MC-485-IC

MAINTENANCE MANUAL

A GUIDE FOR PERFORMING MAINTENANCE AND REPAIRS ON MC-485

SERIAL NUMBER : 124 37 45 AND UP

UPDATED 01.17.2024
DESIGNED BY MOTREC INTERNATIONAL

MOTREC INTERNATIONAL INC.

5-YEAR LIMITED WARRANTY

FOR VEHICLES PRODUCED AFTER NOVEMBER 1, 2024

5-YEAR LIMITED WARRANTY ON AC-POWERED PRODUCTS, STOCK CHASERS AND TRAILERS

2-YEAR LIMITED WARRANTY ON DC OR IC POWERED PRODUCTS AND OTHER MOTREC PRODUCTS

Motrec warrants to the original purchaser that its products are free from defects in parts and workmanship.

STARTING DATE OF WARRANTY. The present terms and conditions of the Motrec Limited Warranty apply to new Motrec products only and do not replace any pre-existing warranty. The warranty period is effective from the date the purchaser receives the product, provided it is registered within ninety (90) days of reception and in conformity with Motrec's registration process.

REGISTRATION. IMPORTANT **:** AIMPORTANT: AS A PURCHASER OF A MOTREC PRODUCT, IT IS IMPORTANT THAT YOUR PRODUCT BE REGISTERED UNDER YOUR NAME AS REQUIRED BY MOTREC'S PRODUCT REGISTRATION PROCEDURE. PLEASE ASK YOUR MOTREC DEALER TO REGISTER YOUR PRODUCT. MOTREC'S LIMITED WARRANTY WILL BECOME EFFECTIVE AT THE TIME OF PRODUCT REGISTRATION. IF YOU DO NOT REGISTER YOUR PRODUCT, THE STARTING DATE OF YOUR MOTREC LIMITED WARRANTY WILL TAKE EFFECT ON THE DATE THE PRODUCT WAS DELIVERED TO YOUR MOTREC DEALER. IF YOU PURCHASED THE PRODUCT DIRECTLY FROM MOTREC AND NOT FROM A MOTREC DEALER, MOTREC HAS AUTOMATICALLY REGISTERED YOUR PRODUCT./

DEFECTS. Subject to the terms and conditions described below, parts, components, or accessories installed on the product by Motrec that fail under normal usage within the warranty period, and that are proven to be defective, will be repaired or replaced without charge for parts or labor unless stated otherwise herein. This is Motrec's sole liability under this Warranty. Motrec reserves the right to require that all parts or components claimed to be defective be returned for inspection and verification of defect. The purchaser is responsible for any and all shipping fees of any and all parts or components that it alleges to be defective.

WARRANTY SERVICES. All warranty services must be rendered by authorized Motrec distributors and approved in writing by Motrec prior to initiating any repairs or adjustments. All approved warranty services will be paid for based on standard rates established by Motrec. Rather than replace or repair parts or components, Motrec may, at its discretion, replace the product or refund a prorated amount of its purchase price (based on service time, wear and tear) upon return of the defective product.

AUTHORIZATION PROCESS. No product shall be returned to Motrec without its prior authorization. All warranty claims must be disclosed to Motrec or its authorized distributor as soon as the purchaser is aware of a suspected defect or any event susceptible to give rise to a claim under the Motrec Limited Warranty. All claims must be processed through an authorized Motrec distributor using the warranty claim procedure approved by Motrec.

THE ABOVE TERMS AND CONDITIONS REPRESENT THE ONLY REPRESENTATIONS MADE BY MOTREC IN RELATION TO ITS PRODUCTS. MOTREC DOES NOT PROVIDE ANY OTHER PARTICULAR WARRANTY TO THE USER OF ITS PRODUCTS. MOTREC DOES NOT MAKE ANY EXPRESS OR IMPLIED WARRANTIES OR REPRESENTATION WITH RESPECT TO ANY RESULT, PERFORMANCE OR DURABILITY EXPECTED FROM THE USE OF ANY OF ITS PRODUCTS. MOTREC EXCLUDES AND DECLINES ANY OTHER WARRANTY OF SUITABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE WOULD THEY BE PROVIDED BY LAW, BY CONTRACT OR OTHERWISE.

PRODUCT MODIFICATIONS ARE PROHIBITED. Motrec prohibits and disclaims all liability for any modification made to the product, including but not limited to, modifications that are susceptible to altering the weight distribution and stability of the product, increasing its speed or affecting its safety. Such modifications can cause serious personal injury or property damage, which Motrec disclaims and excludes all responsibility. It is the purchaser's responsibility to ensure that any technicians servicing the product are properly trained as required by OSHA (Occupational Safety and Health Administration: https://www.osha.gov/) and ANSI-B56 (American National Standards Institute: https://webstore. ansi.org/default.aspx). Service technicians shall read, understand and follow the instructions in the Motrec Owner's Manual before servicing the product. Only qualified and authorized personnel shall be permitted to maintain, repair, adjust and inspect the product.

TRAINING. It is the purchaser's responsibility to ensure that the driver or any person operating, using, maintaining or handling the product (or its accessories) is properly trained and instructed on the product's safety features and operation, including its stability. Operators shall read, understand and follow the safety and operating instructions in the Motrec Owner's Manual before driving the vehicle. Operators shall not be permitted to operate the product unless complete and adequate training has been provided by the purchaser. Driving an electric vehicle constitutes a hazard. The driver is responsible for the control of the product while driving and must always evaluate all unusual situations that he or she may encounter while driving. The driver assumes the inherent hazards related to this activity. Motrec products are designed for off-road use only.

EXCLUSION OF LIABILITY. Motrec disclaims any liability for incidental or consequential damages, including, but not limited to, personal injury or property damage arising from misuse of the product, lack of maintenance or any defect in the vehicle.

UNDER NO CIRCUMSTANCE WILL MOTREC BE LIABLE FOR ANY DAMAGE, WHETHER DIRECT, INDIRECT OR OTHERWISE, RESULTING FROM THE USE OF ITS PRODUCTS, EVEN IF MOTREC OR ONE OF ITS REPRESENTATIVES WAS AWARE OF THE POSSIBILITY OF SUCH DAMAGE. ANY LIABILITY FOR LATENT DEFECT IS LIMITED TO THE PRICE OF THE PRODUCT.

MOTREC INTERNATIONAL INC.

5-YEAR LIMITED WARRANTY

FOR VEHICLES PRODUCED AFTER NOVEMBER 1, 2024

1. Definitions

"*Product*": the complete electrical vehicle manufactured and/or assembled by Motrec, including its parts, components and accessories installed by Motrec.

"*Purchaser*": The party in whose name the product is originally registered at the time of purchase pursuant to the product registration procedure maintained by Motrec at that time, either: (a) the party to whom Motrec sold the product, if that party purchased the product for its own use, or (b) the customer of a Motrec dealer, who bought the product directly from such dealer.

2. Warranty Period

Your Motrec product is covered by the Motrec Limited Warranty for a period of five (5) years or **5,000 hours** of use, whichever comes first. This period of three (3) years starts on the date the product is registered, as mentioned hereinabove. This coverage does not apply to wearable parts, normal use or abusive usage of the product.

3. Warranty Registration

The warranty registration must be completed within ninety (90) days of purchase of the product. If registration is not completed within this time, the warranty will begin on the date the product was delivered. If you purchased the product from a Motrec dealer, please make sure the dealer has completed the registration. If you purchased the product directly from Motrec, Motrec has automatically registered your purchase.

4. Maintenance

Motrec requires that scheduled maintenance be performed at the times shown in the Owner's Manual. If this scheduled maintenance is not done and the product fails as a result of a failure to properly maintain it, repairs will not be covered under any warranty.

5. Warranty will be void if :

- The product has been modified in any manner not approved in writing by Motrec.
- The product has been overloaded beyond its rated capacity.
- The product's maximum speed has been increased.
- The product's motor controller parameters have been tampered without Motrec's authorization.
- The product has been used abusively
- (including, but not limited to improper use; twisted, bent, misaligned front or rear axles; any signs of abusive use).
- The product has been involved in an accident.
- The product has been transferred to a second owner without Motrec's authorization.
- The product has been used in extreme environments (including, but not limited to freezers, excessive moisture areas, corrosive environments, etc.).
- The product has had its serial number modified or altered.
- The product was not maintained as specified in the Motrec Owner's Manual.

6. The following items are not covered by the limited Motrec warranty :

- Batteries, charger, wheels
- Wearable parts (fuses, tires, wheel bearings, seats, brake pads and shoes)
- Wear and Tear resulting from normal use
- Adjustments, including field set-up
- Damage or defects caused by using non-Motrec parts, components, or accessories
- Shipping damage caused by freight carrier
- Shipping fees for warranty parts
- Travel fees for technical support and repair

FOREWORD

WELCOME

MOTREC International Inc. has built a rock-solid reputation as a world-class designer and manufacturer of electric industrial vehicles for the horizontal transportation of goods and people. We innovated, reimagined, engineered, and drove ourselves tirelessly to this preeminent position.
We also consistently exceeded customer expectations, which is why legions of satisfied customers worldwide have been driving MOTREC since 1988.

INTELLECTUAL PROPERTY

MOTREC INFORMATION

- Find us :

4685 Portland Boulevard, Sherbrooke, QC J1L 0J1, Canada

- Call us :

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Fax : +1 (819) 846-3050

- Send us an e-mail : support@motrec.com

ABOUT THE MANUAL

Make sure to read the manual in its entirety before operating or servicing the vehicle. Keep the manual close for reference when necessary. Do not discard the manual. If the vehicle is sold or transferred, provide this manual with it.
This manual is based on the latest available information at the time of publication.

MOTREC®

“AYONE CAN WORK WE PERFORM THAT’S MOTREC ”

-Motrec Tagline

CONTENTS

1. PREFACE

1.1. INTRODUCTION

Read Before Operating

Make sure to read and understand the content of this Maintenance Manual before operating or attempting maintenance on the vehicle. The present document provides a vehicle overview and safety information for the operator, passengers, and others, as well as a detailed list of the maintenance to be executed over the lifespan of the vehicle.

Keep this manual for future reference. If the vehicle is sold or transferred, provide this manual with the vehicle.

A list of quick maintenance references is included at the back of this document. These references are intended for an MC-485 experienced technician to accelerate the maintenance process. The Quick References should not be used by any untrained or inexperienced personnel.

The MC-485

The IC (gas engine) powered MC-485 has long been the ruler of rugged, reliable burden carriers. Safety and productivity are paramount in its design, with precise controls ensuring smooth operation for easy maneuvering. Crafted entirely from durable steel, this robust model demands minimal maintenance and is engineered for rigorous use, promising long-lasting dependability.

If you need a do-it-all vehicle that's strong, safe, and easy to operate, you can't beat the MC-485 with its unlimited configurations and 2-year warranty (Equivalent of 2000 Hours).

Modular Design

The MC-485, like other MOTREC vehicles, can quickly adapt to new work requirements. Its modular design allows for a quick change of configurations based on the task at hand. Predefined packages and options are available to fulfill standard needs, as well as a customization process to accommodate specific customer needs.

Refer to our website www.motrec.com for more details on configurations.

1.2. ACRONYMS AND ABBREVIATIONS

°C : Celsius
°F : Fahrenheit
ANSI : American National Standards Institute
AUX : Auxiliary
EMB : Electromagnetic Brake
ft : Foot/Feet
HD : Heavy Duty
HP : Horsepower
HPD : High Pedal Disable
Hz : Hertz
ITSDF :Industrial Truck Standards Development Foundation
kg : Kilogram
km/h : Kilometer per Hour
kW : Kilowatt
kWh : Kilowatt-Hour
lb : Pounds (Weight)
lbf : Pound (Force)
LD : Light Duty
LED : Light Emitting Diode
m : Meter
mL : Milliliter
mm : Millimeter
N/A : Not Applicable
N·m : Newton Meter
OSHA :Occupational Safety and Health Administration
P/N : Part Number
PMC : Power Motor Controller
PWM : Pulse Width Modulation
SOC : State of Charge
SRO : Static Return To Off
VAC/AC : Volts Alternating Current / Alternating Current
VDC/DC : Volts Direct Current / Direct Current
IC : Internal Combustion

2. SAFETY INFORMATION

2.1 SAFETY SIGNAL WORDS AND SYMBOLS

Before operating the vehicle and reading the manual, it is important to familiarize yourself with the signal words and symbols that appear throughout the manual and on the vehicle. Understanding their meanings will help ensure safe and effective use of the vehicle.

WARNING

WARNING INDICATES A HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN SERIOUS INJURIES.

CAUTION

CAUTION INDICATES A SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN DAMAGE TO SOME EQUIPMENT.

NOTICE : Notice is used to address practices not related to personal injury.

2.2 SAFETY DECALS AND LABELS

WARNING

DECALS, MARKINGS, OR STICKERS MUST REMAIN UNALTERED AND READABLE AT ALL TIMES. REPLACE ANY UNREADABLE DECALS, MARKINGS OR STICKERS. FAILURE TO COMPLY COULD CAUSE SERIOUS INJURIES.

The vehicle contains numerous safety decals that provide essential information for both the operator and technicians. To view a complete list of all the decals, please refer to the **PARTS CATALOG (MPV)**.

3. VEHICULE OVERVIEW

3.1. SPECIFICATIONS AND CONFIGURATIONS

Different configurations are available depending on the task at hand. On standard configurations, although the majority of the vehicle's systems stay the same, a few important differences are to be noted, particularly on the LD (Light Duty) model in comparison to the Standard and HD (Heavy Duty) models.

The notable difference between these models is the differential. The Standard and HD models come with a differential that uses an electromagnetic brake (EMB). The EMB serves as an automatic parking brake and removes the necessity of a handbrake.

For specifications on every standard configuration, refer to the MOTREC website www.motrec.com.

EQUIPMENT COMPARTMENTS:

Removing the deck at the back of the vehicle gives access to all the compartments containing the major systems of the vehicle. Refer to Figure 1 for more details.

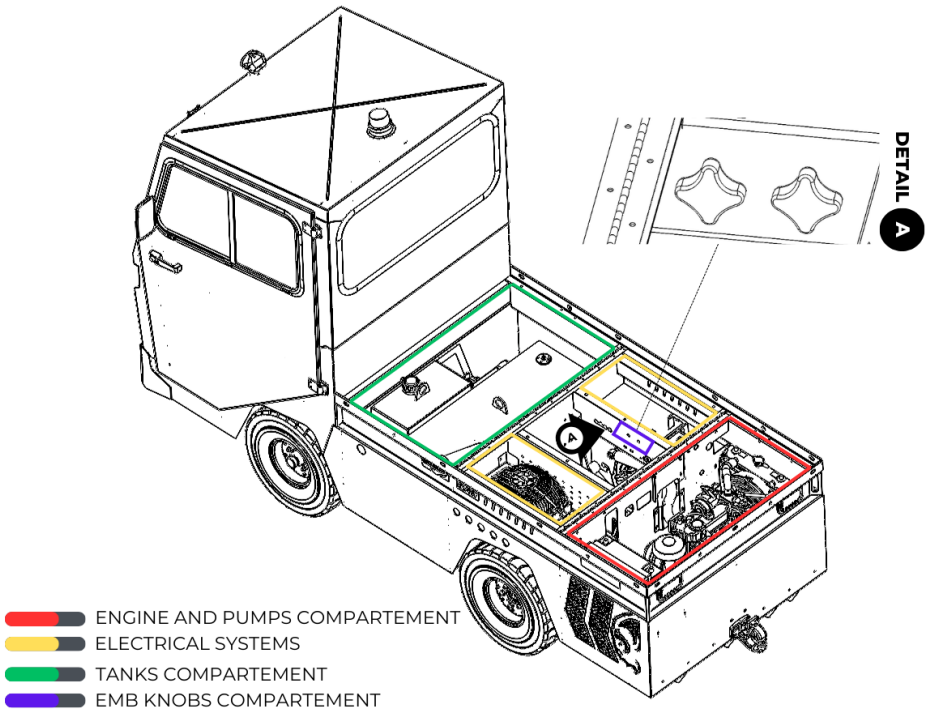


Figure 1. Equipment Compartments.

NOTE 1 : The EMB Service Knobs Compartment is located in the blue zone (illustrated in figure 1) and is easily accessible for maintenance and servicing purposes. The knobs themselves are usually located within the compartment and tightening and loosening the knobs can be done manually.

3.2 ELECTRICAL SYSTEMS

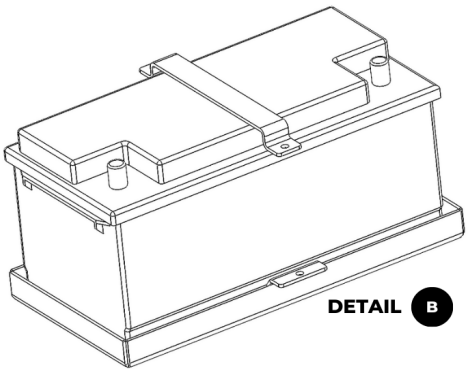
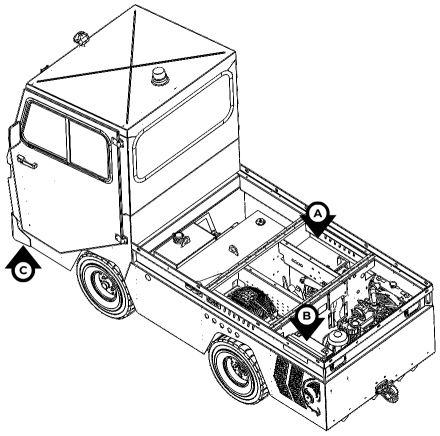


Figure 2. b. 12 V Battery (View B).

Figure 2. a. Electrical System Compartments (View A).



NOTE: The vehicle's frame is to be considered as a ground.

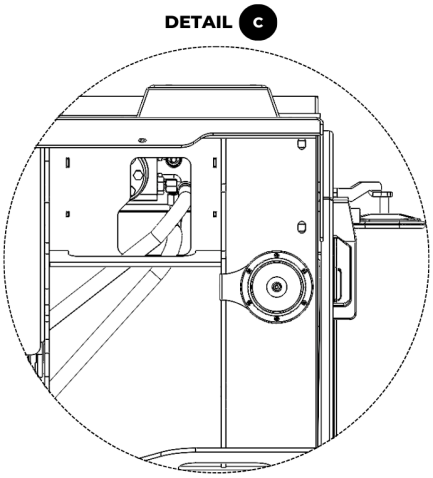


Figure 2. c. Horn Placement (View C).

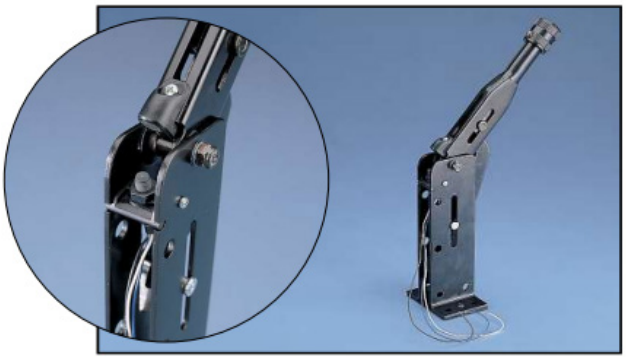


Figure 2. d. Electrical System Compartments : Brake Lever with Electric Switch.

Brake Lever with Electric Switch :

A magnetic electric switch is integrated into the brake lever, serving a pivotal role in the braking system. This switch is responsible for detecting the position of the brake lever, thereby initiating the braking process when the lever is engaged. Additionally, it relays this information to the display, providing real-time feedback on the status of the brake lever to the driver.

3.2.1 TIMER DELAY RELAY

1. **Purpose** : The timer delay annunciator serves as a crucial safety feature designed to promptly shut off the power and bring the vehicle to a stop when specific conditions are met. It is programmed to initiate this action when the temperature exceeds 220°F or when a significant drop in oil pressure is detected. This vital function is executed with a predefined delay of 30 seconds to ensure controlled and safe vehicle shutdown. Additionally, time delay annunciators include a visual alert by activating the emergency lights. This serves as an added layer of safety by alerting the operator.

2. **Connection in the vehicle :**

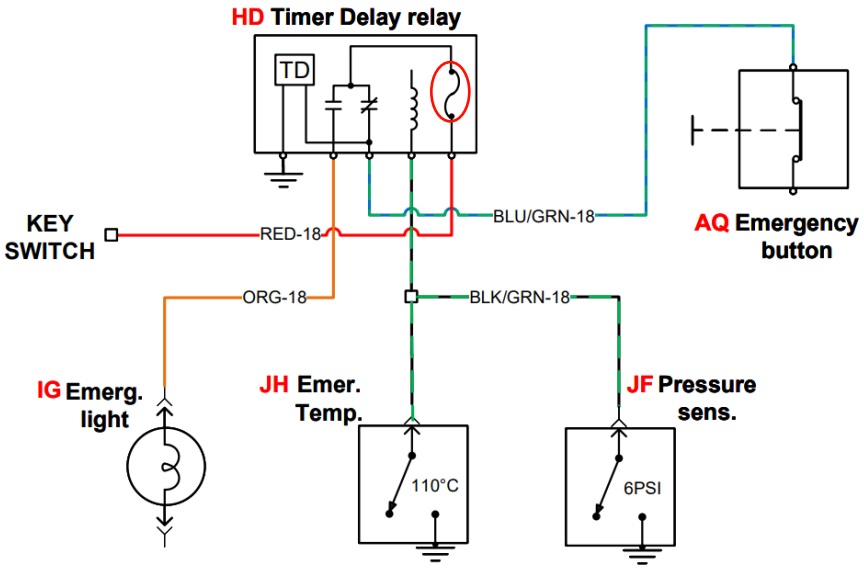


Figure 3. Timer Delay Annunciator Connection -Electrical Diagram-.

IMPORTANT NOTE : A fuse 14 A is connected below the timer delay relay (circled in red) to protect it from potential damage caused by electrical faults. If a fault occurs that could harm the timer delay relay, the fuse will blow, preventing damage to this crucial component.

3.2.2 ADJUSTABLE TIMER INTERLOCK RELAY

1. **Purpose** : The adjustable timer interlock relay's main role is to halt vehicle movement whenever the seat switch no longer detects the operator's weight for duration of 3 seconds (adjustable).

2. **Connection in the vehicle :**

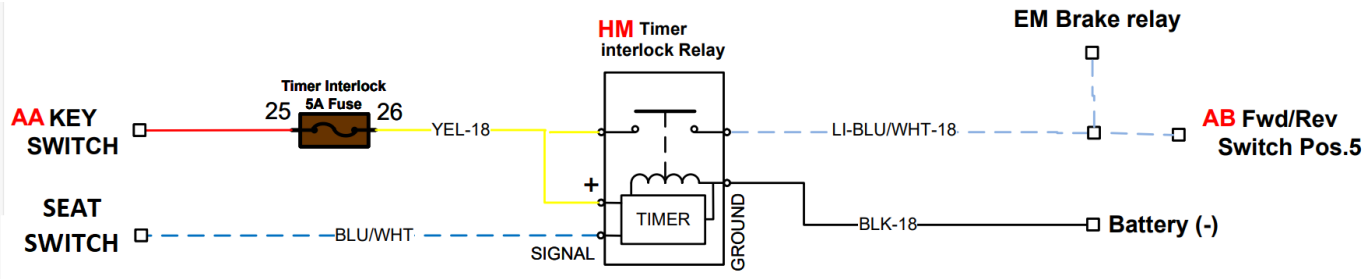


Figure 4. Adjustable Timer Interlock Delay Connection -Electrical Diagram-.

3.4 ENGINE AND REAR AXLE

3.4.1 GAZ ENGINE

The MC-485 IC is powered by gas engine. A gas engine transforms stored fuel energy into mechanical power through controlled explosions within its cylinders. It operates on a four-stroke cycle: intake, compression, power, and exhaust. Fuel is ignited by a spark plug, driving the three pistons, and producing mechanical movement.

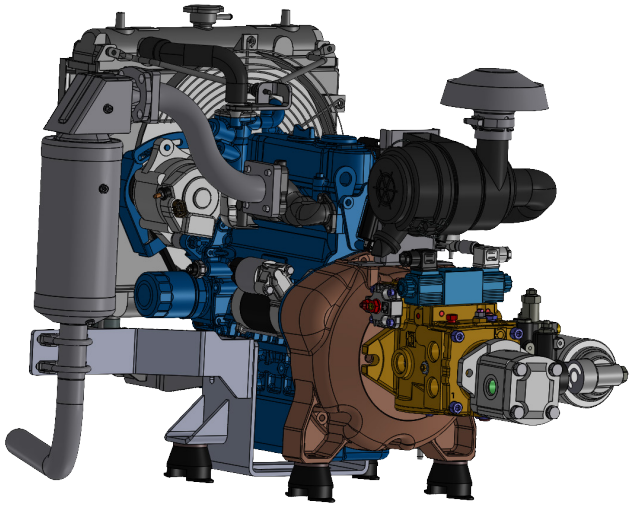


Figure 5. Gas Engine.

3.4.2 LIGHT DUTY (LD) ASSEMBLY

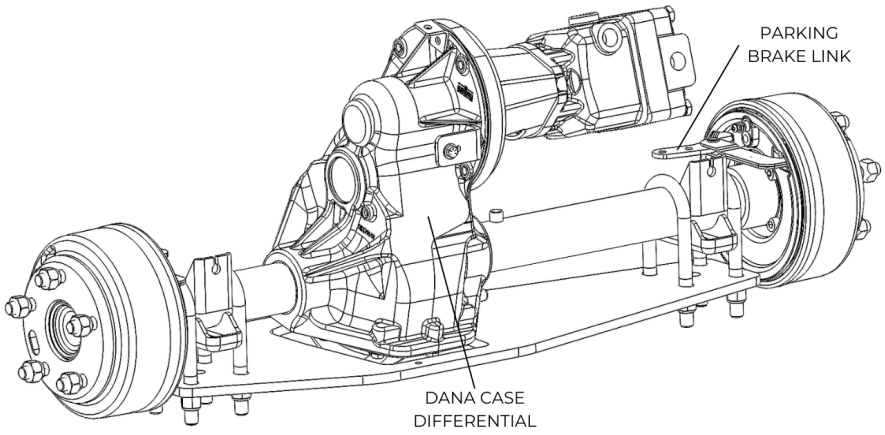


Figure 6. Light Duty Differential.

The LD model is equipped with a specific differential assembly (DANA case). The differential assembly can be identified by its removable bottom cover and protection case (not shown). Compared to the Standard and HD models, the LD model does not include an electromagnetic brake. It instead comes with a manually operated parking brake, connected to the parking brake links on each brake.

3.4.3 STANDARD AND HEAVY DUTY (HD) ASSEMBLY

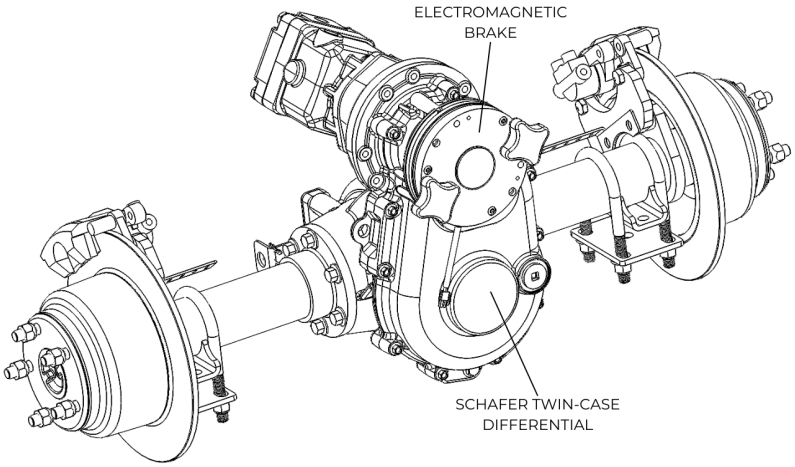


Figure 7. Heavy Duty Differential.

A heavy Duty Differentials are designed to withstand higher loads and torque, making them suitable for rugged and demanding applications, such as towing heavy loads or higher deck capacity. They are essential for ensuring the vehicle's stability, traction, and overall performance under challenging conditions.

3.4.4 ELECTROMAGNETIC BRAKE (EMB)

The MC-485 IC vehicle is equipped with an electromagnetic brake (EMB).

The electromagnetic brake is in a Normally Applied state and is electrically released during operation. This means it requires current to be released and allow movement of the vehicle. This safety feature automatically stops the vehicle in the event of loss of power, therefore removing the need for a handbrake (parking brake).

The spring-applied brake keeps the vehicle stationary when it comes to a stop, or when the power is cut off. In situations where the vehicle is not powered and requires movement, it is necessary to insert the electromagnetic brake's service knobs.

The Electromagnetic Brake System (EMB) is powered by a 24V voltage supplied by a DC/DC converter. This converter takes a 12V input voltage and transforms it into a 24V output voltage, efficiently supplying power to the EMB (Please refer to the electrical diagram shown in Figure 9).

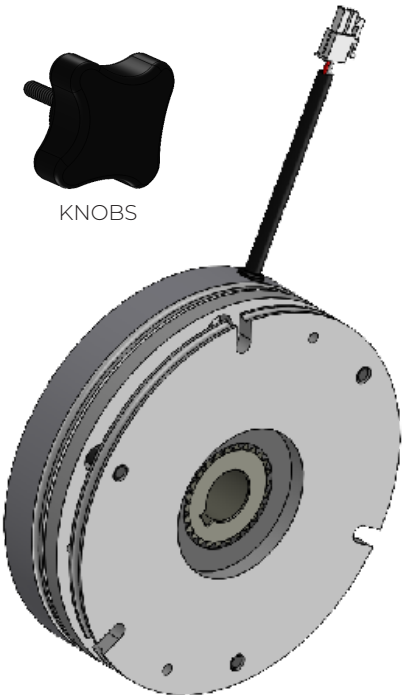


Figure 8. EMB Brake System.

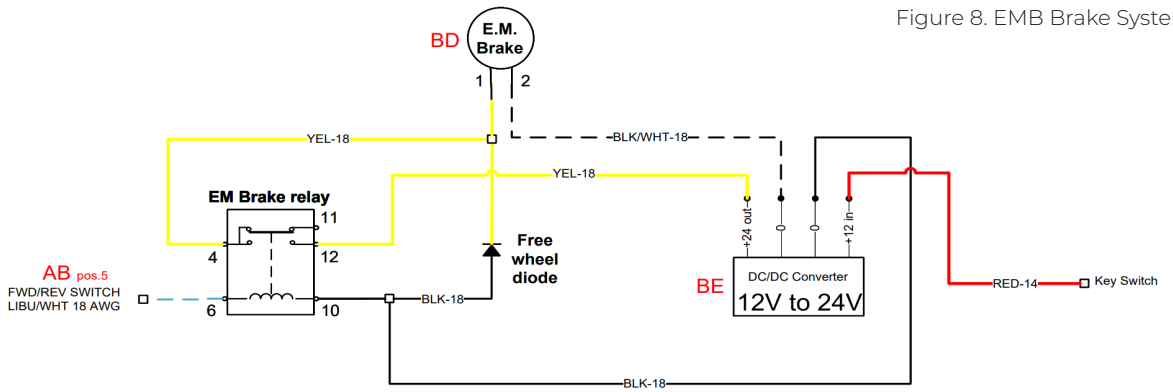


Figure 9. EMB Connection -Electrical Diagram-.

3.5 HYDRAULIC PUMPS

Two hydraulic pumps have been installed within the MC-485.

These are the two types of hydraulic pumps :

1. The hydrostatic pump is responsible for enabling forward and reverse movement. This pump, often referred to as the hydraulic propulsion pump, pressurizes hydraulic fluid from the reservoir and directs it to an axial piston hydraulic motor and a motor-differential adapter that drive the vehicle's wheels forward and backwards.

   Regular inspections for leaks, monitoring fluid levels, and checking for any unusual noises during operation are essential tasks. Additionally, proper maintenance of the entire hydraulic system, including filters and hoses, is necessary to maintain the reliability and efficiency of the propulsion pump.

2. The power steering pump is driven by the vehicle's engine, ensuring a continuous supply of hydraulic pressure while the engine is running. It draws hydraulic fluid from the reservoir, pressurizes it, and sends it through the power steering system to control the right or left movement of the vehicle's wheels.

   Proper maintenance of the power steering pump is essential to ensure optimal steering performance. Regular checks for leaks and proper fluid levels are crucial to the pump's longevity and the overall safety of the vehicle.

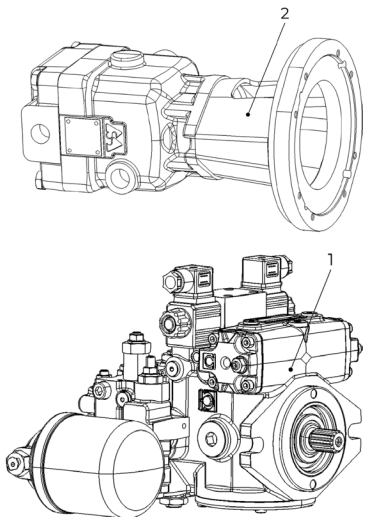


Figure 10. Hydrostatic Pump (1) and Axial Piston Hydraulic Motor / Motor-differential adapter Assembly (2).

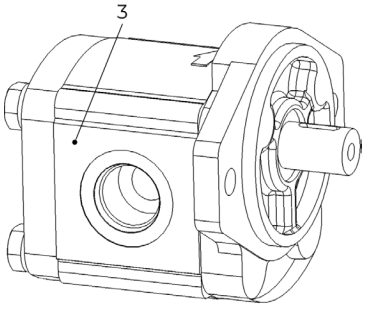


Figure 11. Power Steering Pump (3).

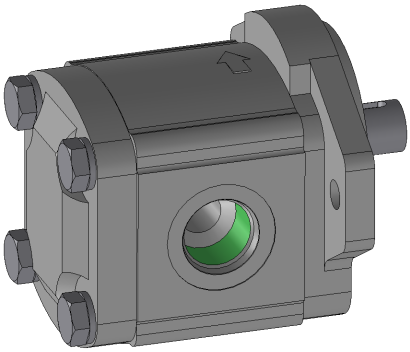


Figure 12. Connections.

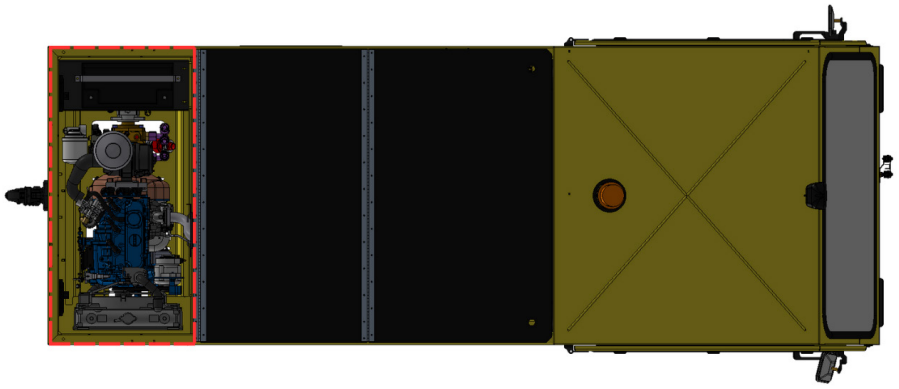


Figure 13. Hydraulic Pumps Compartement (top view).

NOTE : Colors are used to denote connections between elements, as depicted in the figure 12 above with the highlighted green color.

3.6 BRAKE SYSTEM

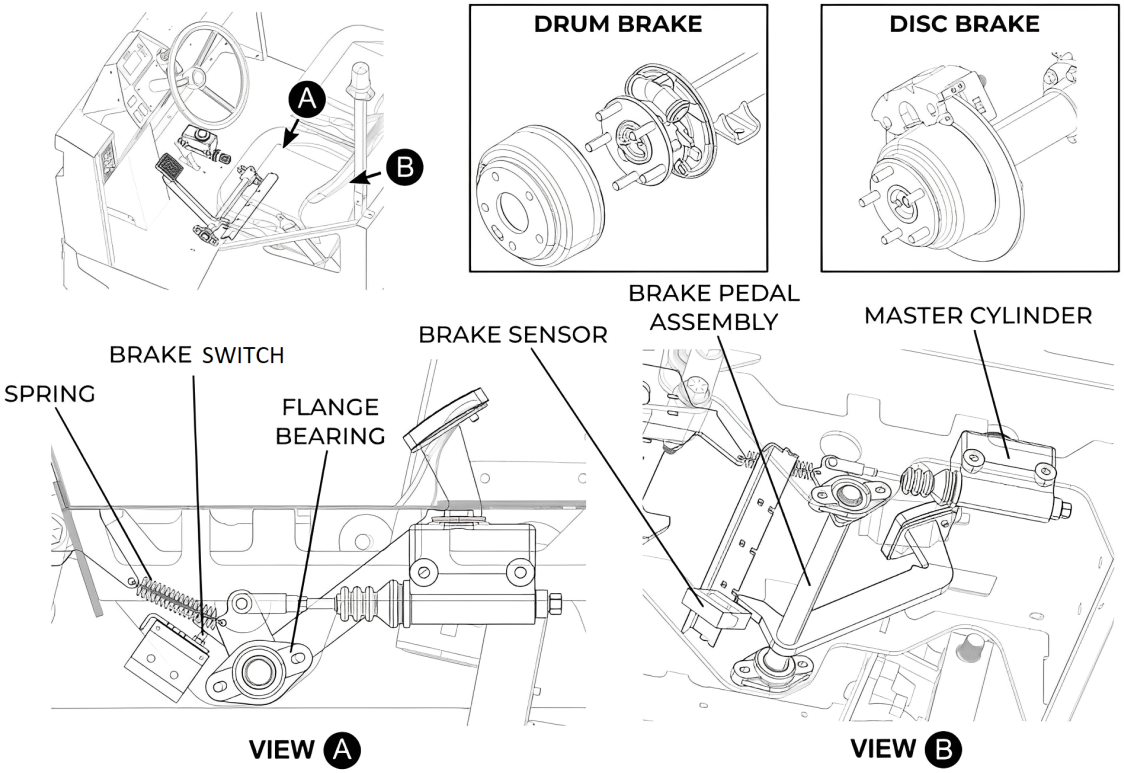


Figure 14. Brake System.

When the driver applies pressure to the brake pedal, it engages the flange bearings, which are components that allow the pedal to move smoothly. The force from the pedal is transmitted to the master cylinder. The master cylinder, in turn, pressurizes brake fluid, which is then directed to the calipers through brake lines. The disc brake assembly includes a rotor and caliper. When the brake pedal is engaged, the caliper squeezes the brake pads against the rotating rotor, creating friction and slowing down the wheel. The brake switch is designed to detect the state of the brake system. Upon contact with the brake assembly, it initiates a signal that activates the brake lights. A spring is incorporated to ensure the prompt release of the brake pedal when pressure is released, allowing for smooth operation. This intricate arrangement guarantees a controlled and reliable deceleration of the vehicle whenever the brakes are applied.

3.7 STEERING SYSTEM

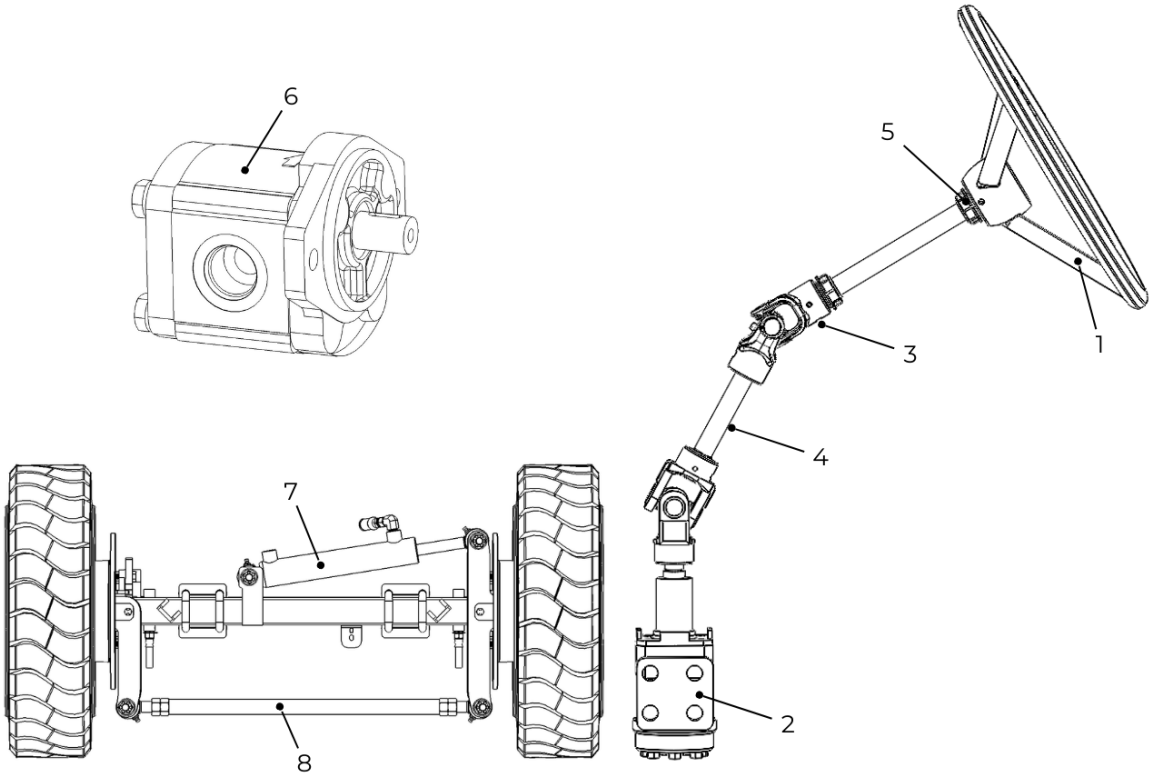


Figure 15. Steering System.

When the driver turns the steering wheel (1), the rotational motion is transmitted through the universal joint (3), steering shaft (4), and igus bushing (5) to reach the orbitrol (2). Essentially, the orbitrol utilizes hydraulic pressure from the power steering pump (6) to convert it into mechanical force, directing the movement of the vehicle's wheels to right or left. This hydraulic pressure is channeled directly to the steering cylinder (7) on the corresponding side of the vehicle, prompting the wheel to turn as needed. The coordinated movement is then replicated by the opposite wheel through an interconnected linkage system (8).

Collectively, these components harmonize their functions, allowing the driver's touch to translate into precise wheel movements, ensuring effortless steering, and ultimately, enhancing the vehicle's navigation and maneuvering capabilities.

3.8 SUSPENSIONS

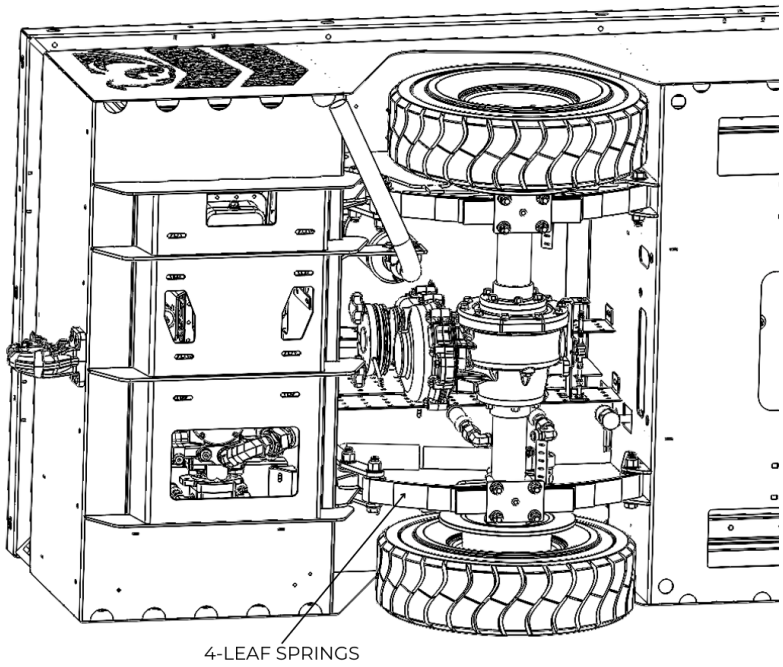


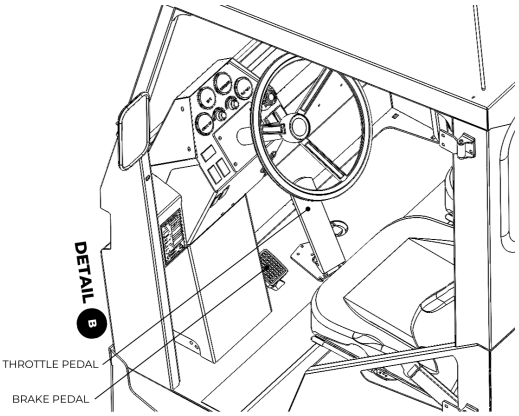
Figure 16. Suspensions.

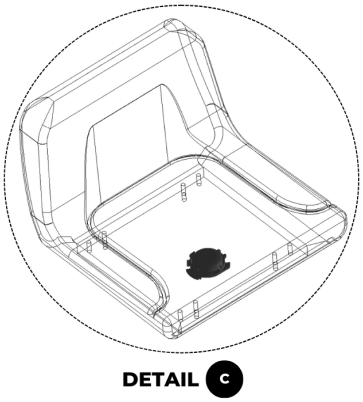
In the default configuration, each MC-485 model is equipped with a leaf spring suspension system at both the front and rear (front not shown). This design ensures optimal stabilization by uniformly distributing the vehicle's weight, effectively absorbing road shocks and vibrations. Furthermore, shock absorbers are installed on the links at the rear and front of the vehicle (front not shown), contributing to enhanced overall handling. The leaf spring suspension, valued for its simplicity, reliability, and remarkable load-carrying capacity, establishes itself as a practical and dependable choice. This configuration not only provides a comfortable and stable ride but also underscores the vehicle's adaptability and performance.

3.9 GENERAL COMPONENTS

Electrical cables

The electrical cables are carefully guided and routed beneath the vehicle. They follow the path provided by the frame, which acts as a designated cable tray. This routing ensures that the cables are neatly organized and protected from potential hazards or obstructions. Their ultimate destination is the console, where they connect to various electrical components, allowing for seamless operation and control within the vehicle.





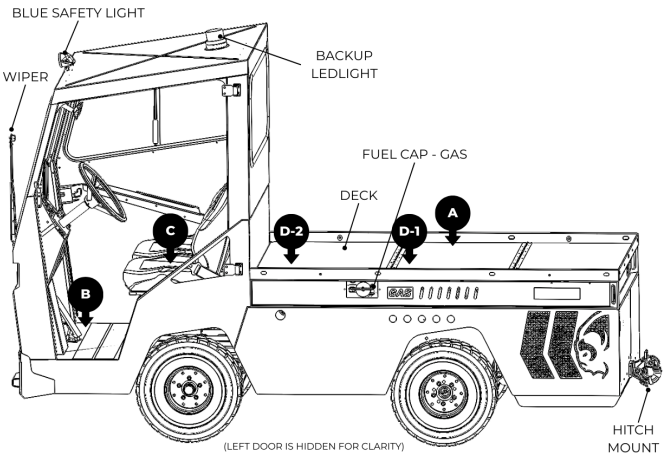


Figure 17. General Components (Detail A, B and C).

Seat Switch

The seat switch installed in every driver's seat acts as a dead man's switch. The vehicle cannot be operated if the seat switch doesn't detect a pressure from the operator.

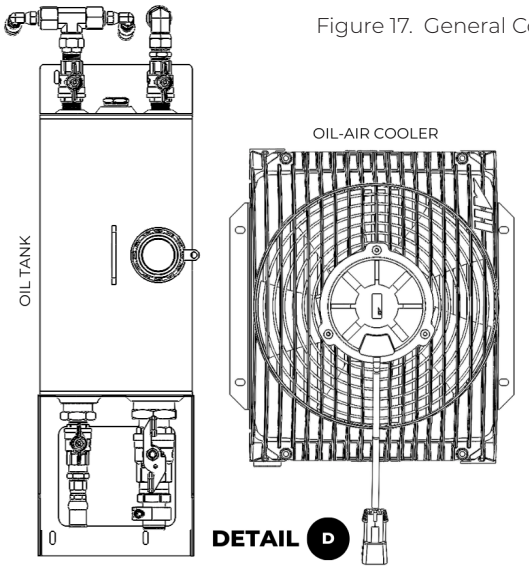


Figure 18. General Components (Detail D).

Oil-Air Cooler

An oil-air cooler is connected to an **oil tank** to manage the temperature of the oil within the system. This type of cooler dissipates heat from the oil by exchanging thermal energy with ambient air. As the oil circulates through the cooler, any excess heat is transferred to the surrounding air, preventing the oil from becoming excessively hot.

3.10 CONSOLE :

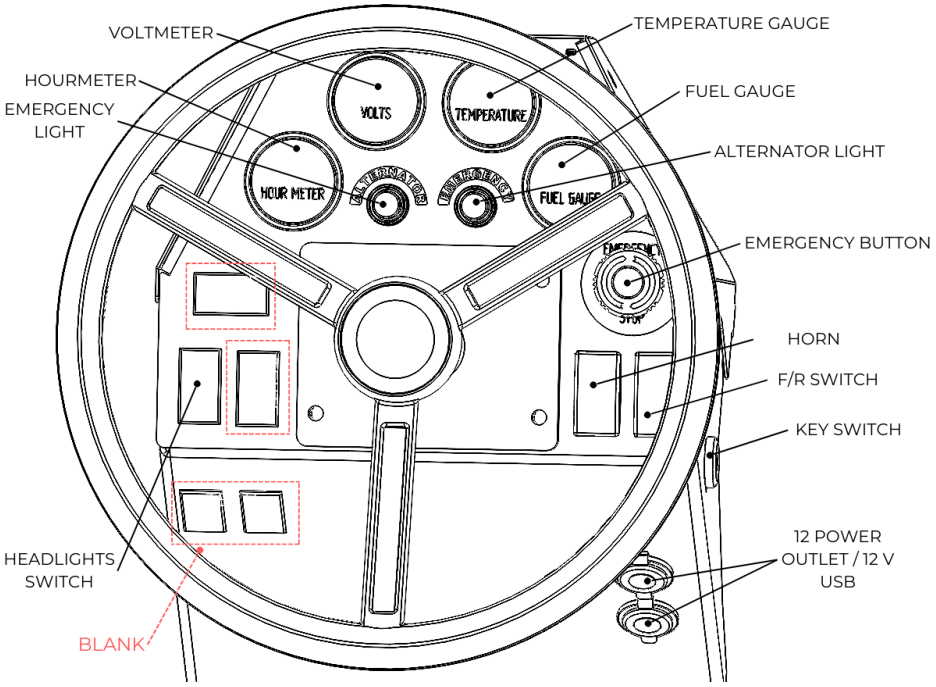


Figure 19. Console.

Direction Switch (Forward/Reverse)

This switch controls the motion direction of the vehicle:

- Pushing the forward arrow on the switch engages the vehicle in forward drive.
- Placing the switch in the neutral position disengages the vehicle.
- Pushing the backward arrow on the switch engages the vehicle in reverse drive.

Key Switch

The key is used to engage or disengage the switch, allowing or preventing the flow of electricity or the operation of the associated device. It also starts the engine.

Emergency Stop Button

The emergency stop button, should only be used in case of emergency. When applied, it will stop immediately the vehicle by engaging the electromagnetic brake (EMB).

CAUTION

DO NOT USE THE EMERGENCY STOP BUTTON TO TURN OFF THE VEHICLE. USE THE KEY SWITCH FOR NORMAL ON/OFF CONTROL. FAILURE TO COMPLY CAN DAMAGE THE EQUIPMENT.

4. MAINTENANCE

4.1 GENERAL INFORMATION

This section provides a general overview of the maintenance procedures for a standard MC-485 vehicle. While the images displayed may not match the exact product due to varying configurations and accessories, the maintenance steps outlined here are applicable to all MC-485 models as they cover the fundamental processes. If you have any maintenance-related questions specific to your product's features, please reach out to MOTREC for assistance.

Before undertaking any maintenance operations, except for daily and weekly preventive maintenance, it is recommended to remove any obstructing accessories installed on the deck. This will facilitate the necessary manipulations and ensure smoother maintenance procedures.

WARNING

DO NOT MANIPULATE ELECTRICAL CONNECTIONS OR GENERATE SPARKS AROUND 12 V BATTERIE. SPARKS CAN CAUSE A BATTERY EXPLOSION AND ACID SPLASHING. DURING MAINTENANCE, USE INSULATED TOOLS THAT DO NOT GENERATE SPARKS. FAILURE TO COMPLY CAN CAUSE SERIOUS INJURIES.

WARNING

KEEP CLEAR FROM MOVING PARTS SUCH AS TIRES, SHEAVES, AND MOTOR. FAILURE TO COMPLY CAN CAUSE INJURIES.

WARNING

WHEN WORKING AROUND THE 12 V BATTERIE, ALWAYS WEAR ACID PROOF PROTECTIVE EQUIPMENT, SUCH AS FACE SHIELD AND THE APPROPRIATE GLOVES. BATTERIES CONTAIN SULFUR ACID THAT CAN CAUSE SEVERE BURNS ON SKIN OR EYES. RINCE CONTAMINATED AREA IMMEDIATELY WITH WATER.

CAUTION

ONLY QUALIFIED AND AUTHORIZED PERSONNEL ARE PERMITTED TO MAINTAIN, REPAIR, ADJUST, AND INSPECT THE VEHICLES AND THEIR BATTERIES. FAILURE TO COMPLY CAN LEAD TO DAMAGE TO THE EQUIPMENT.

NOTICE Follow the maintenance instructions applicable to the type of repair, maintenance, or service.

NOTICE Before maintenance operations, inspect safety decals and labels. Replace if any damage is found and part of the text can't be read.

NOTICE Before replacing a fuse or circuit breaker, identify and repair the cause of failure.

4.1.1 LIFTING POINTS

Please refer to the serial data plate (see Figure 20), positioned on the left side of the console, to determine the total weight of the vehicle. It is important to note that the weight may differ based on the vehicle's specific configuration and accessories.

When utilizing a lifting device, ensure that it can support the precise weight of the vehicle. The suggested lifting points are highlighted below (Figure 21) as a guide for safe and efficient lifting operations.

⚠ WARNING

BEFORE LIFTING, ALWAYS VALIDATE THAT THE LIFTING DEVICE CAN SUPPORT THE TOTAL WEIGHT OF THE VEHICLE, AS INDICATED ON THE VEHICLE'S SERIAL DATA PLATE. FAILURE TO COMPLY CAN LEAD TO SERIOUS INJURIES OR DEATH.

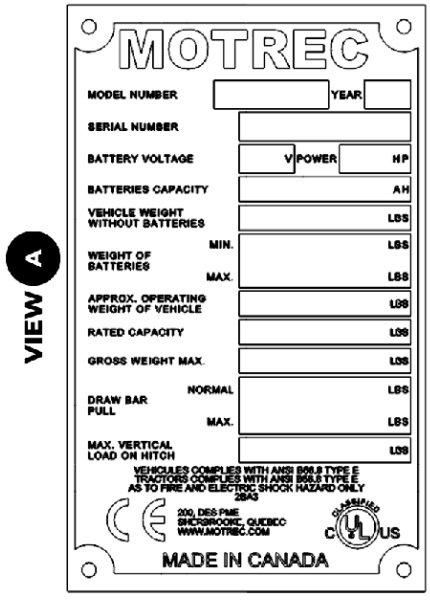


Figure 20. Serial Data Plate.

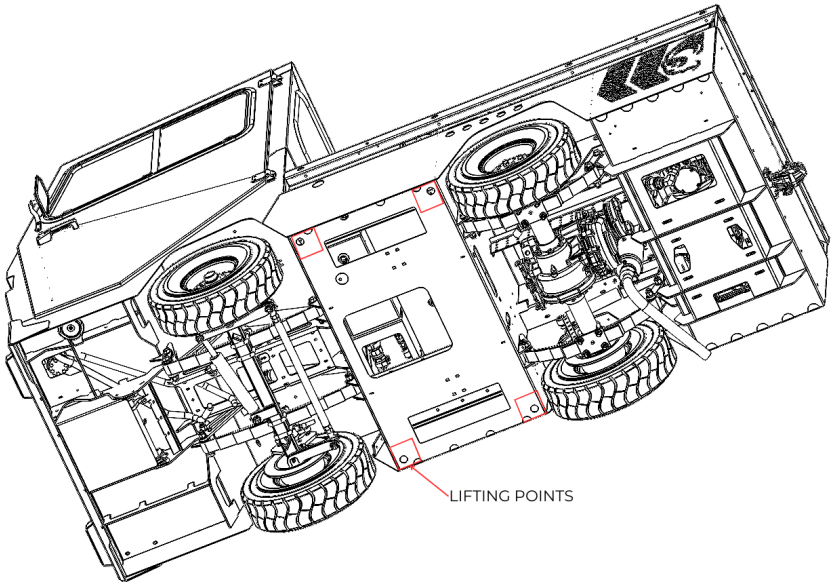


Figure 21. Lifting Points.

4.2.1 DAILY MAINTENANCE

Special Tools	Consumables
▸ N/A	▸ N/A

NOTICE Replace any defective component found during the inspection listed below.

Maintenance Procedures

Visible Damage Inspection

Inspect for excessive visible damage on the exterior of the vehicle or to components under the vehicle (bolts, nuts, pins, ex..).

Fluid Leaks Inspection

A leak could come from the differential. The vehicle may be lifted for further inspection of this symptom as required.

Proceed as follows to inspect :

1. Inspect the following elements for signs of oil and antifreeze leakage :
   - Engine.
   - Radiator.
   - Hoses.
   - Hydraulic steering system.
   - Hydrostatic system.
2. Inspect the master cylinder (1).

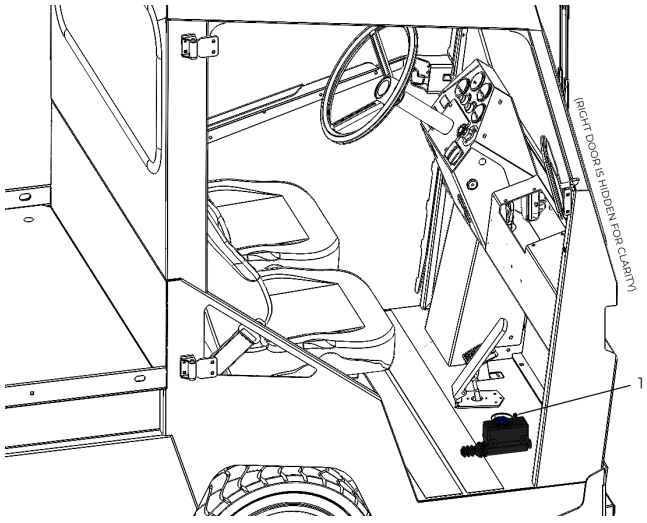


Figure 22. Front Fluid Leaks In The Master Cylinder.

Engine Maintenance

1. Check levels of engine and hydraulic oil.
2. Check the coolant level in the recovery tank.

   Note 1 : If you need to add coolant, do so through the recovery tank. Also, avoid opening the radiator cap while the engine is hot, as it can lead to burns from potential coolant splashes caused by the high pressure within the system.

   Note 2 : If you need to add coolant when the engine is cold, do so through the radiator.
3. Check the fuel gauge on your dashboard to determine the fuel level.
4. Check the engine for abnormal noise or vibrations.
5. Daily cleaning radiator screen and core, panel and hood screens, air filter primary element in the engine compartment.

Steering Inspection

Rock the steering wheel and Inspect the steering system for hard steering, excessive play, or unusual sounds when turning.

Horn and Lights Inspection

Inspect the correct operation of all lights, strobe, horn, and reverse alarm.

Seat Switch Inspection

1. Check that the seat switch is operational by sitting on the driver's seat and validating that no fault is generated on the display while sitting.
2. Validate that the vehicle stops 3 seconds later after removing all weight from driver's seat.

WARNING

DO NOT EXCEED SPEED OF 1 MPH (2 KM/H) WHEN TESTING THE SEAT SWITCH. THE DEACTIVATION OF THE SEAT SWITCH WILL STOP THE VEHICLE SUDDENLY. FAILURE TO COMPLY CAN CAUSE INJURY.

Accelerator Pedal Inspection

1. Inspect the accelerator pedal for free movement and proper return spring tension.
2. Test the accelerator pedal's sensitivity and response. It should provide a smooth and predictable increase in motor as the pedal is pressed. Any delays or irregularities in the response may indicate a problem.

Brake Pedal Inspection

1. Test the pedal's ability to engage and disengage the braking system smoothly. Any inconsistencies or difficulty in brake pedal operation could indicate problems with the mechanical components or linkage.
2. Inspect the pedal for free movement and firm pedal.

Electromagnetic brake (EMB) Inspection

1. Set the vehicle to neutral.
2. Engage the electromagnetic brake (EMB).

   NOTE : turn OFF the vehicle in order for the EMB to automatically engage.
3. Push the vehicle to validate that the parking brake is correctly engaged. The vehicle should not move.
4. Confirm the EMB disengagement by listening for a clicking sound when the vehicle begins to move.

Tire Pressure Inspection

Check that each tire maintains a pressure rating of approximately 60 psi (only if the tires are pneumatic). Additionally, thoroughly inspect the tires for any signs of of punctures, damage, or excessive wear.

Hydrostatic Pump Inspection

Before each starting up of the machine:

1. Check oil level in the reservoir.
2. Clean heat exchanger.
3. Check reservoir breather cleanness.

WARNING

ENSURE THAT THE HYDRAULIC SYSTEM IS SHUT OFF AND DEPRESSURIZED BEFORE STARTING ANY MAINTENANCE WORK. THIS WILL HEPLP TO PREVENT ACCIDENTAL MOVEMENT OF HYDRAULIC COMPONENTS AND REDUCE THE RISK OF INJURY.

WARNING

WEAR APPROPRIATE SAFETY GEAR, INCLUDING GLOVES AND GOGGLES, TO PROTECT YOURSELF FROM HYDRAULIC FLUID AND OTHER CONTAMINANTS.

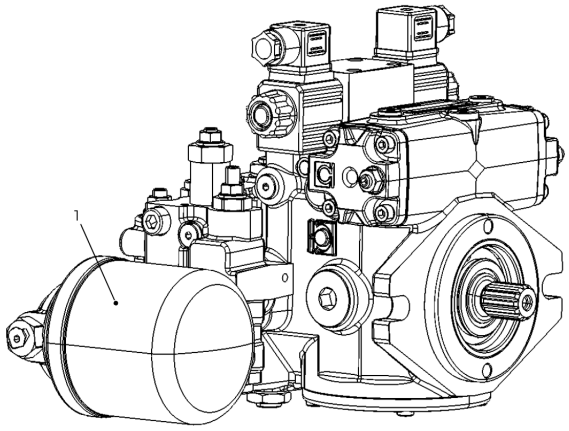


Figure 23. Hydrostatic Pump.

Emergency Button Inspection

1. Visually inspect the button for any visible damage or irregularities.
2. Test the emergency button to verify that it activates as intended. Ensure it depresses and releases smoothly without any sticking.

4.2.2 WEEKLY MAINTENANCE

Special Tools	Consumables
▸ Oil drain pan ▸ Safety glasses and gloves	▸ Engine oil (for refilling) : SAE 10W-30 ▸ Engine oil filter ▸ Hydraulic oil filter ▸ Hydraulic oil (for topping up, if necessary) : ISO32

NOTICE Replace any defective component found during the inspection listed in this procedure.

NOTICE The daily maintenance should be carried out concurrently with this maintenance. Certain steps may not be necessary due to redundancy.

NOTICE Perform “Engine Oil and Oil Filter Replacement” and “Hydraulic Oil Filter Replacement” after the first 50 hours of operation. Subsequently, repeat these tasks at intervals of 1000 or 2000 hours.

Maintenance Procedures

Engine Oil and Oil Filter Replacement

1. Replace engine oil filter that is located on the engine block under the alternator.
2. For engine oil replacement you may proceed as follows :

   2. 1. Place an oil drain pan beneath the engine to catch the draining oil.

   2. 2. Loosen and remove the drain plug (1) at the bottom of the engine.

   2. 3. Allow the old engine oil to drain completely into the oil drain pan.

   2.4. Once the oil has drained completely, replace, and tighten the drain plug. The appropriate torque value is 24 ft lbs.

3. For oil filter replacement you may proceed as follows :

   3. 1. Place an oil drain pan under the oil filter to catch any residual oil when you remove it.

   3. 2. loosen old oil filter (2) and remove it.

   3. 3. Allow any remaining oil in the filter and filter housing to drain into the drain pan.

   3. 4. Before installing the new filter, lightly coat the rubber gasket on the top of the filter with a small amount of fresh engine oil. This will help create a good seal and make it easier to remove during the next oil change.

   3. 5. Screw the new oil filter into place by hand.

   NOTE : Do not use a wrench to tighten it, as this can damage the filter or make it difficult to remove during the next oil change.

4. Add 3.25 L of engine oil.
5. Start the engine and allow it to run for a few seconds to circulate the new oil. Then, turn off the engine and check around the oil filter (2) and drain plug (1) for any signs of leaks. If you see any, tighten the filter or plug as needed.
6. Check oil level.

⚠ WARNING

ENSURE THE VEHICLE OR EQUIPMENT IS SAFELY PARKED AND THE ENGINE IS OFF.

WARNING

ENSURE THE HYDRAULIC SYSTEM IS SHUT DOWN, AND THE VEHICLE IS SAFELY PARKED OR BLOCKED TO PREVENT ANY ACCIDENTAL MOVEMENT.

WARNING

WEAR APPROPRIATE PROTECTIVE EQUIPMENT, SUCH AS SAFETY GLASSES AND GLOVES.

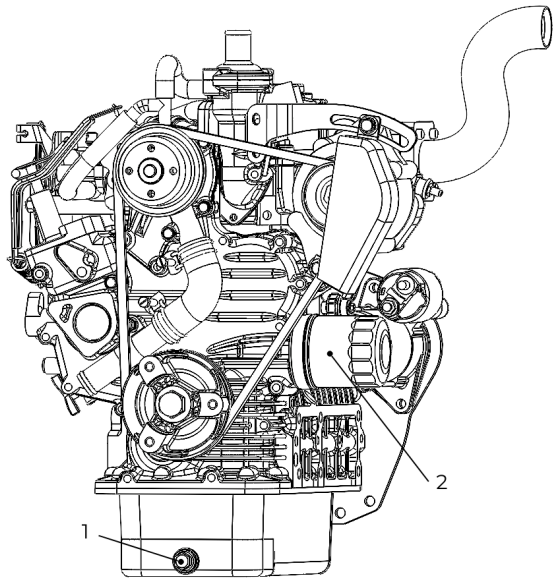


Figure 24. Gas Engine.

Hydraulic Oil Filter Replacement

Replace, if necessary, the hydraulic oil filter (1) to keep the fluid clean (every 50 hours is recommanded).

NOTE : Place a drip pan or absorbent materials beneath the filter housing to catch any spilled hydraulic fluid.

WARNING

ENSURE THAT THE HYDRAULIC SYSTEM IS SHUT OFF AND DEPRESSURIZED BEFORE STARTING ANY MAINTENANCE WORK. THIS WILL PREVENT ACCIDENTAL MOVEMENT OF HYDRAULIC COMPONENTS AND REDUCE THE RISK OF INJURY.

WARNING

WEAR APPROPRIATE SAFETY GEAR, INCLUDING GLOVES AND GOGGLES, TO PROTECT YOURSELF FROM HYDRAULIC FLUID AND OTHER CONTAMINANTS.

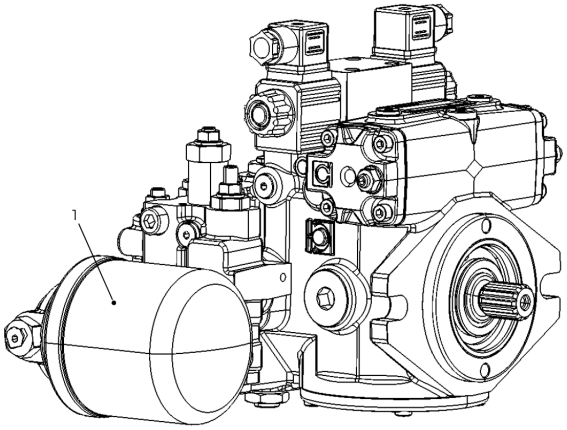


Figure 25. Hydrostatic Pump Oil Filter Replacement.

4.2.3 EVERY 250 HOURS OR 3 MONTHS MAINTENANCE

Special Tools	Consumables
▸ Lifting device ▸ Oil drain pan ▸ Safety glasses and gloves	▸ Multi purpose Grease ▸ Compressed air

NOTICE Replace any defective component found during the inspection listed in this procedure.

NOTICE When required, lift the vehicle using a lifting device as per section 4.1.1 LIFTING POINTS.

IMPORTANTE NOTE : **All** maintenance **procedures** in the "**weekly maintenance**" section need to be **repeated**, except for the "Engine Oil and Oil Filter Replacement" subsection.

Maintenance Preparation Steps

Before conducting any maintenance tasks, it is essential to follow the subsequent steps to ensure safety during maintenance and enable easy access to components.

1. Remove the deck (1).

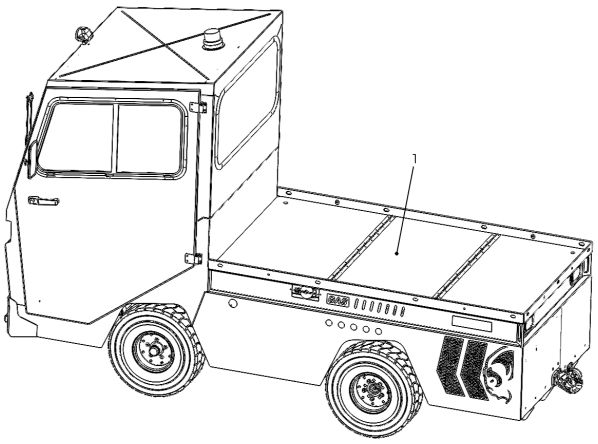


Figure 26. Deck Removal.

2. Remove the dashboard cover (2).

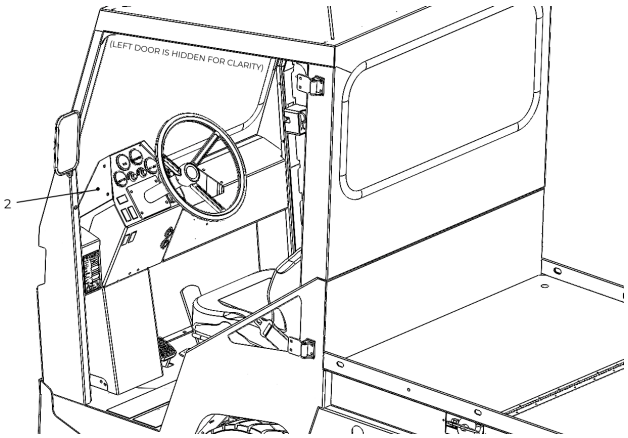


Figure 27. Dashboard Cover.

Maintenance Procedures

Suspension Inspection

1. Inspect the following equipment for damage, corrosion or oil stains:
   - Front leaf springs (1) and their fixtures (2).
   - Rear leaf springs (3) and their fixtures (4).
   - Rear shock absorbers (5).
2. Inspect all suspension frame bearings for play.
3. Examine the bushings and mounts for wear or damage.

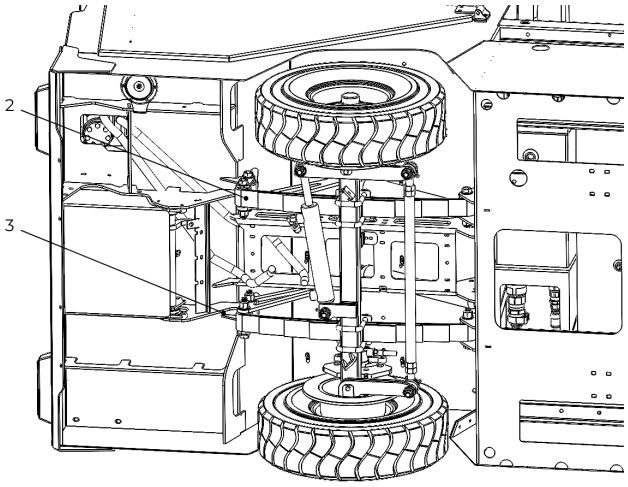


Figure 28. Front Suspension Inspection.

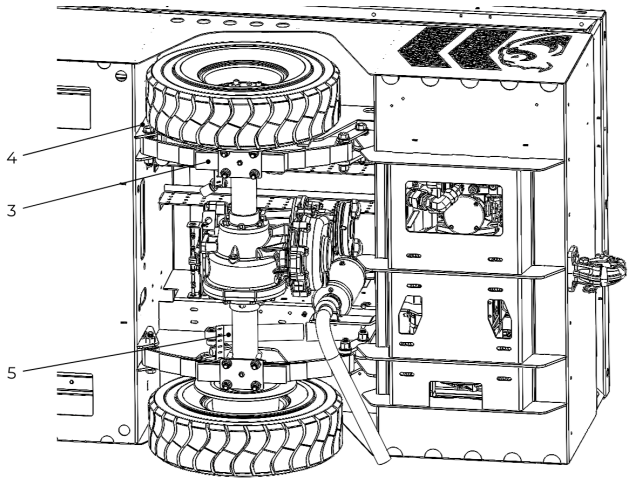


Figure 29. Rear Suspension And Shock Absorbers Inspection.

Rubber Bumper Inspection

Inspect rubber bumper installed on the vehicle components for signs of damage, cracks or dryness.

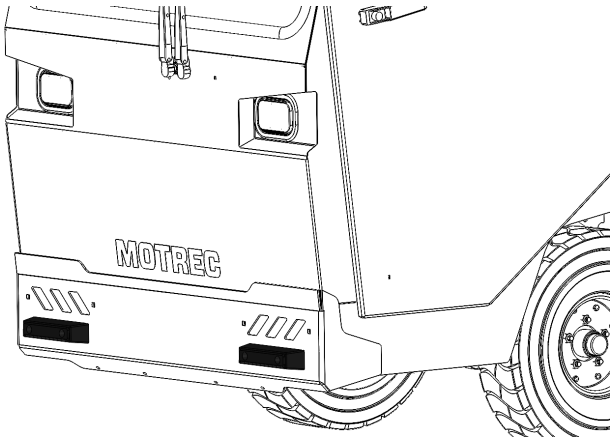


Figure 30. Rubber Bumper Inspection.

Steering Inspection

1. Inspect the universal joint (1) and the four tie rods ends (2) for (See Figures 31 and 32):

   - Play.
   - Damage.
   - Binding.
   - Corrosion.

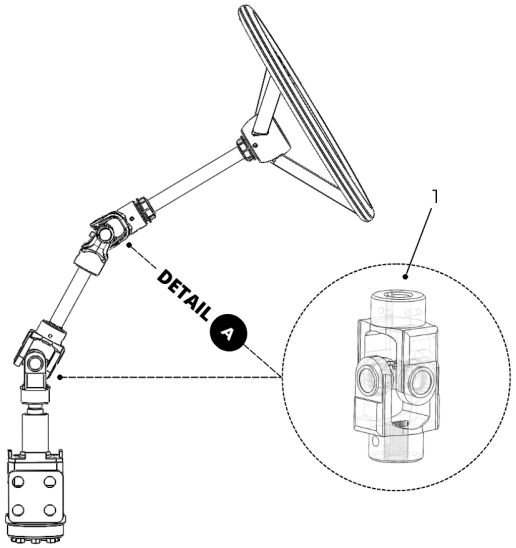


Figure 31. Universal Joint Inspection.

Figure 32. Tie Rods Ends Inspection.

2. Inspect the following elements for damage, corrosion or loose :

   - Steering cylinder (3). (See Figure 33)
   - Steering shafts (4). (See Figure 15 page 16)
   - Axle beam (5). (See Figure 33)
   - Right and left spindles (6). (See Figure 33)
   - Tie rod (7). (See Figure 33)

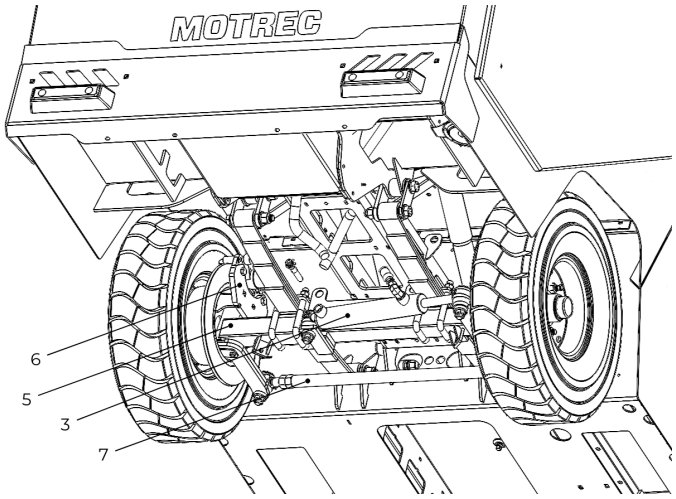


Figure 33. General Steering Inspection.

Grease Fittings Lubrication

Lubricate the grease fittings of the following components (See Figures 31 and 32 page 33) :

- The universal joint (1).
- The four tie rods ends (2).

Electromagnetic Brake Inspection

1. Chock the vehicle's wheels.
2. Remove the electromagnetic brake's rubber shield (1).
3. Insert the service knobs (2) to free the electromagnetic brake's rotor.
4. Clean the gap (3) created with compressed air.

   NOTE : It is crucial not to breathe during this process due to potential airborne particles.

5. Remove the service knobs (2) from the electromagnetic brake.

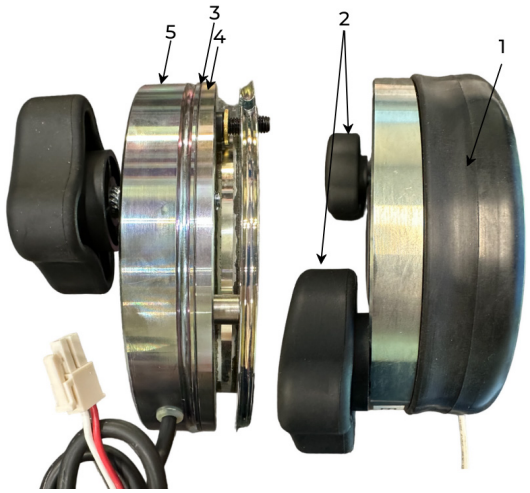


Figure 34. EMB Inspection.

6. Using a feeler gauge, measure the air gap (3) between pressure plate (4) and the electromagnet (5).
   - → If the air gap is 0.030'' or less, skip to next step.
   - → If the air gap is greater than 0.030'', check the tag on the electromagnetic brake:
   - – Replace the EMB's rotor if a CNX brake is installed.
   - – Replace the EMB assembly if a Warner brake is installed.
7. Reinstall the rubber shield (1). Replace rubber shield (1) if the rubber shows any sign of dryness or damages.
8. Remove the knobs (2).

⚠ WARNING

DO NOT BREATHE THE AIR WHILE CLEANING WITH COMPRESSED AIR. USE PROPER RESPIRATORY PROTECTION IF NECESSARY.

Engine Maintenance

1. Check levels of engine and hydraulic oil.
2. Check the coolant level in the recovery tank.

   Note 1 : If you need to add coolant, do so through the recovery tank. Also, avoid opening the radiator cap while the engine is hot, as it can lead to burns from potential coolant splashes caused by the high pressure within the system.

   Note 2 : If you need to add coolant when the engine is cold, do so through the radiator.
3. Check the fuel gauge on your dashboard to determine the fuel level.
4. Check the engine for abnormal noise or vibrations.
5. Daily cleaning radiator screen and core, panel and hood screens, air filter primary element in the engine compartment.
6. Check alternator belt tension and adjust it if necessary.

   6. 1. loosen the two adjustment bolts (1). Turn it counterclockwise to allow the alternator to move more freely.

   6. 2. Insert a pry bar behind the alternator, applying pressure to push it away from the engine.

   6. 3. Apply pressure with the pry bar to create tension on the V-belt. This will increase the tension as the alternator moves away from the engine (Deflection 1/64'' per inch per span).

   6. 4. While maintaining pressure with the pry bar, tighten the two adjustment bolts (1). Turning it clockwise will secure the alternator in the new position and maintain the desired tension on the belt.

   6. 5. After tightening the adjustment bolt (1), check the tension of the belt. Ensure that it is tight enough to prevent slipping but not overly tight, causing strain on the components.

   6. 6. Ensure the belt is properly seated and aligned. Check for any signs of misalignment or unusual noises.

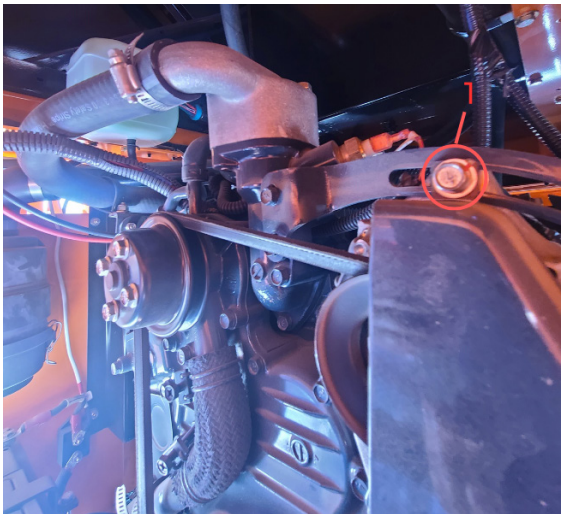


Figure 35. Belt Tension Adjustment.

7. Replace fuel filter element.

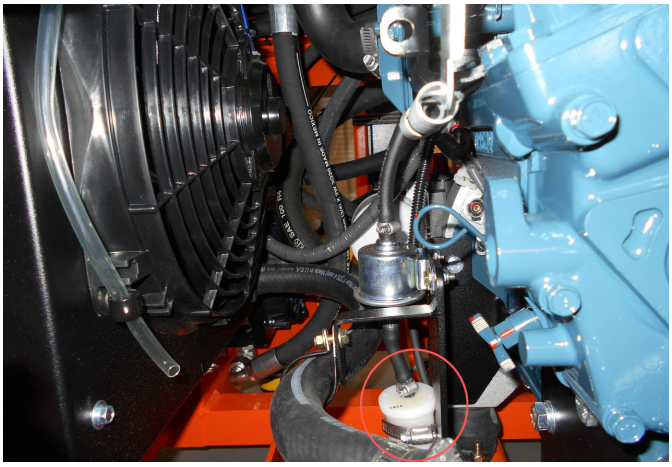


Figure 36. Location of the Fuel Filter In the Gas Engine.

8. Check all engine gaskets and seals for leaks.

Test Drive

After the maintenance is finished, it is necessary to reinstall any disassembled parts and conduct a thorough test on the vehicle to ensure that all systems are functioning correctly.

1. Reinstall the dashboard cover.
2. Turn on all switches and test lights.
3. Turn on the ignition and start the engine.
4. Test the vehicle's forward and backward movement, steering, and handling for proper functionality and responsiveness. Ensure there is no excessive play in the steering and observe how the vehicle performs.
5. Listen for unusual noises and be alert to any unusual vibrations. These could indicate problems with the vehicle.
6. Keep an eye on the vehicle's gauges, such as the hour meter, fuel gauge, temperature gauge, and any warning lights. Ensure they're all functioning as expected.
7. Test any safety features, such as emergency stop button and seat switch, to ensure they function as intended. When either one is pressed, the engine should promptly stop as intended.
8. Reinstall the deck.

4.2.4 EVERY 500 HOURS OR 6 MONTHS MAINTENANCE

Special Tools	Consumables
▸ N/A	▸ Lubricant spray ▸ Multi-purpose Grease

NOTICE Replace any defective component found during the inspection listed in this procedure.

NOTICE When required, lift the vehicle using a lifting device as per section 4.1.1 LIFTING POINTS.

NOTICE The 250 hours or 3 months preventive maintenance should be carried out concurrently with this maintenance. Certain steps may not be necessary due to redundancy.

Maintenance Preparation Steps

Before conducting any maintenance tasks, it is essential to follow the subsequent steps to ensure safety during maintenance and enable easy access to components.

1. Remove the deck (1)

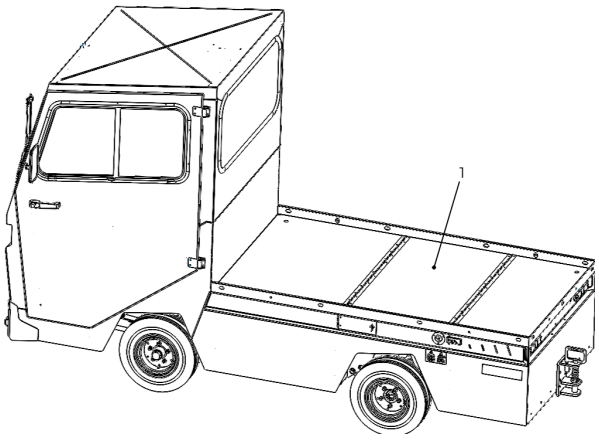


Figure 37. Deck Removal.

Maintenance Procedures

Decals and Labels Inspection

Inspect decals and safety labels for damage. Replace them if any part of the text is illegible.

Door Maintenance

NOTE : Applicable only if the vehicle is equipped with doors.

1. Inspect the following components for damage or corrosion:
   - Hinge (1).
   - Latch mechanism (2).
2. Lubricate the following components with lubricant spray:
   - Hinge (1).
   - Latch mechanism (2).
   - Lock mechanism (3).

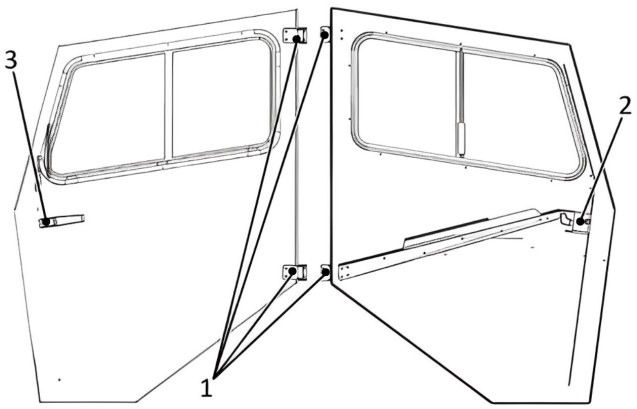


Figure 38. Door Maintenance.

Frame Inspection

1. Inspect the vehicle's frame for the following elements:

   - Cracks.

   - Damage.

   - Corrosion.

2. The following frame locations should be inspected with care:

   – Side panels corners (both sides). There is a possibility of cracks occurring in these corners as they undergo significant stress (see Figure 39).

   – Rear suspension mounting tabs (see Figure 40).

   – Front suspension mounting tabs (see Figure 41).

   – Hitch mounting area (see Figure 42).

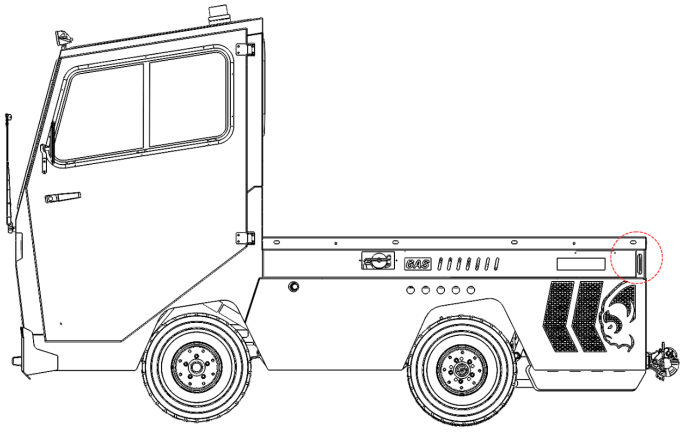


Figure 39. Side Panels.

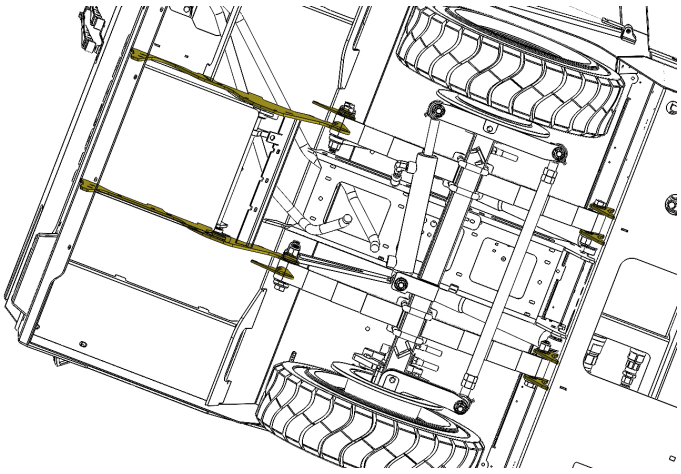


Figure 40. Front Suspension Mounting Tabs.

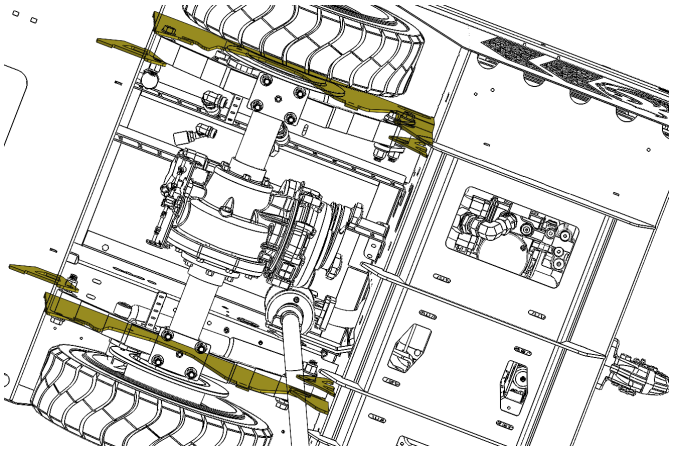


Figure 41. Rear Suspension Mounting Tabs.

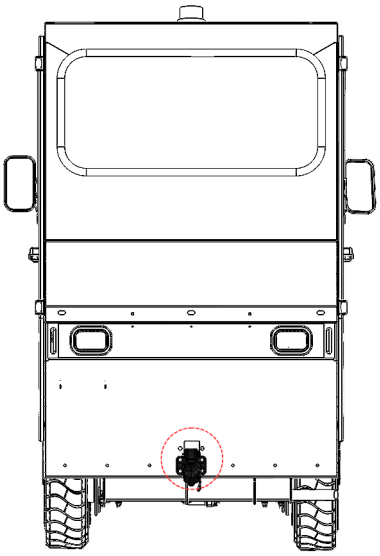


Figure 42. Hitch Mounting.

Disc Brake Inspection

proceed as follows for each of the vehicle's disc brake inspection:

1. Remove all hex bolts (1) and wheel nuts (2) to remove the wheel (3).

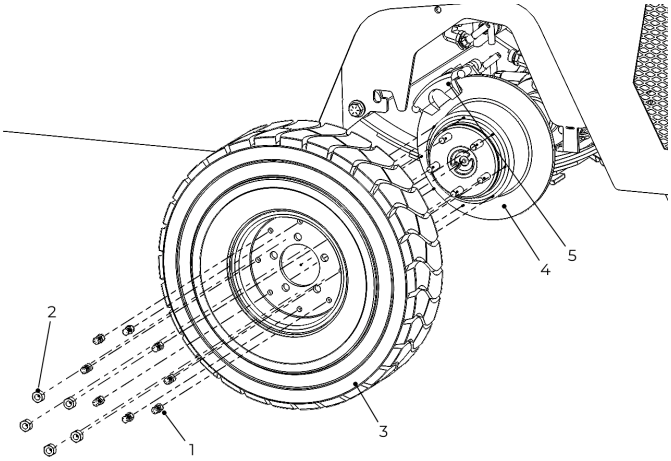


Figure 43. Wheel Removal.

2. Remove the slide pins (6) to release the caliper (5) from the disc (4).
3. Clean both caliper (5) and slide pins (6) from any dust or debris.
4. On the disc (4), clean the seating surface of the caliper (5) from any debris.

Figure 44. Slide Pins and Caliper Removal.

5. Inspect the brake pads (7). Replace them if the lining thickness is 1/16 in (2 mm) or less.
6. Clean the following elements to remove any dust or debris:
   - Shims (8).
   - Shims holders (9).
   - And gap in the brake pad (10).

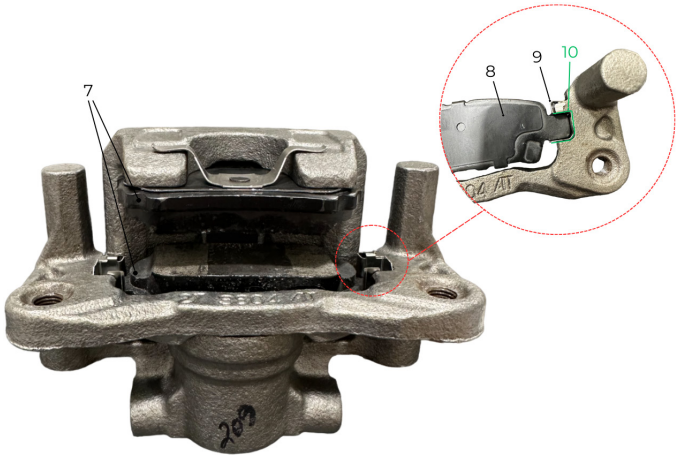


Figure 45. Brake Pads and Shims Inspection.

7. Reassemble all components in the reverse sequence and don't forget to grease the slide pins (6) before returning them to their place.

   NOTE: Regarding the wheel nuts (2), tighten them to the specified standard torque value of 80 ft lbs.

Drum Brakes Inspection

proceed as follows for each of the vehicle's rear drum brakes:

1. Remove the wheel nuts (1) and wheel (2)
2. Remove the brake drum (3).
3. Clean brake dust with water.
4. Inspect the drum brake (3) for excessive wear or scoring.
5. Inspect the drum shoes. Replace the shoes and springs if the lining thickness is 1/16 in (2 mm) or less.

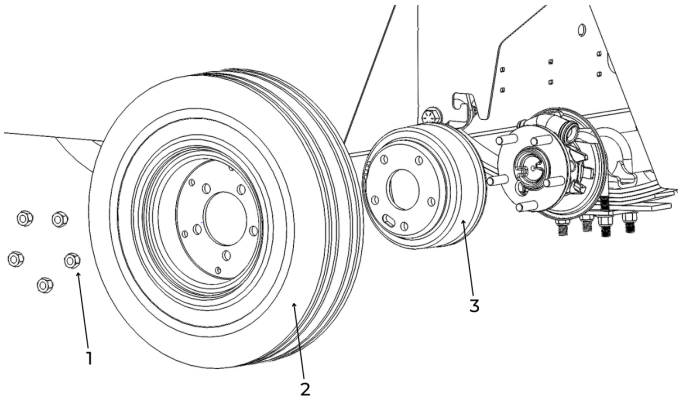


Figure 46. Drum Brakes Inspection.

6. Reinstall the brake drum (3)
7. Reinstall the wheel (2) and the wheel nuts (1). Torque the wheel nuts (1) to standard values. The appropriate torque value is 80 ft lbs.

Brake System Inspection

1. Inspect the brake system components (1) for signs of corrosion, damage or leaks.
2. Inspect the brake fluid level in the master cylinder (2) placed underneath the master pedal mat. Refill with DOT-3 fluid brake if required.

   NOTE : A low level of brake fluid indicate either brake wear or fluid leaks.

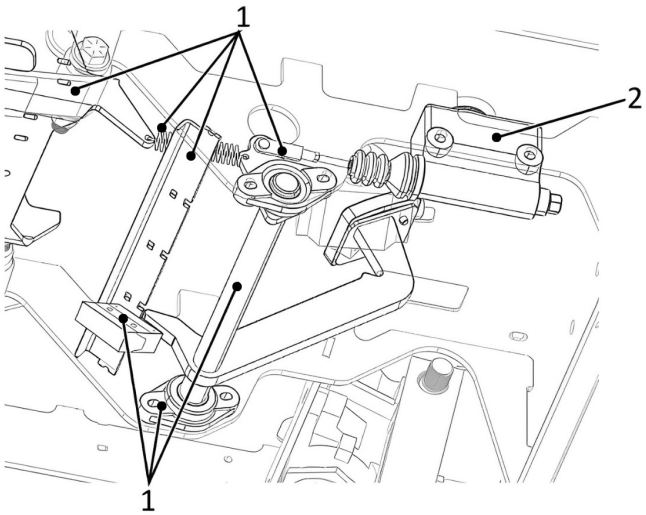


Figure 47. Brake System Inspection.

3. Check brake mechanical linkages for wear and play.
4. Check brake linings / pads for wear (1/16” (1 mm) minimum lining thickness).

Front Wheels Bearings Inspection

Inspect all wheel bearings for:

- Play.

- Stiffness.

- Abnormal noise.

NOTE : Please refer to page 42, specifically the “Front Wheel Bearings Maintenance” section, for instructions on replacing the bearing.

Engine Maintenance

1. Check alternator belt for cracks or wear.
2. Check sparkplugs.

Hydrostatic Pump Inspection

Replace, if necessary, the hydraulic oil filter (1) to keep the fluid clean (every 500 hours is recommanded).

NOTE : Place a drip pan or absorbent materials beneath the filter housing to catch any spilled hydraulic fluid.

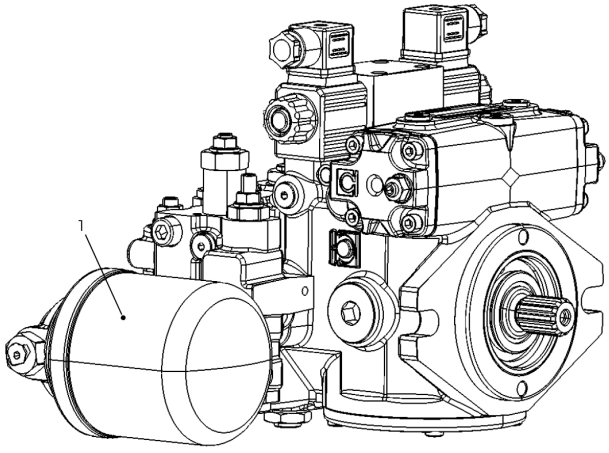


Figure 48. Hydrostatic Pump Oil Filter Replacement.

WARNING

ENSURE THAT THE HYDRAULIC SYSTEM IS SHUT OFF AND DEPRESSURIZED BEFORE STARTING ANY MAINTENANCE WORK. THIS WILL PREVENT ACCIDENTAL MOVEMENT OF HYDRAULIC COMPONENTS AND REDUCE THE RISK OF INJURY.

WARNING

WEAR APPROPRIATE SAFETY GEAR, INCLUDING GLOVES AND GOGGLES, TO PROTECT YOURSELF FROM HYDRAULIC FLUID AND OTHER CONTAMINANTS.

Handbrake Adjustement

Here are the steps for adjusting the handbrake:

1. Loosen the handle locking screw to be able to move the handle adjustment.

Figure 49. Handbrake Adjustement.

2. Then, by hand turn the adjusting handle in the appropriate direction. Turning the adjusting handle clockwise typically tightens the handbrake, while turning it counterclockwise loosens it

   NOTE : If the Clevis Pin is positioned on the lower side, it indicates that the handbrake is loosened. Conversely, if it's on the higher side, it indicates that the handbrake is very tightened.

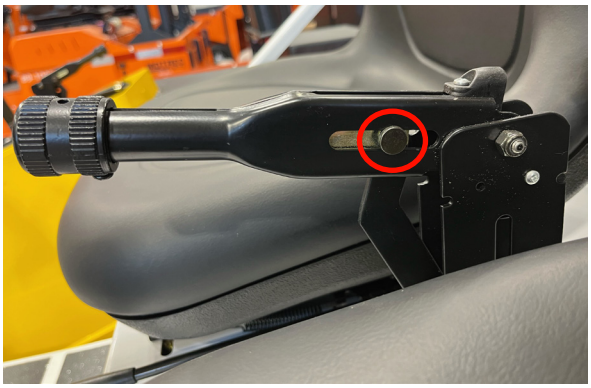


Figure 50. Clevis Pin Position

3. Continue turning the adjusting handle until the desired tension is achieved.
4. Once the adjustment is complete, tighten the handle locking screw securely to maintain the new setting.
5. Test the handbrake to ensure it holds the vehicle securely when engaged.

Test Drive

After the maintenance is finished, it is necessary to reinstall any disassembled parts and conduct a thorough test on the vehicle to ensure that all systems are functioning correctly.

1. Turn on all switches and test lights.
2. Turn on the ignition and start the engine.
3. Test the vehicle's forward and backward movement, steering, and handling for proper functionality and responsiveness. Ensure there is no excessive play in the steering and observe how the vehicle performs.
4. Listen for unusual noises and be alert to any unusual vibrations. These could indicate problems with the vehicle.
5. Keep an eye on the vehicle's gauges, such as the hour meter, fuel gauge, temperature gauge, and any warning lights. Ensure they're all functioning as expected.
6. Test any safety features, such as emergency stop button and seat switch, to ensure they function as intended.
7. Reinstall the deck.

4.2.5 EVERY 1000 HOURS OR 12 MONTHS MAINTENANCE

Special Tools	Consumables
▸ Lifting device ▸ Oil recipient / Drip pan	▸ Differential oil: SAE 80W90 GL5 ▸ Hydraulic pump oil : ISO 32 ▸ Reservoir bleed filter ▸ Molybdenum disulfide grease (6g) ▸ Lubricant spray ▸ Bearing grease ▸ Seal

NOTICE When required, lift the vehicle using a lifting device as per section 4.1.1 LIFTING POINTS.

NOTICE The 500 hours or 6 months preventive maintenance should be carried out concurrently with this maintenance. Certain steps may not be necessary due to redundancy.

Maintenance Preparation Steps

Before conducting any maintenance tasks, it is essential to follow the subsequent steps to ensure safety during maintenance and enable easy access to components.

1. Remove the deck (1)

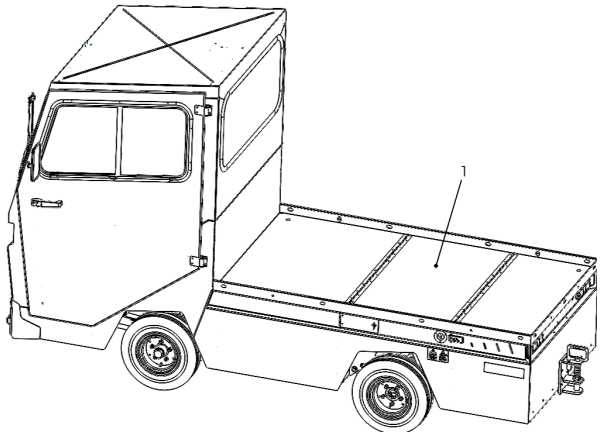


Figure 51. Deck Removal.

Maintenance Procedures

Engine Maintenance

1. Replace cooling system coolant.
2. Replace air filter.
3. Check all coolant hoses for cracks or leaks.
4. Check engine mounts.

Differential Maintenance

Schafer Twin-Case Differential

ALUMINUM CASE

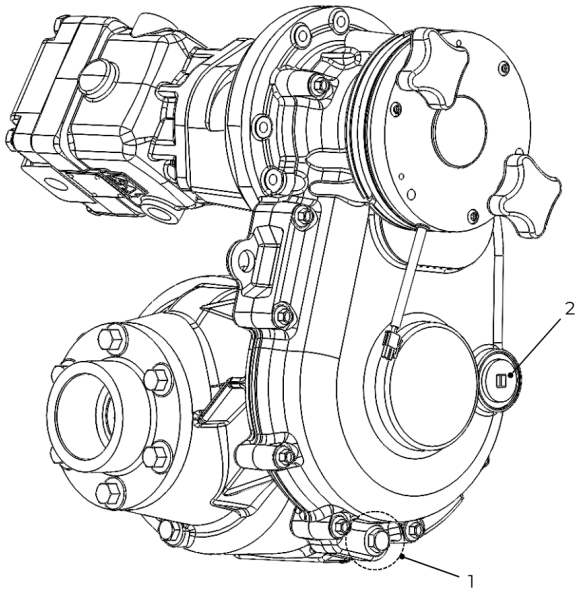


Figure 52. Schafer Aluminum Case.

1. Remove the filler plug (2).
2. Remove the drain plug (1) until the case is completely drained of oil.
3. Reinstall the drain plug (1)
4. Add **625 mL** (stop if the oil reaches the bottom of the filling hole) of SAE 80W90 GL5 differential oil.
5. Reinstall the filler plug (2).

CAST-IRON CASE

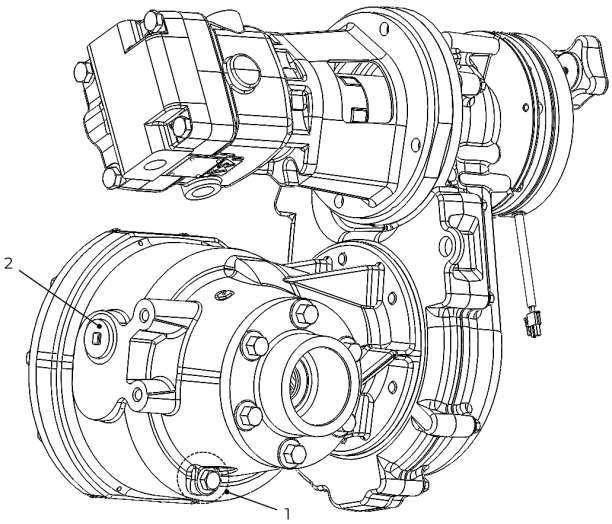


Figure 53. Schafer Cast-Iron Case.

1. Remove the filler plug (2).
2. Remove the drain plug (1) until the gearbox is completely drained of oil.
3. Reinstall the drain plug (1)
4. Add 390 mL (stop if the oil reaches the bottom of the filling hole) of SAE 80W90 GL5 differential oil.
5. Reinstall the filler plug (2).

DANA Differential

TIP : To ease the filling procedure of the DANA gear case with cover: Make a hose adapter that screws into the vent threads. Remove the vent. Fill with 500 mL of oil through the vent hole. Reinstall the vent.

1. Position a recipient under the differential to collect the drained oil in next steps.
2. Remove the drain plug (1) until the oil pan (2) is completely drained of oil.
3. Reinstall the drain plug (1).
4. Remove and clean the oil pan (2)
5. Remove all old sealant and oil residue from cover and differential casing mating surfaces.
   - **NOTE**: Sealant recommended: Permatex RTV gasket maker (P/N 81182) or equivalent.
6. Apply a layer of sealant on the oil pan's (2) mating surface.
7. Add 350 mL of oil at the bottom of the oil pan (2). Do not mix oil with sealant.
8. Install the oil pan (2).
9. Torque the 5/16 screws to 178 in·lbf.

Figure 54. DANA Case Oil Change.

Differentiel Spline Drive Maintenance

1. Disconnect all hoses from the axial piston hydraulic motor (1).
2. Support the motor (1) so that it can be slightly moved horizontally (Hydraulic motor is light enough to even do it by hands) once the screws (2) are removed.

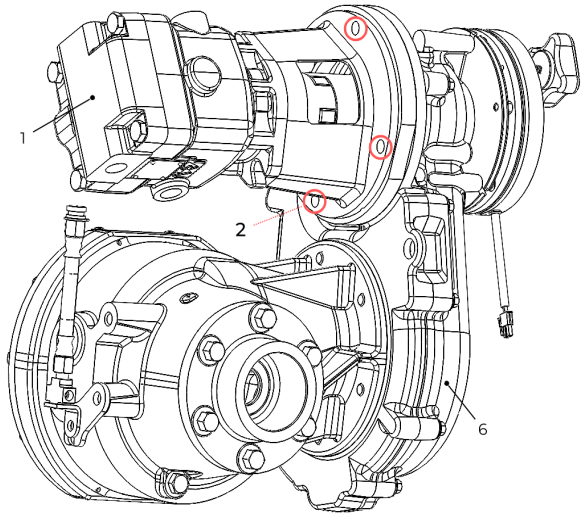


Figure 55. Removing screws.

3. Disassemble the following components: motor (1), coupling 7/8 (3), motor-differential adapter (4) and adapter flange (5) from the differential

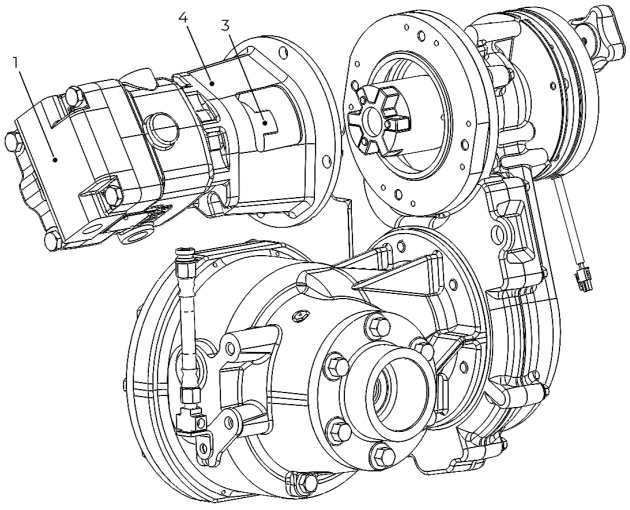


Figure 56. Disconnecting Motor, coupling 7/8 and motor-differential adapter.

4. Clean the motor (1) from dust or debris accumulation (if applicable).
5. Remove the urethan insert (love joy) (7), machined coupling sleeve (8) and set screw (9) to access the differential spline drive (10).
6. Inspect the motor (1) and the spline drive (10) for corrosion or damage.
7. Lubricate the differential spline drive (10) with molybdenum disulfide grease (2.5 ml is required).

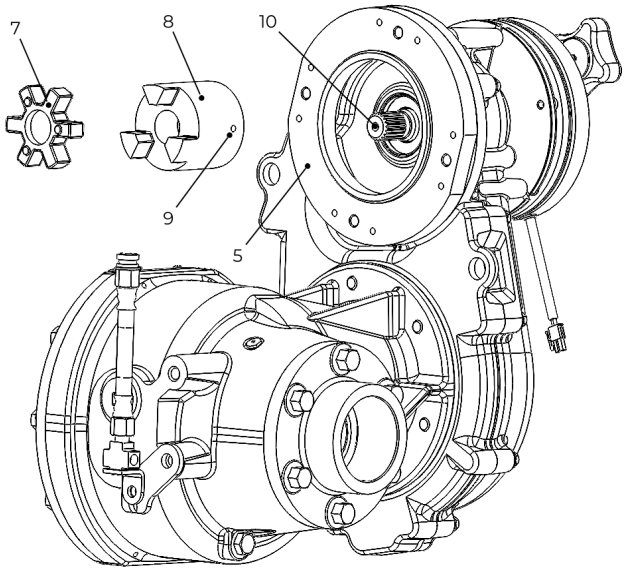


Figure 57. Spline Drive Lubrication.

8. Reconnect the urethan insert (love joy) (7), machined coupling sleeve (8), adapter flange (8) and set screw (9) to the differential spline drive (10).
9. Assemble the following components: motor (1), coupling 7/8 (3), motor-differential adapter (4) and adapter flange (5) to the differential (6).
10. Torque the screws (2) to standard values. The appropriate torque value is 24 ft lbs.
11. Reconnect the motor (1) to the system.

Front Wheels Bearings Maintennace

1. Chock the rear wheels.
2. Remove all hex bolts (1) and wheel nuts (2) to remove the wheel (3).

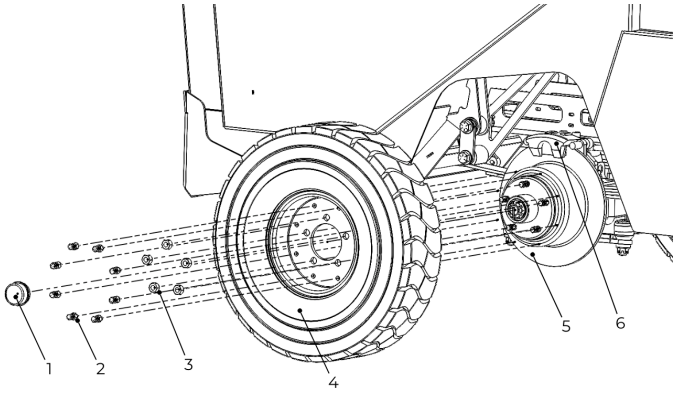


Figure 58. Wheel Removal.

3. Remove the slide pins (6) to release the caliper (5) from the disc (4).
4. Clean both caliper (5) and slide pins (6) from any dust or debris.
5. Remove the disc (4).
6. On the disc (4), clean the seating surface of the caliper (5) from any debris.

Figure 59. Slide Pins and Caliper Removal.

7. Remove the dust cap (7).
8. Remove the cotter pin (8) and unscrew the castle nut (9).
9. Remove the hub (10) from the spindle (11)
10. Remove the spindle washer (12).
11. Inspect the bearings (13) and their races for wear.
12. Discard the seal (14). Refer to the PARTS CATALOG for seal replacement.
13. Clean the bearing (13) and if they are still usable, apply the grease.
14. Install a new seal (14) and the bearings (13) into the hub (10).

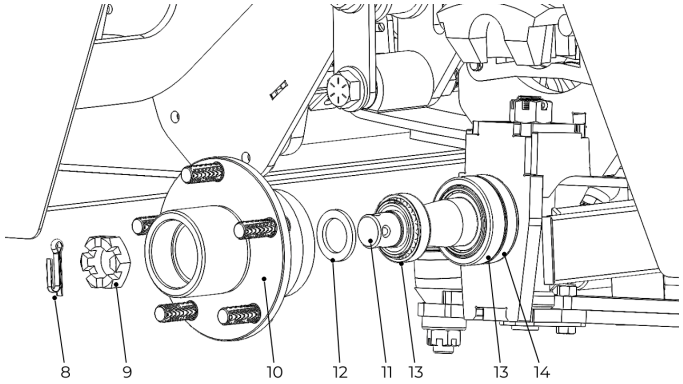


Figure 60. Front Bearing Inspection.

15. On the spindle (11), clean the seating surface of the hub (10) from any debris.
16. Position the hub (10) on the spindle (11).
17. Tighten the castle nut (9) to 103 ft·lbf to seat the bearings (13), then loosen the castle nut (9) by unscrewing one full turn.
18. Hand-tighten the castle nut (9).
19. Install a new cotter pin (8).
20. Reinstall the dust cap (7).
21. Reinstall the slide pins (6), caliper (5) and disc (4).
22. Reinstall the wheel (3), wheel nuts (2) and all hex bolts (1). Torque the wheel nuts (2) to standard values. The appropriate torque value is 80 ft lbs.

Pumps Oil Replacement

WARNING

ENSURE THAT THE HYDRAULIC SYSTEM IS SHUT OFF AND DEPRESSURIZED BEFORE STARTING ANY MAINTENANCE WORK. THIS WILL PREVENT ACCIDENTAL MOVEMENT OF HYDRAULIC COMPONENTS AND REDUCE THE RISK OF INJURY.

WARNING

WEAR APPROPRIATE SAFETY GEAR, INCLUDING GLOVES AND GOGGLES, TO PROTECT YOURSELF FROM HYDRAULIC FLUID AND OTHER CONTAMINANTS.

1. Change the oil in the reservoir. Operate with warm oil.
2. Replace reservoir breather filter.

Hardware Maintenance

1. Inspect and tighten all electrical connections. Clean or replace any connection that shows signs of corrosion or damage.
2. Inspect and tighten all mechanical hardware. Replace any connection that shows signs of damage.

Refer to the QUICK REFERENCES at the end of this document for all torque values.

Test Drive

After the maintenance is finished, it is necessary to reinstall any disassembled parts and conduct a thorough test on the vehicle to ensure that all systems are functioning correctly.

1. Turn on all switches and test lights.
2. Turn on the ignition and start the engine.
3. Test the vehicle's forward and backward movement, steering, and handling for proper functionality and responsiveness. Ensure there is no excessive play in the steering and observe how the vehicle performs.
4. Listen for unusual noises and be alert to any unusual vibrations. These could indicate problems with the vehicle.
5. Keep an eye on the vehicle's gauges, such as the hour meter, fuel gauge, temperature gauge, and any warning lights. Ensure they're all functioning as expected.
6. Test any safety features, such as emergency stop button and seat switch, to ensure they function as intended.
7. Reinstall the deck.

4.2.6 EVERY 2000 HOURS OR 24 MONTHS MAINTENANCE

Special Tools	Consumables
▸ Lifting device	▸ DOT-3 brake fluid

NOTICE

The 1000 hours or 12 months preventive maintenance should be carried out concurrently with this maintenance. Certain steps may not be necessary due to redundancy.

Maintenance Procedures

Hydraulic Brake System Fluid Maintenance

NOTE: The most recommended approach for brake fluid replacement is utilizing a bleeder ball tank or a comparable automatic bleeding device. Alternatively, repetitive manual bleeding is also acceptable.

1. If required, lift the vehicle using a lifting device as per section 4.1.1 LIFTING POINTS.
2. Remove the master cylinder's (1) cap.
3. Bleed rear wheel brakes one at a time :
   i. Fill the master cylinder (1) with DOT-3 brake fluid, then reinstall the master cylinder's (1) cap.
   ii. Bleed the rear calipers (4) one at a time by having someone apply steady pressure on the brake pedal (2), open the bleeder valve (3) and fully depress the pedal by maintaining the pedal all the way down, and then close the bleeder valve (3) before allowing the brake pedal (2) to return to the up position.
4. Bleed front wheel brakes one at a time :
   i. Fill the master cylinder (1) with DOT-3 brake fluid, then reinstall the master cylinder's (1) cap.
   ii. Bleed the front calipers (4) one at a time by having someone apply steady pressure on the brake pedal (2), open the bleeder valve (3) and fully depress the pedal by maintaining the pedal all the way down, and then close the bleeder valve (3) before allowing the brake pedal (2) to return to the up position.

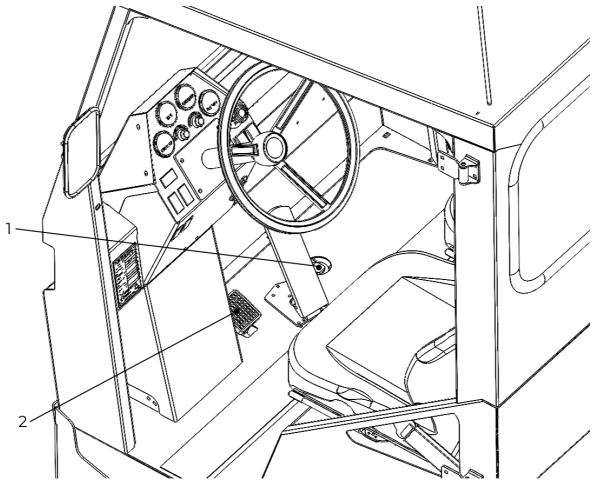


Figure 61. Brake System Bleeding.

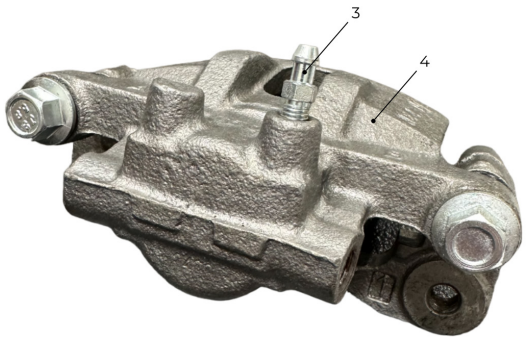


Figure 62. Bleeding.

5. Once bleeding is completed, top-up the master cylinder (1) with DOT-3 brake fluid.
6. Reinstall the master cylinder's (1) cap.
7. Clean every fitting and line and remove traces of oil.

   NOTE : Exercise with caution as oil fluid can potentially damage the paint.
8. Apply continuous pressure on the brake pedal for about ten seconds. Note any loss of pressure.
9. Inspect the brake lines and fittings for leaks.

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4.3 CORRECTIVE MAINTENANCE

4.3.1 HYDRAULIC BRAKES

Maintenance Procedures

Brake Pedal Bleeding

NOTE: The most recommended approach for brake fluid replacement is utilizing a bleeder ball tank or a comparable automatic bleeding device. Alternatively, repetitive manual bleeding is also acceptable.

1. If required, lift the vehicle using a lifting device as per section 4.1.1 LIFTING POINTS.
2. Remove the master cylinder's (1) cap.
3. Bleed rear wheel brakes one at a time :
   i. Fill the master cylinder (1) with DOT-3 brake fluid, then reinstall the master cylinder's (1) cap.
   ii. Bleed the rear calipers (4) one at a time by having someone apply steady pressure on the brake pedal (2), open the bleeder valve (3) and fully depress the pedal by maintaining the pedal all the way down, and then close the bleeder valve (3) before allowing the brake pedal (2) to return to the up position.
4. Bleed front wheel brakes one at a time :
   i. Fill the master cylinder (1) with DOT-3 brake fluid, then reinstall the master cylinder's (1) cap.
   ii. Bleed the front calipers (4) one at a time by having someone apply steady pressure on the brake pedal (2), open the bleeder valve (3) and fully depress the pedal by maintaining the pedal all the way down, and then close the bleeder valve (3) before allowing the brake pedal (2) to return to the up position.

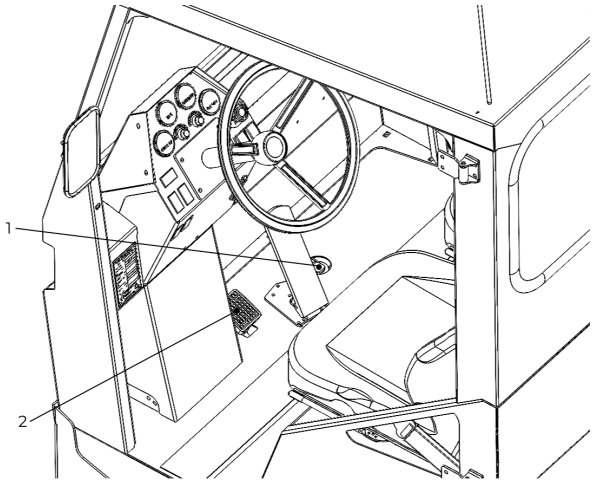


Figure 63. Brake System Bleeding.

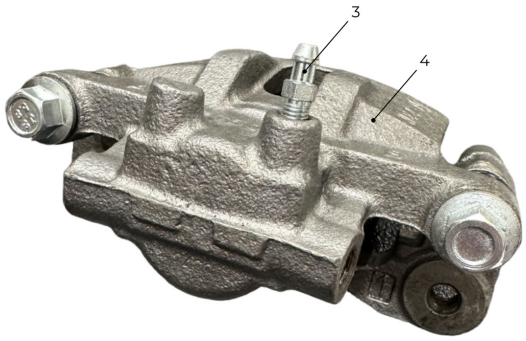


Figure 64. Bleeding.

5. Once bleeding is completed, top-up the master cylinder (1) with DOT-3 brake fluid.
6. Reinstall the master cylinder's (1) cap.
7. Clean every fitting and line and remove traces of oil.

   NOTE : Exercise with caution as oil fluid can potentially damage the paint.
8. Apply continuous pressure on the brake pedal for about ten seconds. Note any loss of pressure.
9. Inspect the brake lines and fittings for leaks.

4.3.2 AXLE AND STEERING

Procedures

Toe-In Adjustment

1. With the wheels in straight forward direction, measure the inside (left to right) distance between the front tires, at the front and rear of the tires.

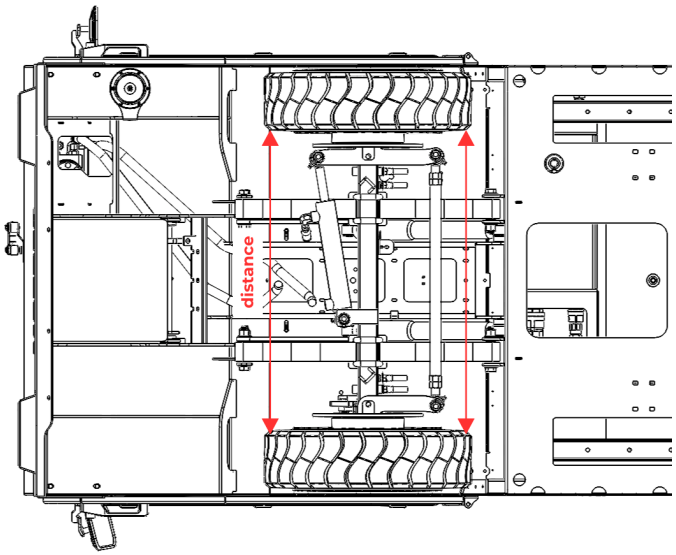


Figure 65. Distance between the front tires.

4.3.3 DIFFERENTIAL

Inspection

1. Look for leaks around:
   - Covers.
   - At axle ends.
   - Casing mating surfaces.
   - Drain/fill plugs.
2. Look for signs of external damage cracks, deformed parts, signs of impacts.
3. Inspect for excessive looseness in internal gears by gently rocking wheels.
4. Drain and inspect oil for excessive shavings/ debris. (If removing cover, perform visual inspection).
5. Inspect suspension mounting (U bolts, shocks, leaf springs, etc.).
6. Test drive: listen for abnormal noise, feel for excess play, **test while turning** as well.

Procedures

Oil Change

The MC-485 can be equipped with 2 different cases based on the configuration:

A. The Schafer Twin-Case, which includes :
   - The aluminum case.
   - The cast-iron case.

B. The DANA Case.

NOTE : Recommended oil for all cases : SAE 80W90 GL5.

Schafer Twin-Case Differential

ALUMINUM CASE

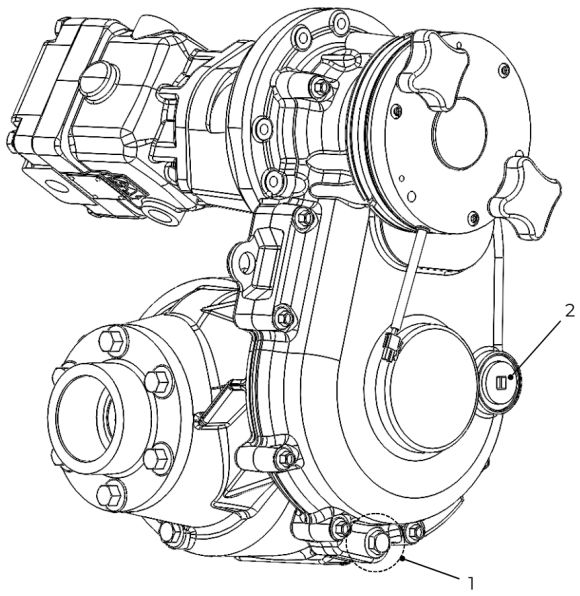


Figure 66. Schafer Aluminum Case.

1. Remove the filler plug (2).
2. Remove the drain plug (1) until the case is completely drained of oil.
3. Reinstall the drain plug (1)
4. Add **625 mL** (stop if the oil reaches the bottom of the filling hole) of SAE 80W90 GL5 differential oil.
5. Reinstall the filler plug (2).

CAST-IRON CASE

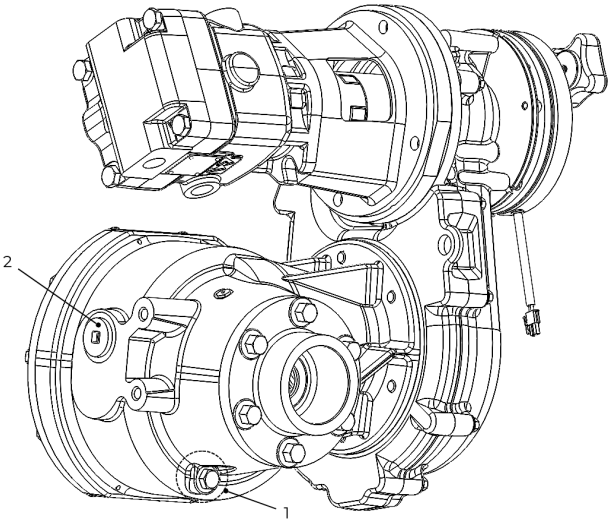


Figure 67. Schafer Cast-Iron Case.

1. Remove the filler plug (2).
2. Remove the drain plug (1) until the gearbox is completely drained of oil.
3. Reinstall the drain plug (1)
4. Add 390 mL (stop if the oil reaches the bottom of the filling hole) of SAE 80W90 GL5 differential oil.
5. Reinstall the filler plug (2).

DANA Differential

TIP : To ease the filling procedure of the DANA gear case with cover: Make a hose adapter that screws into the vent threads. Remove the vent. Fill with 500 mL of oil through the vent hole. Reinstall the vent.

1. Position a recipient under the differential to collect the drained oil in next steps.
2. Remove the drain plug (1) until the oil pan (2) is completely drained of oil.
3. Reinstall the drain plug (1).
4. Remove and clean the oil pan (2)
5. Remove all old sealant and oil residue from cover and differential casing mating surfaces.
   - **NOTE**: Sealant recommended: Permatex RTV gasket maker (P/N 81182) or equivalent.
6. Apply a layer of sealant on the oil pan's (2) mating surface.
7. Add 350 mL of oil at the bottom of the oil pan (2). Do not mix oil with sealant.
8. Install the oil pan (2).
9. Torque the 5/16 screws to 178 in·lbf.

Figure 68. DANA Case Oil Change.

4.3.5 HYDRAULIC STEERING SYSTEM

The hydraulic steering system within your vehicle functions as an integrated ensemble as illustrated in figure 69.

The power steering pump serves as the primary source of hydraulic pressure, generating force for the system. The orbitrol steering unit, acting as a central control hub, directs the distribution of hydraulic fluid based on steering inputs. The double-acting cylinder then transforms hydraulic energy into rotational movement, facilitating wheel articulation.

This integrated system ensures a smooth and responsive steering experience, with the power steering pump activated in tandem with steering actions, pressure modulation regulated by the orbitrol unit.

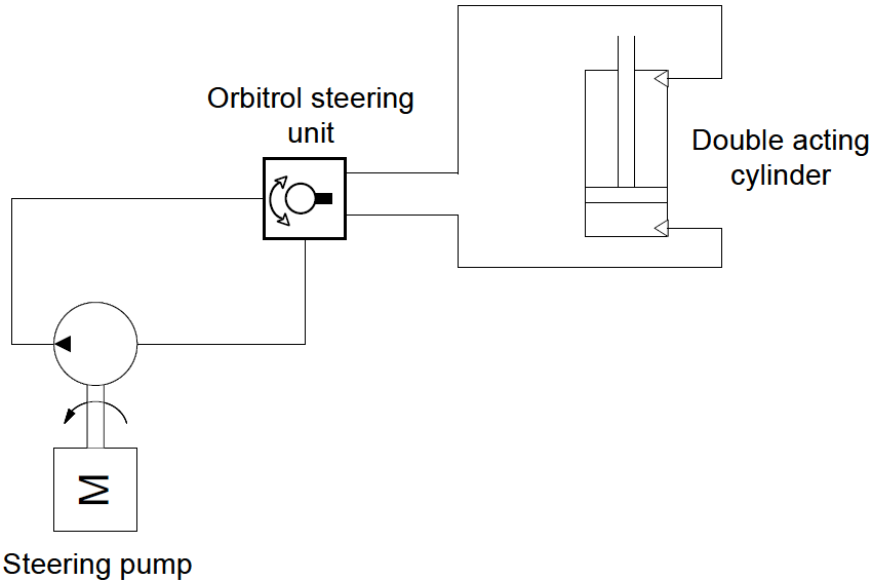


Figure 69. Hydraulic Steering System.

Maintenance procedures

Periodic maintenance of this symbiotic system is imperative to uphold consistent, reliable, and precision oriented steering performance.

To do preventive maintenance of the following elements of a hydraulic system: power steering pump, orbitrol steering unit and a double-acting cylinder, proceed as follows :

1. Inspect all the hydraulic system components for the following elements:
   - Inspect all components for signs of leaks, damage, or corrosion.
   - Look for loose fittings or connections.
2. Check the double-acting cylinder's condition by examining the rod and piston for signs of wear, scoring, and potential alignment issues.
3. Examine the power steering pump for any signs of damage and ensure that all connections and hoses are secure. Additionally, check the fluid level in the reservoir and inspect for any leaks.

4.4 TROUBLESHOOTING

Battery Voltage (12 V Battery)

WARNING

DO NOT MANIPULATE ELECTRICAL CONNECTIONS OR GENERATE SPARKS AROUND BATTERIES. SPARKS CAN CAUSE A BATTERY EXPLOSION AND ACID SPLASHING. DURING MAINTENANCE, ALWAYS DISCONNECT THE CHARGER AND USE INSULATED TOOLS THAT DO NOT GENERATE SPARKS. FAILURE TO COMPLY CAN CAUSE SERIOUS INJURIES.

WARNING

WHEN WORKING AROUND BATTERIES, ALWAYS WEAR ACID PROOF PROTECTIVE EQUIPMENT, SUCH AS FACE SHIELD AND THE APPROPRIATE GLOVES. BATTERIES CONTAIN SULFUR ACID THAT CAN CAUSE SEVERE BURNS ON SKIN OR EYES. RINCE CONTAMINATED AREA IMMEDIATELY WITH WATER.

Some troubleshooting steps require to measure the voltage that the reaches the inspected components. The total battery voltage might be required for these inspections. Make sure that the 12 V battery is securely connected and measure the voltage between the battery terminals.

4.4.1 ACCESSORIES

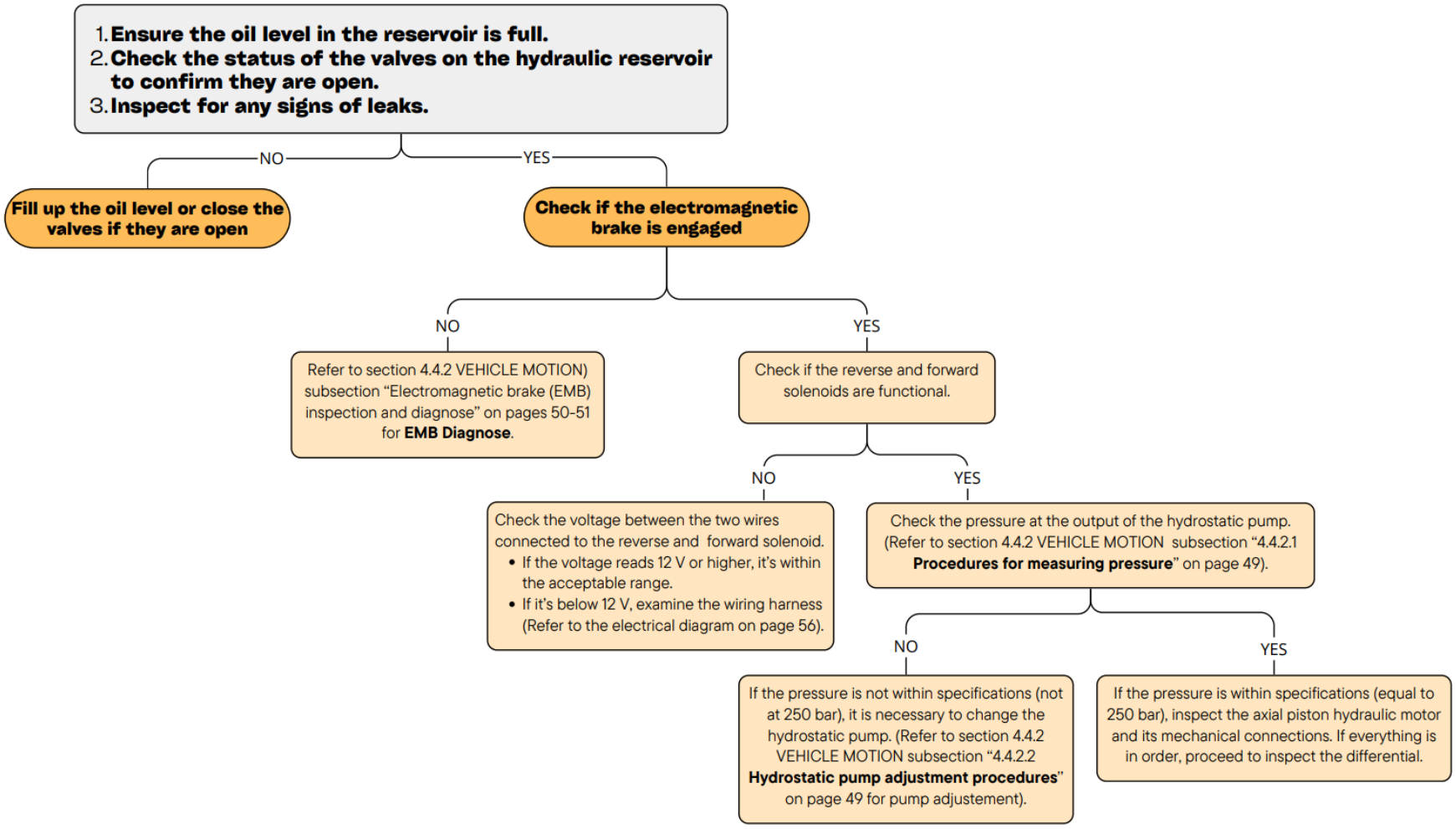
4.4.1. 1 Accessories Not Working

1. Turn the key to the ON position.
2. Depress the accessory switch, measure voltage across accessory terminals.

- If the measured voltage is not between 11.8V and 14.2V, it indicates a problem with the switch, and it should be replaced.
- If the measured voltage is approximately 12V, it suggests a fault with the accessory itself, and it should be replaced.

NOTE : Ensure accurate voltage measurements by doing the voltage drop test between the switch's terminals, ensure that the voltage measurement is below 1 V. Alternatively, consider the voltage drop when measuring between the accessory's terminals.

4.4.2 VEHICLE MOTION


1. Ensure the oil level in the reservoir is full.
2. Check the status of the valves on the hydraulic reservoir to confirm they are open.
3. Inspect for any signs of leaks.
NO
YES
Fill up the oil level or close the valves if they are open
Check if the electromagnetic brake is engaged
NO
YES
Refer to section 4.4.2 VEHICLE MOTION) subsection "Electromagnetic brake (EMB) inspection and diagnose" on pages 50-51 for EMB Diagnose.
Check if the reverse and forward solenoids are functional.
NO
YES
Check the voltage between the two wires connected to the reverse and forward solenoid.
• If the voltage reads 12 V or higher, it's within the acceptable range.
• If it's below 12 V, examine the wiring harness (Refer to the electrical diagram on page 56).
Check the pressure at the output of the hydrostatic pump. (Refer to section 4.4.2 VEHICLE MOTION subsection "4.4.2.1 Procedures for measuring pressure" on page 49).
NO
YES
If the pressure is not within specifications (not at 250 bar), it is necessary to change the hydrostatic pump. (Refer to section 4.4.2 VEHICLE MOTION subsection "4.4.2.2 Hydrostatic pump adjustment procedures" on page 49 for pump adjustement).
If the pressure is within specifications (equal to 250 bar), inspect the axial piston hydraulic motor and its mechanical connections. If everything is in order, proceed to inspect the differential.

4.4.2. 1 Procedures for measuring pressure at the outlet of the hydrostatic pump

1. Disconnect the axial piston hydraulic motor.
2. Remove the hoses from the pump connected to the motor.
3. Install a manometer at the outlet terminals of the hydrostatic pump on both sides.
4. Bleed air from the hoses.
5. Test the forward and reverse modes and check the pressure in each mode to ensure it is at 250 bars.

NOTE : Ensure that the manometer and hoses can withstand 250 bars.

4.4.2. 2 Hydrostatic pump adjustment procedures

1. Drive the vehicle to raise the oil temperature to at least 100°F in closed-loop.
2. Elevate the vehicle, ensuring the wheels are off the ground, and secure it with blocks.
3. With the engine idling, engage forward direction.
4. Loosen screw (3) by one turn.
5. Adjust screw (1) to halt wheel rotation. If the wheels continue turning, turn screw (1) clockwise until they stop. If no turning occurs, unscrew screw (1) counter clockwise to locate the limit point.
6. Fully tighten screw (3).

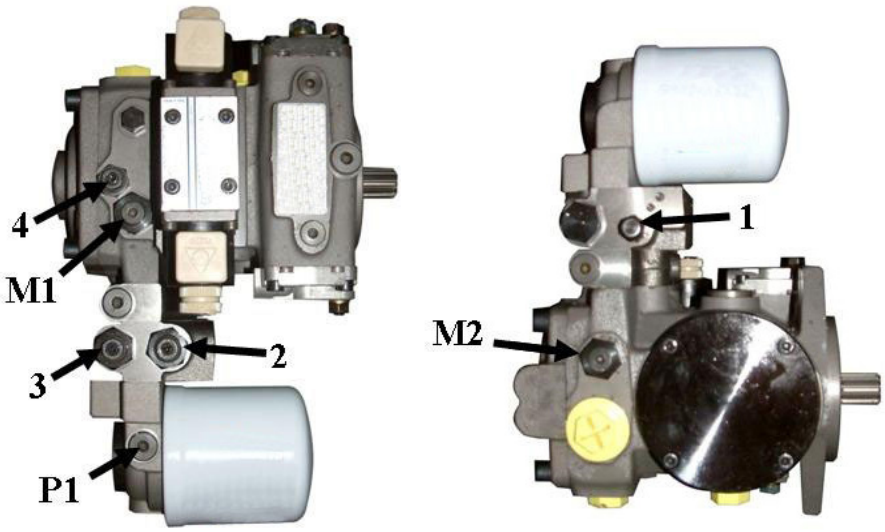


Figure 70. Hydrostatic Pump Adjustement.

4.4.2. 3 Electromagnetic brake (EMB) inspection and diagnose

Before troubleshooting the EMB, validate that the non-moving vehicle issue is caused by the electromagnetic brake by screwing in the service knobs, therefore disengaging the electromagnetic brake.

1. Inspect the Electromagnetic Brake

1. 1. Electromagnetic brake not releasing (vehicle doesn't move).

- Excessive air gap (over 0.030 in).
- No current to electromagnetic brake.

⚠ WARNING

PLEASE PAY ATTENTION TO THE VOLTAGE VALUE INDICATED BY THE VOLTMETER. THE VOLTMETER MAY NOT ACCURATELY DISPLAY THE REAL VOLTAGE; INSTEAD, IT MIGHT SHOW A HIGHER VALUE (E.G., 48V) RATHER THAN THE AVERAGE VALUE (E.G., 24V) DUE TO THE IMPLEMENTATION OF PULSE WIDTH MODULATION (PWM).

- Damaged wiring.
- Defective magnet.
- Mechanically stuck pressure plate.
- Defective controller.

1. 2. Electromagnetic brake dragging (burnt smell / lack of power).

- Low current to electromagnetic brake.
- Defective magnet (partial release).
- Mechanically stuck pressure plate.
- Debris in electromagnetic brake.
- Gripping of rotor hub splines.

1. 3. Electromagnetic brake not engaging.

NOTE: This symptom is sometimes the result of the operator regularly using the Emergency Stop button while the vehicle is still in motion. This wears off the thin friction material on the rotor. Such practice should be avoided.

- Service knobs installed.
- Damaged / broken rotor.
- Mechanically stuck open pressure plate.
- Damaged transaxle internal component.
- Defective controller.

2. Diagnose the electromagnetic brake

Important : EMB activation relies on detecting the operator's presence via the seat switch signal, which is triggered when their weight is on the driver's seat.

2. 1. Measure voltage across DC/DC converter **input** terminals.

2. 1. 1. Check for the presence of voltage between the positive terminal (**B+**) (Red Wire - 14 AWG) and the negative terminal (**B-**) (Black Wire - 18 AWG) of the DC/DC converter (As shown in Figure 71).

- If no voltage is present, it is necessary to inspect both the fuse and the wiring.

2. 2. Measure voltage across DC/DC converter **output** terminals.

2. 2. 1. Check for the presence of voltage between the Yellow wire (18 AWG) and the Black/White wire (18 AWG)of the DC/DC converter (As shown in Figure 71).

- If not between 23V and 25V, it indicates a defective converter that requires replacement.

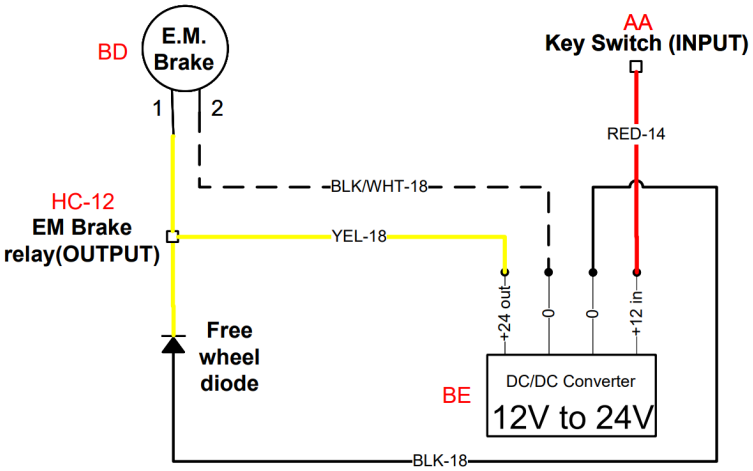


Figure 71. DC/DC Converter Input and Output Terminals Inspection.

4.4.2. 4 Vehicle Moves Forward Only

Check the voltage between the two wires connected to the reverse solenoid.

- If the voltage reads 12 V or higher, it's within the acceptable range.
- If it's below 12 V, examine the wiring harness (refer to the electrical diagram on page 56).

4.4.2. 5 Vehicle Moves Backward Only

Check the voltage between the two wires connected to the forward solenoid.

- If the voltage reads 12 V or higher, it's within the acceptable range.
- If it's below 12 V, examine the wiring harness (refer to the electrical diagram on page 56).

4.4.2. 6 Vehicle Travels at Reduced Speed

Inspect the vehicle for the following elements:

a. Dragging brakes.

b. Low fuel.

c. Clogged air filter.

d. Clogged fuel filter.

e. Clogged Exhaust.

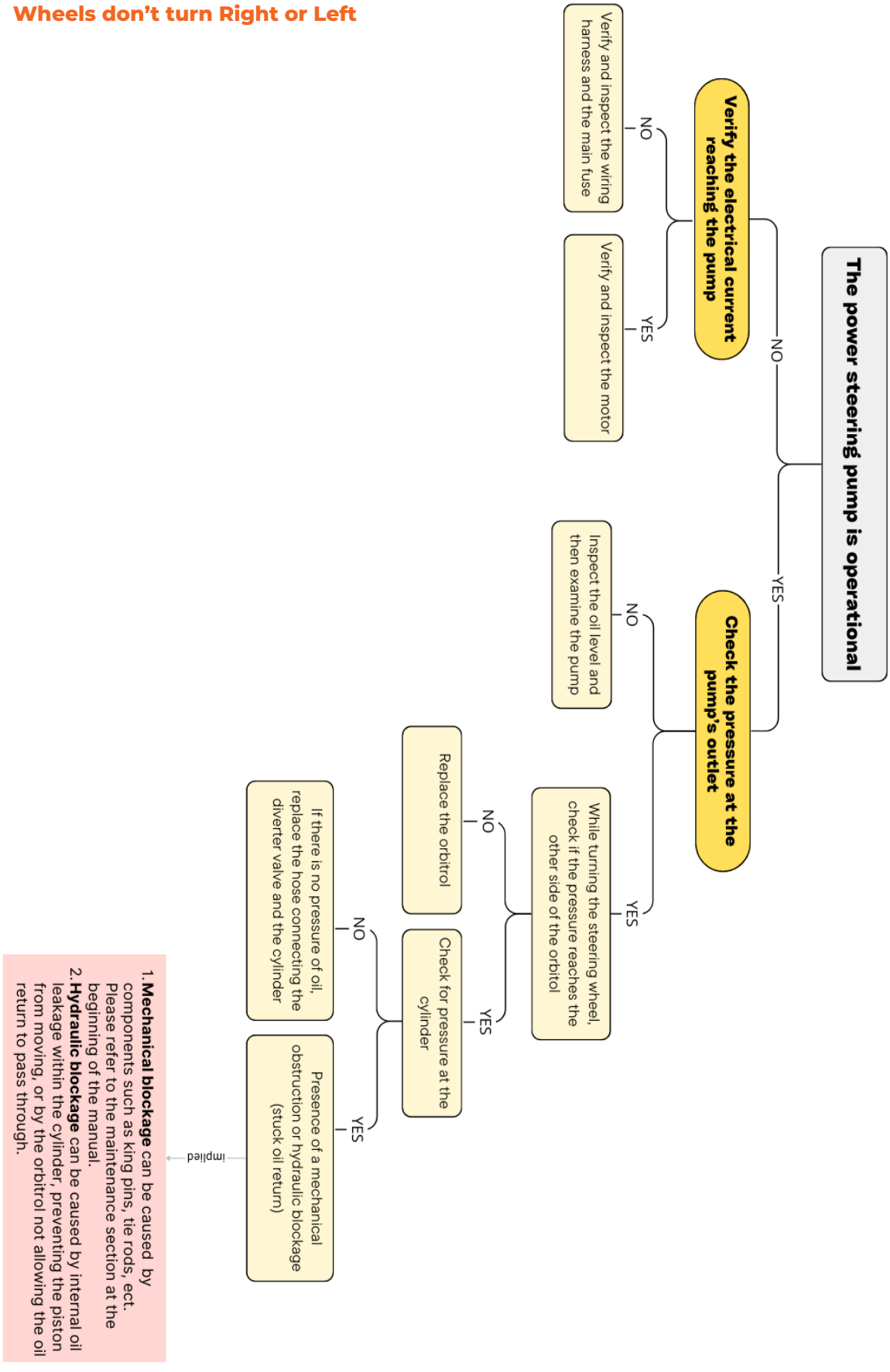
f. Defective gas pump.

g. Defected fuel solenoid.

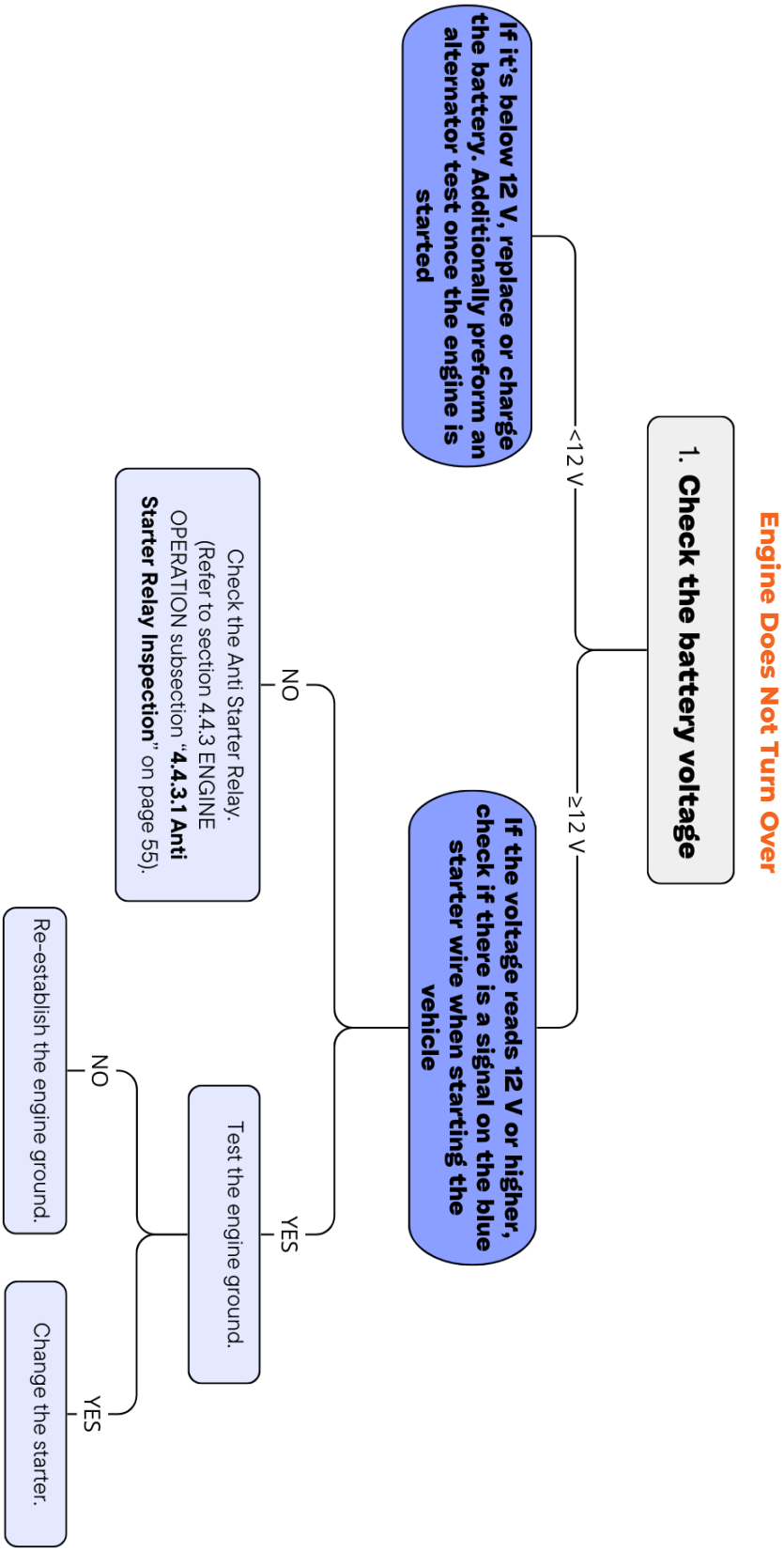
h. Poor gas or fuel quality.

i. Engine damaged.

4.4.2. 7 Wheels don't turn Right or Left



4.4.3 ENGINE OPERATION



4.4.3. 1 Anti Starter Relay Inspection

The anti-starter relay is configured with four pins :

- Pin 16 receives the signal from the key switch.
- Pin 18 receives the signal from the FWD/REV switch.
- Pin 23 sends the signal from the starter.
- Pin 22 is the permanent ground connection.

1. Check the voltage continuity between pin 16 and the blue wire of the starter (pin 25).
2. In case of no current at pin 16 (Signal from the key switch), check the harness, and then inspect the key switch.
3. Verify that there is no current at pin 18 (Signal from the FWD/REV switch) to confirm that the vehicle is in neutral position. If this is not the case, check the FWD/REV switch and the harness.

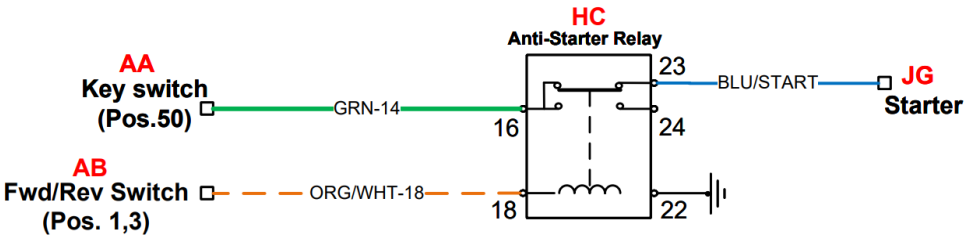
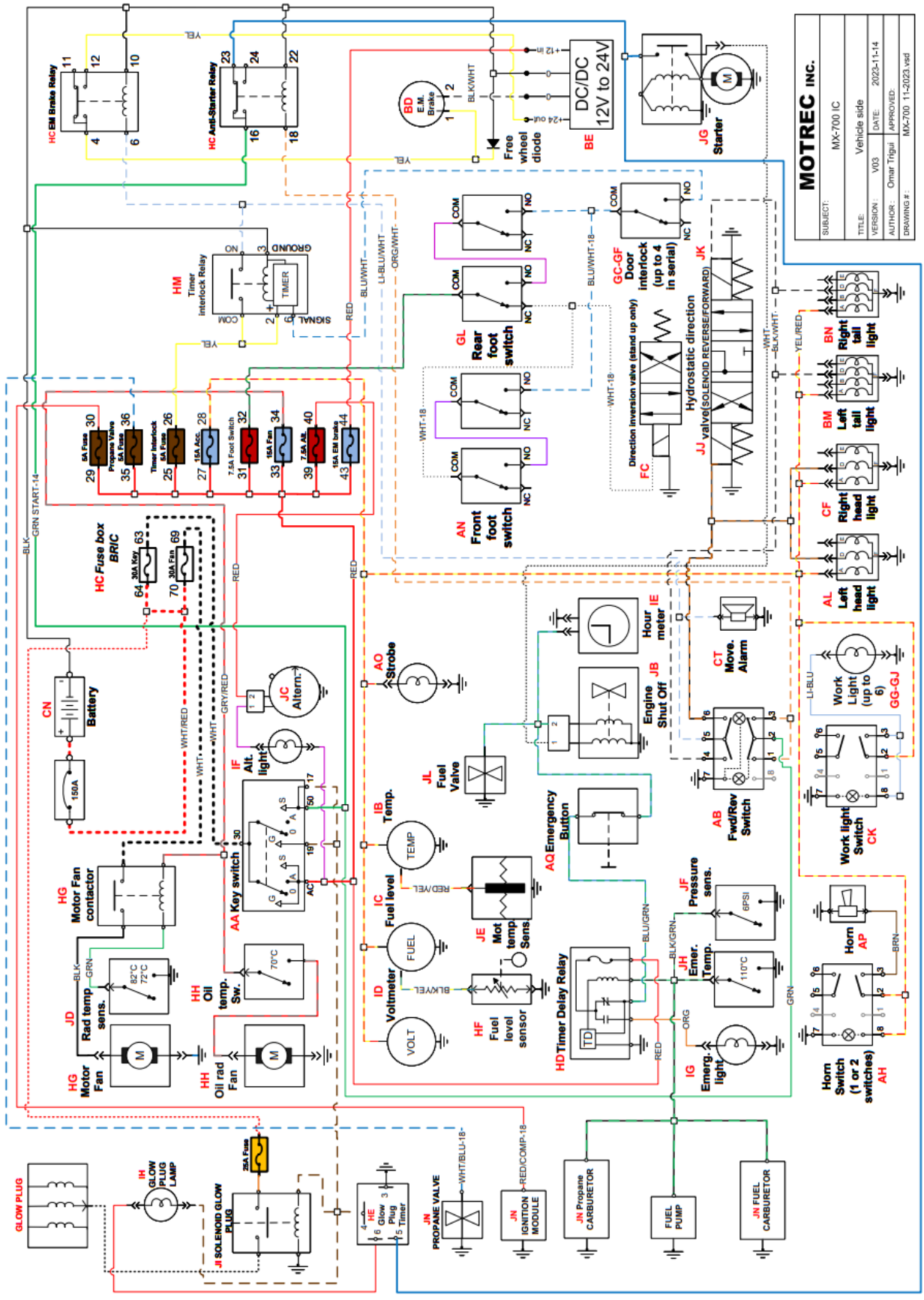


Figure 72. Anti Starter Relay connexions.

Electrical Diagram



Standard Torque

BOLT CLAMP LOADS

Suggested Assembly Torque Values

	USS/SAE GRADE 5					USS/SAE GRADE 8				
DIAMETER & THREADS PER INCH	TENSILE STRENGTH MIN. PSI	PROOF LOAD LB	CLAMP LOAD LB	TORQUE DRY FT LB	LUBRICATED FT LB	TENSILE STRENGTH MIN. PSI	PROOF LOAD LB	CLAMP LOAD LB	TORQUE DRY FT LB	LUBRICATED FT LB
1/4-20	120,000	2,700	2,020	8	6.3	150,000	3,800	2,850	12	9
28	120,000	3,100	2,320	10	7.2	150,000	4,350	3,250	14	10
5/16-18	120,000	4,450	3,340	17	13	150,000	6,300	4,700	24	18
24	120,000	4,900	3,700	19	14	150,000	6,950	5,200	27	20
3/8-16	120,000	6,600	4,950	30	23	150,000	9,300	6,980	45	35
24	120,000	7,450	5,600	35	25	150,000	10,500	7,900	50	35
7/16-14	120,000	9,050	6,780	50	35	150,000	12,800	9,550	70	50
20	120,000	10,100	7,570	55	40	150,000	14,200	10,650	80	60
1/2-13	120,000	12,100	9,050	75	55	150,000	17,000	12,750	110	80
20	120,000	13,600	10,200	85	65	150,000	19,200	14,400	120	90
9/16-12	120,000	15,500	11,600	110	80	150,000	21,800	16,350	150	110
18	120,000	17,300	12,950	120	90	150,000	24,400	18,250	170	130
5/8-11	120,000	19,200	14,400	150	110	150,000	27,100	20,350	210	160
18	120,000	21,800	16,350	170	130	150,000	30,700	23,000	240	180
3/4-10	120,000	28,400	21,300	260	200	150,000	40,100	30,100	380	280
16	120,000	31,700	23,780	300	220	150,000	44,800	33,500	420	310
7/8-9	120,000	39,300	29,450	430	320	150,000	55,400	41,600	600	450
14	120,000	43,300	32,450	470	350	150,000	61,100	45,800	670	500
1-8	120,000	51,500	38,600	640	480	150,000	72,700	54,500	910	680
14	120,000	57,700	43,300	720	540	150,000	81,500	61,100	1,020	760

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