avro GSE

A member of Saskarc Group of Companies

PT350
PUSHBACK TRACTOR

OPERATION, MAINTENANCE AND PARTS MANUAL

Doc ID:	Revision	Effective Date	Originator	Approver
	6.3	September 2024		CDC

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SECTION I: INTRODUCTION

PURPOSE

The purpose of this manual is to detail the effective operation and maintenance of the **AVRO GSE** PT350 Pushback Tractor. This is intended to ensure long service life of the vehicle.

Relevant technical and equipment information are included in this manual, as well as maintenance instructions.

This manual is not intended to serve as a textbook for teaching the basic skills required to drive the vehicle, or to carry out mechanical operations. It is assumed that the personnel employed in carrying out the various duties applicable to the vehicle have the necessary basic skills for their tasks.

SCOPE

This guide covers the following topics regarding the PT350 Pushback Tractor:

- General Information
- Operations and Controls
- Tractor Maintenance
- Hydraulic System
- Electrical System and Circuits
- Axles
- Engines

AUDIENCE

This manual is intended for authorized operator of the **AVRO GSE** PT350 Pushback Tractor responsible for driving and maintaining the vehicle.

SECTION II:
GENERAL INFORMATION

GENERAL DESCRIPTION

The PT350 Pushback Tractor is an essential piece of ground support equipment (GSE) which connects to the nose landing gear of an aircraft via a specifically designed tow bar allowing the movement of aircraft to intended locations on the ground.

The manual is divided into 4 major parts. These are respectively:

GENERAL, OPERATION, MAINTENANCE and SPARE PARTS.

GENERAL INFORMATION – this part provides the basic information on the operation and maintenance of the tractor.

OPERATION – this part is divided into sections that explain the function and operation of the controls and instrumentation incorporated in the vehicle.

MAINTENANCE – this part of the manual is divided into sections, which apply to all parts and systems incorporated in the tractor with procedures laid down for the maintenance operations that must be carried out on the vehicle. This includes a Lubrication Schedule.

SPARE PARTS – this part of the manual provides the parts lists and details not related to any of the major components such as engine, transmission and axles as they have their own sections within this manual.

The major components of the vehicle, such as the Engine, Transmission, Axles and Brakes are not manufactured by **AVRO GSE** but are supplied by reputable manufacturers who are leaders in their respective fields.

For the Operation, Maintenance and Overhaul of these components, the manufacturers own publications are included in this manual. Where modifications have been made to these components for usage in this vehicle, the Procedure and Descriptions detailed by the manufacturers in their publications are not applicable. For these

modifications the appropriate Descriptions and Procedures are included in the company's part of the manual. These procedures must be complied with in all cases.

Should any further requirements for information or procedures beyond which are described in this manual, then the Service Department of **AVRO GSE** and can be contacted at the following address:

Address:
AVRO GSE
308 Industrial Drive
Redwood Falls, MN, 56283
USA

Direct Phone
Toll Free: 1-833-220-2810

Parts and Service
Toll Free: 1-888-208-8745

Email:
parts@avrogse.com
service@avrogse.com

Website:
www.avrogse.com

WARRANTY

Warranty of this Pushback Tractor is 36 months from date of commissioning (unless otherwise stated in contract).

The following clauses are excluded.

Failure to exchange or replace consumable parts during normal running of the vehicle could lead to major breakdown or failure. These are, but not limited to, brake pads, filters, lubricants, light bulbs, relays, fuses, wiper blades, and tires.

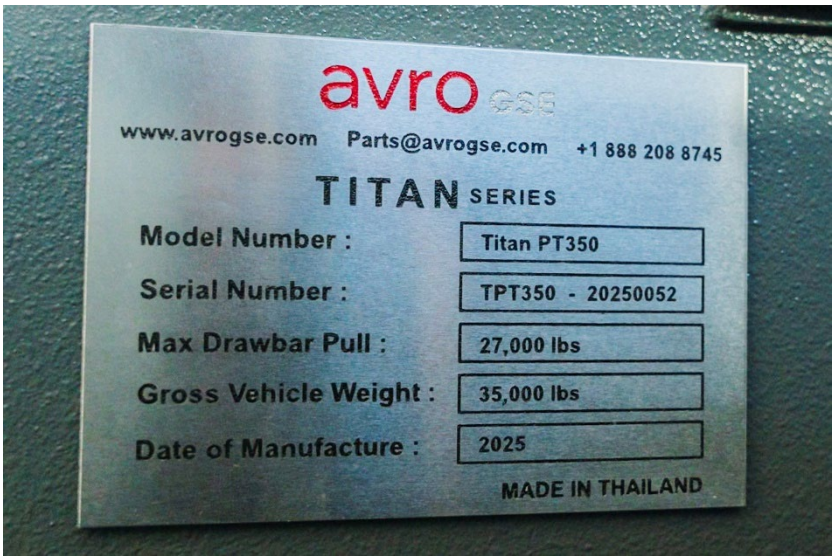
Failure to do Preventative maintenance at OEM recommended time or less such as oil changes, greasing, filter replacements, brake adjustment, fuel system and fuel condition etc.

Any modification to Pushback/ Tow Tractor without prior approval from **AVRO GSE** will with immediate effect make all warranties pertaining to this vehicle null and void.

If it is deemed that the part or tractor has been abused, warranty will be null and void.

Serial Plates

These allow major components to be easily identified for the order of parts and identification of the tractor make model and year of manufacture.



The tractor serial plate showing all relevant information is located on the right-hand side of the cabin, on the front of the electrical cabinet.

SAFETY PRECAUTION SYMBOLS

The safety alert symbols above indicate important safety messages in this manual. When these symbols are seen, read and understand the message that follows, and be alert to the possibility of personal injury or death if the warning is not always adhered to.

WARNING TO DRIVERS AND MAINTENANCE OPERATORS

CAUTION

1. This Pushback Tractor can be hazardous in the hands of untrained or complacent Driver/Operators.

CAUTION

2. A trained careful Driver or Operator is always the best insurance against accidents. Give complete and undivided attention to the job at hand.

3. Incorrect / Inappropriate operation of this Pushback Tractor may cause injury to the Driver/Operator or other personnel. This includes damage to the Pushback Tractor or other equipment such as the aircraft in its immediate vicinity.

4. The Driver/Operator must all times have other operating personnel and ground staff clearly within his field of view, with the Driver/Operator facing the direction of travel.

5. Do not operate this Pushback Tractor or any part thereof, which has loose, worn or broken parts.

6. Do not overload this Pushback Tractor beyond its designed capabilities.

7. Never disconnect or remove any Safety Device or operate any Pushback Tractor where Safety Devices have been disconnected or removed.

8. Prior to entering any wheel arch, ensure that the ignition is in the “OFF” position with the key removed and that the battery isolator is turned off and key is removed, the wheels may move without notice, thereby trapping person(s) between a wheel and chassis of the vehicle, causing severe injury or death.

CAUTION DURING PERIODS OF MAINTENANCE

1. During maintenance, ensure clean dry floors, the use of Work Platforms, Scaffolding, Ladders. Do not use Stools, Boxes, Crates or similar items.

2. Disconnect and lock out the Power Supply from the Battery before initiating any maintenance or repairs.
3. Discharge all Hydraulic accumulators prior to working on any part of the hydraulic system.

4. Do not wear loose clothing, jewelry, or have unrestrained hair which may catch in moving parts during periods of maintenance or operation.

5. Maintenance of this Pushback Tractor can be hazardous. Do not risk injury or death, ensure only suitably qualified personal carry out maintenance at the required service intervals and during any breakdown or emergency.

6. During times of maintenance, safe working conditions are MANDATORY not only for maintenance Personnel, but also to ensure safety to others in the immediate area.

7. During times of removal and installation of heavy components, only use Hoists and Slings of sufficient capacity to lift the heaviest unit (ENGINE module) and have an ample safety margin.

8. Ensure sufficient trained Service Personnel are always available when removing or installing heavy items in-order to maintain control.

9. Ensure heavy items are correctly supported by Hoist etc, before removing supporting member from Towing Tractor.

10. If a heavy item begins to fall, LET IT FALL! Do not try to stop or hold the item.

11. Before working on the Engine and Exhaust System ensure that it has cooled to prevent burning to Servicing Personnel.

12. Do not work on the Radiator or Engine cooling system when hot. Prevent burning or scalding.

13. If any part of this machine should become over lubricated during maintenance causing lubricant to spill or build up, it should be cleaned immediately so as not to hinder maintenance or endanger maintenance personnel.

14. Keep the work area clean and dry and free of obstructions.

15. Keep inflammable liquids (solvents, lubricants etc.) away from electrical equipment and hot components.

WARNING TO DRIVERS AND PUSHBACK TRACTOR OPERATORS

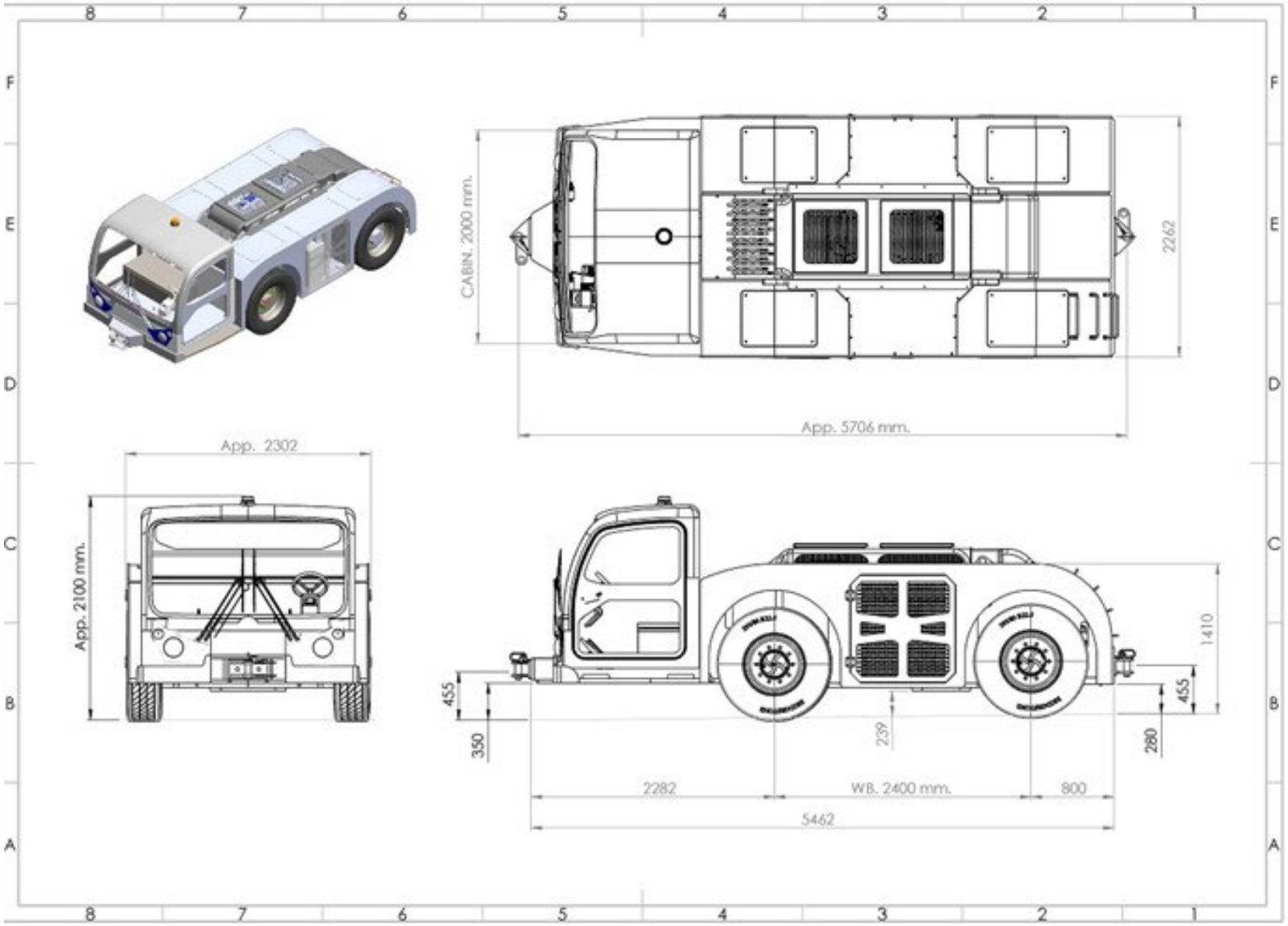
Never place limbs or head through the driver's cabin doors or windows whilst the tractor is under way.

Disconnect the power supply from the battery before initiating any maintenance, general repairs. If any welding is to be done, disconnect all ecu's prior to commencing welding operation.

In the event of engine failure, bring the tractor to a complete stop with the service brakes, and then apply the park brake.

Prior to entering any wheel arch, ensure that the battery isolator switch is to the "OFF" position and the isolator key is removed. The tractor wheels may move without notice, thereby trapping person(s) between a wheel and frame of the tractor, causing severe injury or death.

LAYOUT


CABIN. 2000 mm.
2262
App. 5706 mm.
App. 2302
App. 2100 mm.
455
350
239
1410
455
280
2282
WB. 2400 mm.
800
5462

GENERAL DESCRIPTION

The AVRO PT350 Pushback Tractor is a vehicle which has been designed especially for Pushback or towing operations of aircraft of up to 120,000 kg gross mass.

It is powered by a 4-cylinder Deutz TCD 2011 diesel engine. For more information, refer to Section IX of DEUTZ Engine within this manual).

The engine is coupled to a DANA T12000 4 speed forward with 3 speed reverse powershift transmission via torque converter and flex plate to soften the gear changes.

The gear box is in turn coupled to the front and rear DANA 212 drive steer axle via 2 prop shafts coupled either side of the output from the transmission.

Cabins are spacious and air conditioning / heating can be provided as an option.

The driver's seat is positioned on the left-hand side of the cabin. A pax seat is also provided for a passenger(s) which include seat belts. The driving position provides excellent all-around vision.

Access for maintenance purposes to all compartments of the vehicle is easily obtained via hinged doors, hatches, and lightweight composite covers on the body.

This vehicle is fitted with a hydraulic braking and steering circuits, both can be operated in an emergency such as engine failure. See details in Operation Manual Section V.

Steering is hydraulic via steering orbital to front and rear steering cylinders. 3 steering modes are available namely 4WS (front and rear wheels steer in opposite directions), 2WS (only the front wheels steer), and CRAB steer (front and rear wheels steer in the same direction).

Braking is hydraulic via main hydraulic pump. Emergency braking is also available via DC emergency pump and accumulators in case of engine failure (See details in operations section).

VEHICLE MASS AND DIMENSIONS

Overall Length:	5706 mm (CRS Tow Pins
Overall Height:	2100. mm (Cabin)
Overall Width:	2300mm
Ground Clearance:	280mm
Wheelbase:	2400mm
Track:	1940mm
Outside Turning Radius	300mm
Nominal Gross Mass	15-ton

ENGINE SPECIFICATION

(For more details see Section IX of this manual)
One Deutz TCD3.6 EDG 4 cylinder, 4-Stroke, liquid cooled diesel engine with EMR (electronics).

Capacity:	3.4 litres
Bore and Stroke:	101mm x 126mm
Rated Power:	76 kW @ 2400 rpm
Torque:	520 Nm @ 1600 rpm
Alternator:	24V DC
Fuel Injection System:	Electronic
Engine Lubrication System:	Crankshaft driven gear pump system incorporates an oil cooler and full flow replaceable element type filter.
Oil capacity	10 litre
Oil type	15w 40 or equivalent

2

Engine type designation

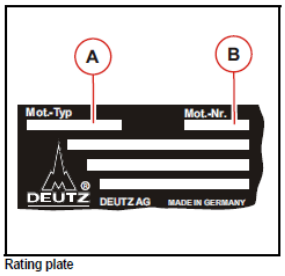
This manual covers the following engine types		
D 2011 L02 i	D 2011 L02 o	D 2011 L04 w
D 2011 L03 i	D 2011 L03 o	TD 2011 L04 w
D 2011 L04 i	D 2011 L04 o	TCD 2011 L04 w
TD 2011 L04 i	TD 2011 L04 o	

TCD	
T	Exhaust gas turbocharger
C	Charge air cooler
D	Diesel

2011	
2011	Series

L02/L03/L04	
L	in series
02	No. of cylinders
03	No. of cylinders
04	No. of cylinders

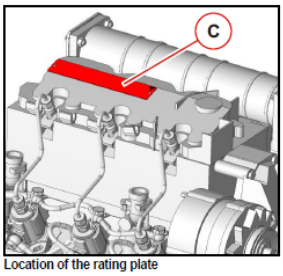
i/o/w	
i	oil-cooled (integrated cooler)
o	oil-cooled
w	water-cooled



Rating plate

The type (A), engine number (B) and performance data are stamped on the rating plate.

The engine type and number must be stated when purchasing spare parts.



Location of the rating plate

The rating plate (C) is fixed to the cylinder head cover or the crankcase.

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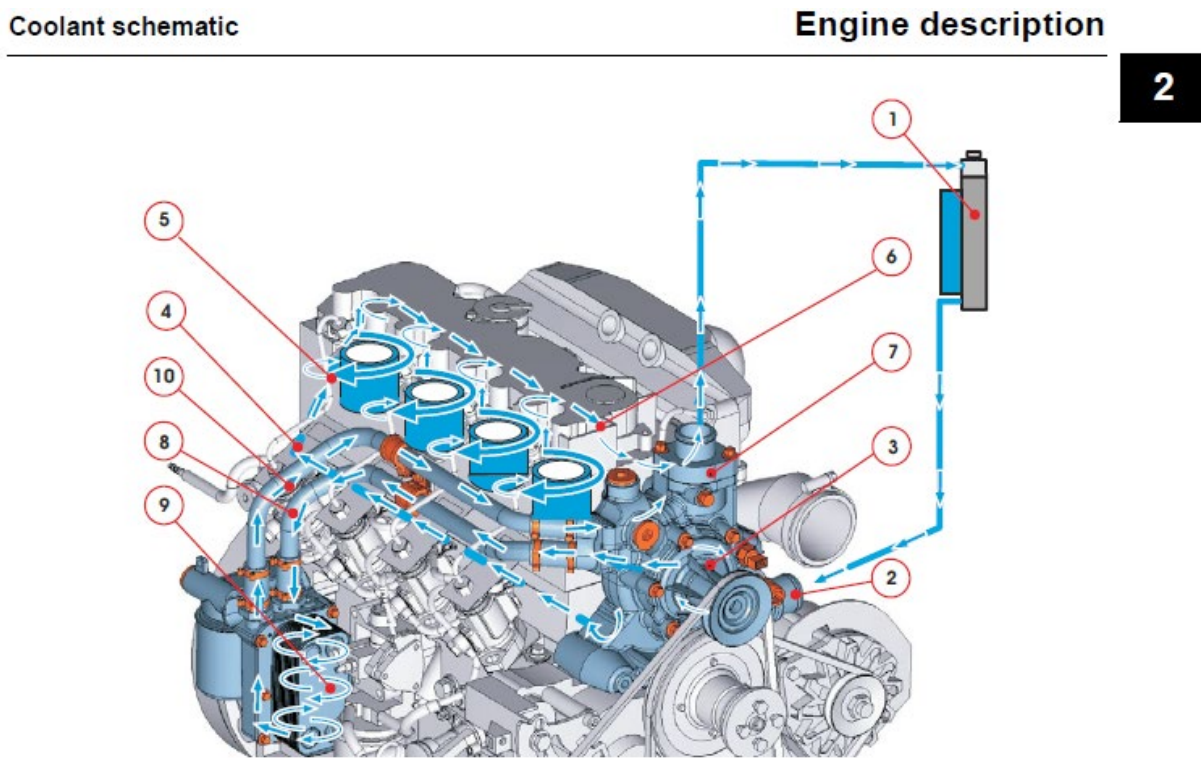
ENGINE COOLING SYSTEM & ENGINE AIR CHARGE COOLER

One radiator, one charge air cooler and one transmission oil cooler are provided for each tractor. They are placed one in front of the other and have a common air flow. They are mounted in front of the engine in the engine bay. Air is drawn from above and below from the front of the tractor and pulled through the radiator and expelled via the engine bay.

Engine coolant is circulated through the system by an engine-mounted pump. The transmission oil is cooled via transmission oil cooler mounted in front of the radiator.

The A/C condenser is positioned in front of the radiators at the front of the engine. The hydraulic oil cooler with temperature sensor controlled electric fan is placed on the left-hand side behind the left-hand doors.



Engine Description:
Coolant schematic (example refer to Deutz engine manual by serial number for specific diagram)
D/TD/TCD w

1. Cooler
2. Coolant inlet
3. Coolant pump
4. Coolant supply for engine cooling
5. Cylinder pipe/head cooling
6. Coolant return to thermostat
7. Thermostat
   (Engine cold) coolant directly for engine cooling
   (Engine warm) coolant flow through the cooler
8. Coolant partial flow to the lubricating oil cooler
9. Lube oil cooler
10. Coolant return to thermostat

TRANSMISSION

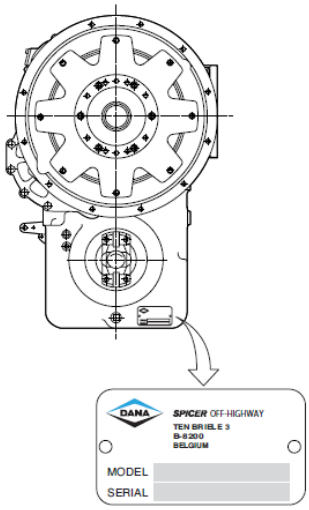
DANA T12000 series power shift transmission. Gear selection by floor mount electronic control type.

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

Note: the following details apply to the transmission.

Number of Forward Gears:		4
Number of Reverse Gears:		3
Ratio of Gears:	First	5.2 : 1
	Second	3.3 : 1
	Third	2.2 : 1
	Fourth	1.4 : 1
	Reverse	4.9 : 1
		2.1 : 1
		0.8 : 1
Oil capacity	15 litres	
Oil type	Dextron III	

T12000 - 3,4,6 speed



IDENTIFICATION OF THE UNIT

1 Model and type of the unit.
2 Serial number.

PROPELLER SHAFT

"WING BEARING" or "C - Positive type" driveshafts

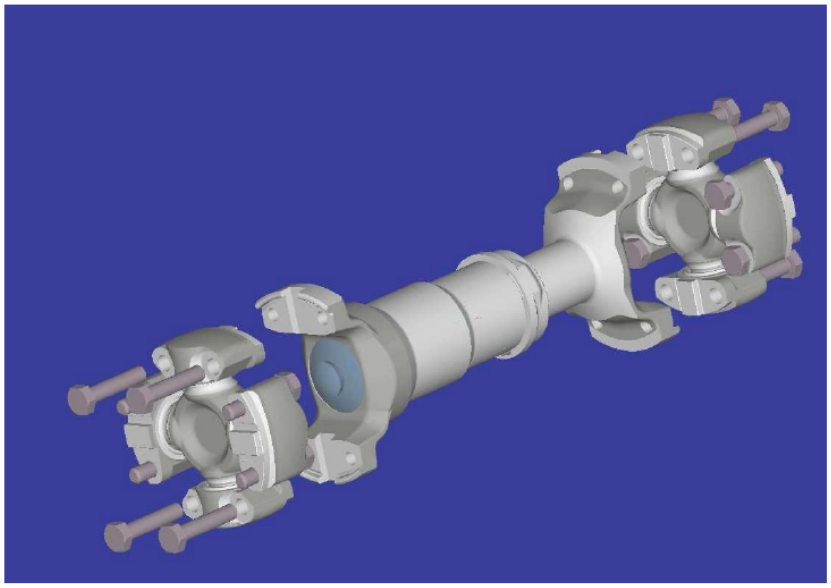
Spicer Italcardano driveshafts main feature is that torque transfer occurs through mechanical drive, by means of keys placed on the bearing blocks .
These keys are mated to corresponding slots machined on connecting fitting yokes.

This feature offers great advantages for all those applications characterized by continuous load variations or shock loads.

The main benefit of having bearing blocks directly connected to output flanges are:

- **Extremely high flexibility of use**
- **Fitting for all applications with short application lengths**
- **Smaller joints working angles**
- **Quicker dismantling of the whole shaft (4 bolts each side)**
- **U-joint kits can be disassembled and replaced without dismantling the whole shaft making field maintenance easier**

This type of driveshaft is already an established leader. A series of end fittings a-re available to facilitate its utilization.

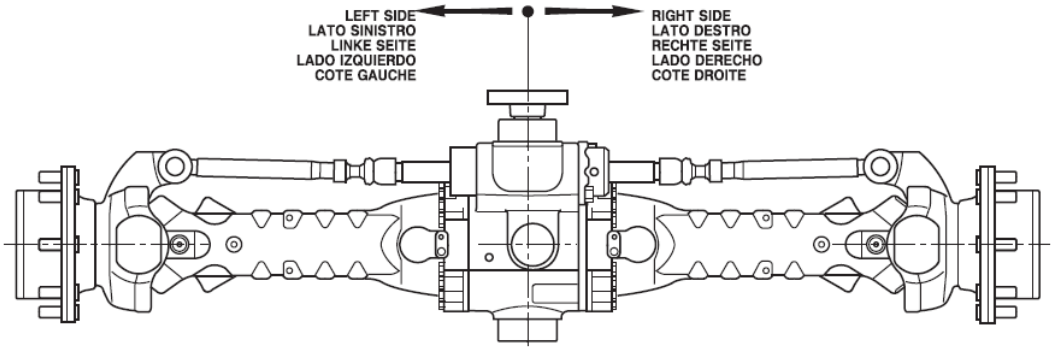


DRIVE AXLE

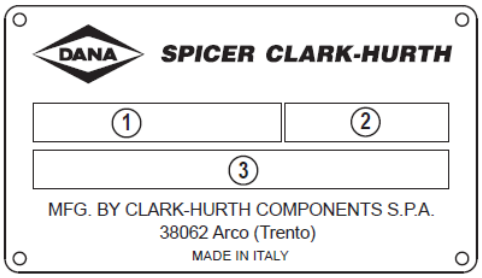
Model:	DANA 212 (Refer to section VIII Axles for maintenance and spare parts)
Manufacturer:	DANA CLARK HURTH components SPA Italy
Front Axle:	PN: 2749540 Drive Steer (fixed) axle with single reduction hypoid gear and differential.
Rear Axle:	PN: 2749541 Drive steer (pivot) axle with single reduction hypoid gear and differential.
Final Drive Reduction Ratio:	6.23
Oil capacity (approx.):	Hubs, 8 litres (all Four) Differential, 16.6 litres x (two)

Note: Refer to DANA service manual for correct procedure to check and maintain oils in axles.

DEFINITION OF VIEWPOINTS



DATA PLATE



1 - Type and model unit - modification index
2 - Serial number
3 - Lubricant

WHEELS AND TIRES

Tire Size:	295/80R22.5
Wheels (rim):	Steel 22.5
Inflation pressure:	8.3 Bar (125 psi)

Note: Tire size/brand may differ at time of manufacture.

SUSPENSION (NONE)

The Front axle solid mounted to chassis.
The Rear axle pivot mounted to the chassis.

STEERING

There are three distinct steering modes. These can be selected via the Eaton Display screen to the right-hand side of the drivers position on the driver's console.

2WS (2-wheel steer)
4WS (4-wheel steer)
Crab

The system is hydraulically powered by an Eaton Vane main pump direct coupled to the rear of the DANA T12000 transmission. The steering wheel, via the hydraulic steering orbital, controls the integral steering cylinders on both the front and rear axles.

The rear steering is hydraulicly powered the same as the front for use in 4WS and Crab steer modes.

This is all incorporated in the in the steering program of the Eaton screen and ECU.

BRAKES

Service Brakes
Under normal operating conditions hydraulic oil is supplied to the heavy-duty wet disc brakes (internal on each axle). The pressure is provided via the engine driven hydraulic pump and is modulated by the brake pedal located in the driver's cabin.

Should the engine fail, pressure will be supplied to the service brake via stored energy in the accumulators. Gently depress the brake pedal until the vehicle is brought to safe stop. Approximately 15 pedal depressions are available using the accumulator stored energy to the service brake. Under normal circumstances this is enough to be-able to bring the vehicle to a safe stop.

Alternately the DC pump can be switched on to provide hydraulic braking pressure in the event of an emergency or engine failure.

Park Brake
The use of the park brake can be explained in the following manner:

Normal operation of tractor with engine running.

Park brake is SAHR (spring applied hydraulic release) via the switch on the driver's console to the right of the steering wheel assembly operated by the driver/operator (see operators manual sec 2 pg. 16-20). The switch is self-centering when the park brake is turned to the left. To release, turn the park brake to the right (the light on the Eaton display will extinguish). To apply the park brake, turn it to the left (the light on the Eaton display will illuminate).

HYDRAULIC SYSTEM

The tractor's hydraulic system is powered by 2 Eaton vane pumps connected directly to the rear of the T12000 transmission. The oil is circulated from the main hydraulic tank positioned at the rear of the engine module frame through the various valves and cylinders (See Section V for circuit details).

There are two principal circuits that make up the entire hydraulic system, as follows:

1. Steering
2. Braking

All the hydraulic requirements are provided by 2 close-coupled, spline driven vane pumps.

1. Steering
2. Braking
   Service brakes (see Brakes on page 22).
   Emergency braking is explained in operation section.
   Emergency Park brake release is explained in operation section.

Note: Always chock the wheels when leaving the vehicle unattended.

ELECTRICAL SYSTEM

24-volt electrical system powered by the heavy-duty alternator mounted on the engine. The alternator is belt-driven by the engine main pulley. Electrical supply storage is provided by 2 heavy duty 12-volt batteries arranged in series incorporated in the system. Electrical power is used for engine starting, vehicle lighting and accessories.

See operator's manual for list of accessories and lighting.

See Section VII for Electrical Layout and Diagrams.

CHASSIS & BODY

The chassis and main frame are of all-steel, welded construction, with the covers bolted to the frame. The CAB is a split cabin. The top half and the engine bay covers are made of light weight composite material. The engine bay covers are hinged allowing access to the main engine bay and other critical equipment. They are fully removable to facilitate easy access to the engine bay for major work to be carried out. The cabin is mounted on rubber mountings to dampen excess noise. All windows, except the opening sliding glass on doors, in the cabin are laminated safety glass. The driver's seat, steering wheel and instrument console are mounted on the left-hand. side of the cabin. A dual fixed passenger seat is located on the right-hand side for passenger use. Seat belts are also provided for both seats.

TOWING FACILITIES

A Tow Hitch connection is provided at the front and the rear of the vehicle.

A locking catch is installed on each hitch to hold the Pin firmly in place.

SECTION III. OPERATION AND CONTROLS

Important Note:

It is not the intention of **AVRO GSE** to teach drivers how to drive a vehicle this section is to provide an operator / maintenance technician the ability to identify and familiarize themselves with the cabin layout so that they can perform their daily duties with confidence.
All persons operating this vehicle would require prior authorization and training from their company and OEM (or the official representative for the OEM).

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

OPERATOR'S CONTROLS

The controls are positioned for easy operation and can be divided into two groups: foot controls and hand controls.

Foot Controls

1. **Accelerator Pedal**
   This pedal is located on the floor of the driver's area, at the far-right hand side of the steering wheel. Depressing this pedal will accelerate the engine and releasing it will decelerate the engine. The throttle pedal is linked to the engine via an electrical CAN system. The pedal must be left in the idle position (with foot off the pedal) when starting the engine.

2. **Brake Pedal**
   This pedal operates a modulated hydraulic power valve and is located slightly to the left of the accelerator pedal. The pedal controls the operation of the service brakes (Dry disc type located externally with 2 calipers on each wheel of axle).

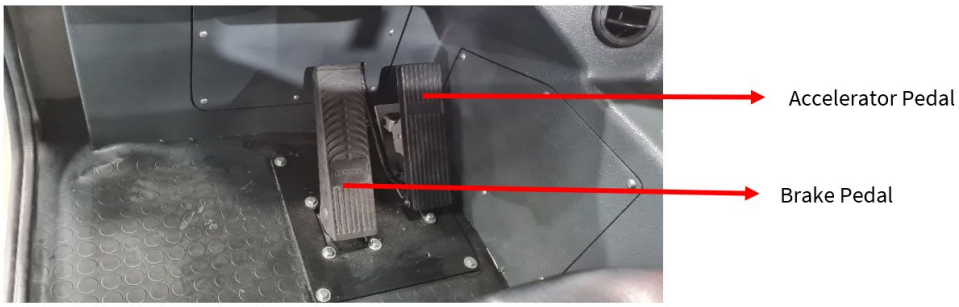
   The application of the service brakes is proportional to the amount of pressure applied to the brake pedal. Therefore, an increase in pressure on the brake pedal will produce a stronger application of the service brake and a higher deceleration rate of the tractor.

   Under normal operating conditions, hydraulic oil is supplied to the heavy-duty wet disc brakes (internal on each axle). The pressure is provided via the engine driven through the transmission PTO, hydraulic pump and is modulated by the brake pedal located in the driver's cabin as described above.

   Should the engine fail, pressure will be supplied to the service brake via stored energy in the accumulators. Gently depress the brake pedal until the vehicle is brought to safe stop. Approximately 15 (minimum) pedal depressions are available using the accumulator stored energy to the service brake. Under normal circumstances this is enough to bring the vehicle to a safe stop.

   The steering wheel becomes difficult to move at this point. It can however still be used to steer as the orbital acts as a pump under these conditions.

   Alternately the DC pump can be switched on to provide hydraulic pressure, braking and steering are functional while the DC pump is operational.



Hand Controls

All hand controls are located on the instrument panel and the steering column stalk switch. The switches or controls are all identified with symbols or name plates and their operation is as follows:

Steering Column Stalk Switch (1)

Note: Pictures may be generic and may not show actual tractor.

The steering column stalk switch is located under the steering wheel on the left side of the steering column. The stalk switch is used to control five functions:

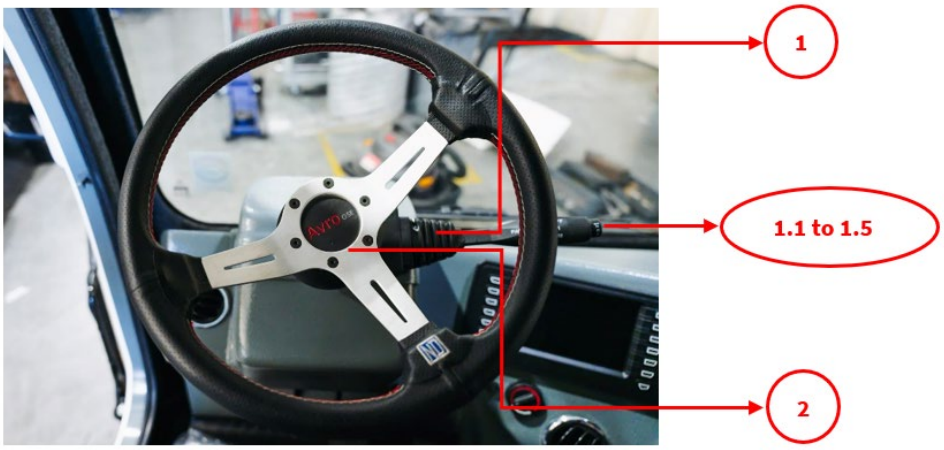
1.1 Turn indicator lights. The turn indicator function is latched in position for the turn signals. The switch is not self-cancelling and therefore must be switched off manually once the turn has been completed.

1.2 Headlight flash/High Beam. To select the high beam, pull the lever towards the steering wheel to turn it on, and pull again to turn it off.

1.3 Horn activation. The horn is activated when depressing the button on the end of the column stalk switch.

1.4 Wiper activation. The wipers are activated when twisting/rotating the column stalk switch in the forward direction and to switch off reverse the procedure.

1.5 Windscreen washer. The wind screen washer is activated by sliding the wiper lever to the right and holding while the washer fluid is directed on to the w/screen during the wiper motion.



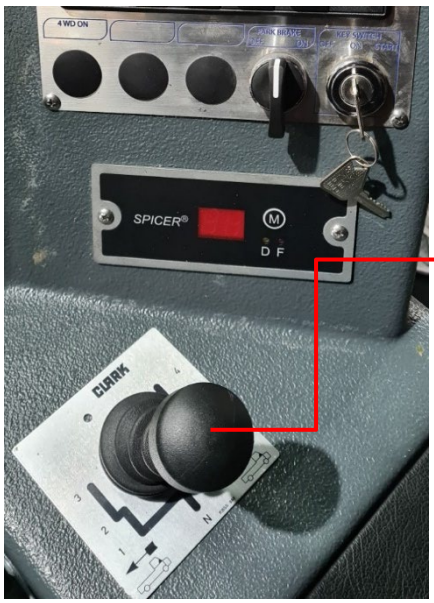
Steering Wheel (2)

The steering wheel operates the hydraulic power assisted steering valve (steering Orbital) that controls the tractor steering according to the mode selected. The operation of the steering is conventional.

Transmission Shift Control Lever

The Joystick that controls the transmission is located to right of the driver's seat. This is used to select gears. 4 forward or 3 reverse by the following method:

1. To select gear the following criteria needs to be met.
    a. The engine needs to be running at normal idle speed.
    b. The vehicle needs to be at a dead stop foot on the service brake.
    (The vehicle direction cannot be changed from forwards to reverse whilst the vehicle is in motion).
    c. Park brake must be released.
    d. Take hold of the Joystick, move it forward and to the left or right, depending on the direction of travel required.
    e. The gear selected will be displayed in the dashboard on both the Eaton screen and the Spicer screen.
    f. When reverse gear is selected the rear camera is automatically activated and displayed on the Eaton screen.



The Joystick must be firmly located in the center and back to enable the tractor to start.

The Spicer display is also used to extract and show diagnostic code faults on the transmission.

Note: Tractor will not start if not in the neutral position

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.

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.

WARNING

Do not apply the park brake when the vehicle is moving except in extreme emergencies. This will result in severe mechanical failure to the driveline and will not be covered under warranty. In general use, wait until tractor comes to a complete stop before applying the park brake.

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 calliper 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 engage. All operators should be aware of the park brake function.

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).

Notes:
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.

DRIVER'S SEAT CONTROLS

a. Fore and aft movement - controlled by a grab bar at the base of the seat at the front.
b. Seat tilt - controlled by a yellow lever on the right-hand side of the seat.
c. Back rest angle - controlled by a yellow knob on the left-hand side of the seat.

PASSENGER SEAT

The PAX seat is a bench type that can accommodate two passengers on the right-hand side of the cabin. The electrical panel is located under the PAX seat and can be accessed by removing the lock pin and flipping the Pax seat forward.

ELECTRONIC DISPLAY MODULE (EDM)

The tractor is equipped with an EATON digital display that serves as a digital dashboard that has been set up to display several different parameters e.g.: engine hours, tachometer, voltage, coolant temperature, engine oil temperature, hydraulic pressure etc.

The EDM also displays some faults and codes related to the engine. Refer to engine code displayed on the Deutz screen located on the right side of drivers footwell.

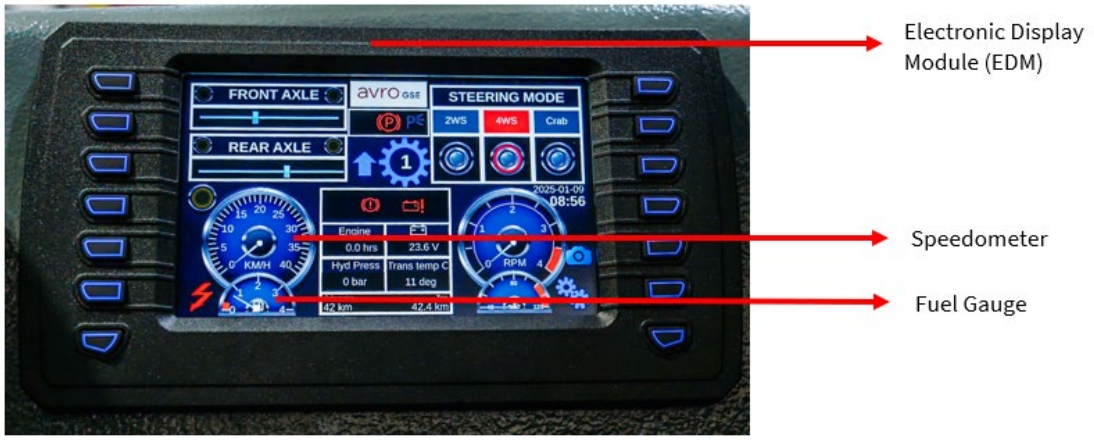
Do not turn off battery isolator immediately after engine shut down. Wait at least one (1) minute before isolating the vehicle.

SPEEDOMETER

The speedometer indicates the road speed of the vehicle in kilometres per hour (km/h). The gauge is calibrated from 0 to 30 km/h.

FUEL GAUGE

The fuel gauge indicates the volume of fuel available in the fuel tank. The gauge is calibrated in a basic empty to full scale in one quarter increments.



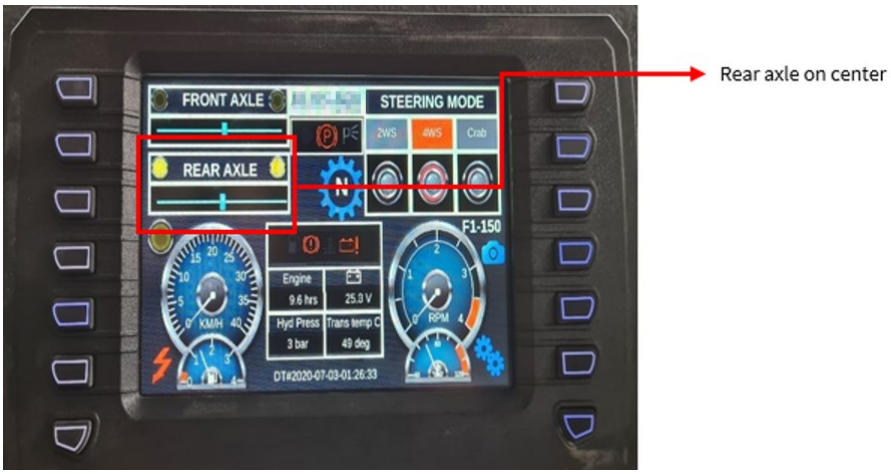
Steering Mode Selection

The tractor is equipped with hydraulic power assisted steering via a steering orbital and there are three distinctive steering modes:

1. 2-wheel steer
2. 4-wheel steer
3. Crab steer

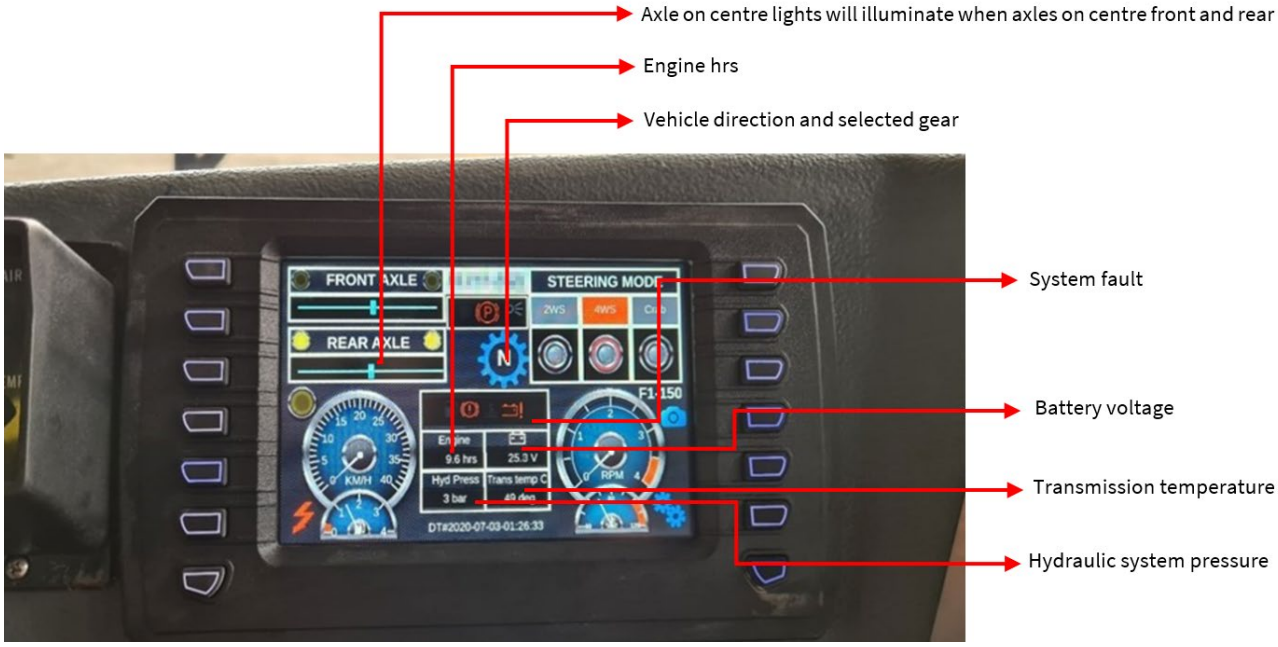
The different steering modes can be selected via the touch screen or the buttons on the side of the screen. The buttons on the side will illuminate when selecting the options from the touch screen.

Note: Either 2WS or 4WS can be selected as the start-up default steering mode.



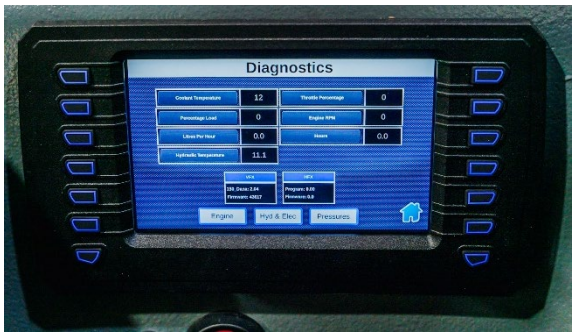
Steering position bar on each axle moves in the direction of the wheels

DASHBOARD LAYOUT



Diagnostic Faults Reference Pages

These pages are easily accessed by either the touch screen or the hard button on the side.



Diagnostics Screen

This screen provides engine information such as coolant temp, engine load, fuel consumption, throttle %, engine rpm, and engine hrs.

It also provides program details for the VFX (Eaton screen) and HFX (Eaton ECU).

The bottom three buttons are selected for information relating to hydraulics and electrical systems and to provide the maintenance team valuable information on the various operating systems.

The home button will return to the main screen.

Warnings and Faults

This screen displays:

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

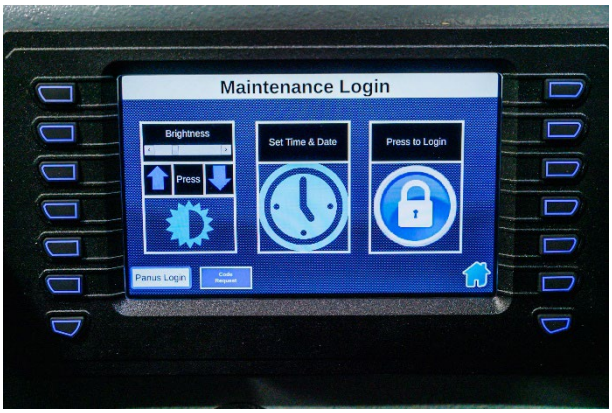
System Pressures

This screen displays hydraulic system pressures. The information displayed removes the requirement for

connecting test equipment to the unit when diagnosing possible pressure related issues.

Maintenance Login Selection

Maintenance Login
Maintenance login page can be selected via either the button or the touch screen.

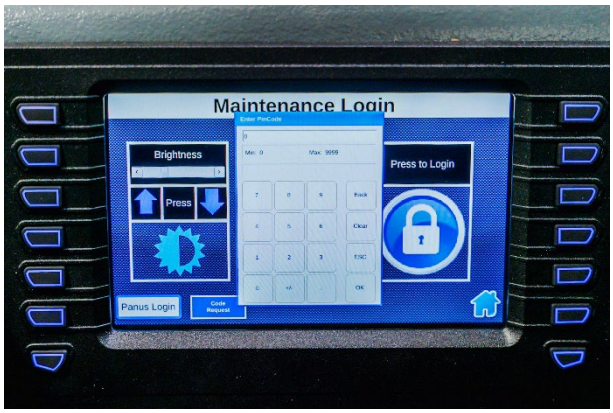


From this screen various functions can be accessed:

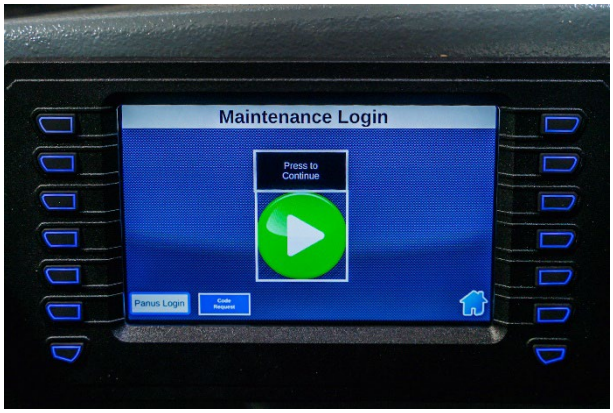
- General maintenance login
- Set screen brightness
- Set time and date
- Customer access login
- OEM (AVRO) login
- Home button returns to main screen

Maintenance Login Procedure

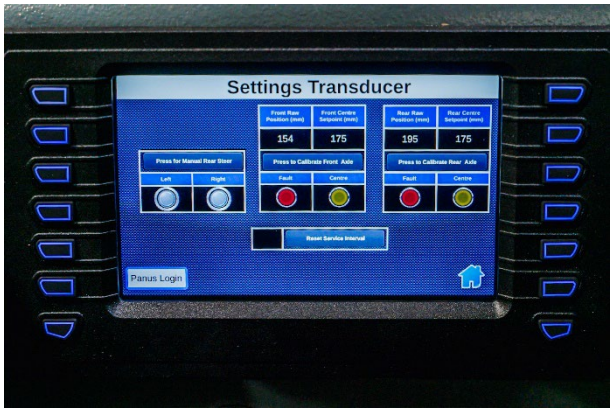
1. Select “Press to Login”, on the “Enter Pin Code” page select “Clear”, enter the code “1234” and select “OK”.



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.



SWITCHES & INDICATORS

Transmission Display Module (TDM) (1)
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.

Park Brake Switch (2)
Engages and disengages the park brake.

Park Brake Light (3)
The light illuminates when the park brake is applied

HEADLIGHT SWITCH

This is a three-position rocker switch:

1. Off
2. Park Lights
3. Main Beam

The green headlight symbol illuminates when the switch is in position two or three.

HAZARD LIGHTS SWITCH

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.

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 TRANS INDICATOR LAMP

This indicator lamp flashes when a fault occurs on the transmission. Diagnostics can be performed using the EDM, see Section IX: Engine for more information.

ENG FAULT INDICATOR LAMP

This indicator lamp will flash when a fault occurs on the engine. Diagnostics can be performed using the EDM, see Section IX: Engine for more information.

ENG TEMP INDICATOR LAMP

This indicator lamp will illuminate when OVER TEMP occurs. Diagnostics can be performed using the EDM, see Section IX: Engine for more information.

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.

Caution: 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.

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.

CAUTION

1. ***Keep the Battery Isolation Switch on while the engine is running.***
2. ***Switch off Battery Isolation Switch when charging batteries.***
3. ***When welding on the tractor, switch off the Battery Isolation Switch and disconnect the batteries, engine and transmission ECU's and the Eaton Screen.***
4. ***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 PT350 Pushback Tractor is an easy vehicle to drive. It requires no specialised 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 miss-judgment 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 organisation local requirements/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 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.
5. 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.

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 manoeuvring the vehicle while at stationary or low speed, there is no need to accelerate the engine. The system is designed to operated 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 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.

CAUTION

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

Braking the Vehicle

1. Always apply the service brakes progressively to ensure a smooth stop, especially when towing aircraft or cargo dollies.
2. 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. See note on battery isolation switch on page 39)
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 (see specifications sheet in Section I for details) 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.

Note: Pushback operators are specially trained to do aircraft 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
- 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 Ref part 2 (Operation) for details

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.**

SECTION IV: MAINTENANCE

ROUTINE MAINTENANCE PROCEDURES AND INFORMATION

Before starting service

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

Engine (TCD 3.6)

Oil capacity:	10 liters
Oil type:	15w 40 or equivalent

Transmission (DANA T12000)

Oil capacity:	15 liters
Oil type:	Dextron III

Axles (DANA 212)

Oil capacity:	8 liters (center differential section)
Oil capacity:	2 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 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, transmissions, 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 DANA and axles Dana) are used in the manufacture 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.

Note: 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.

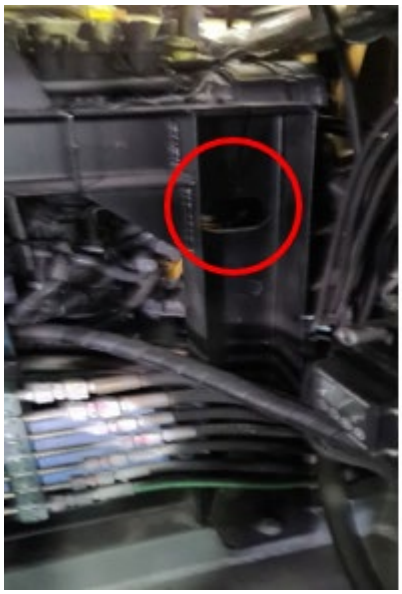
This tractor should be maintained and serviced mechanically, hydraulically and electrically, lubricated and adjusted only by experienced qualified tradespeople.

Service Intervals

Engine Oil
Specification: 15w40D or equivalent
Capacity: 11.8 (with filter) see Deutz spec (tech Data 9-65)

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 RH side of the engine and accessed via the RH engine bay door.



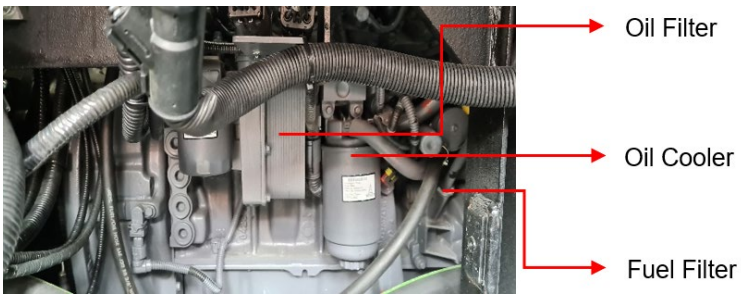
CAUTION
Engine may be hot.

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.

Oil Change Intervals

The engine oil filter is located on the right-hand side of the engine behind the fuel filter, 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 2011 Service manual, for more details on engine preventative maintenance.

See Deutz operating manual 4-31; 4-32; 5-35; 5-36; 5-37.

Recommended oil change interval for PT350 pushback tractor is **500 service hours**.

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.

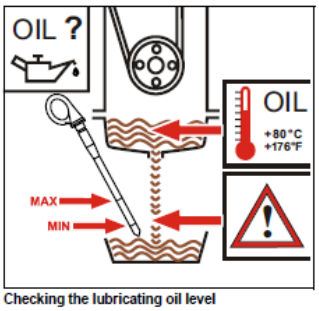
Care and maintenance work

Lubricating oil system

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

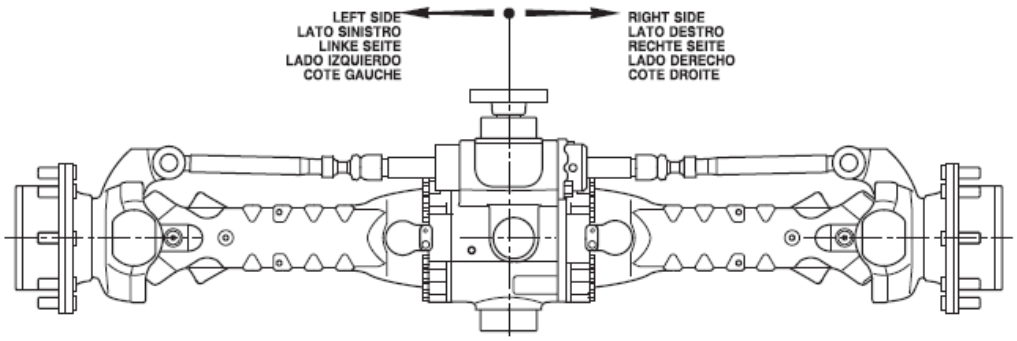
- Warm up the engine (lubricating oil temperature > 80 °C).
- Ensure that the engine or vehicle is in a level position.
- Switch off the engine.
- Place a collecting receptacle underneath the lube oil drain screw.
- Unscrew the lube oil drain screw, drain oil.
- Fit a new sealing ring to the lube oil 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.

Care and maintenance of engine, see Section IX: Engine.

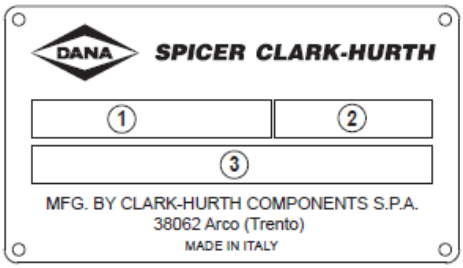
Service Intervals – Axle Components

SPECIFICATIONS

DEFINITION OF VIEWPOINTS



DATA PLATE



1 - Type and model unit - modification index
2 - Serial number
3 - Lubricant

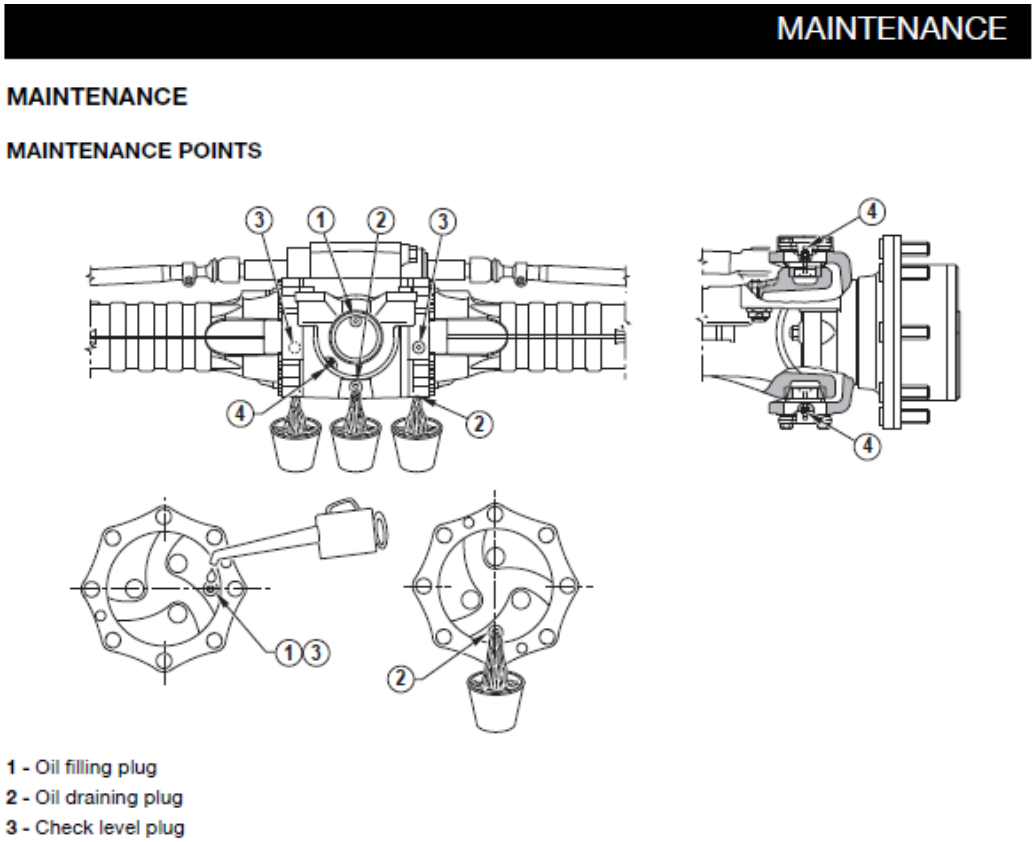
Refer to the DANA Service manual for all details on axle component preventative maintenance, including general lubrication instructions, lubrication points, specifications & intervals.

Brand recommendations are used by **AVRO GSE** and its suppliers as a guide to correct lubrication. Any equivalent grade lubrication from an alternate supplier the supplier must guarantee that it is an entirely suitable equivalent in every aspect and that the responsibility for satisfactory operation is accepted by them.

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.

ROUTINE MAINTENANCE, PROCEDURES, INFORMATION FRONT & REAR AXLES

General Details



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 DANA). 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 DANA manual for location. Ensure the tractor is stationary, the engine is turned off, the park brake is on, and the wheels are choked. 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.
The following procedures must be followed at all times.

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 from the steering cylinders for wear and leaks.
4. Check all grease points on the axle.
5. Drain the differential oil (rear). Refer to DANA 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.

Overhaul

For overhaul of axle, refer to authorized DANA Dealer or to **AVRO GSE**.

Note: All local safety precautions and regulations must be followed at all times.

PROPELLER SHAFTS – BEARING CAP CONSTRUCTION

General Information

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

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.

Procedures

Lubricating the Propeller Shaft

Never use high pressure greasing equipment to grease the universal joints or slip joints as the bearing and shafts could be damaged.

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 operated 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. A small amount of movement, only detectable movement is accepted.
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 movement be detected which is more than that which was described, the propeller shaft should be removed and overhauled.

Removing the Propeller Shaft

1. Take suitable precautions to prevent the vehicle from moving and also take precautions to prevent the engine from being started.
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 the Propeller Shaft

The procedure for installing the propeller shaft is as follows:

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 fitted replaced with new ones and are of grade 10.9 minimum with spring washer torque to 81Nm.9 (Should be fine thread).

Overhaul Procedures

It is recommended that the propeller shafts are overhauled by a qualified tradesperson.

Disassembling the 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 a 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 a 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.

Assembling the 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 3.4.

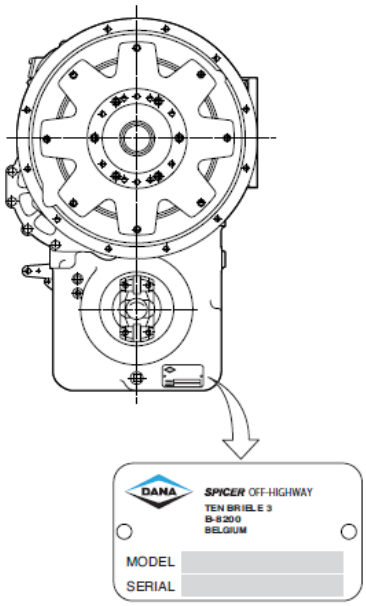
Inspecting the Propeller Shaft Component for Wear

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 suspect must be discarded and replacements obtained.

TRANSMISSION – DANA SERIES

For complete details on service repair, refer to the DANA Manuals in Section IX: Engine.

T12000 - 3,4,6 speed



IDENTIFICATION OF THE UNIT

1 Model and type of the unit.
2 Serial number.

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.

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

Procedures

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.

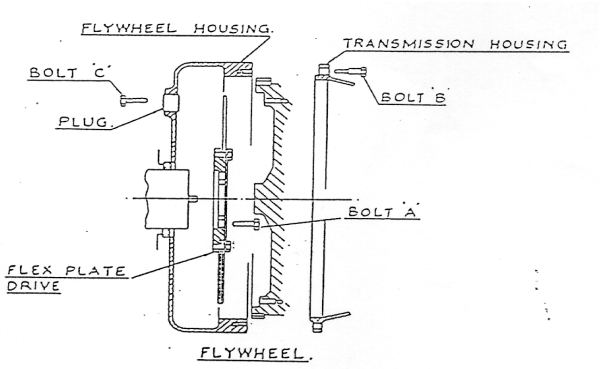
All safety recommendations must be observed and followed.

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 anti clockwise during dis-assembly or assembly of transmission as this will result in major damage to engine components.
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 and the same spec (min grade 10 bolts).

The procedure for installing the transmission to the engine is in the reverse order to 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.

Note: Never rotate the engine anti clockwise during dis assembly or assembly of transmission as this will result in major damage to engine components

Overhaul

Refer all overhauls to authorized DANA Dealer or to **AVRO GSE**.

AIR INLET EQUIPMENT – FILTER ASSEMBLY

The vehicle's engine is provided with two (2) Air Filters - primary and secondary. Both filters are housed in the filter housing on the right-hand side behind the door and 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 LH side of the vehicle behind the engine bay side door. The muffler is connected by clamps to a single tailpipe.

CAUTION

Ensure all parts are cool and not hot.

Check Exhaust Assembly

1. Check all clamps and joints on the exhaust system for leaks and damage.

COOLING SYSTEMS

General Information

The engine cooling system incorporates a radiator in front of the engine assembly and is connected to the engine cooling system. 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.

Procedures

Checking the Coolant Level

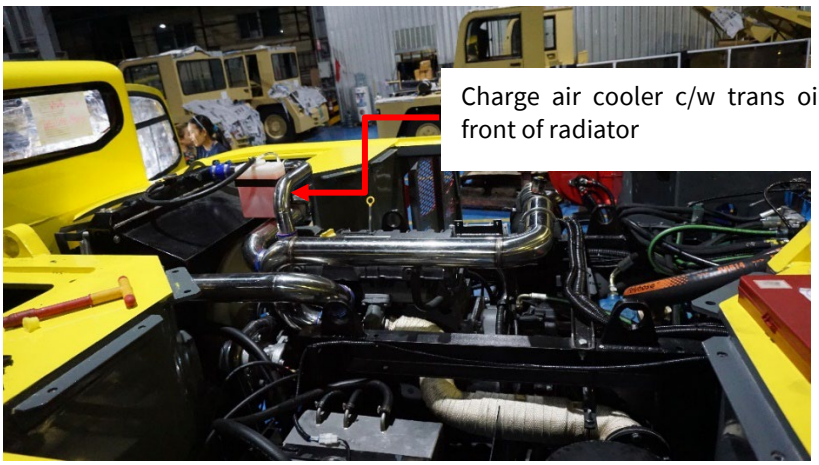
1. Maintain the coolant level within the degas bottle.
2. Use coolant specified in engine manual.

DANGER

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

CAUTION

Eye protection should be worn when filling the radiator.

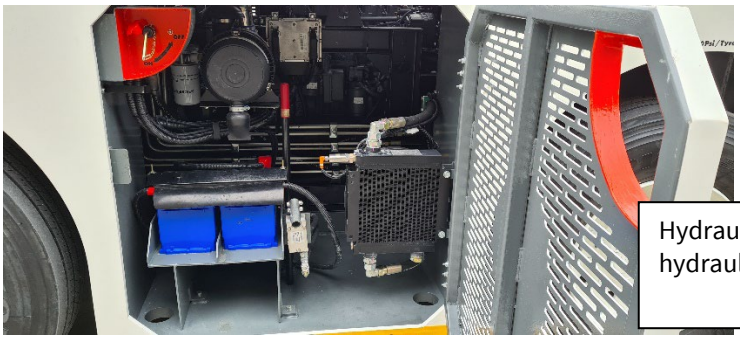


Charge air cooler c/w trans oil cooler in front of radiator

RADIATOR FAN INSTALLATION

General Information

The Fan Drive Assembly consists of a fan assembly and a hub directly installed to the Deutz engine. The fan will turn as soon as the engine is started and is of the suction type – meaning, it draws air from the front through the radiator, charge-air cooler, and auxiliary coolers. The hydraulic oil cooler is separate from this assembly and is located on the right-hand side behind the maintenance door.



Hydraulic oil cooler with hydraulic temp transducer

CAUTION

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

Procedures

Monthly Maintenance

For monthly maintenance, follow the below procedures:

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.

CAUTION

Do not use high pressure washer as this may damage the aluminium radiator core.

Removal of Radiator Assembly

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.

DANGER

Exercise care as steam may be vented from the under the filler cap if the engine is still hot from operation.

Overhaul

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

WHEEL ASSEMBLIES

General Information

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.

CAUTION

Ensure that the tractor is stationary, the engine is turned off and the park brake is on.

Procedures

Tightening Wheel Nuts

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: 130 psi

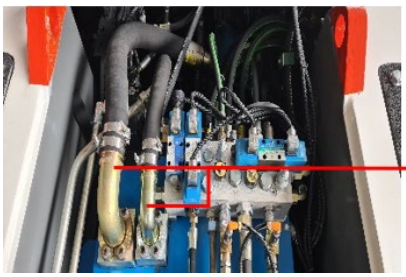
Hydraulic System

The vehicle's steering and braking systems are both hydraulically powered. They are divided into 2 major sections.

1. Steering
2. Braking

Fluid requirements for these systems are provided by two (2) Vane-pumps 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.

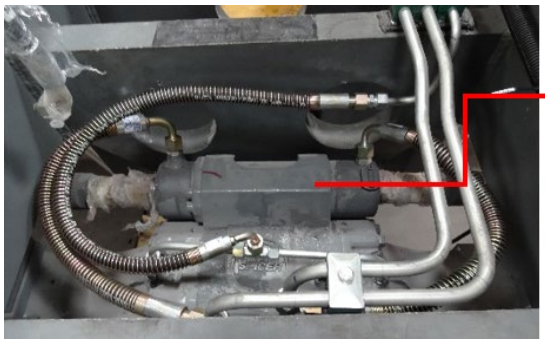
Always ensure that the hydraulic tank supplying the suction hoses has sufficient oil to supply the hydraulic system after servicing. Severe damage will occur to the pump if pumps runs dry.



Two main hydraulic oil suction lines positioned top left-hand side of hydraulic tank to the rear of the engine frame module.

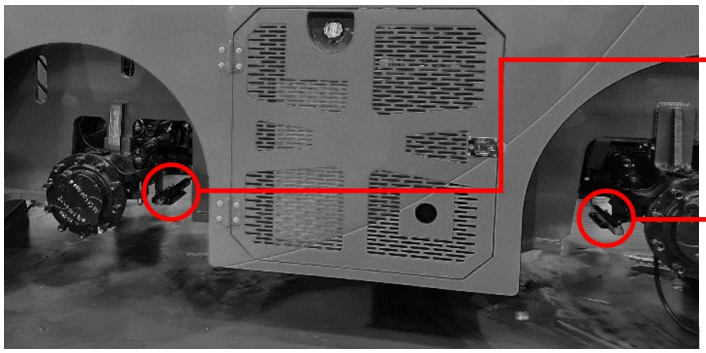
Steering

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



Typical Integrated Steering Cylinder on front and rear axles

The steering is controlled via two 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.



Linear transducers on front and rear axles

Steering Faults and Adjustment

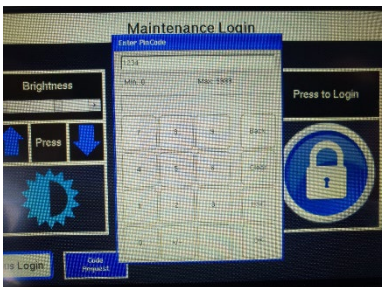
If at any time the steering is not tracking straight, or the rear has moved out of alignment for some reason, follow the following procedure to correct the wheel alignment.

Select maintenance log in page.

Maintenance log in page can be selected via either the button or touch screen.

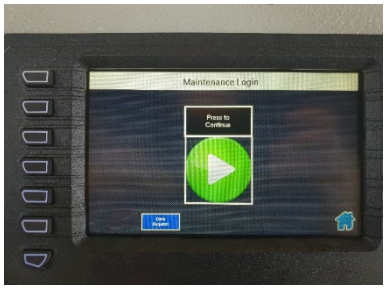
From this screen, various functions can be accessed.

1. General maintenance log in.
2. Set the time, date and screen brightness.
3. Code Request: For this function OEM provides access code. OEM needs to be contacted.
4. AVRO (OEM) level login.
5. Home button back to main screen.



From the maintenance log in page,

1. Select press to login.
2. Enter the code 1234 in the pin code screen.
3. Press OK.

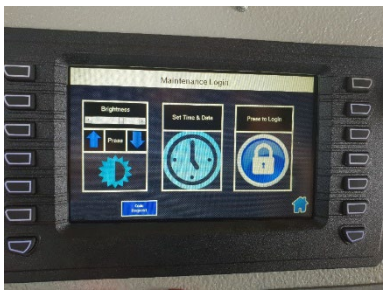


This screen shows an icon with a green arrow, press to Continue.

This screen allows the maintenance team to:

1. Recalibrate the steering transducers if the wheels are not tracking in a straight line.
2. Bring the rear wheels online if there is a fault with the 4 steering wheels.
3. Press Home to return to main screen.

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).
Select log in request.



From the maintenance log in page, select ‘CODE REQUEST’ login. A pin code screen will appear. Press ‘Clear’, then enter the code provided by **AVRO GSE**. Once done, press ‘OK’.

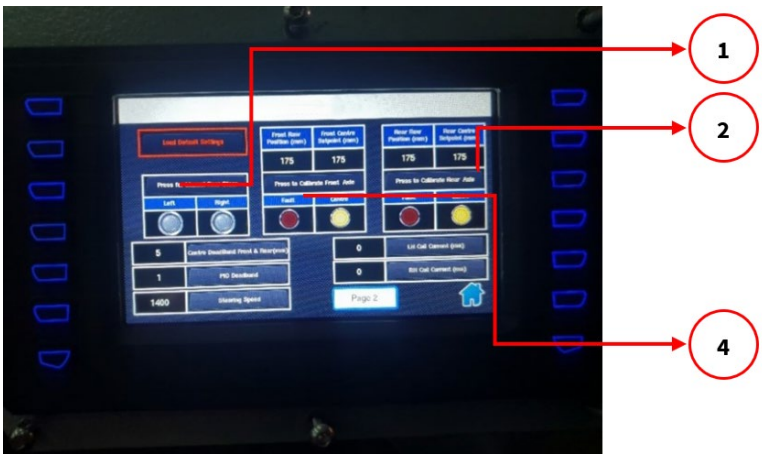
This screen allows the maintenance team to perform the same functions as previous with additional functions provided for trouble shooting.

Page 2 allows the maintenance team to:
1. Update program if required via special tool cable.
2. Set preferred start-up of steering 4 WS or 2 WS (Crab not recommended at start up).
3. Camera on/off if installed.
4. Allows to override interlock in cases of emergency.

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

It is a closed-circuit hydraulic system operated via the service brake pedal which in turn provides pressure to the 16 sets of internal wet disc brakes per axle.

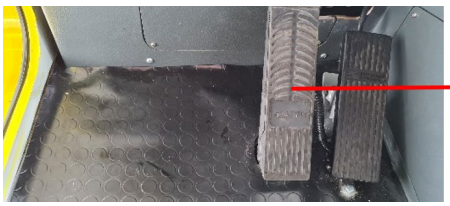
Parking Brakes

Park brake is activated via an on/off. Return to 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. Gear cannot be selected if park brake is applied.

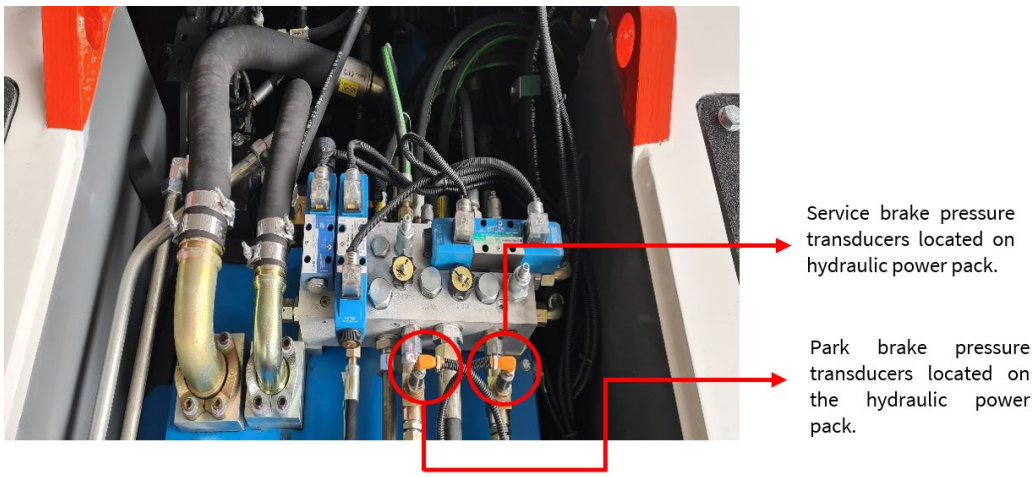
Do not apply park bake while tractor in motion. This will result in severe mechanical failure to the driveline and will not be covered by warranty!

Service Brakes

Wet Disc (DANA) internal type operated from the foot brake valve and pedal. The 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 shown, brake valve below plate.

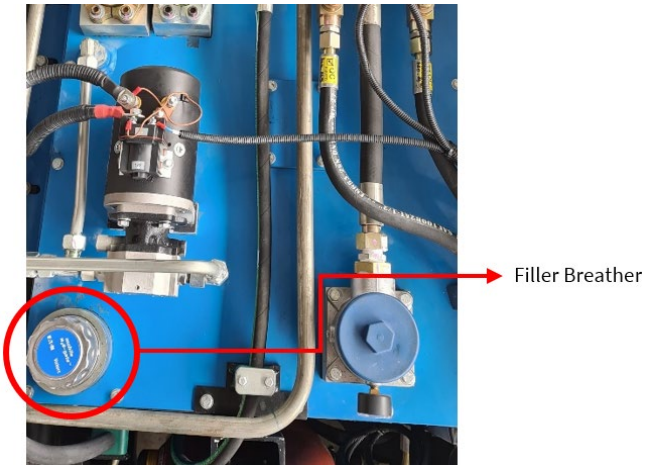


Reservoir and Ancillary Equipment

The hydraulic reservoir is mounted in the rear section under the composite cover of the chassis and holds approximately 80 litres 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 a large composite inspection cover which is located at the rear of the tractor between the rear wheels. Filling is done via the filler-breather located on the left side of the hydraulic reservoir.

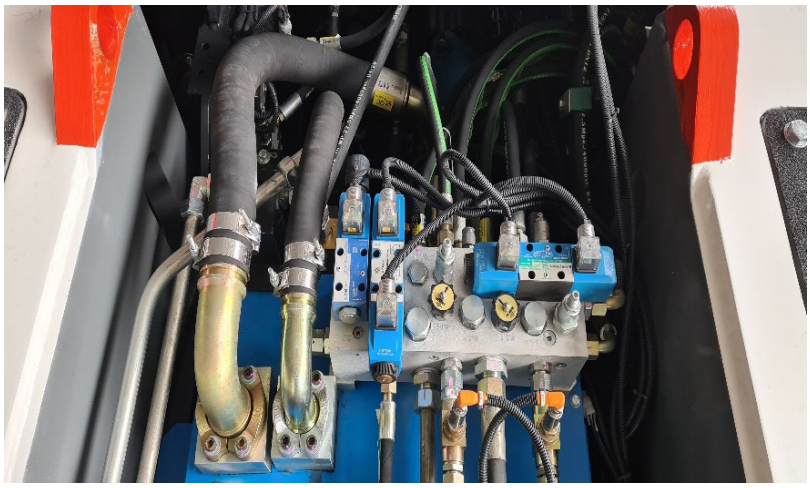
Note: if oil is not clear in the sight glass and it appears to look milky it will require immediate changing as in this condition it is contaminated with water or some other liquid substance and will cause serious damage to the hydraulic pump and valves.



A plugged outlet is provided for reservoir draining.

Components in Hydraulic System

Main System Relief Valve is provided to offer protection to the entire system and is set to be slightly higher than maximum system pressure.



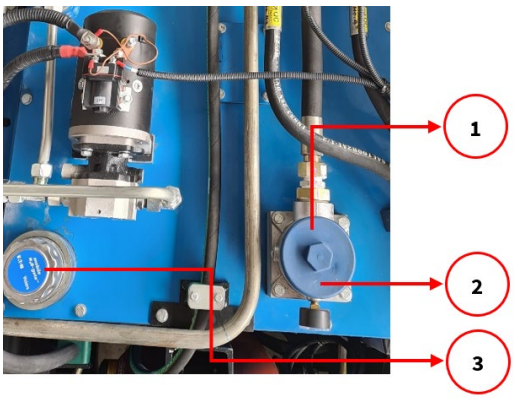
Main Manifold

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 normally require gauges to be connected to the system.

Return Line Filter (1) is positioned so that all valves return functions flow though 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. The filter assembly also has a filter blocked indicator (2).

Hydraulic Oil Filler/Breather Cap (3)

The filler/breather cap is positioned on the top left side of the hydraulic reservoir. It has an integral strainer to remove any large foreign debris that may be accidentally introduced while filling / toping up oil. It also acts as a breather to prevent any pressure building up in the tank.



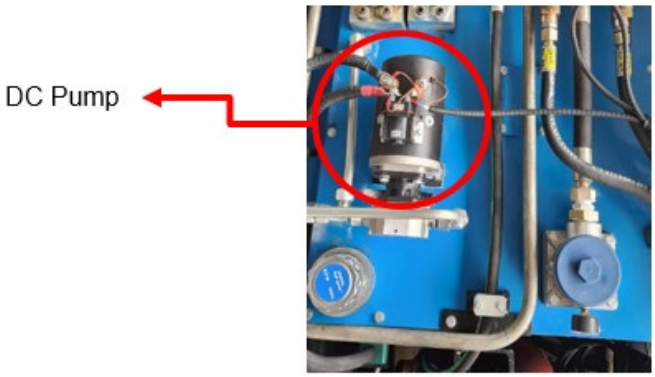
Oil Level sight glass level indicator located at the rear of the tractor fitted to the hydraulic tank indicates oil level. It contains a warning Symbol ⚠ on the Eaton screen in the cabin to the operator. The maintenance team can access the diagnostic page when the red warning shows low hydraulic oil.

Notes:

- ***If oil is not clear in the sight glass and appears to look milky, immediate changing is required. The reason for this is that the oil is contaminated with water and will cause serious damage to the hydraulic pump and valves.***
- ***The oil level must be in the sight level gauge.***
- ***Oil level is not at the top of the filler breather. Topping up is done through the filler-breather.***

DC Pump

The DC pump is 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 Pumps

The two Variable displacement pumps (Vane type) provide all the fluid requirements under normal operating conditions to the hydraulic systems. They are directly coupled to the transmission's PTO drives. The pumps are fed from the oil reservoir by individual "flooded" suction lines. The pump is self-compensating, meaning, it automatically provides the flow required by the system.

System operating pressures need to be referred from the Hydraulic drawing in this manual.

CAUTION ⚠

- ***Care must be taken when setting system pressures and only qualified hydraulic technicians that understand hydraulic systems and drawings should be allowed to do this function.***
- ***Care must be taken that a 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, then 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.

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

Preventative Maintenance

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

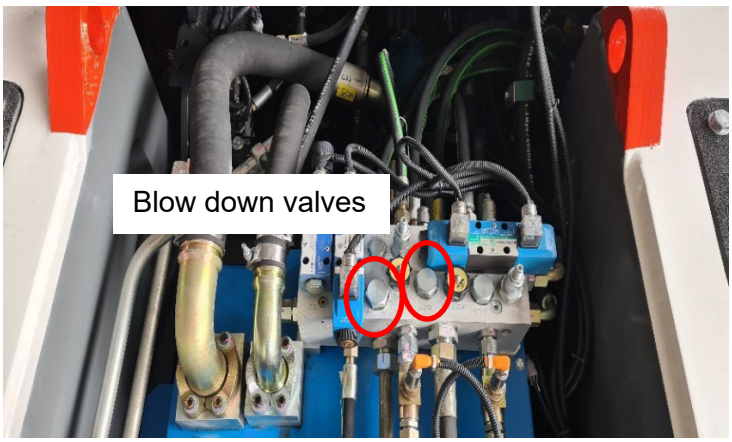
Replacement of Return Line Filter Element
The return line filter is fitted with a filter condition indicator. Replace filter element if the indicator is in the Amber or Red section of the Condition Gauge or at the bi-annual hydraulic oil change. This indicator is located on the filter housing.

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 – Maintenance of Components

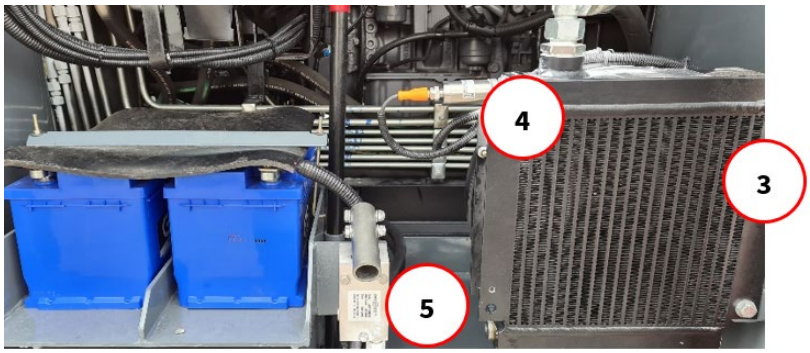
General Precautions
Any maintenance on the vehicle hydraulic components must be done with the engine shut down and the Park Brake is applied, and the vehicle chocked. Should the pumps need removing for servicing, the Suction Gate Valves (where installed) must be closed before removing any hoses. Remember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

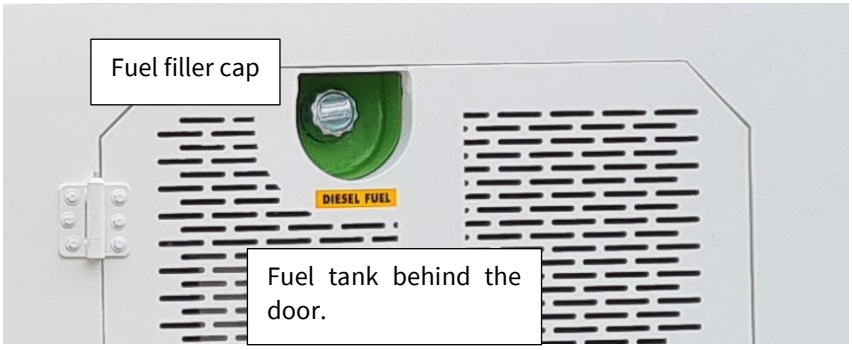
1. Check all hydraulic hoses for any signs of leakage or damage. Replace any hose that is faulty.
2. Check for oil leaks at all valves and fittings. Take note of the parking area for signs of leakage on the ground and report to maintenance staff immediately.
3. Check the Hydraulic cooler (see photo above) 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 (See emergency release in Section V: Hydraulic System).

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.

Fuel Reservoir

The fuel reservoir is mounted on the left side of the engine bay, behind the hydraulic tank, and has a capacity of approximately 140 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.

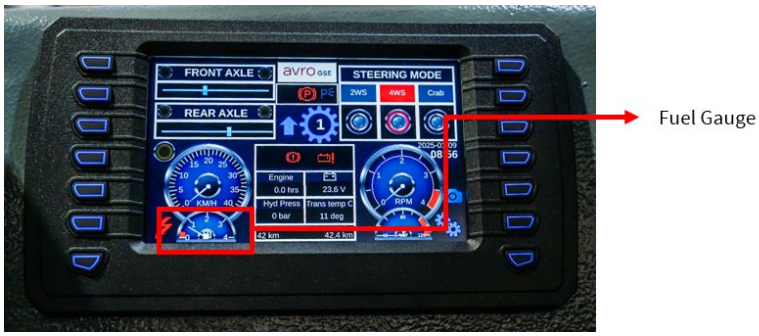


A suitable filler Breather Cap is fitted to the top of the Reservoir and must be always kept clean.

A plugged outlet is provided at the base of the Reservoir for draining fuel at the bottom of the tank when required.

CAUTION

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.

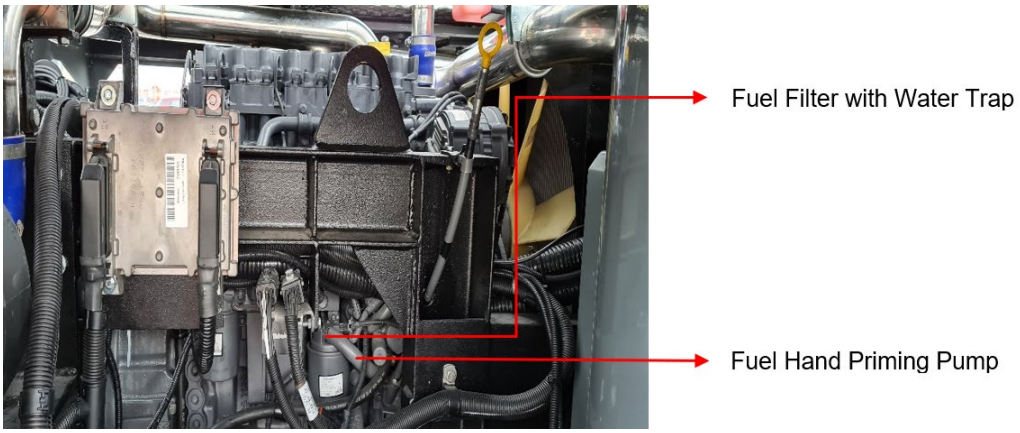
When in doubt, fill up the Fuel Reservoir/tank.

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



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

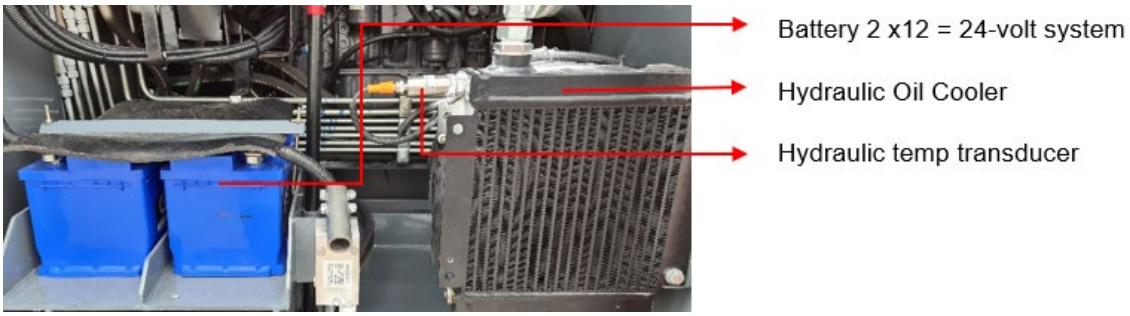
Preventative Maintenance

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 right 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.

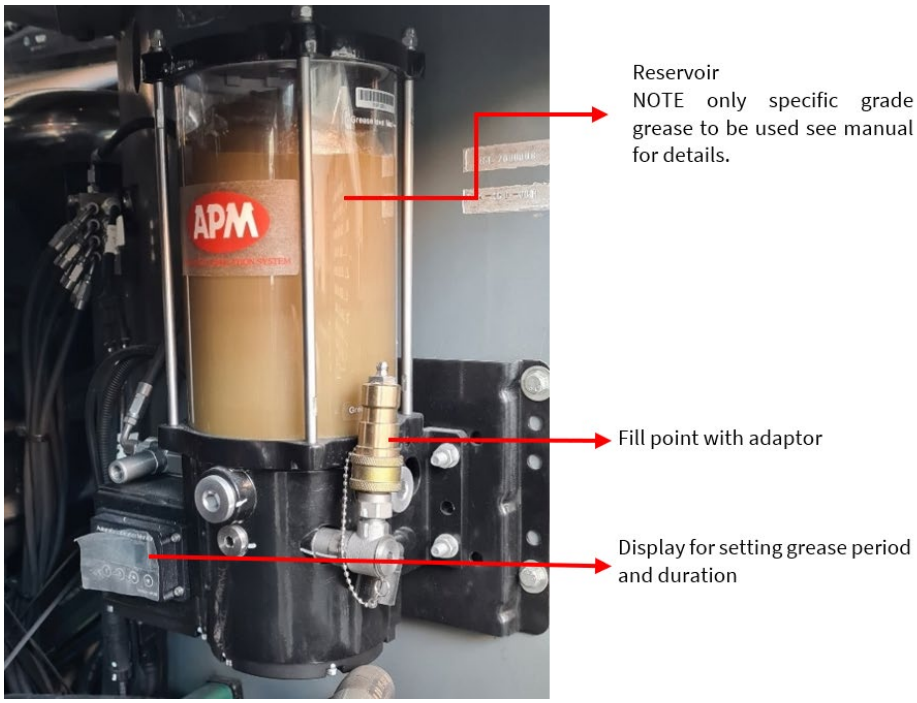
Battery Fluid Level
Check the fluid level in all cells of all batteries where applicable.
Ensure the fluid level just covers the top of each vertical plate where applicable.

Only top up the batteries with distilled water where applicable.

Eye protection should be worn when filling or servicing batteries.

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.

Auto Greasing System (Optional)
The tractor is fitted with an Auto greasing system. (See Manual)
The reservoir is located on the rear platform allowing easy access for checking and refilling.



The auto greaser provides grease to 10 key areas on the tractor, including the top and bottom trunnion bearings on both axles and the pivot bearings on the front axle. The greaser is an industrial-grade system, and it is important to understand how the greasing cycle is configured. For example, if the tractor operates for 20 hours per week, set the cycle to 20 hours. The amount of grease applied is controlled by the cycle duration in minutes. Therefore, to grease the tractor weekly, set the cycle to 20 hours and the duration to 1 minute.

See manual for instructions.

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.

Refer to engine manufacture for the minimum fuel requirements.

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) litres of Isopropyl Alcohol should be added to 570 litres 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 Insolubles (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.

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				

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 T12000
- Engine: Deutz TCD2011L4
- Axles: DANA 212

DAILY MAINTENANCE INSPECTION

The following items must be checked before the operation of the PT350 Tow Vehicle on a daily basis. Refer to the AVRO Daily Maintenance Manual for a more detailed explanation of the following items.

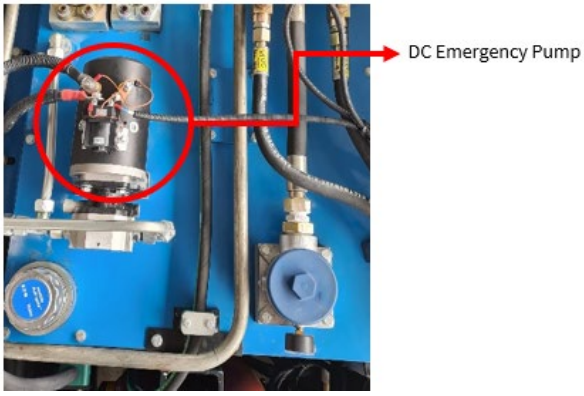
Tick the following items once completed.

☐	**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
☐	**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 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	

SECTION V:
HYDRAULIC SYSTEM

EMERGENCY OPERATION PROCEDURE



If the engine is unserviceable but electrical (battery) power is still available, limited steering, limited service brake & park brake operation can be achieved by use of the Emergency Pump switch is Located on the Right hand side of steering column on the control panel above the ignition key.

Procedure

1. Turn Ignition 'ON'
2. Switch on Emergency Pump, via rocker switch (press and hold, if it is released the pump will stop) in Cabin, as shown above.
3. To release the park brake, operate the park brake switch as per normal procedure.

Note: The emergency pump will only run if the switch is held. One-minute intervals are recommended to maximize battery life and prevent damage to the electric motor. Note the DC motor has a thermal overload protection built in. If the motor overheats it will not operate until it cools down.

Hand Pump

The hand pump is used to release the park brake only.

Emergency Hand Pump

Photo A

The park brake is spring-applied and requires hydraulic pressure to release it.
To release the park brake when the engine and emergency pump is unserviceable, follow the below procedures:

1. On Solenoid 'B' (Blow Down Solenoid) push in the black knob and turn to the right to lock in position, refer Photo B.
2. On Solenoid 'A' (ON/OFF Solenoid) using a small screwdriver or similar tool, push in the solenoid spool (center part of solenoid) blue arrow until park brake spool is in the off position (as far as it can move usually only moves a couple of millimeters).

Note: Push from the front side of manifold as per Photo C.

3. Ensure that the valve on the side of the hand pump is closed, where fitted. Using the pump handle located behind the pump, pump the handle until the vehicle moves freely. Note that if the vehicle does not move, return to Step 2 and push the solenoid spool from the opposite side. See red arrow in Photo C.

Photo B

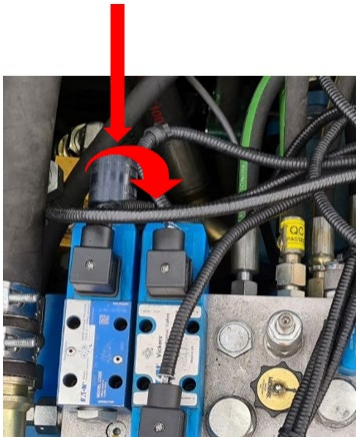
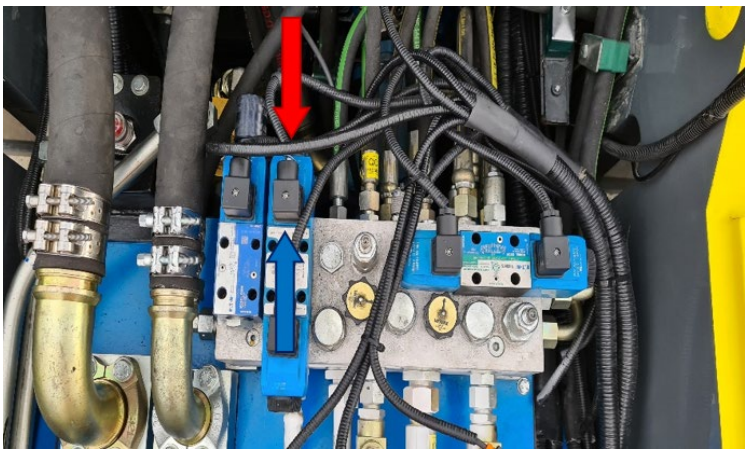


Photo C



SECTION VI:
COLD CLIMATE

SECTION VII: ELECTRICAL SYSTEM AND CIRCUITS

SECTION VIII: AXLES

SECTION IX: ENGINE

SECTION X: APPENDIX

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

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	194	291	412	581	762	1012
	L	5	9	17	27	40	58	81	143	145	218	309	436	572	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	214	326	462	644	868	1138
	L	5	10	19	30	46	65	91	159	160	245	347	483	651	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	2556
	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	062	=	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

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

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