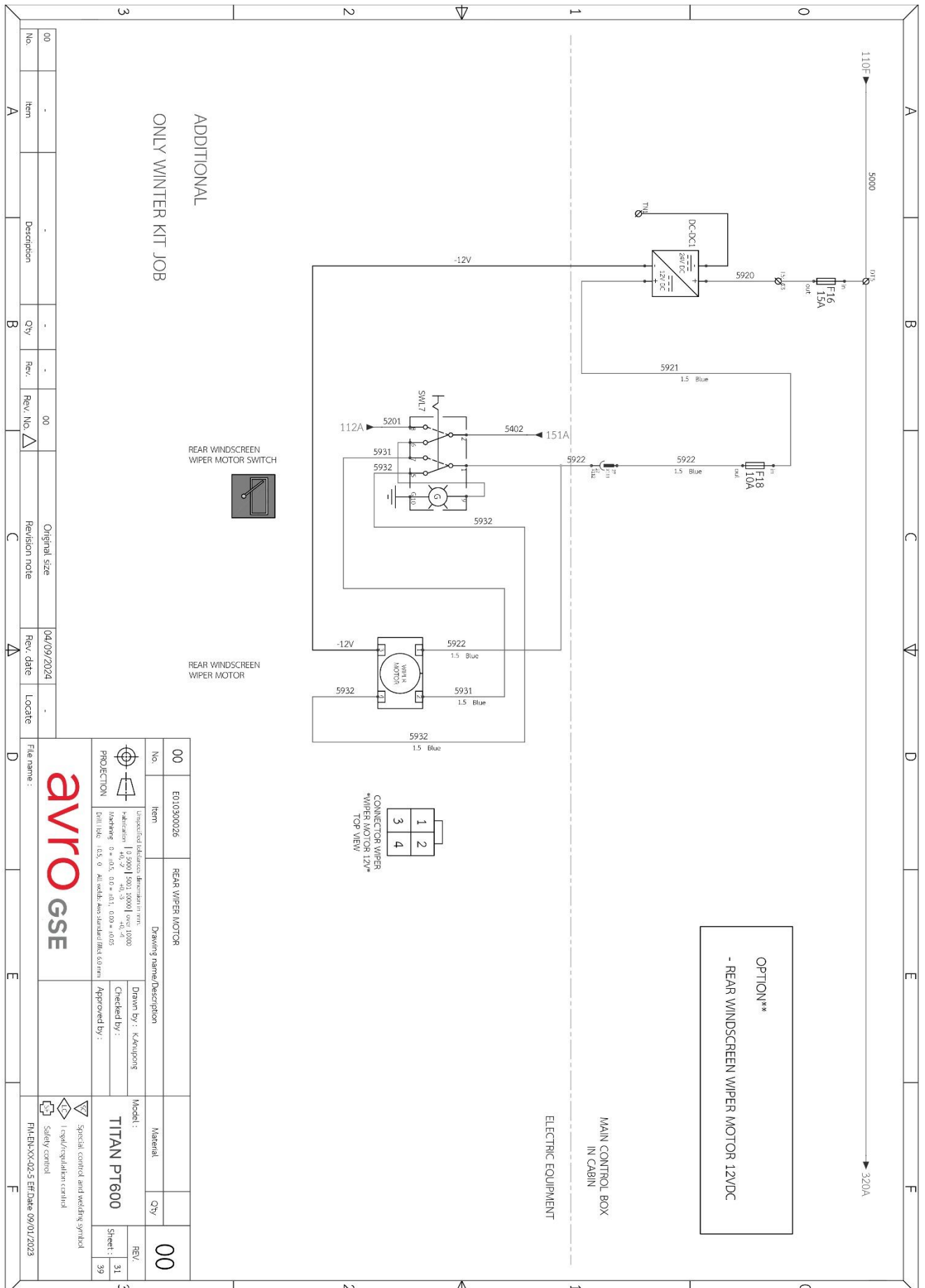




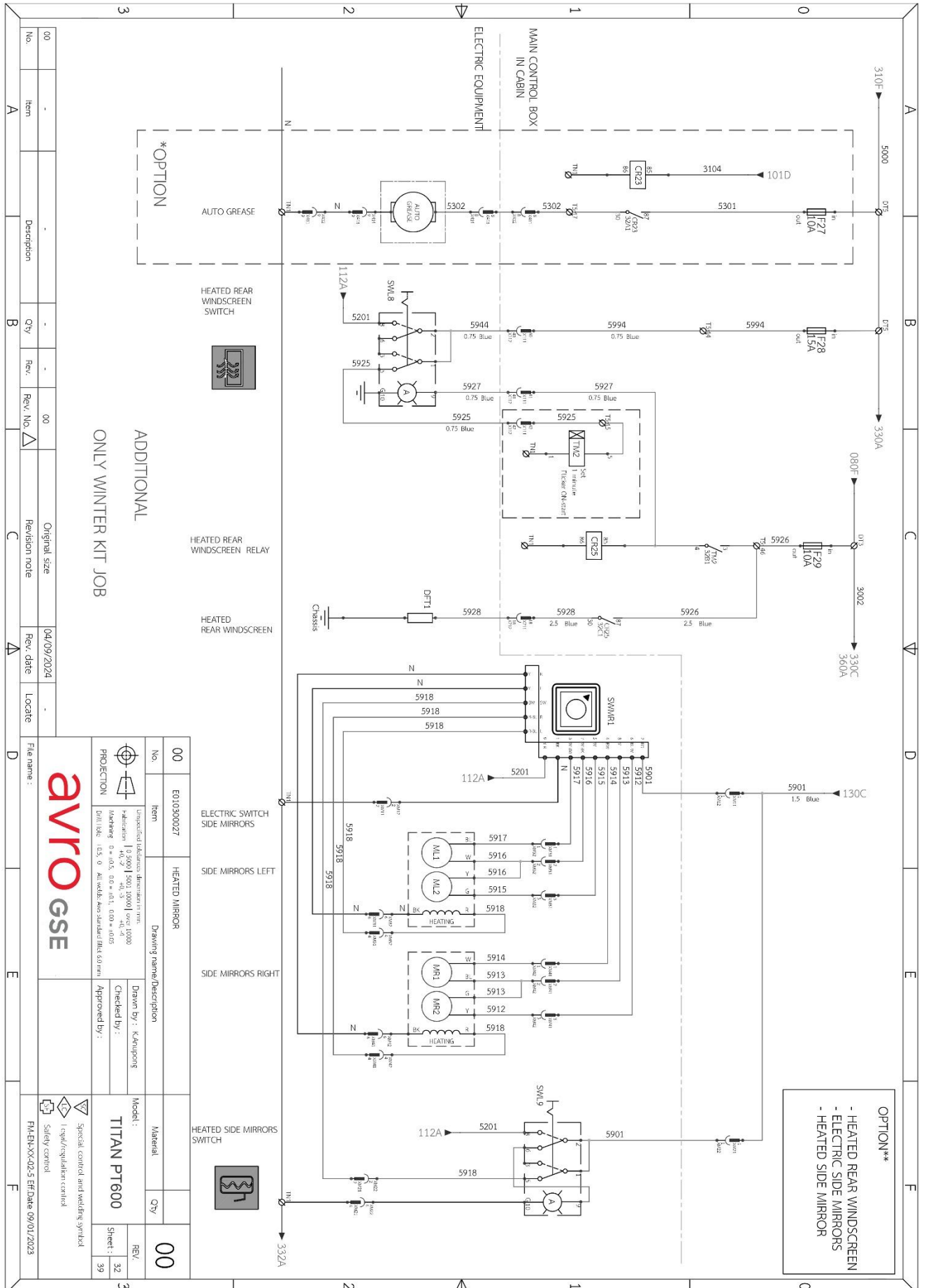


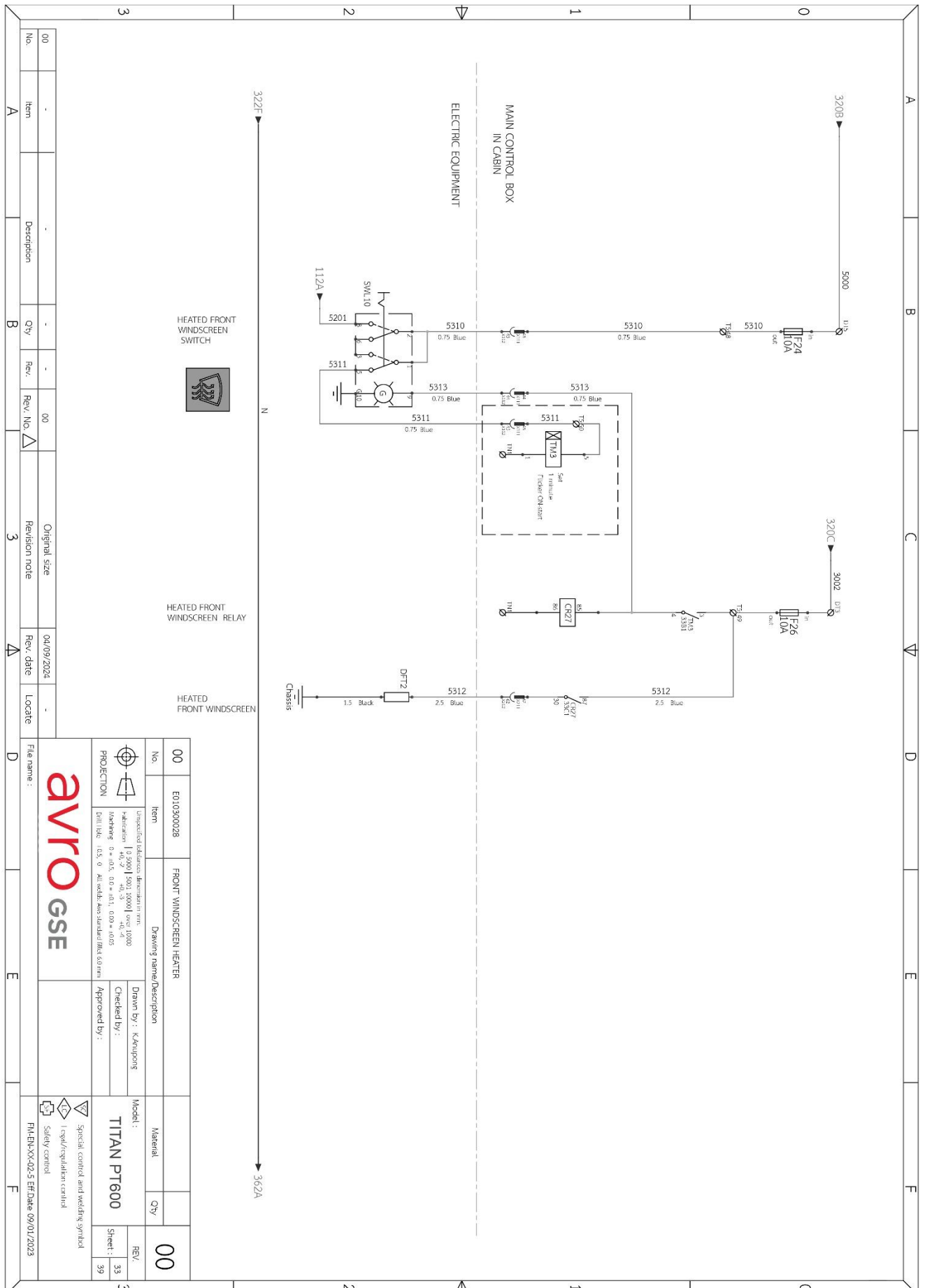


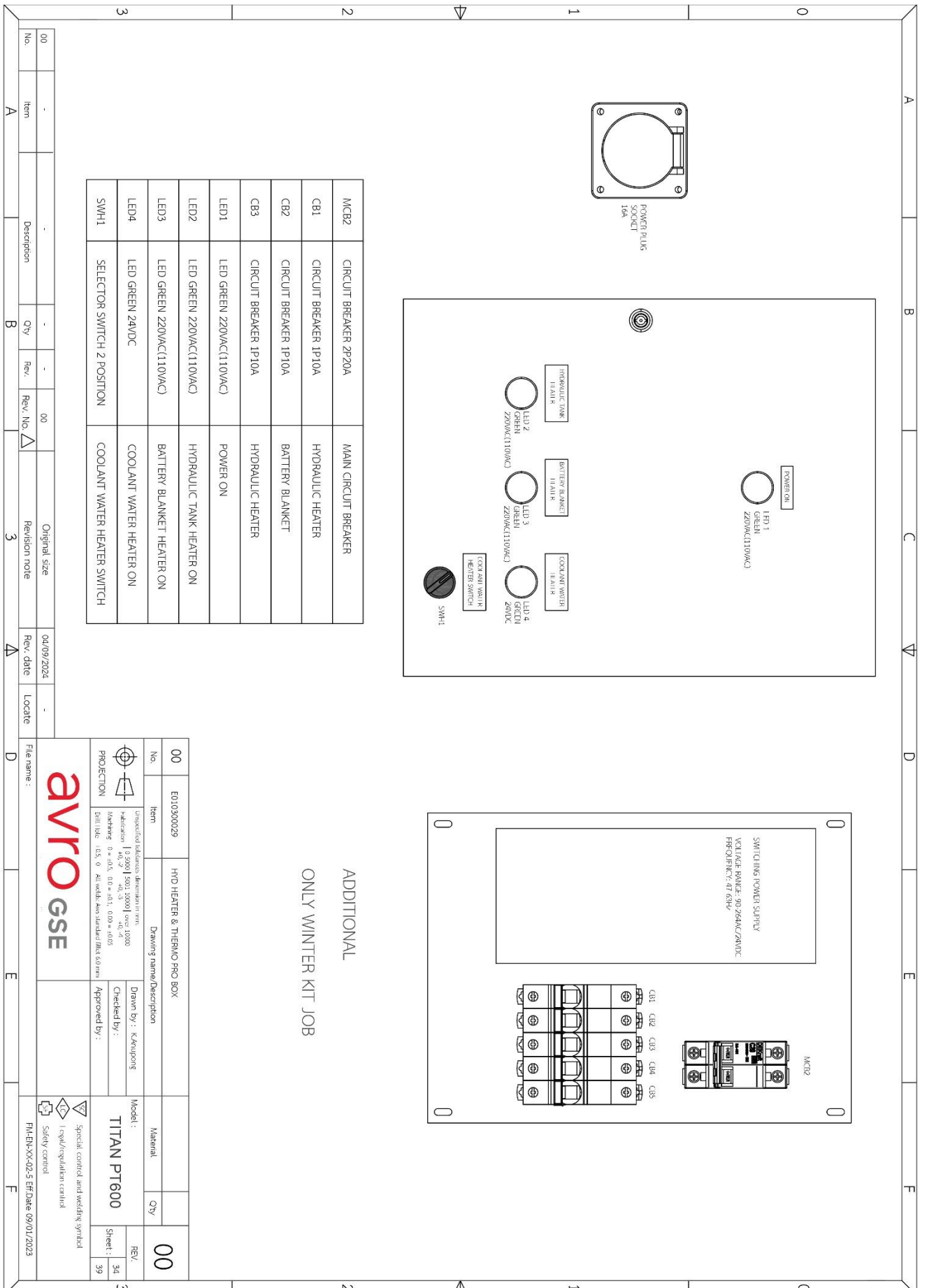




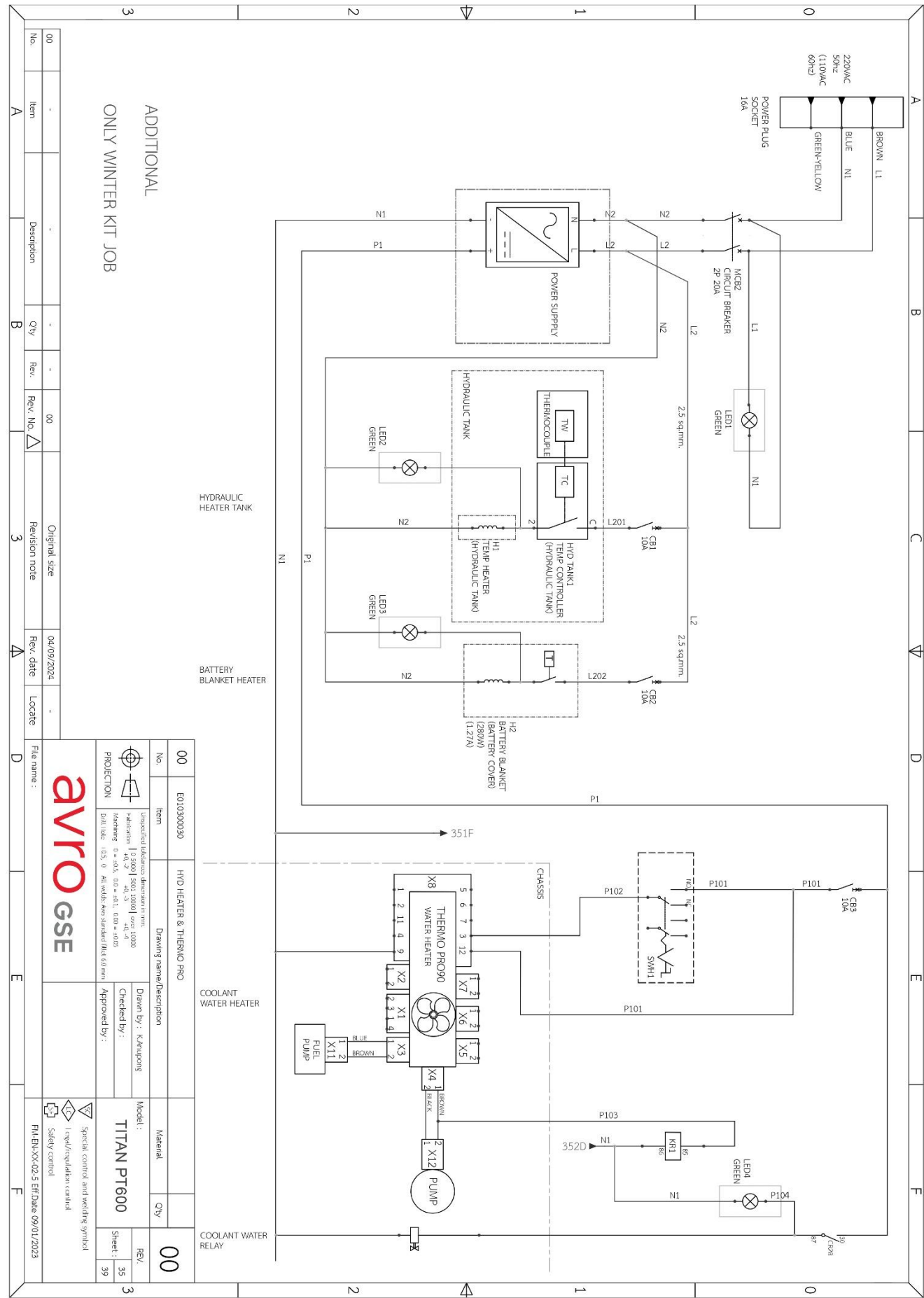
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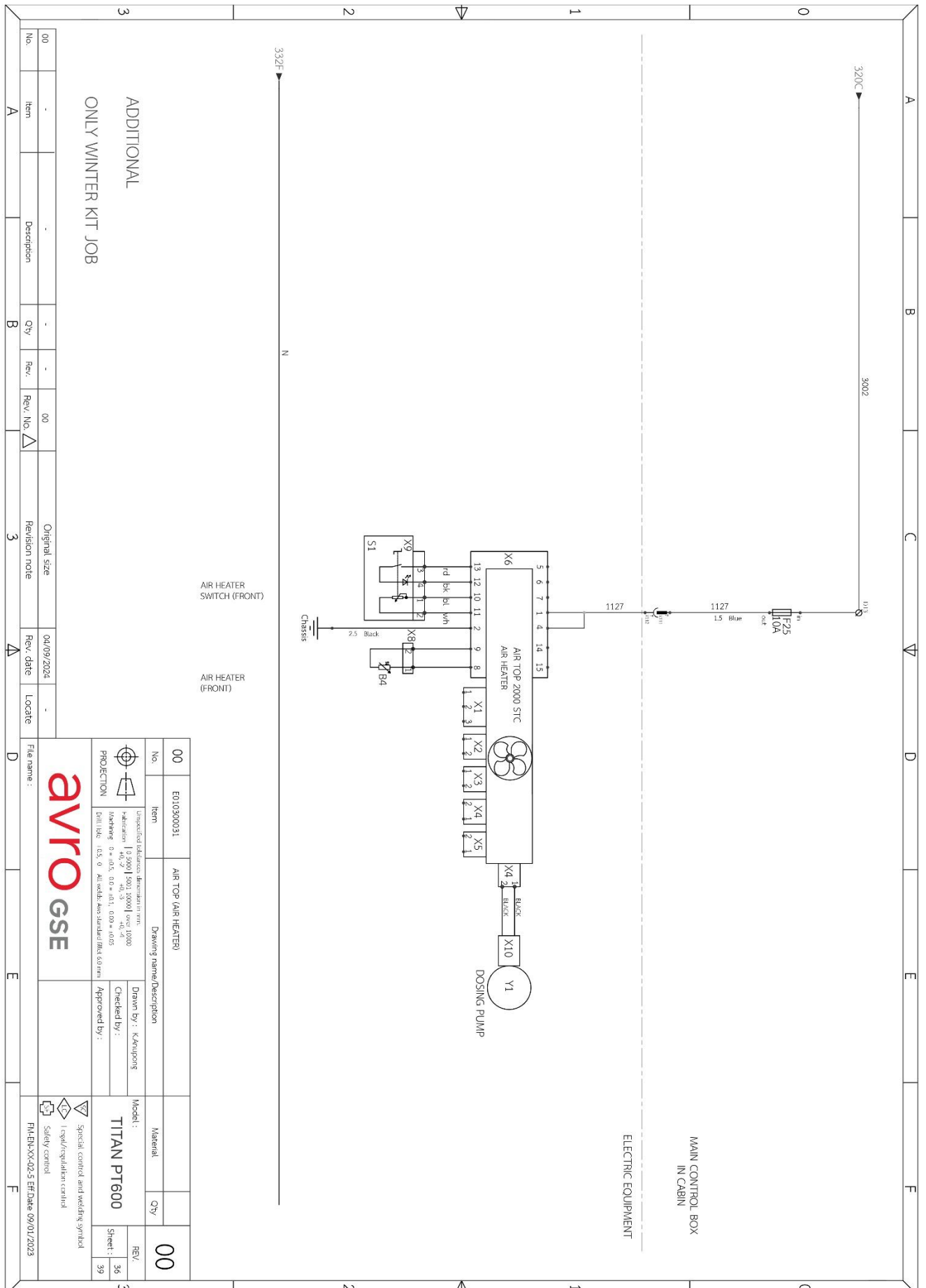


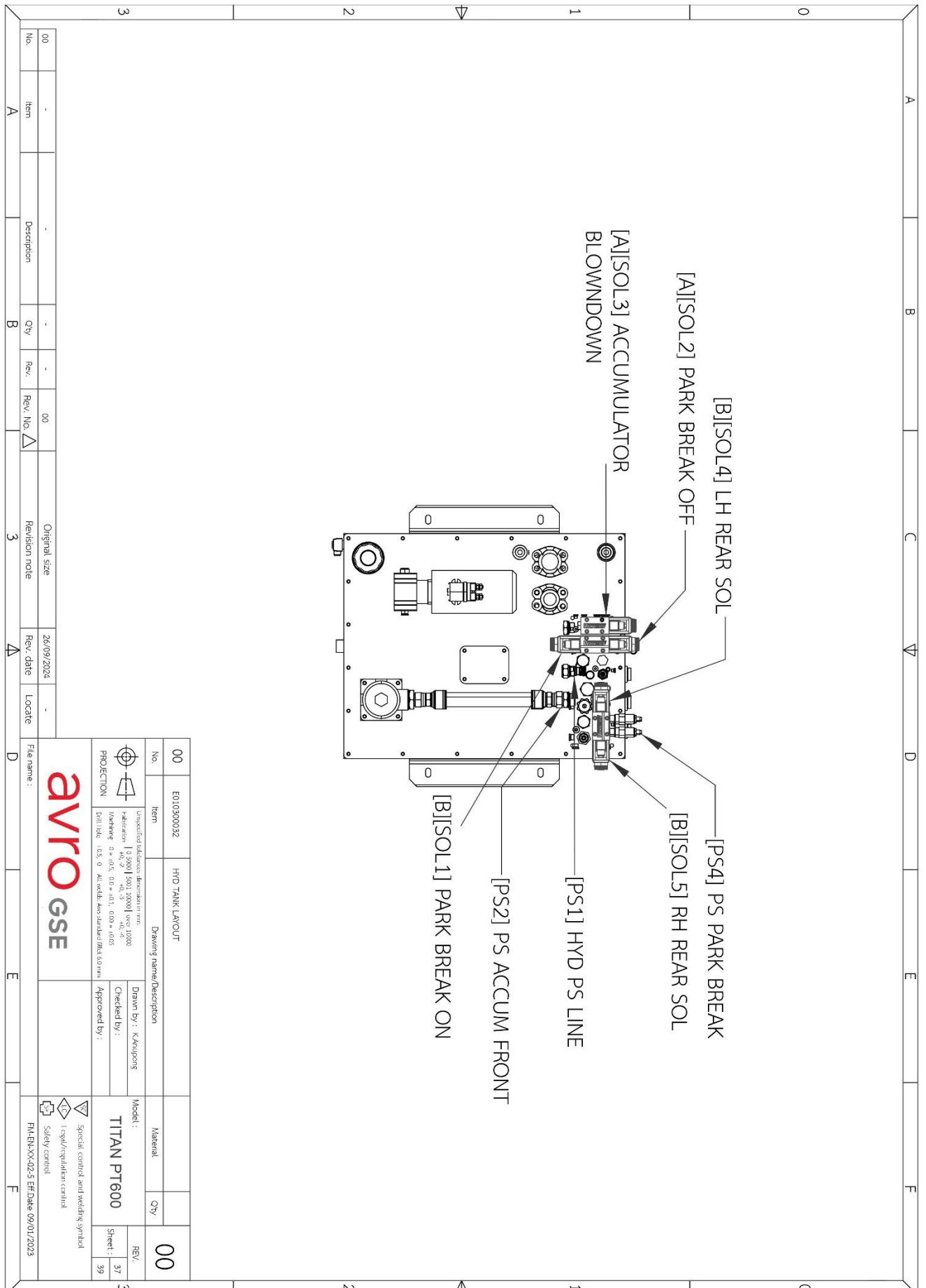


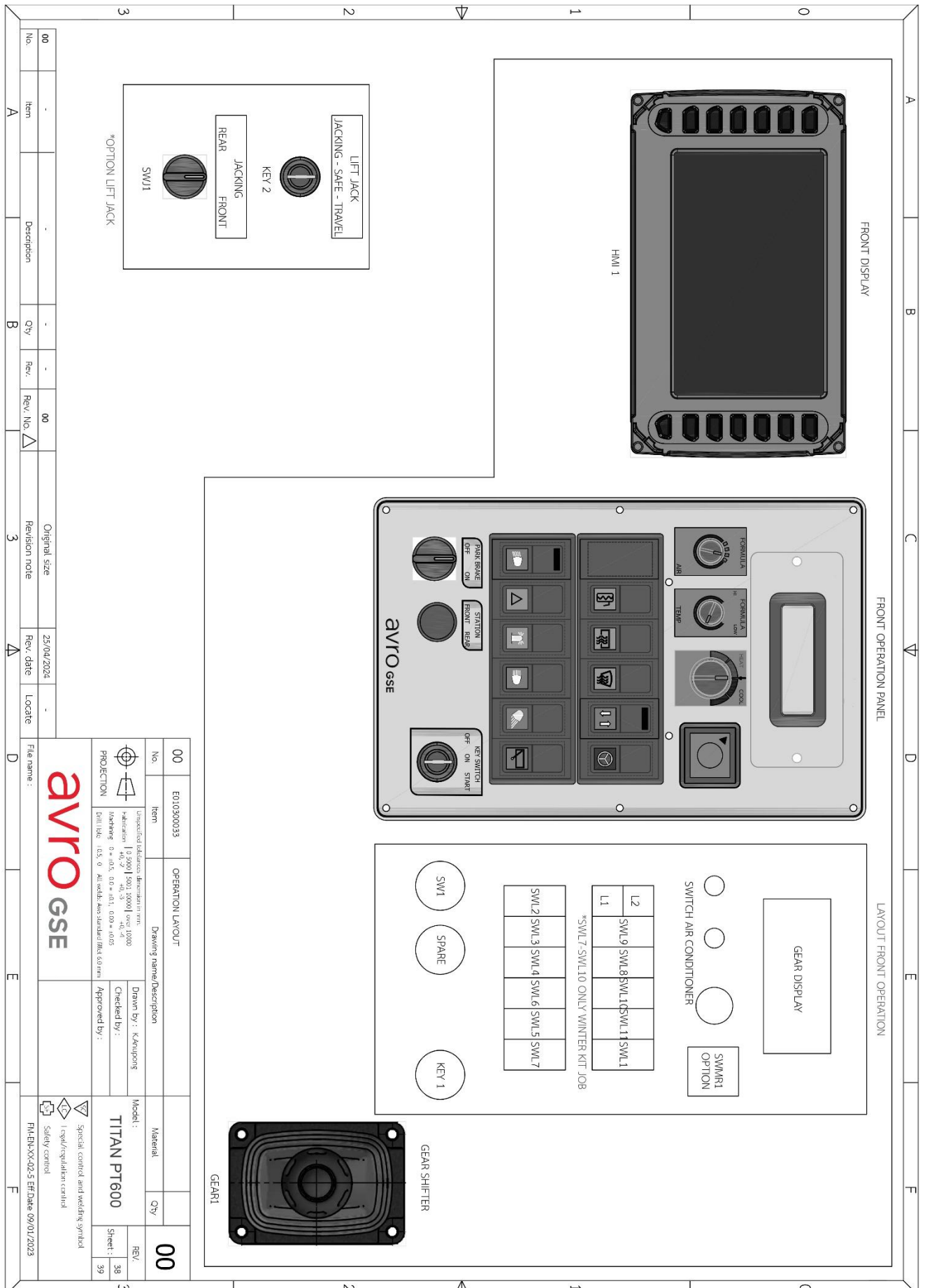


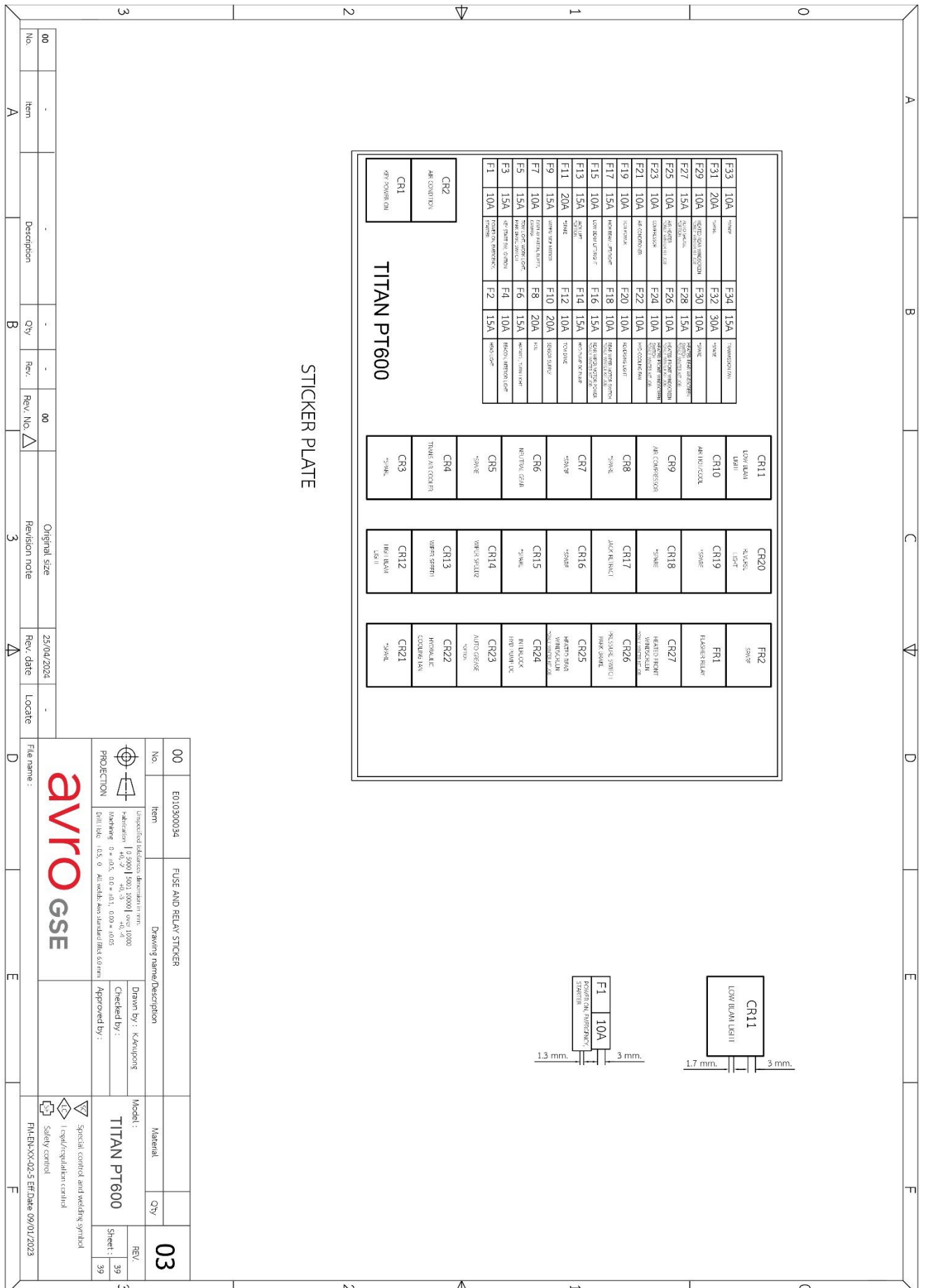
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APPENDICES








Torque Reference Table

This table is used only when specific torques are not available.

This table refers to both metric and imperial Lubricated (WET), Not Lubricated (DRY) and includes fastener conversion chart.

TIGHTENING TORQUE REFERENCE CHART FOR SAE AND METRIC BOLTS

NL = Not Lubricated
L = Lubricated
1 lbs ft = 1.356 N*M

 =  =  =  =  =  = 

HEX KEY INTERCHANGE

SAE	Metric
5/64	2
3/32	2.5
7/64	3
1/8	3.5
5/32	4
3/16	5
7/32	6
1/4	7
5/16	8
3/8	10

TIGHTENING TORQUE FOR SAE BOLTS (80% of yield strength Sy) in lbs ft

MATERIAL	UNC	1/4"-20	5/16"-18	3/8"-16	7/16"-14	1/2"-13	9/16"-12	5/8"-11	3/4"-10	7/8"-9	1"-8	1 1/8"-7	1 1/4"-7	1 3/8"-6	1 1/2"-6
GRADE 1	NL	4	8	14	22	34	49	68	120	194	291	412	581	762	1012
	L	3	6	10	17	26	37	51	90	145	218	309	436	572	759
GRADE 2	NL	6	12	22	35	54	78	107	191	291	412	581	762	1012	1012
	L	5	9	17	27	40	58	81	143	218	309	436	572	759	759
GRADE 5/5.2	NL	10	20	36	57	87	126	173	308	496	743	1053	1486	1948	2586
	L	7	15	27	43	65	94	130	231	372	557	790	1114	1461	1939
GRADE 8	NL	14	28	50	81	123	177	245	435	700	1050	1488	2100	2752	3654
	L	10	21	38	60	92	133	184	326	525	787	1116	1575	2064	2740
MATERIAL	UNF	1/4"-28	5/16"-24	3/8"-24	7/16"-20	1/2"-20	9/16"-18	5/8"-18	3/4"-16	7/8"-14	1"-14	1 1/8"-12	1 1/4"-12	1 3/8"-12	1 1/2"-12
GRADE 1	NL	4	9	16	25	38	55	77	134	214	326	462	644	868	1138
	L	3	7	12	19	29	41	58	101	160	245	347	483	651	854
GRADE 2	NL	7	14	25	39	61	87	122	213	326	462	644	868	1138	1138
	L	5	10	19	30	46	65	91	159	245	347	483	651	854	854
GRADE 5/5.2	NL	11	22	40	64	98	140	196	343	547	834	1181	1645	2217	2909
	L	8	17	30	48	74	105	147	257	410	625	886	1234	1663	2182
GRADE 8	NL	16	31	57	90	139	198	277	485	773	1178	1669	2325	3133	4111
	L	12	24	43	68	104	148	208	364	580	884	1251	1744	2350	3083

TIGHTENING TORQUE FOR METRIC BOLTS (80% of yield strength Sy) in lbs ft

MATERIAL	ST. PITCH	M6-1	M8-1.25	M10-1.5	M12-1.75	M14-2	M16-2	M18-2.5	M20-2.5	M22-2.5	M24-3	M27-3	M30-3.5	M33-3.5	M36-4
CLASS 4.6	NL	3	8	16	29	46	71	98	139	189	240	351	477	649	833
	L	3	6	12	21	34	53	74	104	142	180	263	357	486	625
CLASS 8.8	NL	9	22	44	76	122	190	262	370	503	640	936	1271	1730	2221
	L	7	17	33	57	91	142	197	278	378	480	702	953	1297	1666
CLASS 10.9	NL	13	32	64	112	179	279	385	544	739	940	1375	1867	2540	3263
	L	10	24	48	84	134	209	289	408	555	705	1031	1400	1905	2447
CLASS 12.9	NL	16	38	75	131	209	326	451	636	865	1100	1609	2185	2973	3818
	L	12	29	56	98	157	245	338	477	649	825	1207	1639	2230	2863
MATERIAL	FINE PITCH	M6-0.75	M8-1	M10-1	M12-1.25	M14-1.5	M16-1.5	M18-1.5	M20-1.5	M22-1.5	M24-1.5	M27-1.5	M30-1.5	M33-1.5	M36-1.5
CLASS 4.6	NL	4	9	18	31	50	76	110	154	207	273	393	545	733	958
	L	3	7	14	23	37	57	83	116	156	204	295	409	550	719
CLASS 8.8	NL	10	24	49	83	132	202	294	411	553	727	1048	1455	1954	2557
	L	7	18	37	63	99	151	220	308	415	545	786	1091	1466	1917
CLASS 10.9	NL	15	35	72	123	194	296	431	603	813	1068	1539	2136	2870	3754
	L	11	26	54	92	146	222	323	453	610	801	1155	1602	2152	2815
CLASS 12.9	NL	17	41	84	143	227	347	505	706	951	1249	1802	2500	3358	4393
	L	13	31	63	108	170	260	379	530	713	937	1351	1875	2519	3295

HEX KEY INTERCHANGE	
SAE	Metric
5/64	2
3/32	2.5
7/64	3
1/8	3.5
5/32	4
3/16	5
7/32	6
1/4	7
5/16	8
3/8	10

Standard Conversion Table

Standard conversion factors and terms related to this vehicle

Length				
Kilometers (km)	x	0.62	=	Miles (mi)
Miles (mi)	x	1.61	=	Kilometers (km)
Kilometers (km)	x	3280.8	=	Feet (ft)
Feet (ft)	x	.0003048	=	Kilometers (km)
Meters (m)	x	3.28	=	Feet (ft)
Feet (ft)	x	0.3	=	Meters (m)
Centimeters (cm)	x	0.39	=	Inches (in)
Inches (in)	x	2.54	=	Centimeters (cm)
Millimeters (mm)	x	0.039	=	Inches (in)
Inches (in)	x	25.4	=	Millimeters (mm)
Meters (m)	x	39.37	=	Inches (in)
Inches (in)	x	0.0254	=	Meters (m)
Meters (m)	x	1.09361	=	Yards (yd)
Yards (yd)	x	0.91	=	Meters (m)
Kilometers (km)	x	1093.61	=	Yards (yd)
Yards (yd)	x	0.00091	=	Kilometers (km)
Temperature				
Fahrenheit (F)	(Temperature (F) - 32)*(5/9)			Celsius (C)
Celsius (C)	(Temperature (C)*(9/5)+32)			Fahrenheit (F)
Volume				
Liters (L)	x	1.057	=	Quarts (qt)
Quarts (qt)	x	0.95	=	Liters (L)
Liters (L)	x	0.264	=	Gallons (gal)
Gallons (gal)	x	3.785	=	Liters (L)
Milliliters (ml)	x	0.0042	=	Cups (c)
Cups (c)	x	236.6	=	Milliliters (ml)
Milliliters (ml)	x	0.0338	=	Ounces (oz)
Ounces (oz)	x	29.57	=	Milliliters (ml)
Mass				
Kilograms (kg)	x	0.0011	=	Tons (ton)
Tons (ton)	x	907.18	=	Kilograms (kg)
Kilograms (kg)	x	2.2046	=	Pounds(lb)
Pounds(lb)	x	0.454	=	Kilograms (kg)
Grams (g)	x	0.035	=	Ounces (oz)
Ounces (oz)	x	28.35	=	Grams (g)
Grams (g)	x	0.002205	=	Pounds (lb)
Pounds (lb)	x	453.592	=	Grams (g)
Milligrams (mg)	x	0.000035	=	Ounces (oz)
Ounces (oz)	x	28350	=	Milligrams (mg)

Pressure And Torque Conversion Table

CONVERSION TABLES

CONVERSION TABLES

UNITS OF PRESSURE

1 ATM=1 BAR=105 PA=14.4 PSI

UNIT OF WEIGHT

	N	daN	kN	kg	lbs
1N	1	0,1	0,001	0,102	0,225
1daN	10	1	0,01	1,02	2,25
1kN	1000	100	1	102	225
1kg	9,81	0,981	0,00981	1	2,205

UNITS OF TORQUE

	N-m	daN-m	kN-m	kg-m	lb-in
1N-m	1	0,1	0,001	0,102	8,854
1daN-m	10	1	0,01	1,02	88,54
1kN-m	1000	100	1	102	8854
1kg-m	9,81	0,981	0,00981	1	86,8
1 lb-in	0,1129	0,01129	0,0001129	0,01152	1

Torque Specification

COARSE PITCH

SIZE OF BOLT	TYPE OF BOLT					
	8.8	8.8 + Loctite 270	10.9	10.9 + Loctite 270	12.9	12.9 + Loctite 270
M6 x 1 mm	9,5 – 10,5 N·m	10,5 – 11,5 N·m	14,3 – 15,7 N·m	15,2 – 16,8 N·m	16,2 – 17,8 N·m	18,1 – 20 N·m
M8 x 1,25 mm	23,8 – 26,2 N·m	25,6 – 28,4 N·m	34,2 – 37,8 N·m	36,7 – 40,5 N·m	39 – 43 N·m	43,7 – 48,3 N·m
M10 x 1,5 mm	48 – 53 N·m	52 – 58 N·m	68 – 75 N·m	73 – 81 N·m	80 – 88 N·m	88 – 97 N·m
M12 x 1,75 mm	82 – 91 N·m	90 – 100 N·m	116 – 128 N·m	126 – 139 N·m	139 – 153 N·m	152 – 168 N·m
M14 x 2 mm	129 – 143 N·m	143 – 158 N·m	182 – 202 N·m	200 – 221 N·m	221 – 244 N·m	238 – 263 N·m
M16 x 2 mm	200 – 221 N·m	219 – 242 N·m	283 – 312 N·m	309 – 341 N·m	337 – 373 N·m	371 – 410 N·m
M18 x 2,5 mm	276 – 305 N·m	299 – 331 N·m	390 – 431 N·m	428 – 473 N·m	466 – 515 N·m	509 – 562 N·m
M20 x 2,5 mm	390 – 431 N·m	428 – 473 N·m	553 – 611 N·m	603 – 667 N·m	660 – 730 N·m	722 – 798 N·m
M22 x 2,5 mm	523 – 578 N·m	575 – 635 N·m	746 – 824 N·m	817 – 903 N·m	893 – 987 N·m	974 – 1076 N·m
M24 x 3 mm	675 – 746 N·m	732 – 809 N·m	950 – 1050 N·m	1040 – 1150 N·m	1140 – 1260 N·m	1240 – 1370 N·m
M27 x 3 mm	998 – 1103 N·m	1088 – 1202 N·m	1411 – 1559 N·m	1539 – 1701 N·m	1710 – 1890 N·m	1838 – 2032 N·m
M30 x 3,5 mm	1378 – 1523 N·m	1473 – 1628 N·m	1914 – 2115 N·m	2085 – 2305 N·m	2280 – 2520 N·m	2494 – 2757 N·m

FINE PITCH

SIZE OF BOLT	TYPE OF BOLT					
	8.8	8.8 + Loctite 270	10.9	10.9 + Loctite 270	12.9	12.9 + Loctite 270
M8 x 1 mm	25,7 – 28,3 N·m	27,5 – 30,5 N·m	36,2 – 39,8 N·m	40 – 44 N·m	42,8 – 47,2 N·m	47,5 – 52,5 N·m
M10 x 1,25 mm	49,4 – 54,6 N·m	55,2 – 61 N·m	71,5 – 78,5 N·m	78 – 86 N·m	86 – 94 N·m	93 – 103 N·m
M12 x 1,25 mm	90 – 100 N·m	98 – 109 N·m	128 – 142 N·m	139 – 154 N·m	152 – 168 N·m	166 – 184 N·m
M12 x 1,5 mm	86 – 95 N·m	94 – 104 N·m	120 – 132 N·m	133 – 147 N·m	143 – 158 N·m	159 – 175 N·m
M14 x 1,5 mm	143 – 158 N·m	157 – 173 N·m	200 – 222 N·m	219 – 242 N·m	238 – 263 N·m	261 – 289 N·m
M16 x 1,5 mm	214 – 236 N·m	233 – 257 N·m	302 – 334 N·m	333 – 368 N·m	361 – 399 N·m	394 – 436 N·m
M18 x 1,5 mm	312 – 345 N·m	342 – 378 N·m	442 – 489 N·m	485 – 536 N·m	527 – 583 N·m	580 – 641 N·m
M20 x 1,5 mm	437 – 483 N·m	475 – 525 N·m	613 – 677 N·m	674 – 745 N·m	736 – 814 N·m	808 – 893 N·m
M22 x 1,5 mm	581 – 642 N·m	637 – 704 N·m	822 – 908 N·m	903 – 998 N·m	998 – 1103 N·m	1078 – 1191 N·m
M24 x 2 mm	741 – 819 N·m	808 – 893 N·m	1045 – 1155 N·m	1140 – 1260 N·m	1235 – 1365 N·m	1363 – 1507 N·m
M27 x 2 mm	1083 – 1197 N·m	1178 – 1302 N·m	1520 – 1680 N·m	1672 – 1848 N·m	1834 – 2027 N·m	2000 – 2210 N·m
M30 x 2 mm	1511 – 1670 N·m	1648 – 1822 N·m	2138 – 2363 N·m	2332 – 2577 N·m	2565 – 2835 N·m	2788 – 3082 N·m

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