MOTREC

T-8000

OPERATOR AND MAINTENANCE MANUAL
SPARE PARTS LISTS INCLUDED

SERIAL NUMBER: 1094193 & UP

Printed in Canada

One Year Limited Warranty

Effective April 25, 2005, Motrec International Inc. (MOTREC) hereby warrants to the Original Retail Purchaser (Owner) that any of its vehicles shall be free from any defect in materials for a period of 90 DAYS while in the possession of such Original Retail Purchaser. This warranty IS NOT TRANSFERABLE to any subsequent Buyer.

The warranty period is extended to one year or one thousand (1,000) hours, which ever first occurs, on the electric motor, differential (parts that bathe in oil) and the electronic speed controller. MOTREC makes no warranty or representation with respect to the internal combustion engine, tires and batteries, since their respective manufacturers cover such parts. Accessories (light, gage, horn, etc), electrical contacts (switch, solenoid, contactor, relay), diodes & fuses, belts & pulleys, filters & spark plugs, lubricants, brake linings & shoes, brake drums & discs, seals, seats, trim and other items subject to wear are not included in this warranty; nor is any item that in MOTREC sole opinion, shows evidence of neglect, misuse, abuse, collision or alteration.

This warranty shall not apply to normal maintenance requirements as described in the User Manual, and to damages during shipment. The latter is the carrier's responsibility. No compensation will be allowed for delays.

To initiate warranty coverage on any MOTREC vehicle, the Dealer must complete and return the “Sales/Installation Report” to MOTREC within 30 days after delivery to the Original Retail Purchaser; or within 90 days after the delivery date to the Dealer, which ever occurs first. Failure to follow these procedures will result in considering the warranty coverage effective as of the shipment date from the factory.

The defective vehicle must be returned, at the Owner's expense, to an authorised MOTREC Dealer within 30 days after failure. The Owner will not be charged for parts and labour required for warranty repairs, which must be performed by an authorised MOTREC Dealer only. The vehicle will be returned at the owner’s expense. The Warranty Claim Forms must be completed and returned with the defective part(s) to MOTREC within 30 days after repair was done. No compensation will be allowed for damages caused by vehicle downtime.

It is the responsibility of the owner of the vehicle to make sure that the driver is properly trained and instructed in the safety features and operation of the vehicle, including vehicle stability, as required by OSHA and ANSI-B56. Operators shall read, understand and follow the safety and operating instructions in MOTREC Manual before driving the vehicle. Operators shall not be permitted to drive the vehicle unless a complete and adequate training has been provided. Driving a vehicle constitutes a hazard. The driver is responsible for the control of the vehicle while driving and must always evaluate and care for all peculiar situations that he or she may meet while driving. The driver assumes the inherent hazards related to this activity. The vehicle is designed for off-road use only. MOTREC disclaims any liability for incidental or consequential damages, to include, but not be limited to, personal injury or property damage arising from vehicle misuse, lack of maintenance or any defect in the vehicle.

It is the responsibility of the Owner of the vehicle to make sure that the service technicians are properly trained as required by OSHA and ANSI-B56. Service technicians shall read, understand and follow instructions in the MOTREC manual before servicing the vehicle. Only qualified and authorized personnel shall be permitted to maintain, repair, adjust and inspect the vehicle.

MOTREC prohibits, and disclaims responsibility for, any vehicle modification altering the weight distribution and stability, increasing the speed or affecting the safety of the vehicle. Such modifications can cause serious personal injury or property damage for which MOTREC disclaims any responsibility.

For Owners that are located outside North America, the warranty period starts the date of shipment from the factory, and the defective parts must be returned at the Owner's expense to MOTREC prior to warranty repair.

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INSTRUCTIONS

SAFETY WARNINGS FOR OPERATORS

- FAILURE TO OBEY THE FOLLOWING SAFETY RULES MAY RESULT IN SEVERE INJURY.
- It is the responsibility of the owner of this vehicle to train operators to ensure that they understand the operating characteristics of this vehicle, including training in vehicle stability, and obey the following safety rules and guidelines. Owner shall comply with OSHA and ANSI/ITSDF B56.8 & B56.9 Standards for vehicle use, safety rules, operator training and certification. Do not drive this vehicle unless you are a qualified operator.
- Do not drive this vehicle under the influence of drugs or alcohol.
- Do not drive this vehicle on public roads and highways. This vehicle is designed to be driven in buildings.
- The electrical system of this vehicle will make sparks which can ignite inflammable materials. Never use the vehicle in hazardous areas where there are inflammable materials, explosive dust or fumes in the air.
- Have your vehicle inspected regularly by trained personnel, and cease operation if a malfunction occurs.
- Do not open battery compartment to prevent battery explosion, acid splashing, severe damage to eyes or skin.
- Do not open motor compartment. Keep clear from moving, rotating(wheels, sheaves, etc) or lifting parts.
- Never carry more passengers than number allowed for this vehicle. Wait until all occupants are seated and holding on before moving. Always keep all body parts inside vehicle. Keep both hands on steering wheel.
- Do not exceed the vehicle cargo load capacity and gross trailing weight capacity, rated for flat hard even surface. Different operating conditions such as loose terrain or ramps reduce vehicle capacity.
- Avoid loose, unbalanced or top-heavy loads to keep a good stability and prevent overturn. Do not load cargo that can fall off the vehicle. Do not carry cargo that is longer, wider or higher than this vehicle.
- Always depress slowly the accelerator for smooth acceleration. Avoid stunt driving or horseplay.
- Avoid sharp turns, always slow down before turning, to prevent vehicle overturn or trailer jack knife. Vehicle is more sensitive to overturn and jack knife when traveling on inclines or when carrying a heavy load.
- Always drive straight up and down the face of an incline, never across the face, to prevent overturn and trailer jack knife. Drive slower and start applying brakes sooner on inclines to adjust for longer stopping distance.
- Use extra care and drive slowly in reverse, in congested areas or on wet or slippery ground.
- Keep to the right under normal conditions. Maintain a safe distance from all objects.
- Slow down and sound the horn when approaching a corner or other blind intersections.
- Before leaving the vehicle, park on a level ground flat surface, turn off all switches, set the forward/reverse switch to neutral, set the parking brake, remove the key. Do not park the vehicle on an incline.
- Before battery charging, park the vehicle in a well ventilated area set for. Do not operate it when charging. To interrupt a charging cycle, disconnect the AC plug; disconnecting the DC plug or a battery terminal, or operating the vehicle, could damage the charger and produce a spark, battery explosion and acid splashing.
- Use another driver to steer this vehicle while it is towed. Be sure the driver uses brakes when you slow or stop the towing vehicle. Do not exceed 5 MPH or carry any passenger while towing this vehicle.

OPERATING INSTRUCTIONS

It is the responsibility of the owner of this vehicle to ensure that the operator understands the operating characteristics of this vehicle, and obeys the safety instructions in this manual and ANSI/ITSDF B56.8 & 9 Standards. Do not drive this vehicle unless you are a certified operator as required by OSHA.

BEFORE TURNING ON KEYSWITCH

Set to neutral, set parking brake, check for visible damage, check brake pedal.

AFTER TURNING ON KEYSWITCH

Check safety devices: seat switch, reverse alarm, motion beeper, strobe light, and all other safety devices.

BATTERIES

Never open the battery compartment unless you have received proper training for battery maintenance.
Batteries emit explosive hydrogen gas that can be ignited by a spark or loose terminal. Battery acid causes severe damage to eyes or skin. Flush the contaminated area immediately with water. Park the vehicle in a well ventilated area for battery charging. Most battery chargers come with an electronic control that starts when the charger is plugged and stop when the battery is fully charged. To interrupt the charging cycle, disconnect the AC-plug, do not disconnect the DC plug.

BATTERY DISCHARGE INDICATOR

The green light moves from right to left as batteries are being discharged. When the green light is at the last position on the left the batteries must be recharged. A flashing light warns the operator that further discharge will damage batteries. See HOBBS indicator instructions.

EMERGENCY SAFETY DEVICE

The emergency push button or battery disconnect handle, when present, should only be used in case of emergency. Use the key switch for normal ON/OFF control.

KEYSWITCH

Depress brake pedal and turn the key switch clockwise for on position. Always turn off all switches, set the F/R selector to neutral, set the parking brake, remove the key before leaving the vehicle.

HORN

Depress the horn button on the steering column or handle bar.

F/R SWITCH

Three positions with neutral at center. Depress the front part of the rocker switch for forward direction. Depress the rear part of the rocker switch for reverse direction. Always set switch to neutral, turn off all switches, set the parking brake, remove the key before leaving the vehicle.

ACCELERATOR PEDAL

It is designed for right foot operation only, and controls the speed of the vehicle. Apply slowly.

FOOT BRAKE PEDAL

It is designed for right foot operation only. The brake force is proportional to the pressure on the pedal.

PARKING BRAKE

Pull handbrake lever to apply. Never park the vehicle on an incline. Always turn off all switches, set the F/R selector to neutral, set the parking brake, remove the key before leaving the vehicle.

INCHING CONTROL INSTRUCTIONS

It is the responsibility of the owner of this vehicle to ensure that the operator understands the operating characteristics of this vehicle, and obeys the safety instructions in this manual and ANSI/ITSDF B56.8 & 9 Standards. Do not drive this vehicle unless you are a certified operator as required by OSHA.

INCHING CONTROL FEATURE

Inching control allows the operator to move the tractor slowly using push buttons located on the rear of the tractor. It is used to facilitate the utilisation of the hitch.

BEFORE USING INCHING CONTROL

Always use driving position to get close to the trailer: never use inching control if the trailer eye is more than 12'' (inches) far from the hitch. Never use inching control if tractor is on an incline. Inching control also limits the torque and the floor must be clean from debris that could bloc the wheels. Before using inching control, make sure no one else is on or nearby the tractor, key switch is turned on and tractor is set to neutral.

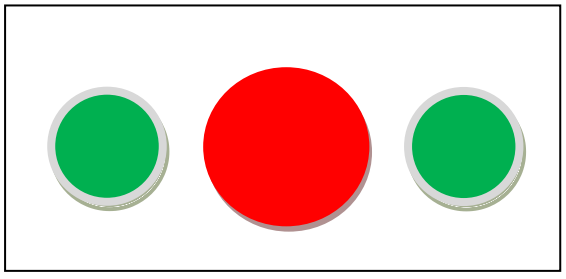
INCHING CONTROL OPERATION

There are two green buttons (see illustration). The left button is for forward movement and the right button is for reverse movement. To operate inching control, jog the forward or reverse green button. Keep the button pressed to obtain a creeping speed in the desired direction.

EMERGENCY STOP

There is a red push button between the green buttons (see illustration). It is an emergency push button and should only be used in case of emergency.

FRONT OF THE VEHICLE



MAINTENANCE

SAFETY WARNINGS FOR SERVICE TECHNICIANS

FAILURE TO OBEY THE FOLLOWING SAFETY RULES MAIN RESULT IN SEVERE INJURY.

Owner shall comply with OSHA and ANSI/ITSDF B56.8 & B56.9 Standards for vehicle maintenance.

Only qualified and authorized personnel shall be permitted to maintain, repair, adjust and inspect carriers, vehicles, tractors, and batteries.

Before any maintenance work, park the vehicle on flat level surface, turn off all switches, remove key, lift wheels off the ground and secure with jack stands of adequate capacity. Don't connect charger.

Keep clear from moving parts such as tires, sheaves and motor.

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

Always wear a face shield and gloves when working around batteries.

Before opening the battery compartment, disconnect the charger, turn off all switches and remove the key. Batteries emit highly explosive gases which greatly increase when charging; do not disturb connections or produce sparks around batteries to avoid a battery explosion and acid splashing. Battery acid causes severe damage to eyes or skin. Flush contaminated area immediately with water.

Use insulated tools to avoid sparks that can cause battery explosion and acid splashing.

Use two counteracting tools, double-wrench technique, when disconnecting or tightening terminals on the battery and the speed controller to avoid cracking the terminal or battery post welds.

Before cleaning or replacing a battery, charger, speed controller, contactor, relay, diode, or any other component in the power circuit, always disconnect the charger, turn off all switches, remove the key, wear a face shield and gloves, identify battery polarity and disconnect battery leads, discharge the capacitor in the controller with a 10 ohms, 25 W resistor for a few seconds across B+ and B-.

After cleaning, the power must not be reapplied until terminal areas are thoroughly dry.

On EE-Rated vehicles make sure that the control box is sealed, the static strap makes good contact with the ground, the motor is sealed by bands, the cable protectors are properly installed.

Keep cables and wires clear from mechanical and rubbing action. Make sure that cable insulation is free from cutting or visible damage. Make sure that EE-Rated cable protectors are properly installed.

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

Programmable controllers must be programmed using the parameter settings in this service manual, before connecting the motor, to avoid sudden vehicle movement and accident.

Do not try to increase motor speed by changing parameter settings in the speed controller; it can cause accident and severe damage to the motor.

SEPEX speed controls are protected by a diode in the power circuit to filter inductive loads in the event of a sudden power interrupt. Some speed controllers require a diode to filter inductive loads on the KSI input. Removing the diodes will cause the speed control failure.

Before resuming maintenance operations, inspect safety warnings stickers and replace any if damage is found and part of the text can't be read.

Check decals and labels, see "DECAL AND LABELS" page.

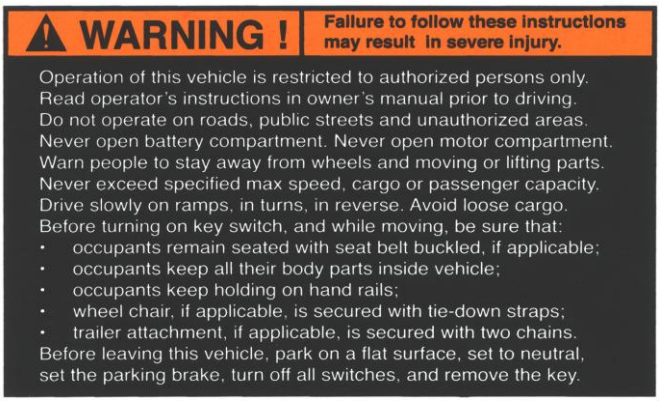
DECALS AND LABELS

! CAUTION !

The images included in this section depict the decals/markings installed on the vehicle. It is of the utmost importance that theses decals/markings remain unaltered and readable. Else, the sticker or the part baring the marking has to be replaced.

Dashboard security warning label:
5100000002

General security warning label:
5100000001

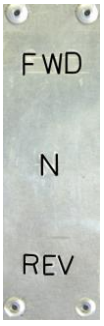


When an emergency push button is installed, this label is required (located under push button): # 3109800006

When a disconnect handle is installed, this label is required (located in front of handle):
4800012J

Respectively, key switch markings, forward/reverse selector markings and light switch marking:

266211



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PERIODIC MAINTENANCE CHECKLIST

! WARNING !
Maintenance operations must be made by properly trained service technicians.

- Keep clear from moving parts such as tires, sheaves and motor.
- Check for all EE protections, when applicable, and keep cables and wires clear from mechanical and rubbing action
- Batteries contain sulphur acid that can cause severe burns on skin or eyes.
- When working around batteries, wear acid proof protective equipment: face shield and gloves.
- Use electrically insulated tools to avoid sparks that can cause battery explosion.
- Before any maintenance work, park the vehicle on a flat level surface, turn off all switches, remove the key, lift the wheels off the ground and secure with jack stands of adequate capacity, identify and disconnect battery leads. Don't connect the charger.

CHECK/PERFORM **PERIOD HOURS**	**DAY**	**WEEK 20**	**MONTH 50**	**BIANNUAL 500**	**YEAR 1000**	**2 YEARS 2000**
MECHANICAL DAMAGE, OIL LEAKS	**X**					
REVERSE ALARM, DEADMAN SWITCH	**X**					
STATIC STRAP, min 2" contact with ground	**X**					
TIRE PRESSURE, pressure rating on tire		**X**				
CHECK/FILL BATTERIES, add distilled water to cover plates. Fill to recommended level after batteries have been fully charged.		**X**				
WARNING DECALS & MARKINGS			**X**			
MASTER CYLINDER FLUID (DOT 3)			**X**			
BRAKE PEDAL TRAVEL 2" (50 mm) maximum travel			**X**			
STEERING FOR PLAY			**X**			
PARKING BRAKE LEVER requires 75 lbs. (34 kg) force to apply			**X**			
POWERSTEERING OIL (ISO VG46) LEVEL			**X**			
CLEAN/TIGHTEN WIRE TERMINALS				**X**		
WASH BATTERY TOP WITH WATER				**X**		
HYDR. BRAKE LINES FOR LEAK				**X**		
STEERING ASSEMBLY, as instructed				**X**		
BRAKE MECHANICAL LINKAGES for wear & play				**X**		
BRAKE LININGS FOR WEAR 1/16" (2 mm) minimum lining thickness.				**X**		
LUBRICATE (GREASE EP-2) brake pedal pivots, steering column, ball joints and kingpins.				**X**		
OIL (SAE 80W90 / API GL4) LEVEL IN GEARBOX As instructed				**X**		
OIL (SAE 80W / API GL4 UTTO TYPE) LEVEL IN BRAKE CHAMBER As instructed.				**X**		
FRONT WHEEL BEARINGS PLAY				**X**		
TIGHTEN NUTS/BOLTS, electric terminals; drive; steering; brakes; suspension; body.				**X**		
CLEAN AND RE-PACK FRONT HUBS					**X**	
REPLACE BRAKE CHAMBERS AND GEARBOX OIL As instructed.						**X**

OIL GRADE CHART

Vehicle system	Oil grade
BRAKE CYLINDER	DOT 3, concurring with DMVSS116 standard
DRIVE AXLE	
Brake chamber	SAE 80W / API GL4 UTTO TYPE
Quantity	0.8L per chamber
Gearbox	SAE 80W90 / API GL4
Quantity	1.5L on differential gear side / 0.8L on speed sensor side
Power steering	ISO VG46

ACCELERATOR

GEAR

- Remove the cover.
- Backlash between gears must be reduced to a minimum by sliding holder; use locktite 262 to lock the three screws.
- When the plastic gear is fully depressed a small backlash must remain between the gears.
- When the plastic gear is released its rear portion must not exceed the pedal case.

MICRO-SWITCH

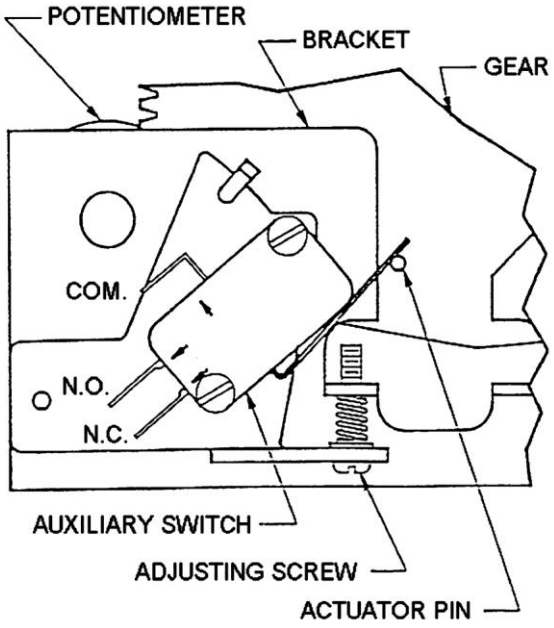
The micro-switch must deactivate the on/off solenoid when the accelerator is released; turn the adjusting screw (shown on figure below) to adjust the micro-switch height.

POT

- Remove the terminals 2 and 3 on PMC to measure resistance signal.
- When the micro-switch is activated the signal must be less than 50 ohms. When the front portion of the pedal is fully depressed the signal must be more than 4600 ohms.
- To modify the resistance, turn the adjusting screw to change the micro-switch height (see figure below).

Proceed with the same verifications after the accelerator cover is on and then connect terminals 2 and 3.

AUXILIARY SWITCH IS WIRED N.O. WITH BLUE LEAD TO COM. & ORANGE LEAD TO N.O. CIRCUIT. THE GREEN LEAD IS GROUNDED. AUXILIARY SWITCH IS SHOWN WITH THE TREADLE IN THE UP POSITION. SWITCH WILL ACTUATE AT BEGINNING OF TREADLE STROKE. SYMBOLS COM., N.O. & N.C. ARE TERMINAL MARKINGS, AS MARKED ON SWITCH.



FOOT PEDAL FP-6 MAINTENANCE GUIDELINES

FEATURES -

- FP 6 is designed for IP rating 64
  - It can work in dusty atmosphere.
  - It has sealing against splashing and spraying water from all side.
  - We do not recommend low pressure or high pressure washing.

SPECIFICATIONS -

- Pedal high point is pedal free condition
- 1st Microswitch Setting ;
  a) First micro switch should operate at 3º ± 1º (i.e. between 2º to 4º) from free condition
- Pot setting
  a) Operate pedal slowly; find reading at which first Microswitch operates.
  b) Pot resistance reading across pot low and wiper (i.e. black and white) must be within 100Ω to 400Ω.
- 2nd Micro switch setting
  a) 2nd micro switch should operate between 4600 Ω and *pot max* resistance, across *pot low and wiper* (i.e. black and white)

INSTALLATION PROCEDURE

Terminology - ***"Pot low", "wiper" and "pot high"*** are pot terminals. (Black, white and red cables respectively) "***Pot max resistance***" is the resistance value across pot low and pot high. (Black and Red cables)

1. MICRO SWITCHES AND POT SETTING

For Foot Pedal FP-6, use pot low and wiper (black and white) for setting micro switches.

- Set Pedal at free condition.
- Adjust pedal at 3° deflection. Set first micro switch to operate about set deflection.
- Adjust pot resistance from high valve to get (100 to 400Ω) across *pot low and wiper* (i.e. black and white).
- Set 2nd micro switch between 4600 Ω and *pot max* resistance.

CHECK LIST / CAUTION

- Pedal angle must be within 30 +/- 3 degree. Check freeness of pedal.
- Select 'resistance' measurement range in as per requirement on the Multi meter. Minimum resistance between pot low and wiper must be less than 10 ohms. Pot Max Resistance (between pot low and pot high) must be within 4500 to 5500 ohms.
- Confirm that micro switch settings are as per specifications.
- Measure the resistance between each of the seven wires and the housing of the Foot Pedal. It should measure "Infinity"
- Visually check the insulating sleeves are put around the soldered side of all seven cables, and that the sleeves are firmly in place.

YEARLY MAINTENANCE

- Remove cover of Pedal.
- Apply 3 to 5 drops oil on pedal return spring.
- Apply 2 drops oil in the slot of front bush.
- Do not apply oil on shaft from outside. It is of no use, due to sealing on the shaft.
    i. Oil Specification
    ii. 20W Motor Oil (Or 3 in one motor oil)
    iii. 20 stand for weight of motor oil.
    iv. W Stands for winter grade.

HYDRAULIC & PARKING BRAKES

Revision 2012-01-10

DRUM BRAKES

Remove brake drums and check lining wear. Replace shoes and springs if the lining thickness is 1/16" (2mm) or less. Turn the brake adjustment to reduce the clearance between lining and drum. Wheels must turn free when the pedal is released.

DISC BRAKES

Check pad linings. Replace pads if lining thickness is 1/16" (2 mm) or less.

PARKING BRAKE

Replace cables and stoppers if cable play exceeds 1/8" (4mm).
Wheels and/or differential pinion must turn freely when the parking brake is released.
On pinion brake, use spacers at pad fixed ends to reduce space between pads and pulley to 1mm.
To install new cables and stoppers:
-insert the new cable through the hand lever end;
-pull the cable out from the brake assembly end;
-insert the stopper on the cable and leave a maximum play of 1mm;
-for a two-cable system, make sure that cable length is the same at hand lever end;
-tighten 1/4-NCx3/4 grade-5 bolt in stopper at 8 LbFt (11NM) torque;
-cable must extend 1.5" (4cm) out of the cable stopper, cut cable excess.

Once cable play has been checked and/or adjusted, turn the knob on the brake lever until a force of 65-75 Lbs or 30-34 kg is required on the handle to set the parking brake. Tighten the locking screw.

BRAKE PEDAL

If the brake pedal becomes soft or spongy, air may have entered the hydraulic system and the brake system has to be bled:

1. fill the master cylinder with brake fluid (DOT-3);
2. bleed front callipers one at a time by having someone applying a steady pressure on the brake pedal, and close the bleeder before allowing the brake pedal to return to up position;
3. fill the master cylinder with brake fluid (DOT-3);
4. bleed rear wheel brakes one at a time, following the same procedure;
5. fill the master cylinder with brake fluid (DOT-3);
6. clean every fitting and line, remove traces of oil;
7. apply a continuous pressure on the brake pedal for about five minutes ;
8. Finally, inspect brake lines and fittings for leaks ;

FRONT AXLE AND STEERING

! CAUTION !

Before maintenance, turn off all switches, set to neutral, set parking brake, remove the key, and raise the front end of the vehicle supporting it with two jack stands of adequate capacity

STEERING INSPECTION

- Check tire inflation pressure, suspension components, tie rods straightness, tie rod ends play (wear), play (wear) in wheel bearings, kingpins and bushings.

REPLACING & ADJUSTING THE STEERING GEAR

- Remove the pitman arm;
- The steering box makes 6.5 turns, center the steering gear (3.25 turns from either side);
- Align the front wheel straight. Install the pitman arm.

TOE-IN ADJUSTEMENT

- 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;
- Turn the rear tie rod until the distances are equal and tighten the two lock nuts on the tie rod.

REMOVING & GREASING OF FRONT HUBS, required once-a-year

- Remove dust cap and cutter pin, unscrew nut, remove hub;
- Inspect bearings and races for wear and replace worn bearings;
- Replace the seal;
- Pack the hub with wheel bearing grease and re-assemble.

ADJUSTING FRONT HUBS

- Tighten spindle nut to 30 ft-lb to seat the bearing and back off the nut to the next slot;
- Install a new cutter pin and the dust cap.

BATTERY MAINTENANCE

! WARNING !

- It is the responsibility of the owner of this vehicle to ensure that the service technicians are properly trained, read and obey the safety rules and guidelines in this manual (ANSI B56).
- Maintenance operations must be made by properly trained service technicians only.
- Before any maintenance work, park the vehicle on a flat level surface, turn off all the switches, set to neutral, remove the key, lift the wheels off the ground and secure with jack stands of adequate capacity.
- Keep charger disconnected while doing any maintenance work.
- Always wear a face shield and scarf when working around batteries.
- Battery emits highly explosive gases; do not produce sparks to avoid battery explosion and acid splashing. Battery acid causes severe damage to eyes or skin. Flush contaminated area immediately with water.
- Use insulated tools to avoid sparks that can cause battery explosion and acid splashing.
- Use two counteracting tools, double-wrench technique, when disconnecting or tightening battery posts.
- Before cleaning or replacing a battery, discharge the capacitor in the controller with a 10 ohms, 25 W resistor for a few seconds across B+ and B-, identify battery polarity and disconnect battery leads.
- After cleaning, the power must not be reapplied until terminal areas are thoroughly dry.

BATTERY LEADS AND CONNECTORS

Check for loose connections, damaged cables, acid spill, loose terminal posts, quarterly.

BATTERY POST CORROSION

If corrosion is present on battery posts, remove the cable connectors, use a wire brush to remove particles, and then clean them with a cloth that has been moistened with ammonia.

ELECTROLYTE LEVEL

Does not apply to sealed battery.

- Disconnect battery connectors on roll-out or lift-out installations.
- Make sure the battery roll-out tray is provided with stops before rolling out.
- Fill with distilled water.
- Daily charged batteries normally require watering once a week. Under watering leads to a shortened battery life. Over watering leads to battery corrosion. Be careful not to overfill any cell to avoid electrolyte to be forced out while charging.
- Fill each cell to plate level with distillated or de-ionized water, before battery charging. When the battery is charged, the fluid expands and can seep out if overfilled. Refill each cell after full charge, when the fluid has expanded to its maximum level.
- Reinstall battery caps before charging.

BATTERY MOUNTING

A loose battery increases damaging effects of vibrations and is more prone to short out.

BATTERY DISCHARGE LIMIT

Discharging below a 20% state of charge cuts down the battery life and the number of cycles available. At 20% state of charge, specific gravity of 6V battery should be 1180; and 1220 for industrial battery.

CHARGING AREA

- Always charge battery in a well ventilated area set for and approved for charging.
- Never leave a charger connected for more than 20 hours.

FREQUENCY OF CHARGE

- When a battery is discharged to its 20% state of charge, it is best to charge immediately.
- Batteries require a low current equalization charge (min 4 hours) at least every week, to equalize battery cells, improve battery performance and life in number of cycles.
- Never leave a charger connected for more than 20 hours.

STORAGE

- Keep the battery from getting cold, it would loose its capacity.
- Let the battery warm up before charging.
- Charge batteries in “stored” vehicles every month.

DEFECTIVE BATTERY

Check specific gravity of each cell; if a cell is shorted, voltage drop may occur only when there is current.

ELECTRICAL TROUBLESHOOTING

! WARNING !

Maintenance work must be performed by trained service technicians only.

It is the responsibility of the owner of this vehicle to ensure that the services technicians are properly trained, understand and obey the safety rules and guidelines (ANSI B56).

All service technicians must read and understand the maintenance warning section in this manual.

! WARNING !

Before any maintenance work, park the vehicle on a flat level surface, turn off all switches, remove the key, lift the wheels off the ground, secure with jack stands of adequate capacity, disconnect charger.

Always wear safety glasses.

Batteries emit highly explosive gases that can be ignited by a spark. Before disconnecting a high current terminal, turn off all switches, disconnect battery charger, disconnect batteries.

Keep clear from moving parts such as tires, sheaves and motor.

PMC SELF DIAGNOSTIC

If your PMC comes with a status led, use the flashing code to help troubleshooting.

BATTERY VOLTAGE

Make sure batteries are securely connected. Measure voltage between + and - terminals. We will call this value B+ or full battery voltage.

ACCESSORIES NOT WORKING

- Check the fuses on the batteries and the DC/DC converter.
- Check voltage across + and – terminals on the battery gage; if not B+, check wiring.
- Turn the key switch ON, check voltage between output terminal on the key switch and the - terminal on the battery gage; if not B+, replace the key switch.
- Check voltage across DC/DC converter output terminals; if not 12-Volt, replace the converter.
- Depress the accessory switch, check voltage across accessory terminals. If not 12-Volt, replace the switch. If 12-Volt, replace the accessory.

FORWARD ONLY

On a SEPEX motor control, check the reverse signal input on the controller.
On a series wound motor control, a bad reverse contactor is the most probable cause of the problem.
Switch to reverse and check voltage on the reverse control wire. If not B+, replace the F/R switch. If B+, turn off the key switch, disconnect batteries, disconnect power terminals on the F/R contactors, check the resistance across N.C. power terminals of the reverse contactor. If not 0 ohm, change the reverse contactor. If 0 ohms, switch to forward and check the resistance across the forward N.O. power terminals. If not 0 ohms, change the forward contactor.

REVERSE ONLY

On a SEPEX motor control, check the forward signal input on the controller.
On a series wound motor control, a bad forward contactor is the most probable cause of the problem. Switch to forward and check the voltage on the forward control wire. If not B+, replace the F/R switch. If B+, turn off the key switch, disconnect batteries, disconnect power terminals on the F/R contactors, check the resistance across N.C. power terminals of the forward contactor. If not 0 ohm, change the forward contactor. If 0 ohms, switch to reverse and check the resistance across the reverse N.O. power terminals. If not 0 ohms, change the reverse contactor.

TRAVEL AT REDUCED SPEED

Check batteries.

Turn off all switches and disconnect charger. Wear face shield and gloves. Do not disturb any battery connection to avoid sparks. Check the specific gravity of each cell. Cold batteries, highly discharged batteries or dead cells are the most frequent causes of reduced travel speed.

Check potentiometer.

Turn off the key switch, disconnect potentiometer terminals. Check the resistance between terminals.

Other causes of lower speed:
- dragging brakes;
- cold temperature (higher differential oil viscosity).

INTERMITTENT OPERATION

A bad potentiometer is the most probable cause of the following:
- acceleration is not constant;
- maximum speed is erratic;
- sudden stop after a bump or shock;
- erratic starts, requiring several pedal cycles.

A bad F/R contactor is also a probable cause of the following:
- sudden stop after a bump or shock;
- would not start to move at times.

Erratic starts could also be the cause of a misadjusted potentiometer or micro-switch; the pot signal must be less than 50 ohms when the micro-switch turns on.

PMC has an HPD safety feature that prevents the vehicle from moving if the accelerator pedal is depressed before the key switch is ON and seat switch is activated.

PMC may also have an SRO safety feature that prevents the vehicle from moving if the F/R switch is activated before turning on the key switch and activating the seat switch.

The vehicle stops on a steep and long ramp or while towing a heavy load: the circuit breaker has open to prevent motor overheating and will reset automatically after one minute. The PMC is also equipped with an internal thermal protection that cutback the current until the PMC has cooled down.

NO MOTION

Make sure that the PMC surface is clean and dry; check the terminal areas. Dust Particles or acid contamination, can create current leaks and cause a PMC malfunction.

Check F/R switch

Turn on the key switch and set to forward. Check voltage between the forward terminal and the – terminal on the battery gage, check voltage between the reverse terminal and the – terminal on the battery gage; if both B+, replace the F/R switch.

Check switches and wiring

Disconnect control terminals on the PMC and check all control signals. If a switch pin does not read B+, check wiring or replace the switch.

Check potentiometer

Turn the key switch to OFF, disconnect potentiometer terminals. Check the resistance across terminals: if not within the recommended limits, adjust or replace the potentiometer. Check for shorts between potentiometer wires and vehicle frame; resistance should read at least 1 megohm.

Check main contactor or solenoid

Check voltage across power terminals; if not B+, check circuit breaker or replace the solenoid.
Turn to on the key switch and activate the seat switch. Check voltage across the coil terminals; if not B+, check wiring and interlock switches. Check resistance across power terminals; if not 0 ohms, replace the solenoid.

Check circuit breaker and SEPEX DIODE

Before replacing the circuit breaker, check for shorts in the power circuit and check the SEPEX diode in the power circuit using a diode tester. If no such instrument is at hand, use an ohmmeter: the reading should be weak in one direction and strong in the other way.
Check the resistance across the circuit breaker. If not 0 ohms, replace the circuit breaker.

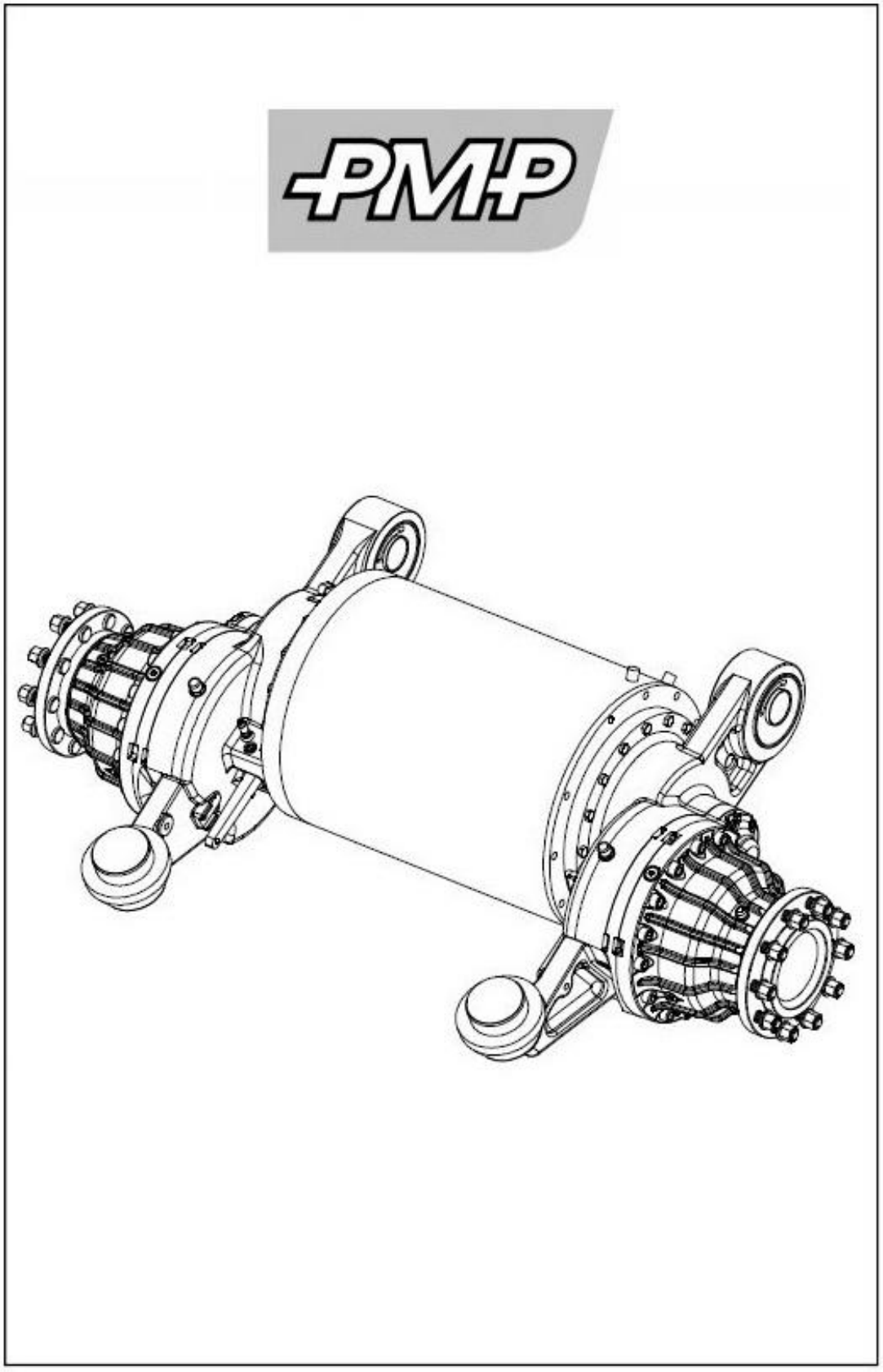
Check PMC

First disconnect battery B+ and B-, then PMC B+ and M-. Check the internal diode between B+ and M- terminals using a diode tester. If no such instrument is at hand, use an ohmmeter: the reading should be weak in one direction and strong in the other way. If the internal diode is defective, the PMC must be replaced.

Check the Motor

First disconnect battery B+ and B-, disconnect power terminals and check the motor armature and field for opens.

DRIVE AXLE INSTRUCTIONS



SAFETY REGULATION

This handbook provides just an overview of the wheel drive unit and is addressed to skilled workmen properly equipped to perform maintenance.

Detailed descriptions of the disassembly and assembly of this axle are available in separate documents.

During maintenance, assembly and disassembly activities use caution and proper safety equipment, in observance of the rules provided by safety laws.

ATTENTION! The gearbox is made with heavy parts: secure the parts and use proper lifting equipment.

MAIN CHARACTERISTICS

PMS 701 HS-TR is an axle designed for electrical traction, where a high torque is required at the wheel with low load structural capacity.

PMS 701 HS-TR is composed of five independent and separate parts, and namely:

1) The single motor with hollow shaft with mechanical differential;

2) The reduction gearboxes;

3) The main bodies, containing the wet disks braking system.

The **patented** technical solution of the separation between the brake chamber and the gearbox allows to optimise the performance of the unit, because:

- The reduction gear can be lubricated with the oil adapting best to the characteristics of the driving unit;
- The brake can be lubricated with the oil adapting best to the braking unit (usually more fluid than oil for driving units).
- Deposits forming up during braking cycles remain in the cartridge only, and do not contaminate the reduction gear lubricant; this way, bearings and the driving unit are better protected and the reduction gear oil need be replaced at longer intervals.
- Replacing brake discs not requires the whole reduction gear to be disassembled.
- It is possible to shift from the positive brake mechanism (hydraulic or mechanism control) to the negative brake mechanism (hydraulic release) by replacing the mechanical parking lever.

ATTENTION! :

Under normal working conditions the gearbox shall never exceed a temperature of **120°C**. If this temperature limit is exceeded it is recommendable to suspend usage and allow the gearbox to cool down.

GEARBOX MAINTENANCE

The reduction gearboxes are supplied without oil. Prior to operating axle, gearboxes must be with oil.

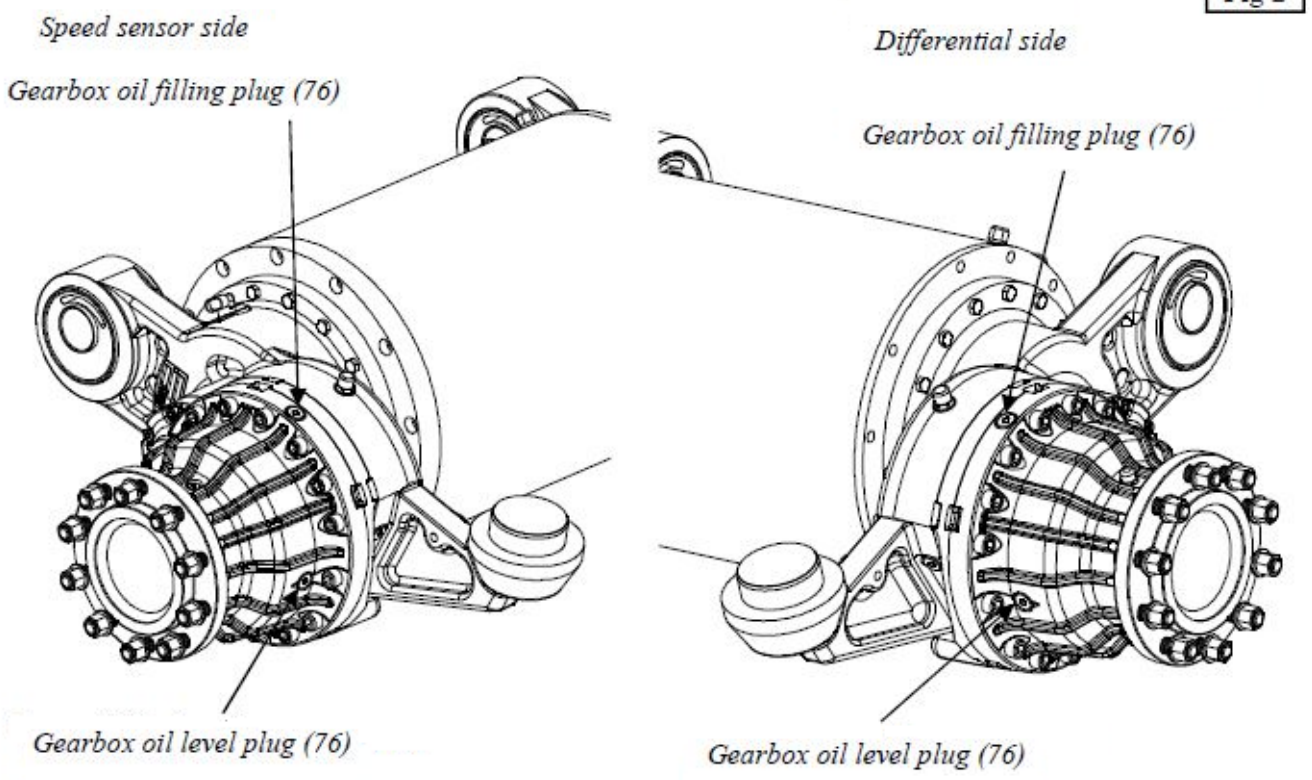
For oil filling, use the filling plug (76), as shown on fig.2. Each gearbox must be filled with the following volumes of oil:

- **Speed sensor side: 0.8 litres**
- **Differential side : 1.5 litres**

The gearboxes work properly with the nominal volumes of oil indicated; therefore, the quantities above must always be respected.

When changing the oil, drain the oil from drain plugs (78) and differential drain plug (76) (fig.3 page 28). Pay attention to the oil flow which will start immediately upon plug unscrewing. To facilitate oil draining, also filling plugs can be removed.

Fig 2



Oil should be changed every **3000 working hours**.

You are recommended to use oil type SAE 80W90 / API GL4 as the following:

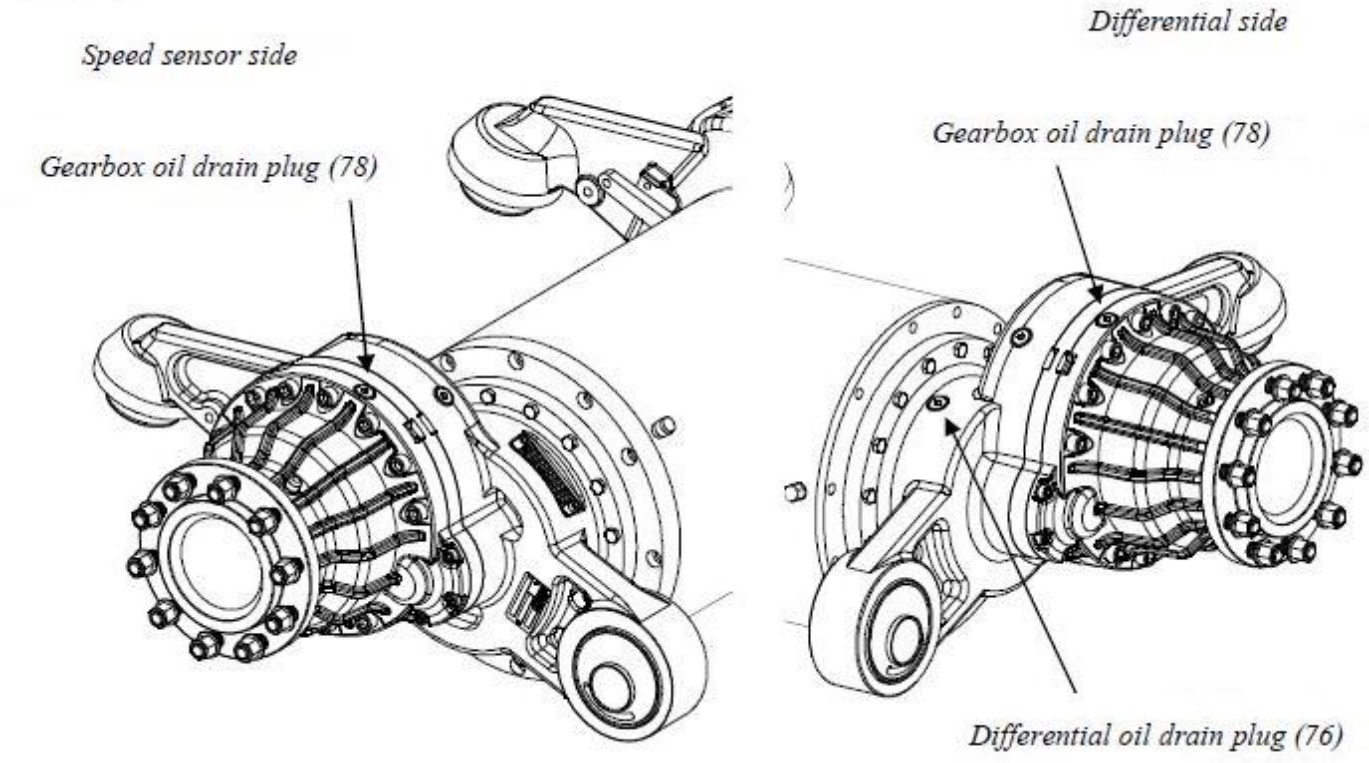
AGIP ROTRA MP

Verification of the correct oil levels inside the gearboxes shall be done under normal operative conditions: axle placed horizontally and vehicle not working.

Oil check shall be done unscrewing the level plugs (76) (see fig.2 page 27). If there is no oil flow when unscrewing the level plugs, axle should be inspected.

The oil level check is "overflow", this means than the correct oil level is present when the oil flows from the hole of level plug.

Fig 3



DIFFERENTIAL GEAR AND SENSOR

The differential gear is installed inside the left side flange, looking from the tractor seat, of the electric motor and it's lubricated with the same oil of the near gearbox (see fig.4).

The tone wheel (80 teeth) and the speed sensor are installed inside the other side flange of the electrical motor (see fig.5).

Fig 4

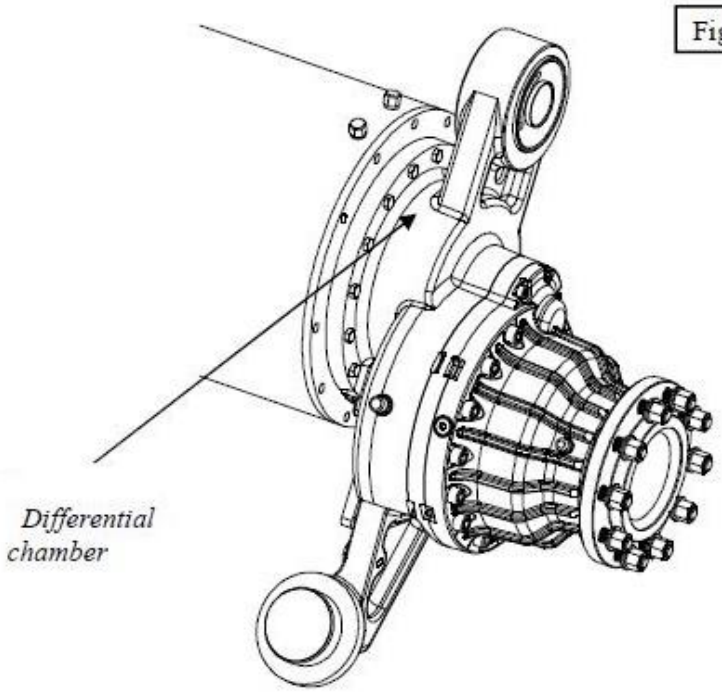
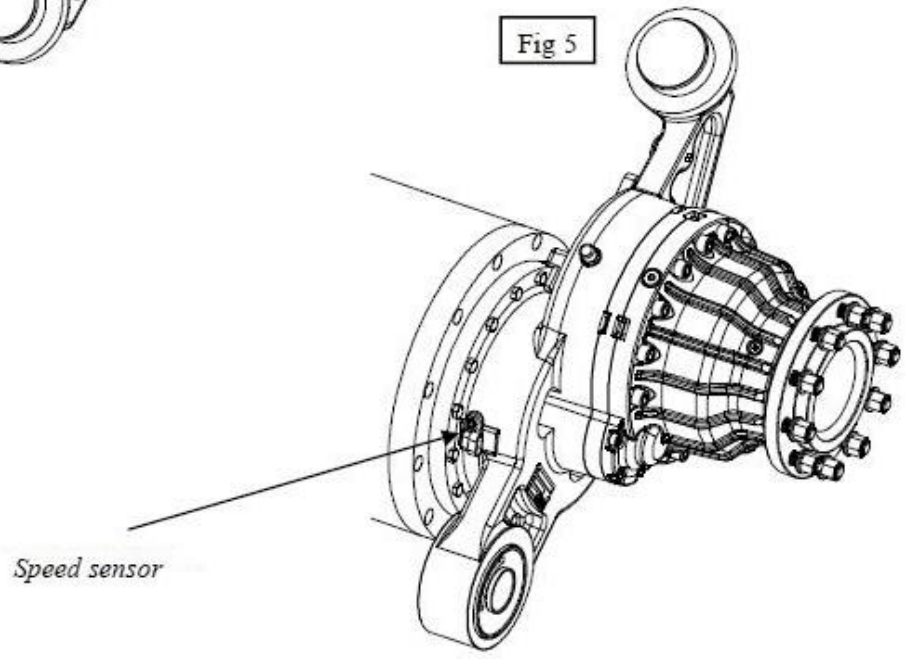


Fig 5



BRAKE MAINTENANCE

The brake cartridge is supplied without oil. Prior to operating to axle, brake chambers must be filled with oil.

For oil-filling operations, use the filling plugs (79) as shown on fig. 6.

Every brake cartridge need be filled with **0.8 litres of oil**.

Oil should be changed every **3000 working hours**.

You are recommended to use oil type SAE 80W / API GL4 as the following:

AGIP ROTRA JD/F (MOBILFLUID 424-MOBIL)

The oil level check is "overflow", this means that the correct oil level is present when the oil flows from the level plug (76). When changing the oil, drain oil from draining plugs (76) (see fig. page 31).

It is necessary to check every 3000 working hours that the stroke of the brake piston is not bigger than 3,5 mm, otherwise it is necessary to replace the brake discs. In order to estimate the wear of the discs, disconnect the brake rod (continues next page).

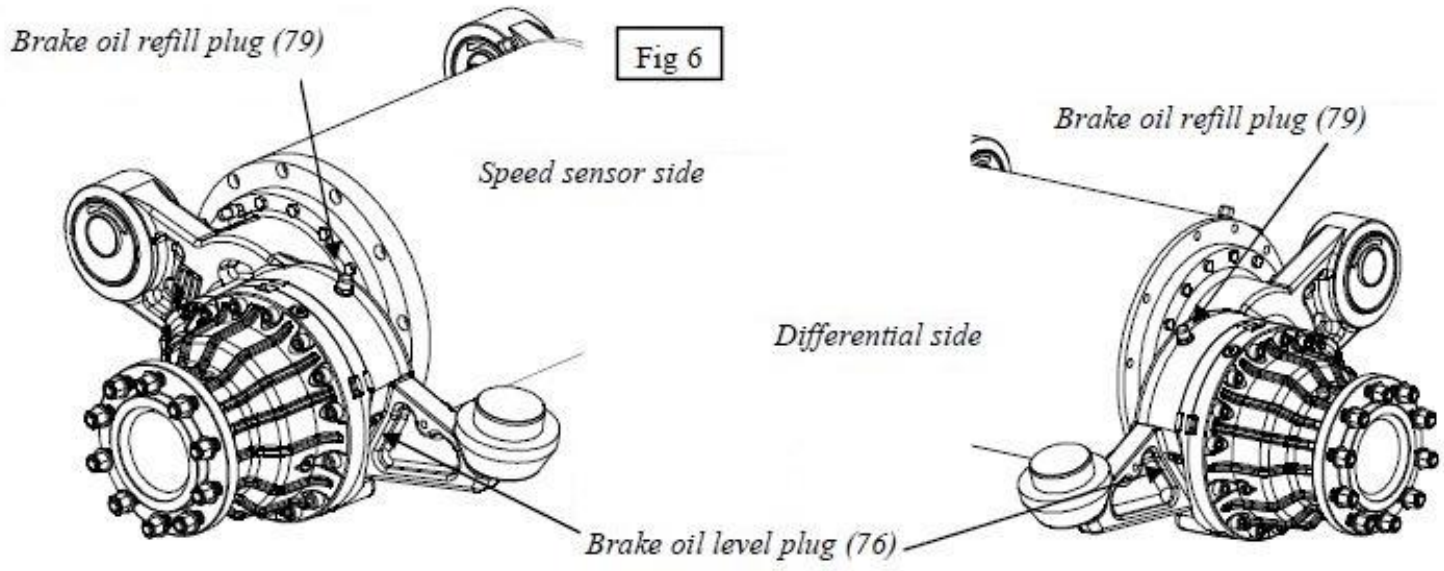
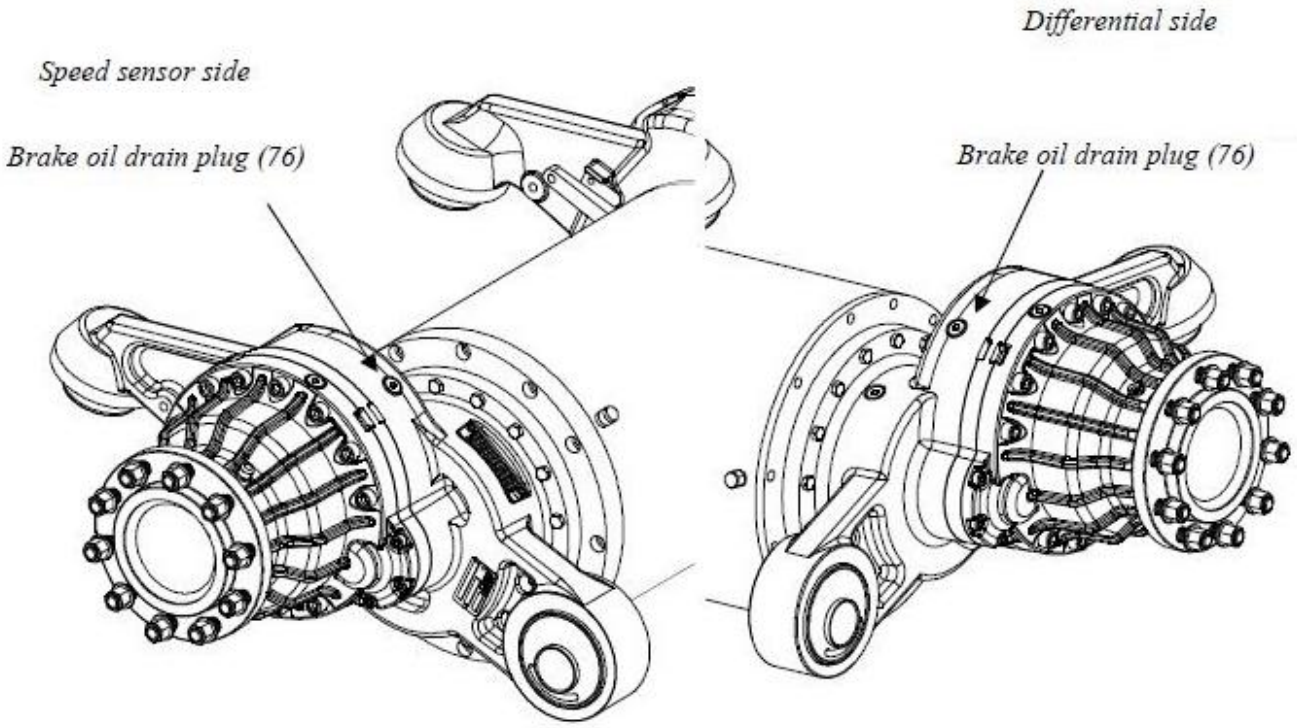


Fig 6

Move the lever closer the brake piston, then pull it strongly and measure the stroke of the lever: it has not to be over 21 mm. In case the stroke exceed this value, it's suggested to replace the disc pack.

Fig 7



The M10xl (*) plug is used as connection to the hydraulic service brake circuit (see fig. 8).

The bleeding located near the lever is used for bleeding the braking circuit before it is started.

The brake is designed to guarantee that the wheel maximum braking torque exceeds 3000 Nm under a pressure of 75 bars or with a pull of approx. 2000N on the brake lever.

For parking brake purpose the relation is 550 N at lever = 1000 Nm at wheel.

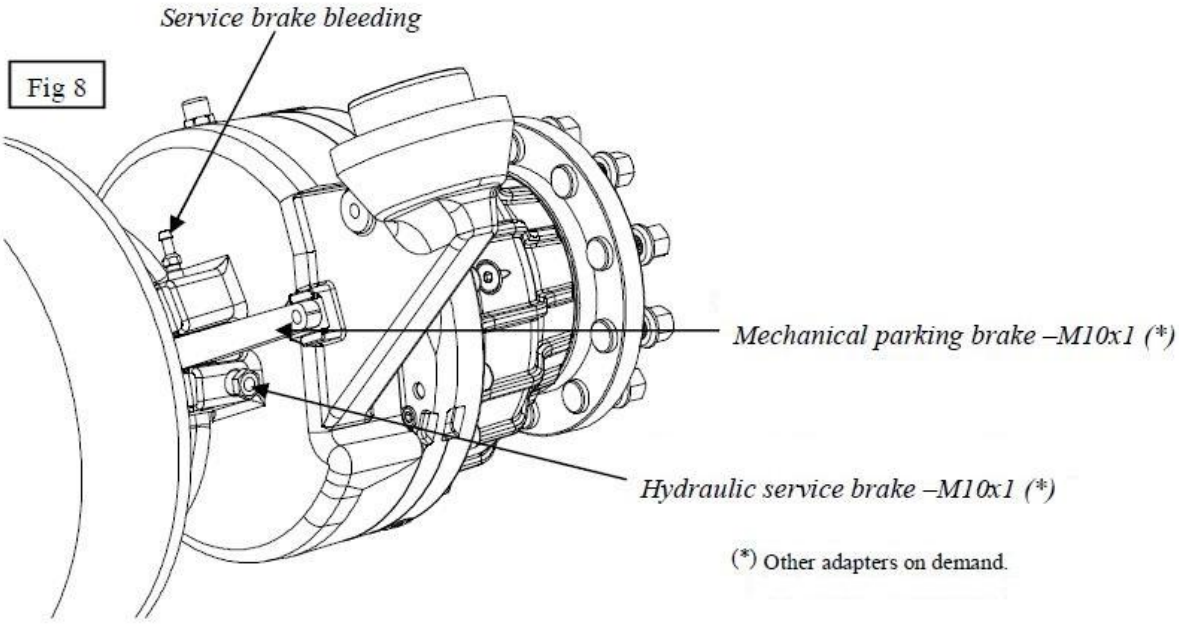
The lever stroke is 15 to 21 mm depending on brake disks consumption.

From a mechanical point of view, the brake discs can temporarily bear a pressure exceeding 200 bars in total security; tightness of gaskets on the brake inner piston is not guaranteed when pressure exceeds 150 bars.

Piston gasket (**) have been successfully tested with **DOT4 oil**.

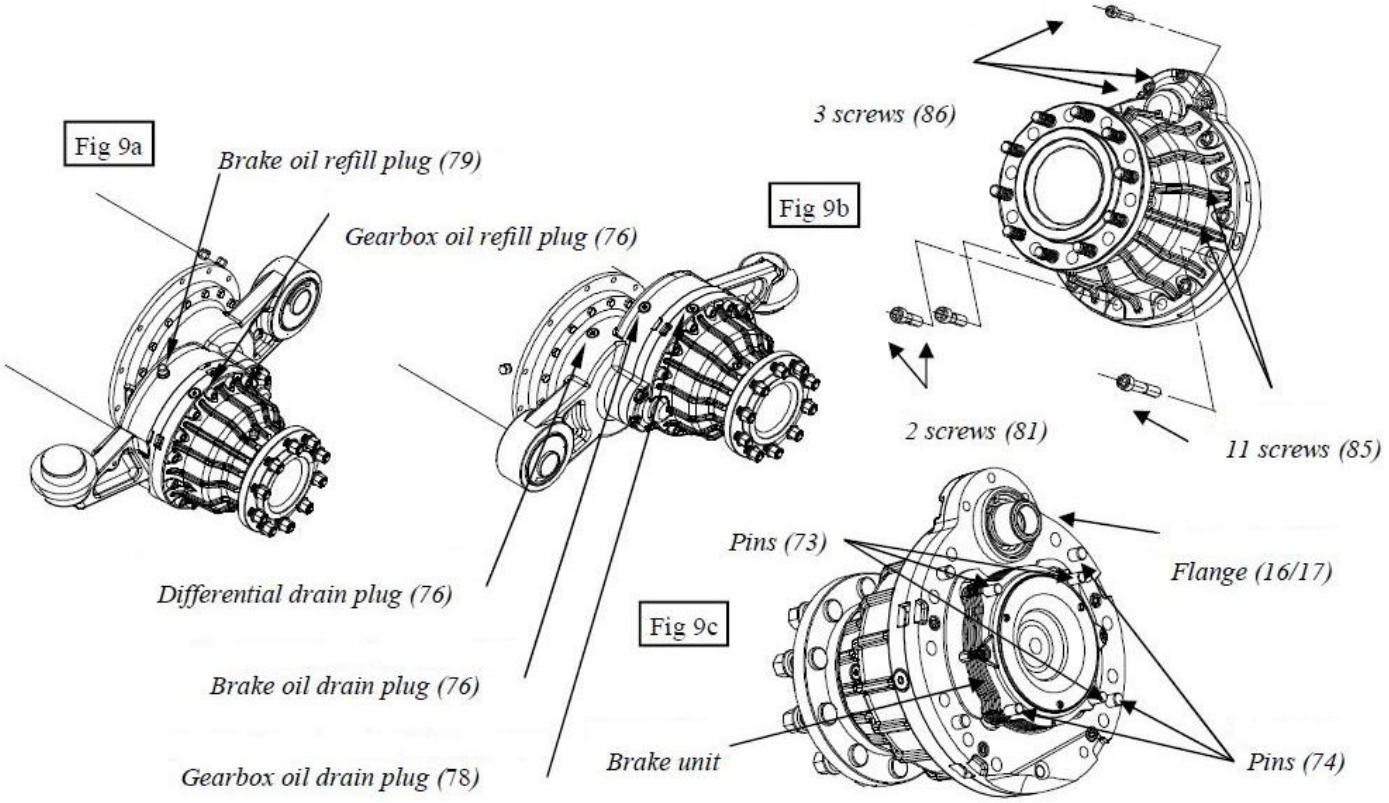
(**) It is possible to assembly special gaskets (for hydraulic fluid – mineral type) on special request

Fig 8



Brake disassembly/assembly procedure - general desciption[1] –

You have to drain the oil both from the brake disc chamber from the reduction gearbox, removing the plugs (76 and 78 magnetic) [2] on the top (see fig. 9a) and the differential drain plug (76) on differential side. Secure the gear box and then unscrew the 16 screws (81, 85, 86) (see fig. 9b). Remove the box inserting a tool in the 4 seats on the edge of the box and pulling it along the wheel axis. Please, pay attention during this operation in order to avoid damaging the pins (74) and the pins (73). In case one pin (73) remain trapped in the casing (7/8), you are recommended to remove and replace it in its own housing on the flange (16/17) (fig. 9c).



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1 Detailed description of disassembly-assembly of axle are available in separate document

2 Numbers in brackets refer to the parts as listed

REPLACE OF THE BRAKE DISCS

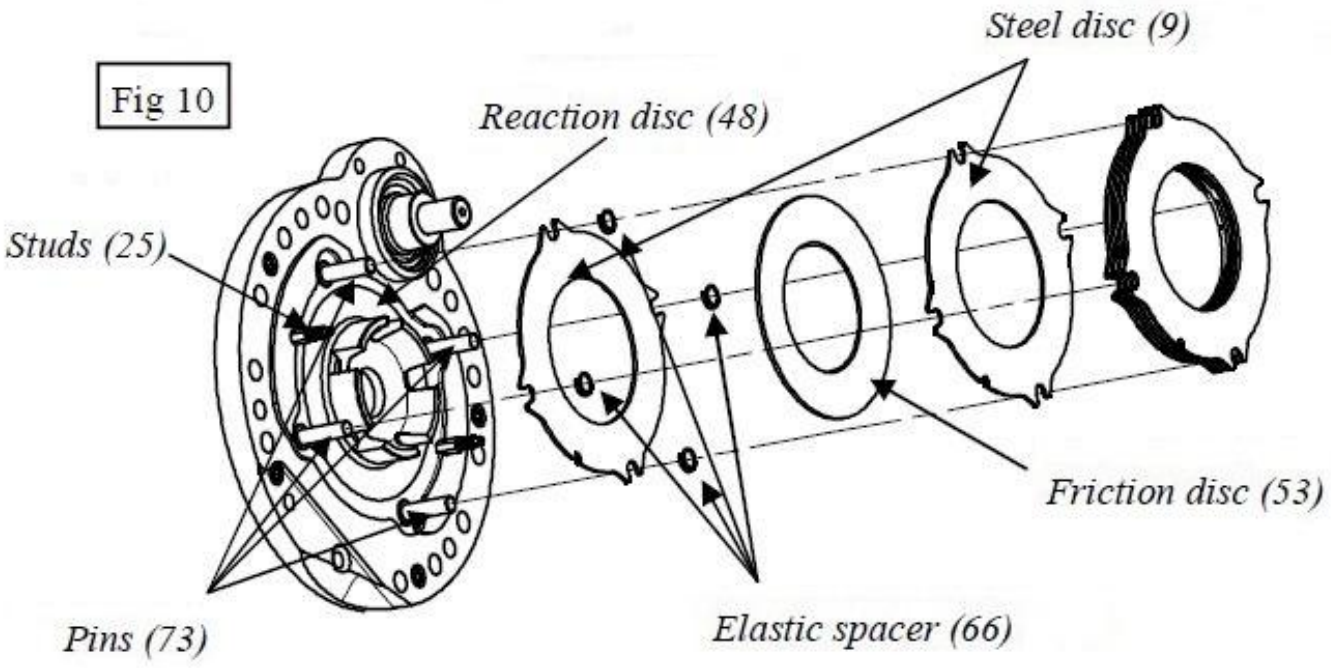
The brake discs unit is made of 6 steel discs (9) and friction discs (53), ordered in an alternate way the first one and the last one must be smooth). Between every couple of steel discs four elastic spacers are inserted (66), one spacer on each locking pin (73) (see fig. 10)

Remove first the 2 retaining rings (43) from the studs (25), then the discs pusher device (13 + 75 + 10) and the brake disc unit. Pull the springs (67) out from the studs (25). Remove the aluminium reaction disc (12).

Wash down the cartridge thoroughly, then to assemble the parts again follow next steps:

- **Step 1**: insert the reaction disc (12)
- **Step 2**: insert steel disc (9), 4 elastic spacers (66) one spacer on each locking pin (73), friction discs (53).
- **Step 3**: repeat step 2 for 4 times
- **Step 4**: place last steel disc and the 2 springs (67) in the studs (25).
- **Step 5**: insert the discs pusher device (13 + 75 + 10) onto the pins (25), then, pressing down all, place the 2 retaining rings (43) into the seat on the pins (25).

Fig 10



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1) Numbers in brackets refer to the parts as listed in the spare part list

Lay a coat of sealant on the cartridge contact surface. Insert the gearbox, centre on its 4 pins (74) and, using a rubber hammer, fine-tune the cartridge position until it is completely inserted.

Now, insert the screws in their own holes (see fig. 9b on page 33) and set them with the following torque wrenches:

(81) screw M12 cl. 8.8 80 Nm

(85) screw M12 cl. 8.8 80 Nm

(86) screw M8 cl. 12.9 40 Nm

OIL FILLING

Unscrew the two brake oil level plugs (76) in the front side (see fig. 11), close the discharge holes in the bottom side using the 4 plugs (76 for the brake chamber, 78 magnetic for the gearbox), and the differential drain plug (76) on the left casing.

Refill with oil through the 2 holes on the top. Please pay attention to put brake chamber oil into the brake chamber, gearbox oil into the gearbox.

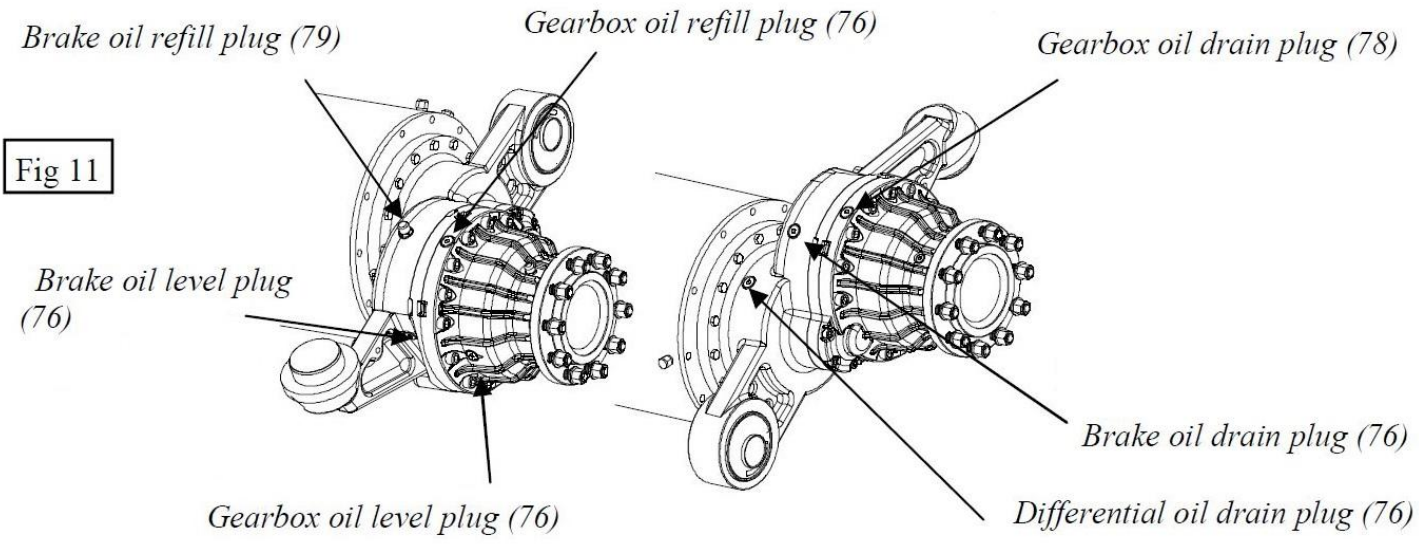

Fig 11

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1) Numbers in brackets refer to the parts as listed in the spare part list

ATTENTION !

Every reduction gearbox need to be filled with the following oil quantities:

- **Speed sensor side: 0.8 litres**
- **Differential gear side: 1.5 litres**

Oil should be changed every **3000 working hours**.

You are recommended to use oil type SAE 80W90 / API GL4 as the following:

AGIP ROTRA MP

Every brake need to be filled with:

0.8 litres of oil.

Oil should be changed every **3000 working hours**.

You are recommended to use oil type SAE 80W / API GL4 as the following:

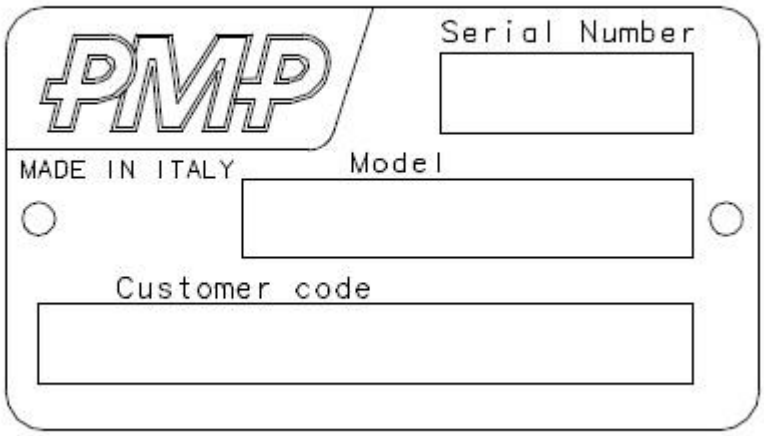
AGIP ROTRA JD/F (MOBILFLUID 424-MOBIL)

Drive in lever and refill plugs (two plugs 79 and two plugs 76 as showed in fig. 11).

SPARE PARTS

It is necessary to identify the model and the serial number on the name-plate of the gearbox (see fig. 12) while asking for spare parts.

Fig 12



DIASASSEMBLY / ASSEMBLY

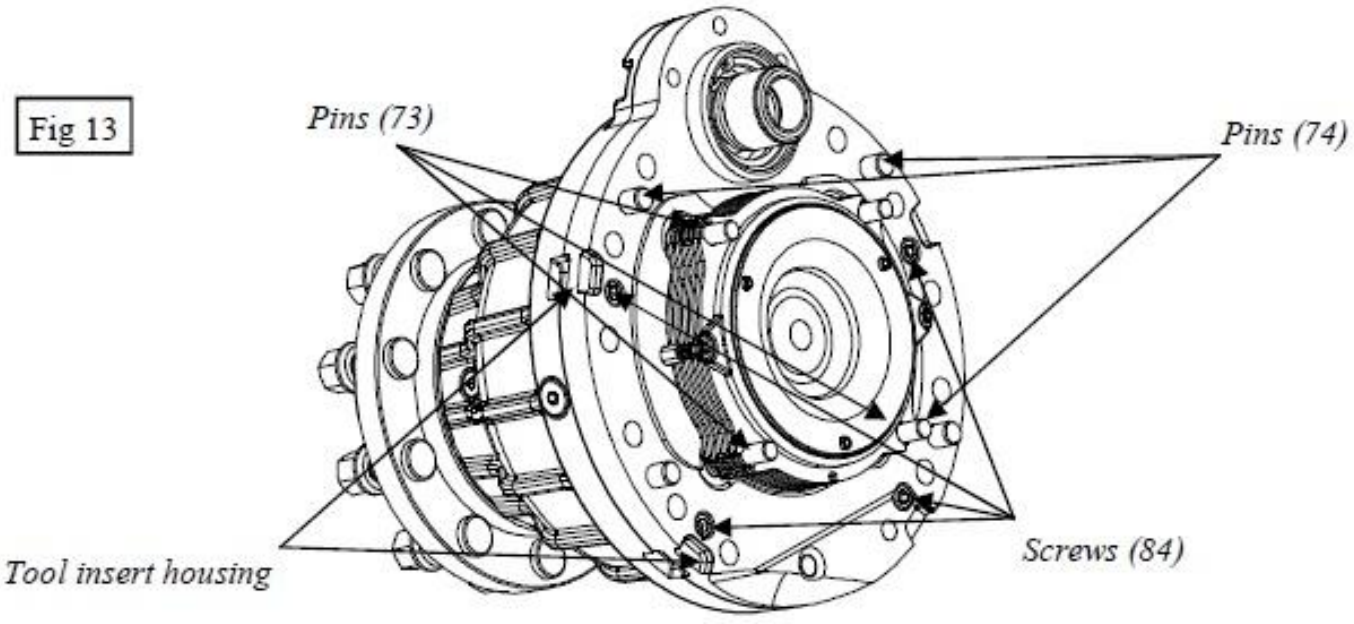
Gearbox disassembly – general description [1] –

You have to drain the oil both from the brake disc chamber and from the reduction gearbox, removing the plugs (76 and 78 magnetic) [2] from the bottom side and the 2 plugs (76 and 79) on the top and on differential side the cup (76), on the bottom (see fig. 9a page 33). Secure the gearbox and then unscrew the 16 screws (81, 85, 86) (see fig 9b page 33). Remove the box inserting a tool in the 4 seats on the edge of the box and pulling it along the wheel axis. Please, pay attention during this operation in order to avoid damaging the pins (74) and the pins (73). In case one pin (73) remain trapped in the casing (7/8), you are recommended to remove and replace it in its own housing on the flange (16/17).

Cover Removal (16/17)

Unscrew the 4 screws (84) on the cover (16/17) and remove the cover inserting a tool in the 4 housing on the edge of the cover itself.

Fig 13



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1 Detailed description of disassembly-assembly of axle are available in separate document

2 Numbers in brackets refer to the parts as listed on the spare part list

Disassembly of the Input Shaft (1/2)

Remove first the retaining ring (45) and using a rubber hammer take out the input shaft.

Helping yourself with an extractor pull out the bearing (57) and/or the helix pinion (90) (see fig. 14).

Disassembly of the Sun Pinion (22)

Attention, please: prior to this operation you have to remove the brake disc unit following the instructions on page 33!!

Remove the retaining ring (39). To remove the helix gear (87) put a disc ($Ø_i$ = 92mm, $Ø_e$ = 130mm) on the cover (looking from the brake side) and carefully press on a pipe ($Ø_i$ = 17mm, $Ø_e$ = 27mm) placed on the sun pinion (22) (looking from the gearbox side).

Fig 14

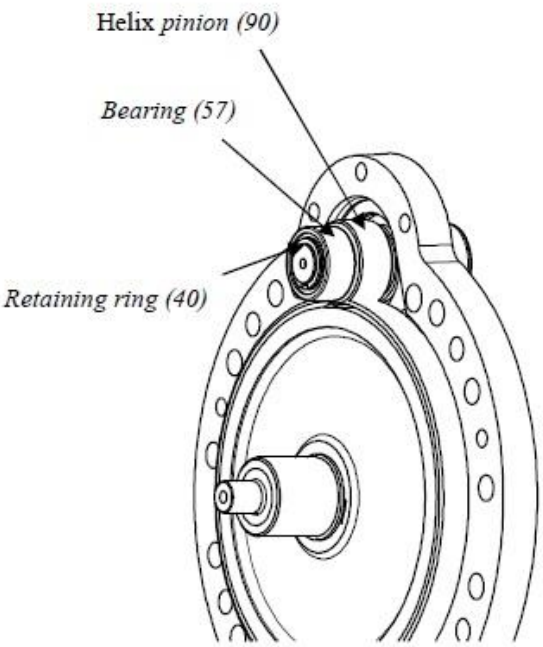
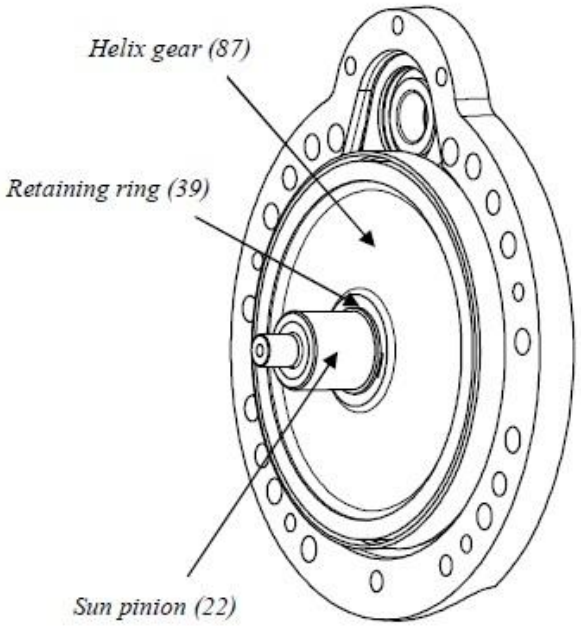


Fig 15



Disassembly of the Planet Crown (6) and of the Wheel Hub

In order to pull out the planet gears (30) and their bearings (54), remove the retaining ring (38) and use a special extractor (see fig. 16a).

To unscrew the ring nut (18) a special tool is required; this tool is described on page 46. To remove the wheel hub (21) place a pipe ($Ø_i$ = 17mm. $Ø_e$ = 27mm) on the centre of the M40 thread of the hub, and carefully press it out. At this point slip off the planet carrier (24) (see fig. 16c).

Fig 16a

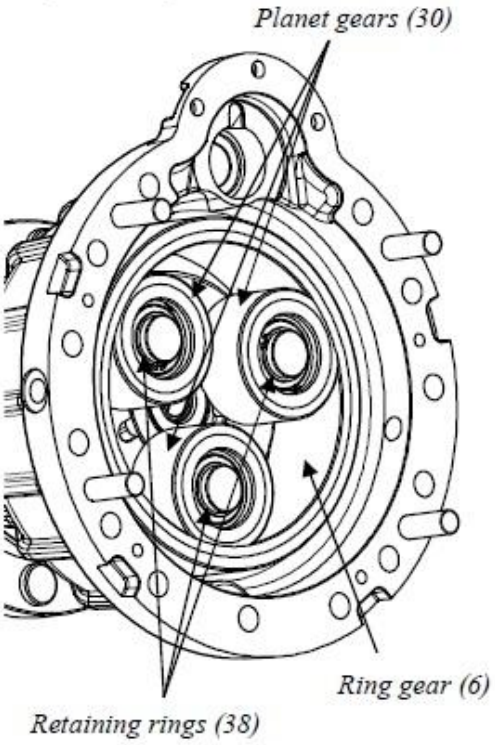


Fig 16b

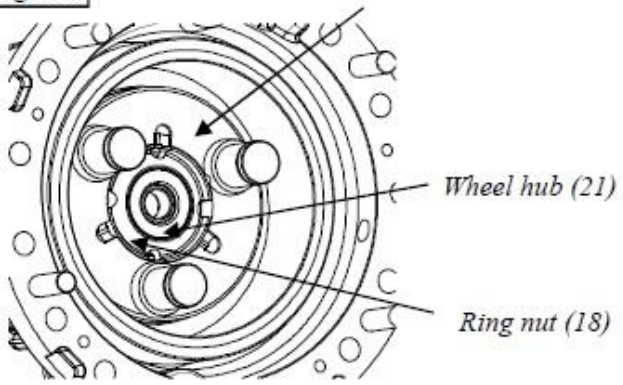
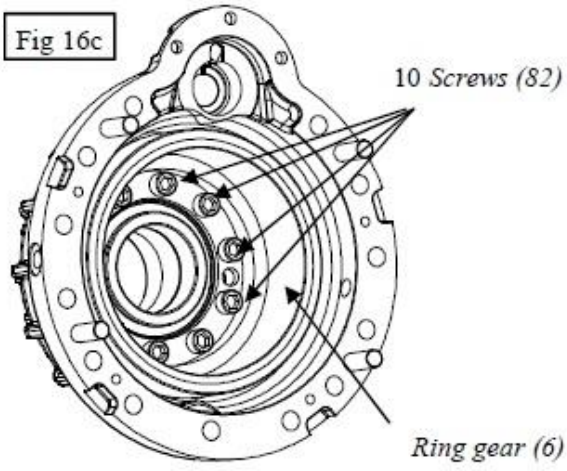


Fig 16c

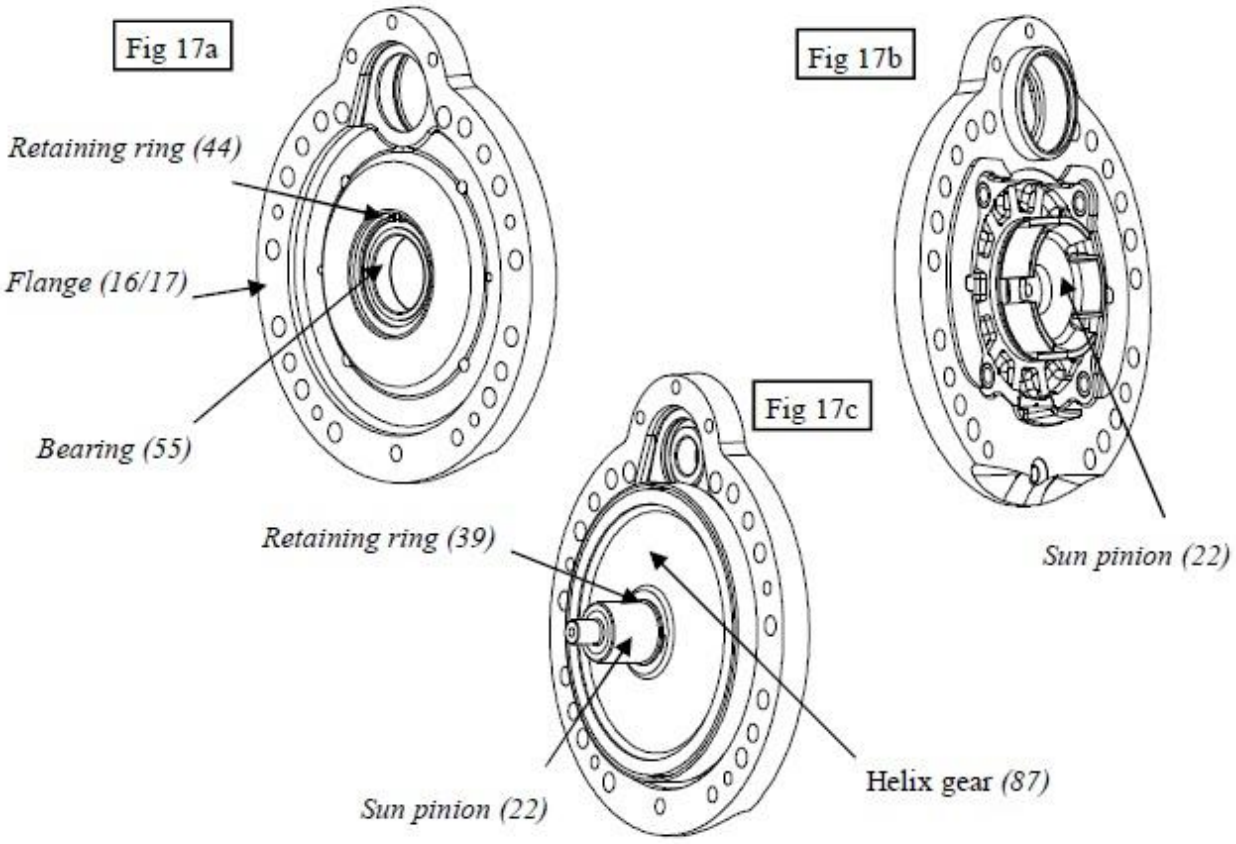


Assembly of the Reduction Gear – general description [1] –

After the worn-out parts have been replaced, to assemble the unit again follow the disassembling process steps in reverse order.

Assembly of the Sun Pinion (22) [2]

Key the bearing (55) in its own slot on the flange (16/17), locking it with the retaining ring (44) (fig. 17a), insert the sun pinion (22) (fig.17b) using a press and pushing on the inner ring of the bearing; place the feather key (65) into its own slot and insert the helix gear (87) on the sun pinion (22) (fig. 17c). To easy keying operations, you may heat the helix gar (87) to maximum 100-120°C. Insert the retaining ring (39).



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1 Detailed description of disassembly-assembly of axle are available in separate document

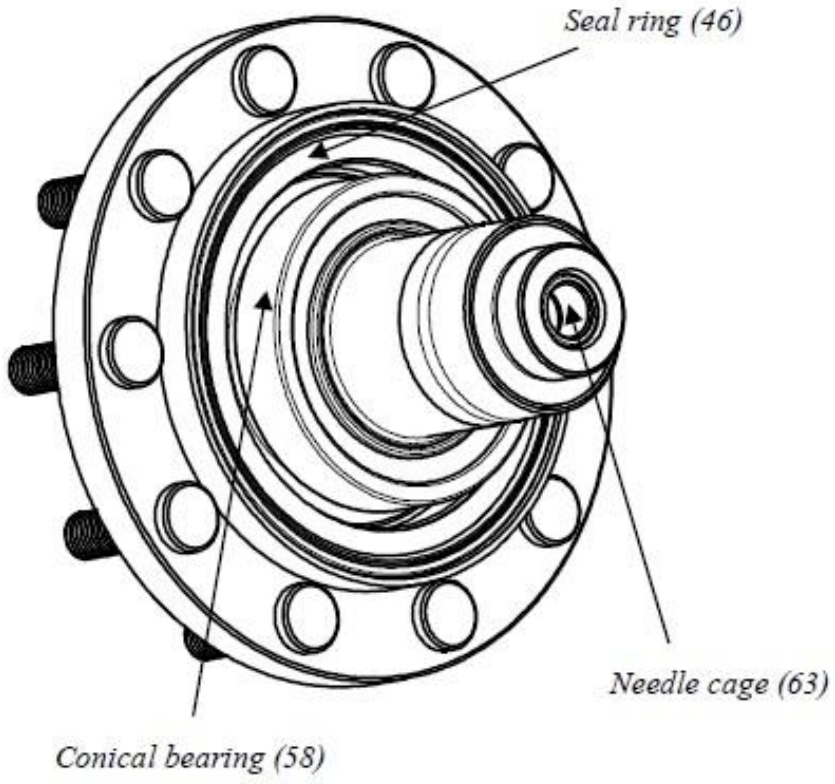
2 Numbers in brackets refer to the parts as listed in the spare part list

Assembling the Ring gear (6) and the Wheel Hub (21)

Insert the cup (outer ring) of the conical bearings (58) and (59) in their front and rear housings on the casing (31); insert the cone (inner ring) of bearing (58) onto the hub (21) – possibly heating it up to 100-120°C -. Insert the needle shell (63) in its own slot in the hub (21) (fig. 18).

Introduce the pre-assembled hub into the casing, insert the spacer (14) into the shaft and then place the cone of the bearing (59), pressure-keying it in.

Fig 18



Insert the ring-gear carrier disc (19) into the ring-gear (6) and fix it introducing the retaining ring (68) in its housing (fig.19a). Place the disc in the housing (31) centring it on the two pins (72) and then tighten its 10 screws (82) with a 80Nm torque wrench setting (fig. 19b).

Heat the planet carrier (24) up to 120°C, then place it onto the wheel hub spline (21) and press it down until the group is pack-closed; tighten the ring nut (18) with an dynamometric key set at 500 Nm torque wrench, (fig. 19c) then **lay the outer edge low.**

Insert the planet gears pre-mounted with their bearings (30 + 38 + 3 + 3) into the 3 axes of the planet carrier (24), then lock them with the retaining rings (38), one for each planet gear (fig. 19d).

Fig 19a

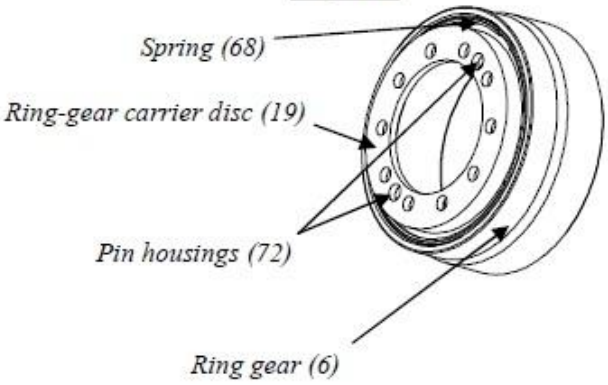


Fig 19b

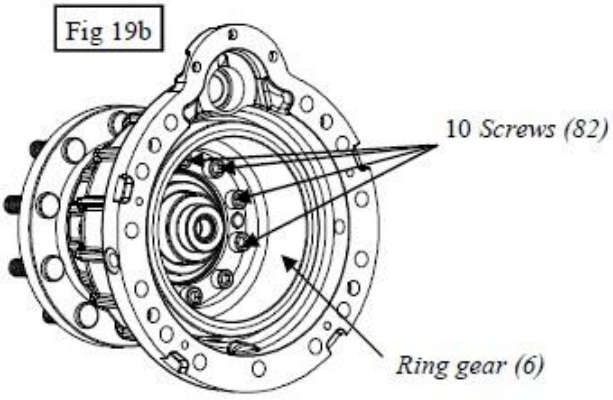


Fig 19c

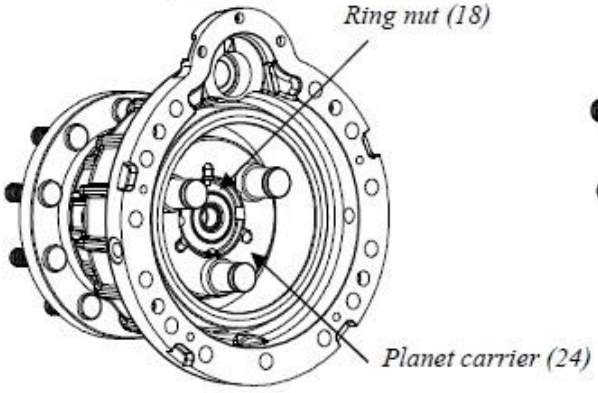
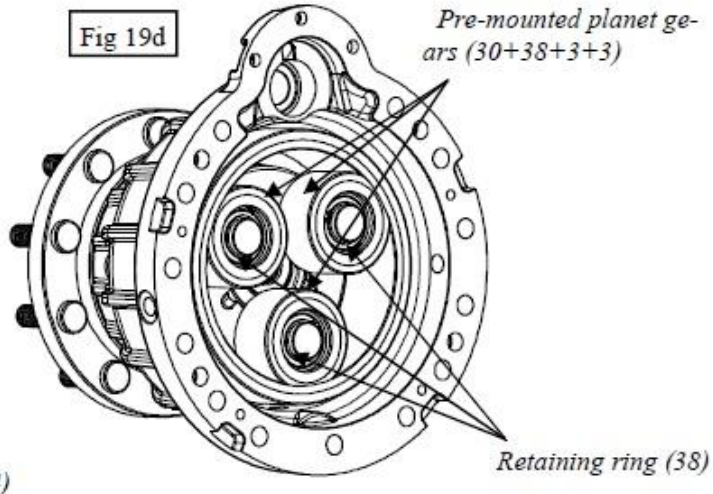


Fig 19d

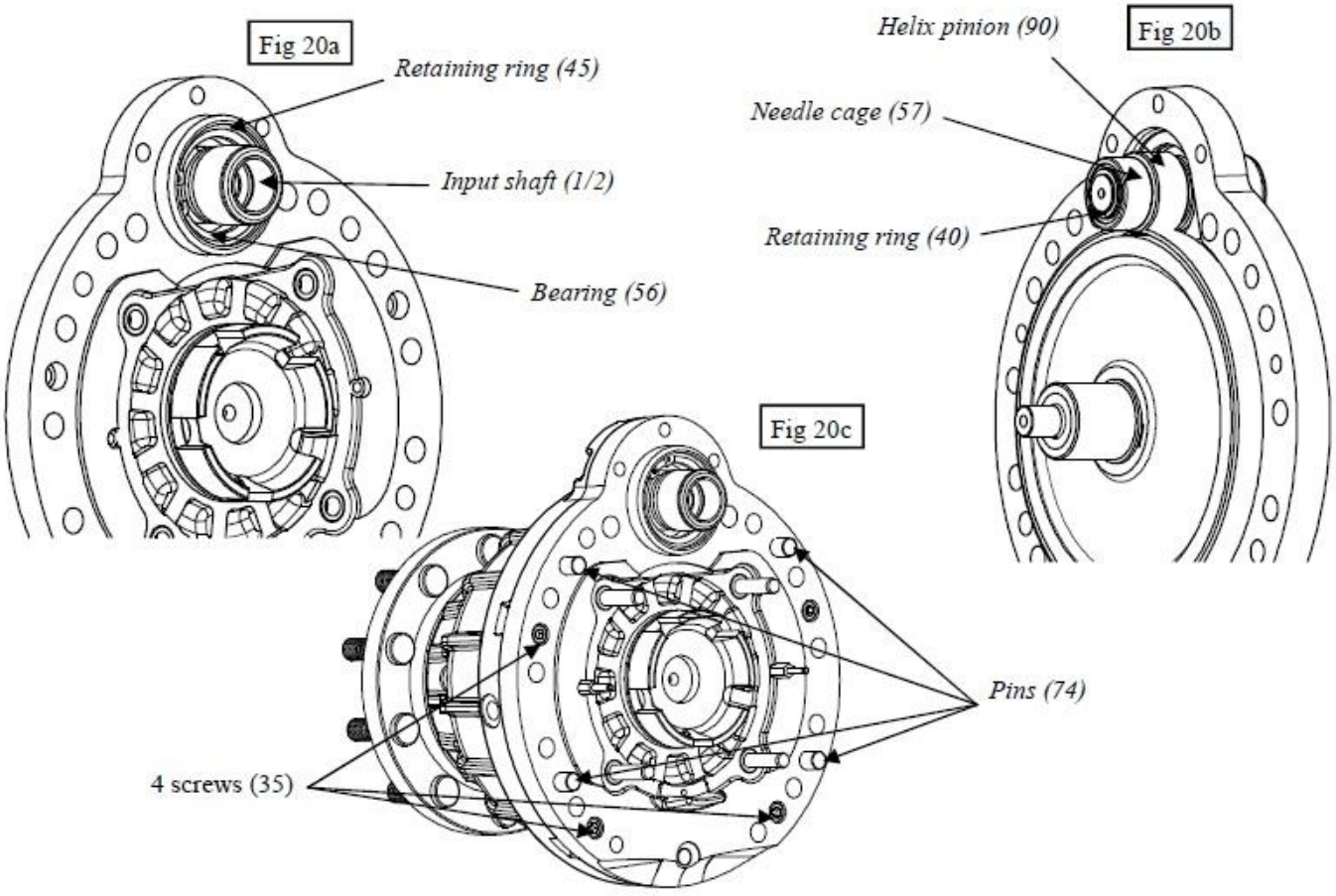


Assembling the Input Shaft (1/2)

Key the bearing (56) onto the input shaft (1/2), insert it into the housing in the flange (16/17) and lock all with the retaining ring (45) (fig. 20a), then place the feather key (64) into its own slot on the shaft, insert the helix pinion (90), the needle cage (57) and finally lock all with the retaining ring (40) (fig. 20b).

Assembly of the Cover (16/17)

Lay a coat of sealant on the housing contact surface (31) and key the pre-mounted flange (16/17) onto the housing centring it on the four pins (74) (fig.20c) and, using a rubber hammer, seal it all.
Insert the 4 screws (84) into their own seats and tighten them at 40Nm torque wrench setting.



Now is possible to assemble the brake disc unit paying attention to respect the steps on page 34. Then lay a coat of sealant on the flange contact surface (16/17) and set the gearbox to the casing (7/8), centering on its 4 pins (74). Using a rubber hammer, beat gentle the unit until it is completely inserted.

Now, insert the screws in their own holes and set them with the following torque wrenches:

(81) Screw M12 cl. 8.8 80 Nm

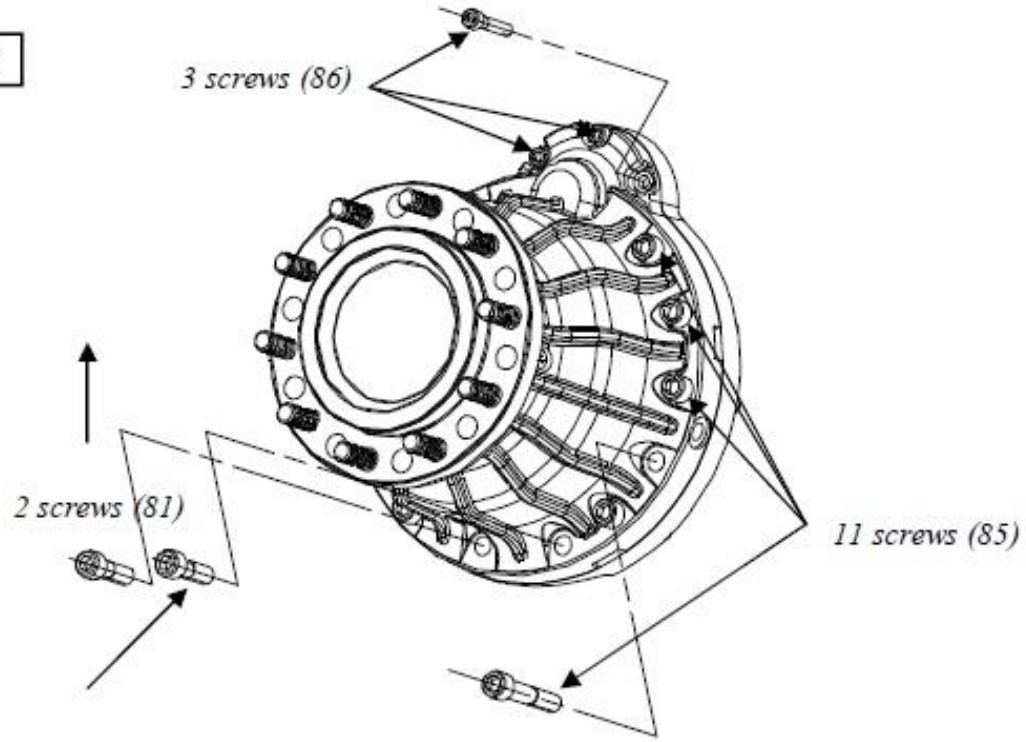
(85) Screw M12 cl. 8.8 80 Nm

(86) Screw M8 cl. 12.9 40 Nm

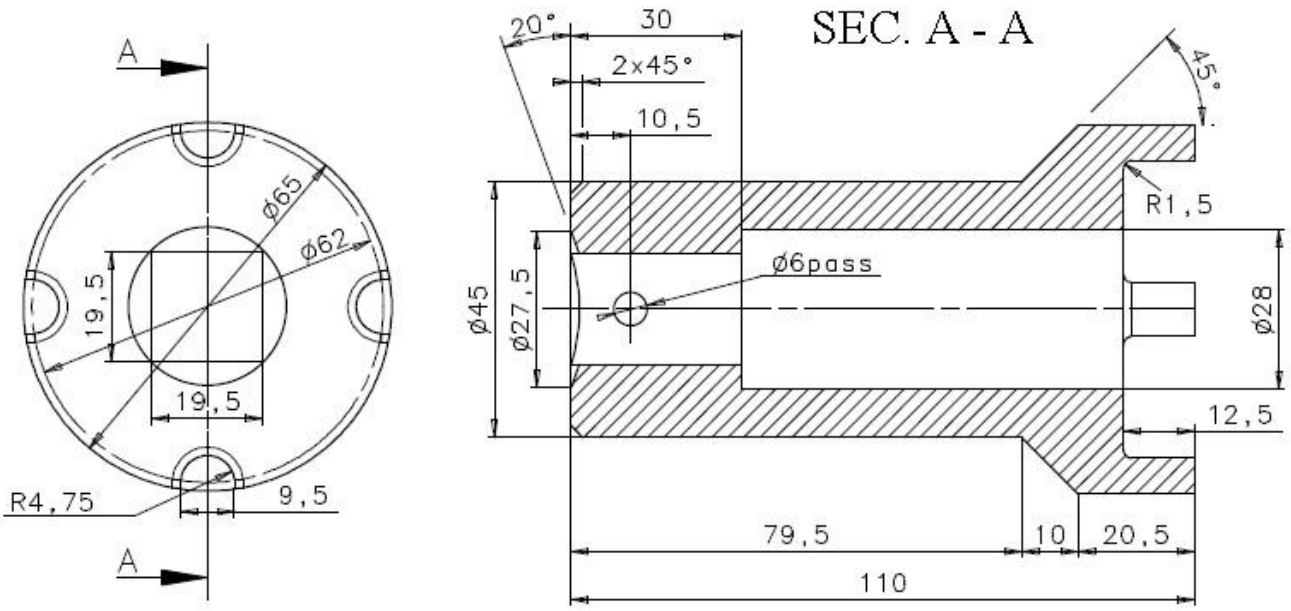
Oil filling

Follow with great attention instructions on page 27.

Fig 21



General specifications for the tool needed to open (see page 40) and close (see page 43) the ring nut (18)



Disassembly the differential gear/tone wheel

After the brake unit + reduction gearbox have been removed, disconnect the sleeves of the hydraulic service brake circuit and the positive park lever cable.

In order to removing motor, tone wheel (11) and differential gear, you have to disassembly the driving axle from the truck: disconnect control and supply wirings and disassembly the must from the driving axle.

After the driving axle has been removed from the truck, secure the casing (7/8) and then unscrew the 14 screw (91).

Working from the Differential side:

(numbers refer to the exploded view on page 61)

After the casing (7) has been removed, take away the gasket (50).
Pull from the axle shaft the differential unit out.

The differential unit has been well-balanced. In order to ensure a correct working, you are recommended to replace it taken as a whole.

Working from the Tone Wheel side:

(numbers refer to the exploded view on page 61)

After the casing (8) and the shaft seal (47) have been removed, unscrew the grub screw (62) and pull the tone wheel (11) out using a special extractor.

On the casing (8) you can find the speed sensor (36) screwed in with 1 screw (83).

SEVCON SPEED CONTROLLER GEN4

Gen4

Applications Reference Manual

DOCUMENT NO:

177/52701

REV. 3.0

TECH/OPS SEVCON

Partner with Performance™

Safety and protective functions

GENERAL

Electric vehicles can be dangerous. All testing, fault-finding and adjustment should be carried out by competent personnel. The drive wheels should be off the floor and free to rotate during the following procedures. The vehicle manufacturer's manual should be consulted before any operation is attempted.

The battery must be disconnected before replacing the controller. After the battery has been disconnected wait 30 seconds for the internal capacitors to discharge before handling the controller.

Never connect the controller to a battery with vent caps removed as an arc may occur due to the controller's internal capacitance when it is first connected.

As blow-out magnets are fitted to contactors (except 24V) ensure that no magnetic particles can accumulate in the contact gaps and cause malfunction. Ensure that contactors are wired with the correct polarity to their power terminals as indicated by the + sign on the top molding.

Do not attempt to open the controller as there are no serviceable components. Opening the controller will invalidate the warranty.

Use cables of the appropriate rating and fuse them according to the applicable national vehicle and electrical codes.

Where appropriate use of a suitable line contactor should be considered.

Electric vehicles are subject to national and international standards of construction and operation which must be observed. It is the responsibility of the vehicle manufacturer to identify the correct standards and ensure that their vehicle meets these standards. As a major electrical control component the role of the Gen4 motor controller should be carefully considered and relevant safety precautions taken. The Gen4 has several features which can be configured to help the system integrator to meet vehicle safety standards. Sevcon accepts no responsibility for incorrect application of their products.

WIRING : STANDARD CONFIGURATION

SINGLE TRACTION WIRING DIAGRAM

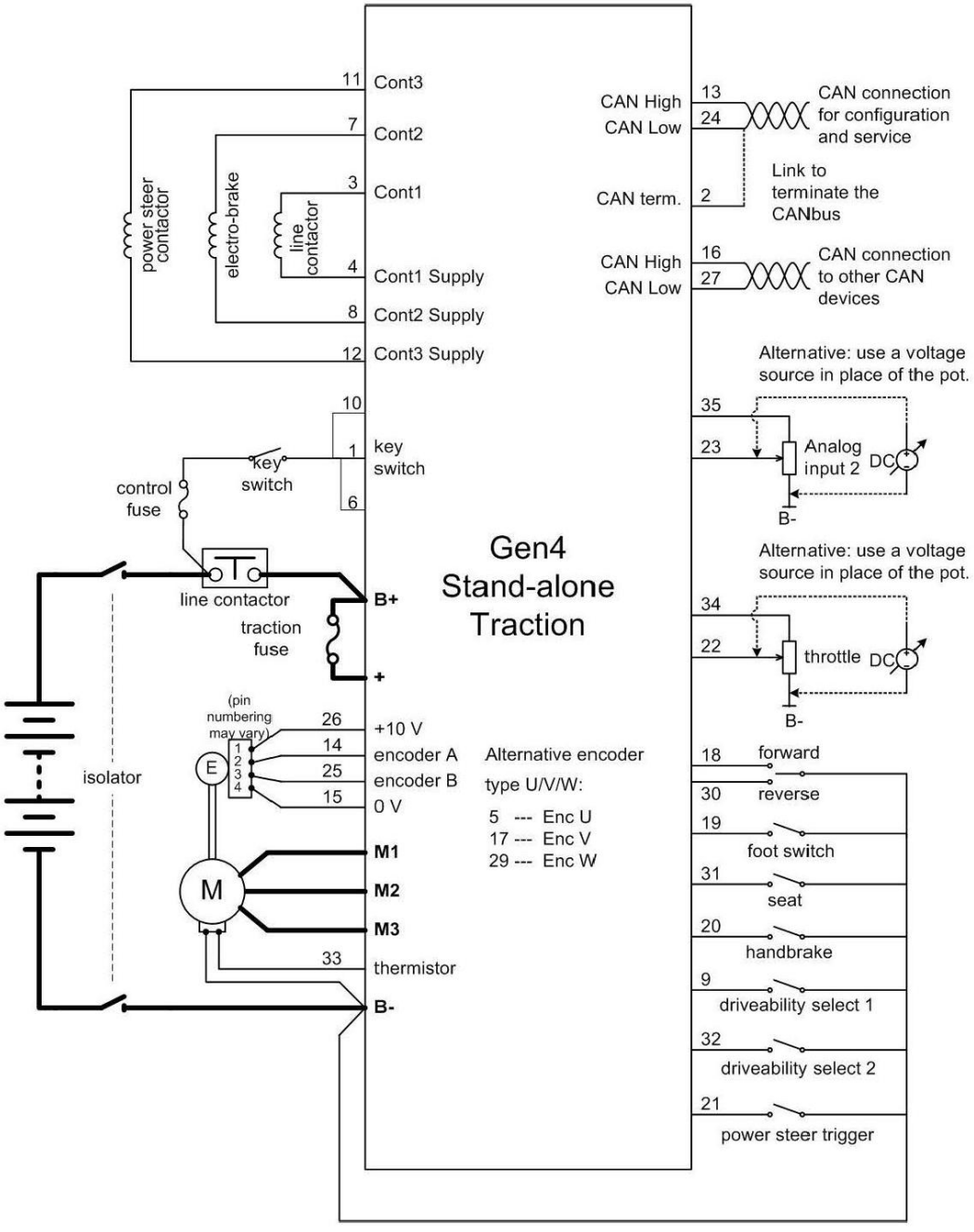


Figure 14 Single traction wiring diagram

5-6

DIAGNOSTICS AND TROUBLESHOOTING

Faults and warnings

INTRODUCTION

In the event of a fault Gen4 takes the following action:

1. Protects the operator and vehicle where possible (e.g. inhibits drive).
2. Sends out an EMCY message on the CANbus.
3. Flashes the LED in a pattern determined by the fault type and severity.
4. Logs the fault for later retrieval.

FAULT IDENTIFICATION

You can identify a fault as follows:

- Check the number of LED flashes and use below to determine what action can be taken. A complete and comprehensive fault identification table will be available from Sevcon in due course.
- Pick up the EMCY on the CANbus and read the fault condition using configuration software
- Interrogate the fault on the node directly using DriveWizard or other configuration software.

LED FLASHES

Use below to determine the type of fault from the number of LED flashes. The LED flashes a preset number of times in repetitive sequence (e.g. 3 flashes – off – 3 flashes – off – and so on). Only the faulty node in a multi-node system flashes its LED. Possible operator action is listed in the right hand column of the table.

LED flashes	Fault	Level	Set conditions	Operator action
0 (off)	Internal hardware failure	RTB	Hardware circuitry not operating.	
1	Configuration item out of range	VS	At least one configuration items is outside its allowable range.	Set configuration item to be in range. Use 5621_h to identify out of range object.
1	Corrupt configuration data	VS	Configuration data has been corrupted.	
1	Hardware incompatible with software or invalid calibration data	VS	Software version is incompatible with hardware. Calibration data for sensors invalid.	
2	Handbrake fault	I	Direction selected with handbrake switch active.	Release handbrake
2	Sequence fault	DI	Any drive switch active at power up.	Reset drive switches
2	SRO fault	DI	FS1 active for user configurable delay without a direction selected.	Deselect FS1 and select drive
2	FS1 recycle	DI	FS1 active after a direction change	Reset FS1

LED flashes	Fault	Level	Set conditions	Operator action
2	Seat fault	DI	Valid direction selected with operator not seated or operator is not seated for a user configurable time in drive.	Must be seated with switches inactive
2	Belly fault	DI	Set after belly function has activated.	
2	Inch sequence fault	DI	Inch switch active along with any drive switch active (excluding inch switches), seat switch indicating operator present or handbrake switch active.	
2	Invalid inch switches	DI	Inch forward and inch reverse switches active simultaneously.	Both inch switches inactive.
2	Two direction fault	DI	Both the forward and reverse switches have been active simultaneously for greater than 200 ms.	Reset switches
2	Invalid steer switch states	VS	Steering switches are in an invalid state, for example, both outer switches are active.	Check steer switches.
3	Fault in electronic power switching circuit	VS	Fault in electronic power switching circuit (e.g. MOSFET s/c).	
3	Hardware over voltage activated	VS	Hardware over voltage circuit activated	Investigate and reduce battery voltage below user defined maximum level. Ensure suitable over voltage is configured in $2C01_h$ and 4612_h.
3	Hardware over current trip activated	VS	Hardware over current circuit activated	Check motor load and wiring. Check motor parameters are correct.
4	Line contactor welded	S	Line contactor closed at power up or after coil is de-energized.	Check line contactor condition/wiring.
4	Line contactor did not close	S	Line contactor did not close when coil is energized.	Check line contactor condition/wiring.
5	PST fault	DI	Fault detected on PST power steer module.	Check PST condition.
5	Motor open circuit	S	Unable to establish current in motor.	Check motor condition/wiring.
6	Throttle pressed at power up	DI	Throttle demand is greater than 20% at power up.	Reduce demand
6	Analog input wire-off	VS	Analog input voltage is outside allowable range.	Check analog input wiring

LED flashes	Fault	Level	Set conditions	Operator action
6	Analog output fault (over/under current, failsafe, short circuit driver)	VS	Analog output fault caused by over current (>4A), under current if actual current < 50% target (current mode only), failsafe circuit fault, short circuit driver MOSFET.	Check analog output wiring.
7	BDI warning or cutout	I	BDI remaining charge is less than warning or cutout levels.	Charge battery.
7	Battery low voltage protection	I	Battery voltage or capacitor voltage is below a user definable minimum battery level for a user definable time.	Increase battery voltage above user defined level
7	Controller low voltage protection	I	Battery voltage or capacitor voltage is below the minimum level allowed for the controller.	Increase battery voltage above minimum level
7	Controller high voltage protection with line contactor closed.	I	Battery voltage or capacitor voltage is above the maximum level allowed for the controller with line contactor closed.	Investigate and reduce battery voltage below maximum level.
7	Battery high voltage protection	I	Battery voltage or capacitor voltage is above a user definable maximum battery level for a user definable time.	Investigate and reduce battery voltage below user defined maximum level.
7	Motor low voltage protection	I	Capacitor voltage has entered the motor low voltage cutback region defined in 4612_h.	Increase battery voltage above start of motor low voltage cutback region.
7	Motor high voltage protection	I	Capacitor voltage has entered the motor high voltage cutback region defined in 4612_h.	Reduce battery voltage below start of motor high voltage cutback region.
7	Controller high voltage protection with line contactor open.	S	Battery voltage or capacitor voltage is above the maximum level allowed for the controller with line contactor open.	Isolate controller and investigate high battery voltage
7	Battery voltage below critical level for controller.	S	Battery voltage is below the absolute minimum voltage at which the controller hardware is guaranteed to operate.	Increase battery voltage.
7	Precharge failure	VS	Capacitor voltage is less than 5V after pre-charge operation is complete.	Check controller wiring to ensure there are no short circuits between B+ and B-.

LED flashes	Fault	Level	Set conditions	Operator action
8	Controller too hot	I	Controller has reduced power to motor(s) below maximum specified by user settings due to controller over temperature.	Remove loading to allow controller to cool down.
8	Controller too cold	I	Controller has reduced power to motor(s) below maximum specified by user settings due to controller under temperature.	Allow controller to warm up to normal operating temperature.
8	Motor over temperature	I	Controller has reduced power to motor(s) below maximum specified by user settings due to motor over temperature.	Reduce load to motor to allow it to cool down.
8	Motor too cold	I	Motor thermistor reports less than -30°C.	Allow motor to warm up. Check motor thermistor.
8	Heatsink over temperature	VS	Heatsink temperature measurement has exceed absolute maximum for controller and system has powered down.	Remove loading to allow controller to cool down.
10	Pre-Operational	I	Controller is in pre-operational state.	Use DriveWizard to put controller into operational state.
10	I/O initializing	I	Controller has not received all configured RPDOs within 5s of power up.	Check CANbus wiring and PDO configuration.
10	RPDO Timeout	I / DI / S	One or more RPDOs have not been received within 3s at power up or within 500ms during operation.	Check CANbus wiring and PDO configuration.
11	Encoder fault	VS	Speed measurement input wire-off is detected.	Check encoder wiring
11	Over current	VS	Software has detected an over current condition	Check motor load and wiring. Check motor parameters are correct.
11	Current Control fault	VS	Software is unable to control currents on PMAC motor.	Check motor load and wiring. Check motor parameters are correct.
12	Communication error	S	Unrecoverable network communication error has been detected.	Check CANbus wiring and CANopen configuration.
13	Internal software fault	RTB	Software run time error captured	
13	Current sensor auto-zero fault	RTB	Current sensor voltage out of range with no current.	

LED flashes	Fault	Level	Set conditions	Operator action
13	DSP parameter error	RTB	Motor parameter written to while motor control is operational.	Recycle keyswitch to allow parameters to be reloaded correctly.
14	3rd Party Anonymous Node EMCY received	I / DS / RTB	3rd party node has transmitted an EMCY message.	Check CANbus wiring and 3rd party node status.
15	Vehicle service required	I	Vehicle service interval has expired.	Service vehicle and reset service hours.

Table 8 Fault identification

FAULT LIST

Use DriveWizard to access the Fault list. If you don't have DriveWizard you can use any configuration tool as follows:

1. Object 5300_h gives information about all active faults. Read sub-index 1 to get the number of active faults. Write to sub-index 2 to select one of the active faults (0 = highest priority) and read back sub-index 3 to read the fault ID at that index.
3. Object 5610_h can be used to read a text description of the fault. Write the fault ID to sub-index 1 and read back the fault description from sub-index 2.

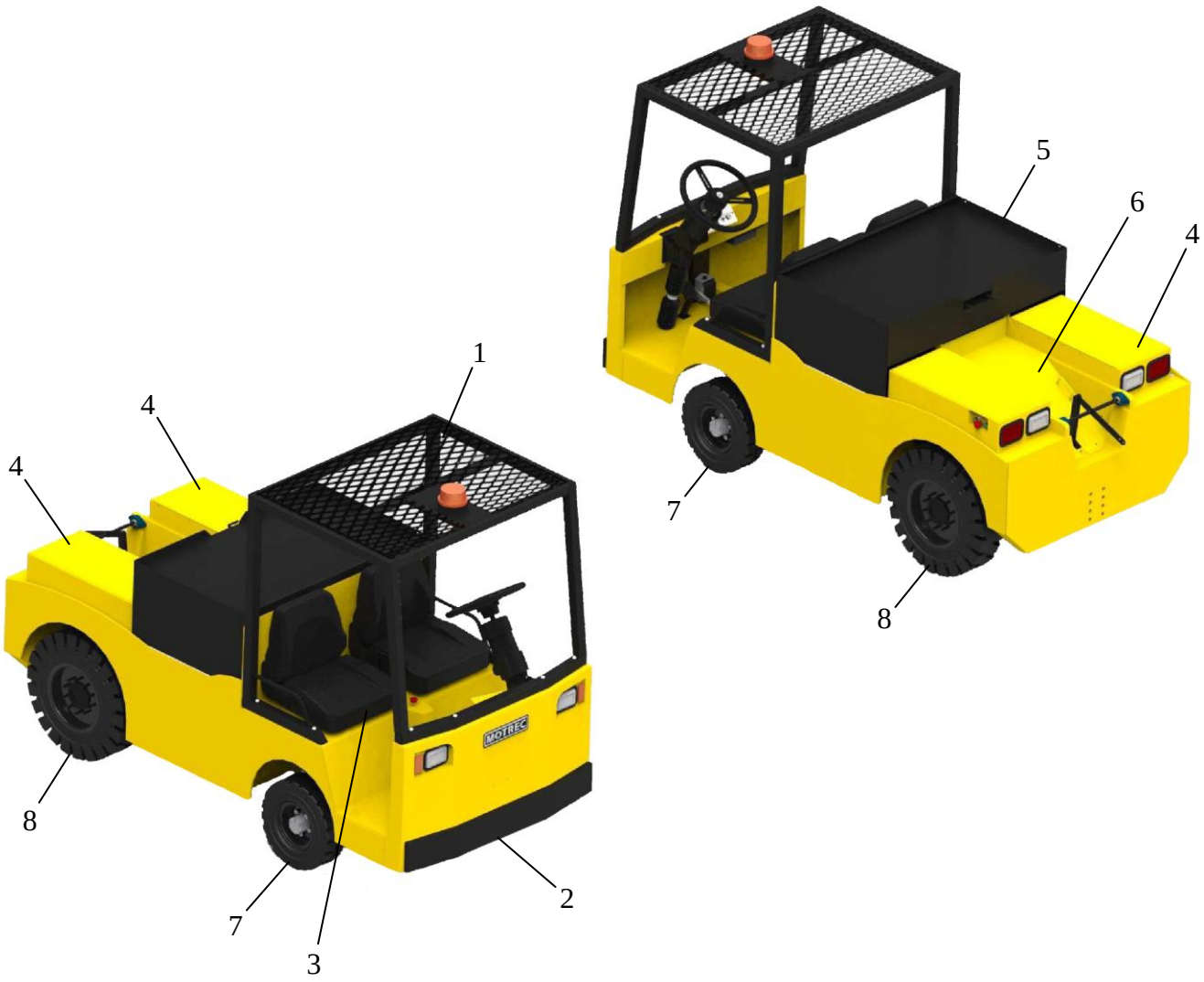
Upgrading the controller software

It is possible to field update the firmware of the Gen4 controller , typically using Sevcon's DriveWizard configuration tool.

Please contact Sevcon for assistance with this process.

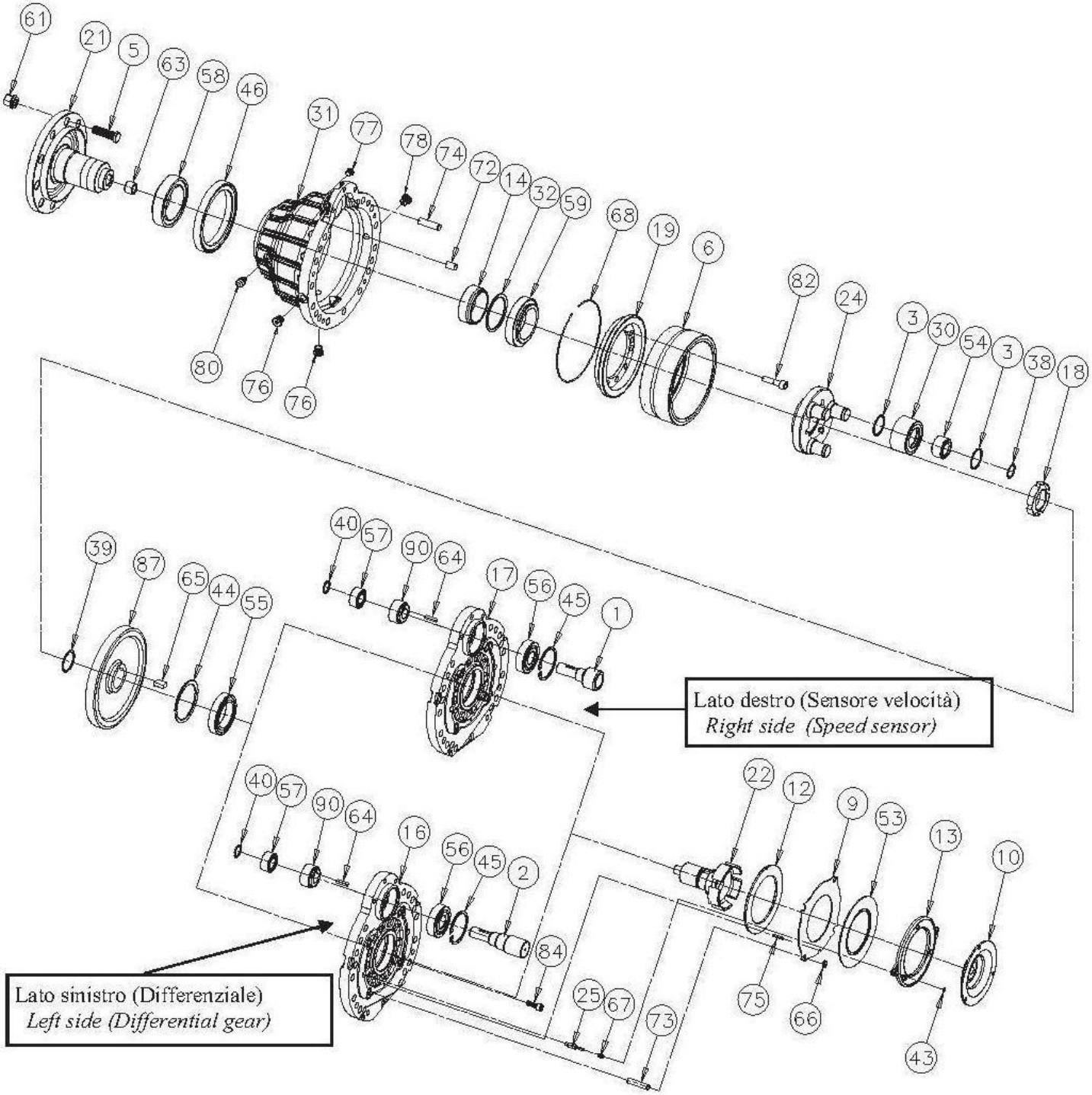
SPARE PARTS

BODY



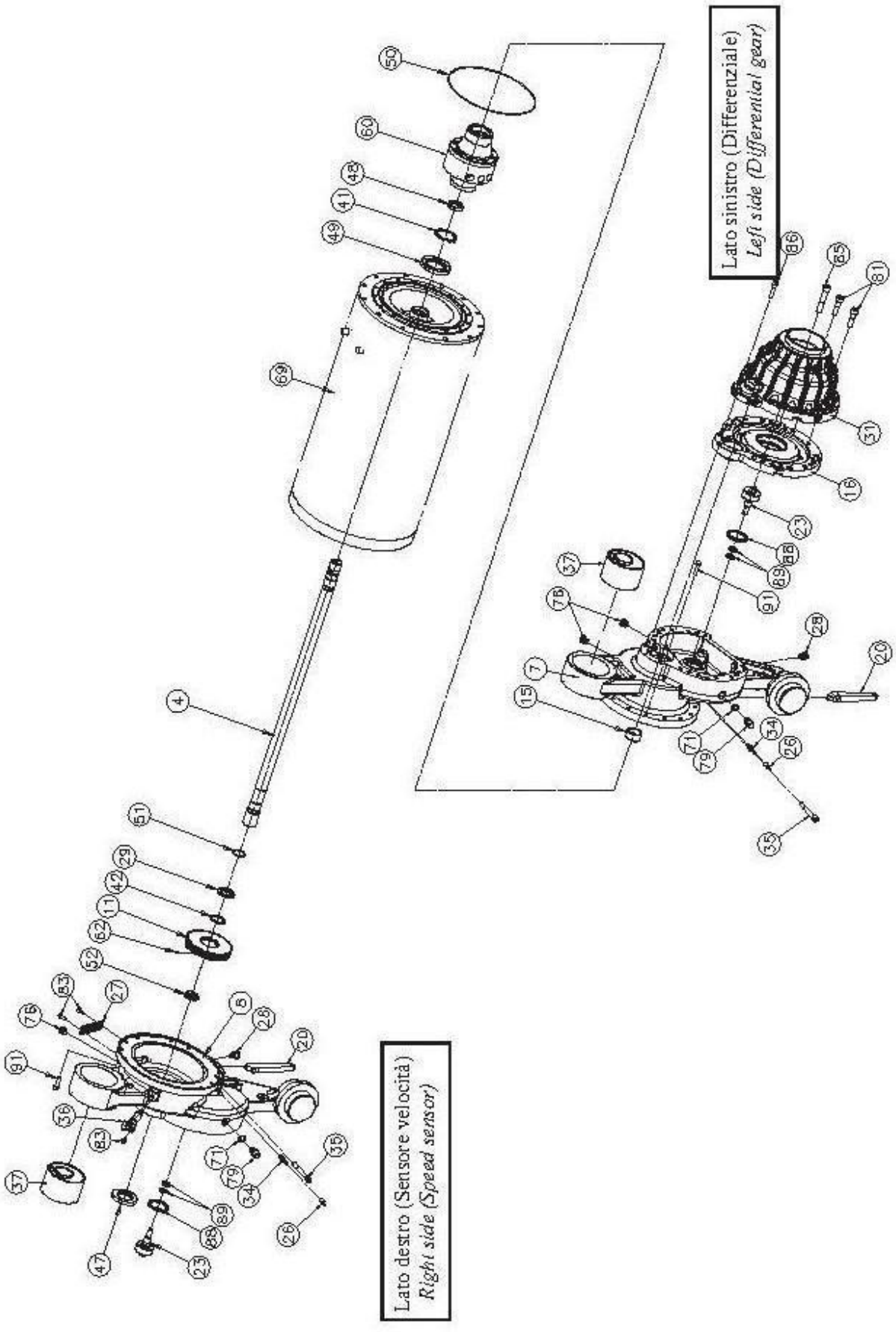
REF.	*PART NO.*	*DESCRIPTION*
1	2363800007	OVERHEAD GUARD
2	2311800004	FRONT BUMPER
3	2385224001	SEMI SUSPENSION SEAT BLACK CLOTH
	2205002VYN	SEMI SUSPENSION SEAT BLACK CLOTH, VINYL SEAT
	2305007	DELUXE SEAT
4	2805800010	REAR COVER
5	2331800025	BATTERY COVER
6	2330800003	MOTOR COVER FOR HITCH RELEASE
	2330800002	MOTOR COVER
7	2223360003	LUG 500X8 SOFTY WHEEL
8	2223800001	SOLID RUBBER WHEEL

DRIVE AXLE (PMP)



TAB.A

PART N°	REF. N°	DESIGNATION	QTY
1	010.0050	INPUT SHAFT	1
2	020.0068	INPUT SHAFT	1
3	040.0016	RETAINING RING	12
5	207.0001	WHEEL FIXING SCREW	20
6	250.0073	RING GEAR	2
9	320.0028	STEEL DISK	12
10	320.0030	ELASTIC DISC	2
12	320.0035	SUPPORT DISK	2
13	320.0038	DISK PUSHER	2
14	330.0054	SET-RIGHT SPACER	2
16	381.0042	LEFT FLANGE	1
17	381.0043	RIGHT FLANGE	1
18	470.0008	LOCKNUT M40 x 1.5	2
19	520.0069	RING-GEAR CARRIER DISC	2
21	660.0011	WHEEL HUB	2
22	735.0091	SUN PINION	2
24	750.0011	PLANET CARRIER	2
25	770.0006	STUD	4
30	835.0013	PLANET GEAR	6
31	840.0047	HOUSING	2
32	875.0027	SPACER	2
38	AE0.0008	RETAINING RING (UNI 7435 D24)	6
39	AE0.0009	RETAINING RING (UNI 7435 D40)	2
40	AE0.0018	RETAINING RING (SW-D20)	2
43	AE0.0044	RETAINING RING (7435 - 3.2)	4
44	AE1.0006	RETAINING RING (UNI 7437 D80)	2
45	AE1.0010	RETAINING RING (UNI 7437 - D62)	2
46	AT1.0033	SHAFT SEAL (110x140x16)	2
53	AUX.0012	FRICTION DISK	10
54	CC1.0011	ROLLER BEARING	6
55	CR1.0033	BALL BEARING (6010 SPECIALE RS DHC)	2
56	CR2.0002	BALL BEARING	2
57	CRU.0004	NEEDLE CAGE (NA 20x37x17)	2
59	CU1.0047	TAPER ROLL. BEARING (32012X)	2
61	DM0.0011	SPHERICAL HEAD NUT (M14 x 1.5 DIN 74361/A)	20
63	GUR.0002	NEEDLE CAGE (HK 16 - 16)	2
64	LIN.0033	FEATHER KEY (B 6x4x25)	2
65	LIN.0037	FEATHER KEY (B 12x8x20)	2
66	MOL.0019	SPRING	40
67	MOL.0021	SPRING	4
68	MOL.0025	RETAINING RING	2
72	SP1.0003	LOCKING PIN (D12x20 DIN 6325)	4
73	SP1.0018	LOCKING PIN (D10x50)	8
74	SP1.0023	LOCKING PIN (D12x45 DIN 6325)	8
75	SP4.0017	ELASTIC PIN (Ø4x22 UNI 6873)	2
76	TAP.0024	SCREW PLUG (M14x1.5 DIN 908)	9
77	TAP.0025	SCREW PLUG (M10x1 DIN 908)	1
78	TAP.0045	MAGNETIC SCREW PLUG (M14x1.5 DIN 908)	1
80	TAP.0053	BREATHER PLUG (M10x1)	1
82	VC1.0045	SOCKET HEAD CAP SCREW (M10x40 12.9)	20
84	VC1.0069	SOCKET HEAD CAP SCREW (M8x25 12.9)	2
87	SEE TAB1	HELIX GEAR	2
90	SEE TAB1	HELIC PINION	2


Lato sinistro (Differenziale)
Left side (Differential gear)
Lato destro (Sensore velocità)
Right side (Speed sensor)

TAB. C

PART N°	REF. N °	DESIGNATION	QTY
4	065.0011	AXLE SHAFT	1
7	260.0040	LEFT CASING	1
8	260.0047	RIGHT CASING	1
11	320.0032	TONE WHEEL	1
15	330.0086	DIFFERENTIAL SPACER	1
20	615.0006	LEVER	2
23	740.0030	PISTON	2
26	780.0009	BLEEDING VALVE CAP	2
27	780.0010	PROTECTION	1
28	796.0003	CONNECTION	2
29	800.0011	AD JUST. SHIM	1
34	980.0006	BLEEDING VALVE	2
35	990.0016	SOCKET HEAD CAP SCREW	2
36	ACC.0025	SPEED SENSOR	1
37	ACC.0019	EAR-RING (10-02764-01 70sh)	1
41	AE0.0027	RETAINING RING (UNI7435 D.50)	1
42	AE0.0029	RETAINING RING (UNI7435 D.30)	1
47	AT1.0048	SEAL RING (TIPO AS 40x68x8 VITON)	1
48	AT4.0009	SHAFT SEAL (A 30x40x7 VITON)	1
49	AT4.0010	SHAFT SEAL (A 50x80x8 DIN 3760 VITON)	1
50	AT5.0058	O-RING (OR3925 Di = 234.62x2.62)	1
51	AT5.0114	O-RING (OR2118 29.87x1.78)	1
52	AT9.0035	V-RING (cr400251 VR2 24-27)	1
60	DIF.0002	DIFFERENTIAL GEAR	1
62	GRA.0002	GRUB SCREW (M6x10 UNI5923)	1
69	MOT.0031	MOTOR	1
71	TO1.0014	KASHER (M14)	2
79	TAP.0046	BREATHER PLUG (M14x1.5)	2
81	VC1.0002	SOCKET HEAD CAP SCREW (M12x40 8.8 nera)	4
83	VC1.0053	SOCKET HEAD CAP SCREW (M6x14 – 8.8 nera)	3
85	VC1.0078	SOCKET HEAD CAP SCREW (M12x70 8.8 nera)	22
86	VC1.0085	SOCKET HEAD CAP SCREW (M8x40 12.9 nera)	6
88	SEE TAB2	GASKET (Ø 45x56.1x6.2 OMS-SF9)	2
89	SEE TAB2	GASKET (Ø 18x22.922 OMS-MR C VITON/FPM)	4
91	VT1.0057	SCREW (M8x30 – 12.9 nera)	24

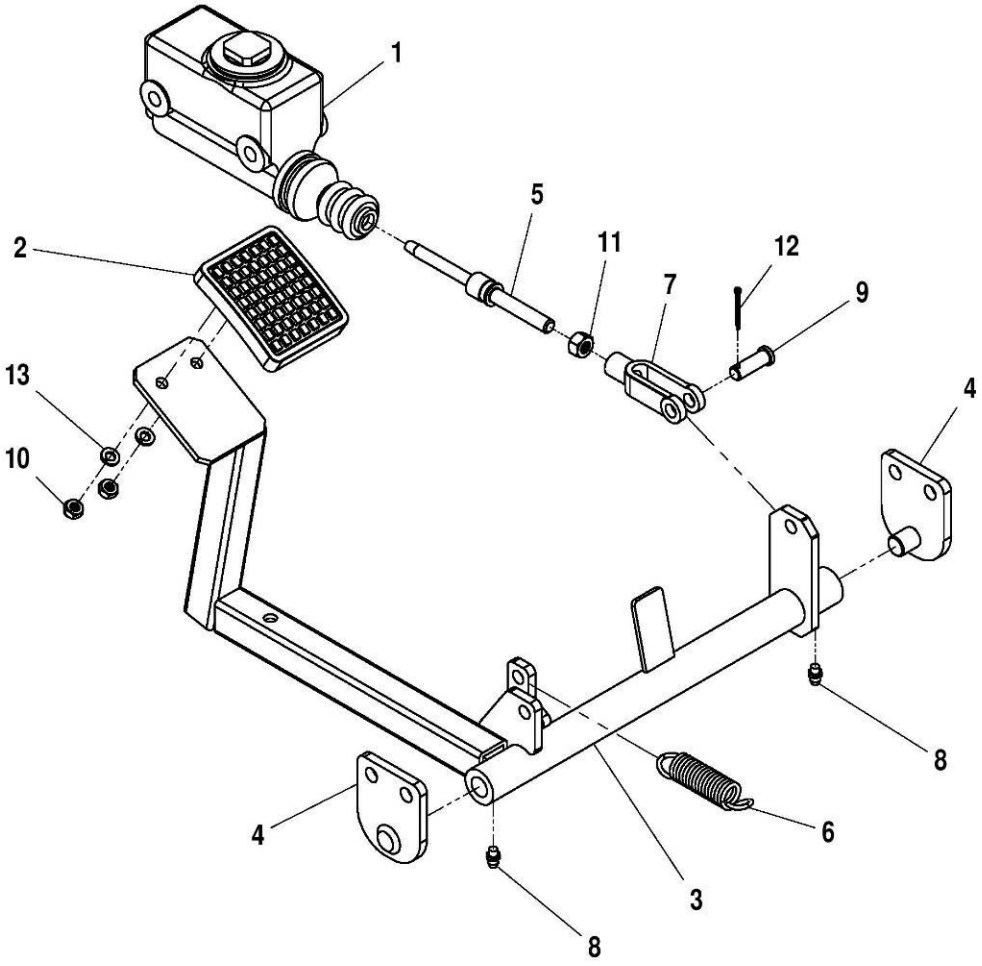
TABLE1

PART N°	REF. N°	DESIGNATION
87	250.0047	HELIX GEAR R.17.5
90	735.0060	HELIX PINION R.17.5
87	250.0087	HELIX GEAR R.20.4
90	735.0112	HELIX PINION R.20.4
87	250.0071	HELIX GEAR R.24.2
90	735.0100	HELIX PINION R.24.2
87	250.0086	HELIX GEAR R.27.3
90	735.0111	HELIX PINION R.27.3
87	250.0064	HELIX GEAR R.29.5
90	735.0092	HELIX PINION R.29.5

TABLE2

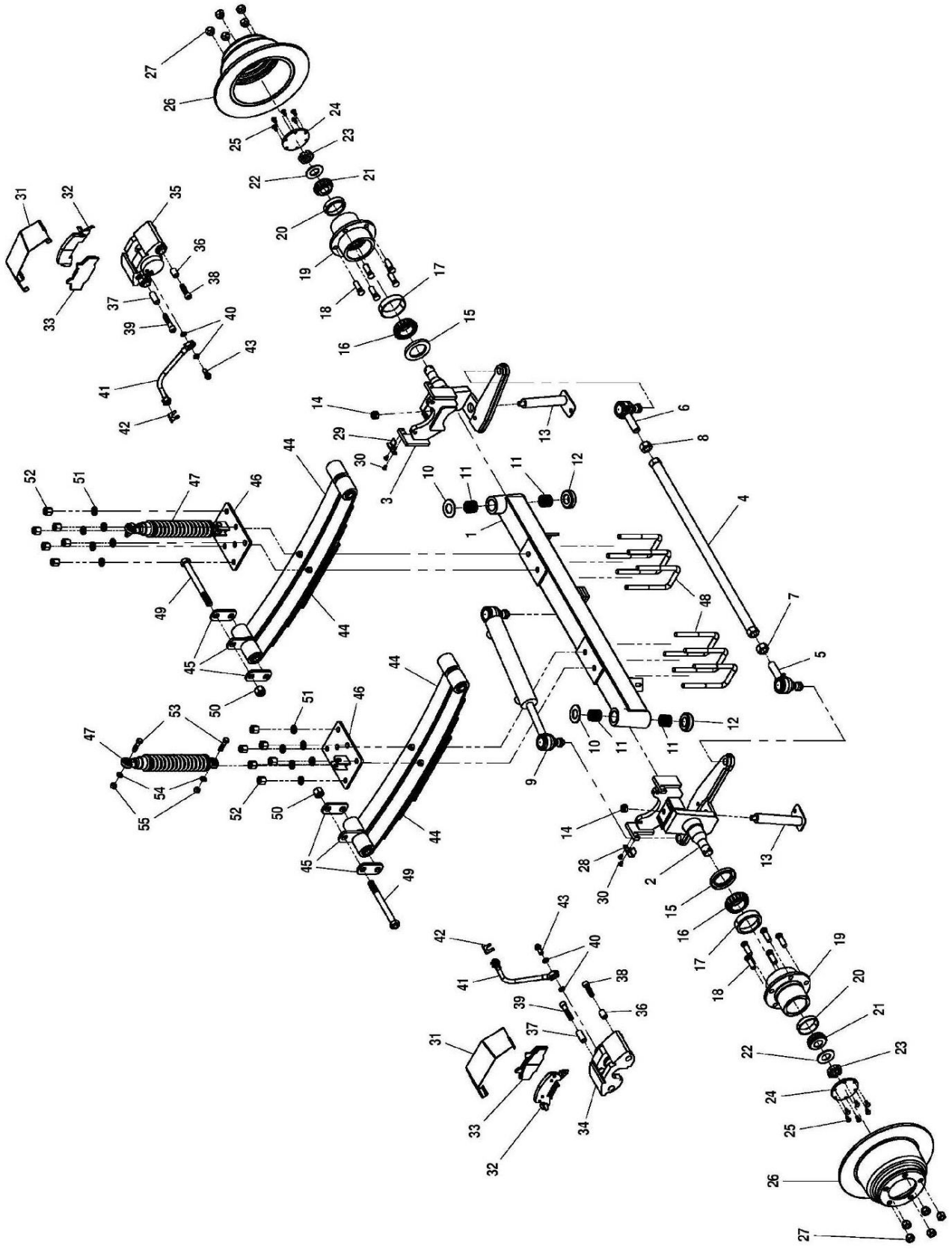
PART N°	Az. MINERALE	Az. DOT 4
88	AT9.0043	AT9.0044
89	AT9.0045	AT9.0039

BRAKE CONTROLS



REF.	*PART NO.*	*DESCRIPTION*
1	2125000001	MASTER CYLINDER
2	2131100002	RUBBER PAD
3	2131800001	BRAKE PEDAL
4	2132448001	PIVOT
5	2133280001	PUSH ROD – MASTER CYLINDER
6	2190000003	SPRING (EXTENTION)
7	2910000015	YOKE
8	2930000012	LUBRIFICATION FITTING
9	2910000028	CLEVIS PIN 3/8 x 1 3/32”
10	——	NUT 1/4-20UNC
11	——	NUT 3/8-24UNF
12	——	COTTER PIN 3/32 x 1”
13	——	LOCK WASHER 1/4

FRONT AXLE

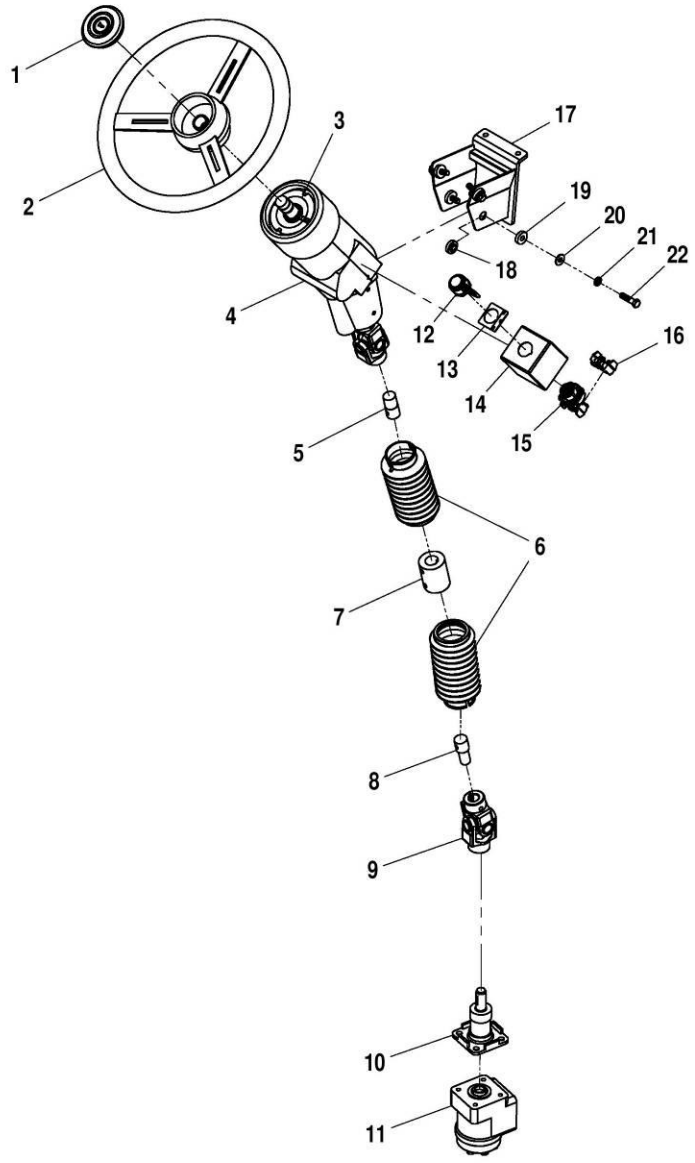


REF.	*PART NO.*	*DESCRIPTION*
1	2201800021	AXLE BEAM
2	2201800026	LEFT SPINDLE
3	2201800025	RIGHT SPINDLE
4	2207800001	REAR TIE ROD
5	2207000002	ROD END, RIGHT HAND
6	2207000001	ROD END, LEFT HAND
7	2910000006	RIGHT HAND NUT
8	2910000005	LEFT HAND NUT
9	4130448001	STEERING HYDRAULIC CYLINDER
10	2201364032	BRASS FLAT WASHER
11	2101364002	NEEDLE BEARING
12	361414	THRUST BEARING
13	2205800001	KING PIN
14	2910000065	CASTELLATED NUT ¾-NF
15	2104364001	CR SEAL
16	2103364003	CONE – INTERNAL BEARING
17	2103364004	CUP – INTERNAL BEARING
18	2910000001	WHEEL STUD
19	2224364001	HUB
20	2103364002	CUP – EXTERNAL BEARING
21	2103364001	CONE – EXTERNAL BEARING
22	*	WASHER
23	*	NUT – HUB
24	2229364002	HUB COVER
25	*	BOLT – COVER
26	2120800002	DISK
27	2910000019	WHEEL NUT

REF.	*PART NO.*	*DESCRIPTION*
28	2122300001	LEFT CALIPER SUPPORT
29	2122300002	RIGHT CALIPER SUPPORT
30	——	MACHINE SCREW 1/4-NC X 3/8
31	2139000001	CALIPER PROTECTOR
32	2128280001	PADS
33	2128280001	PADS
34	481430K	LEFT CALIPER
35	481431K	RIGHT CALIPER
36	2121000006	BUSHING, SHORT
37	2121000005	BUSHING, LONG
38	2910000018	BOLT, SHORT
39	2910000017	BOLT, LONG
40	2139000002	WASHER
41	2134000001	FLEXIBLE HOSE
42	2129000001	CLIP
43	2139000003	BOLT
44	2192280001	LEAF SPRINGS
45	2182320001	SHACKLE LINK
46	2185800003	PLATE, DOUBLE FRONT LEAF
47	2180240001	SHOCK ABSORBER
48	2916800001	FRONT SQUARE U-BOLT
49	——	BOLT 5/8-NC X 6 1/2
50	——	NYLON NUT 5/8-NC
51	2910000042	FLAT WASHER 12mm
52	2910000041	HEAVY NUT 1/2-NF
53	——	BOLT 3/8-NC X 1 1/2
54	——	LOCK WASHER 3/8
55	——	NUT 3/8-NC

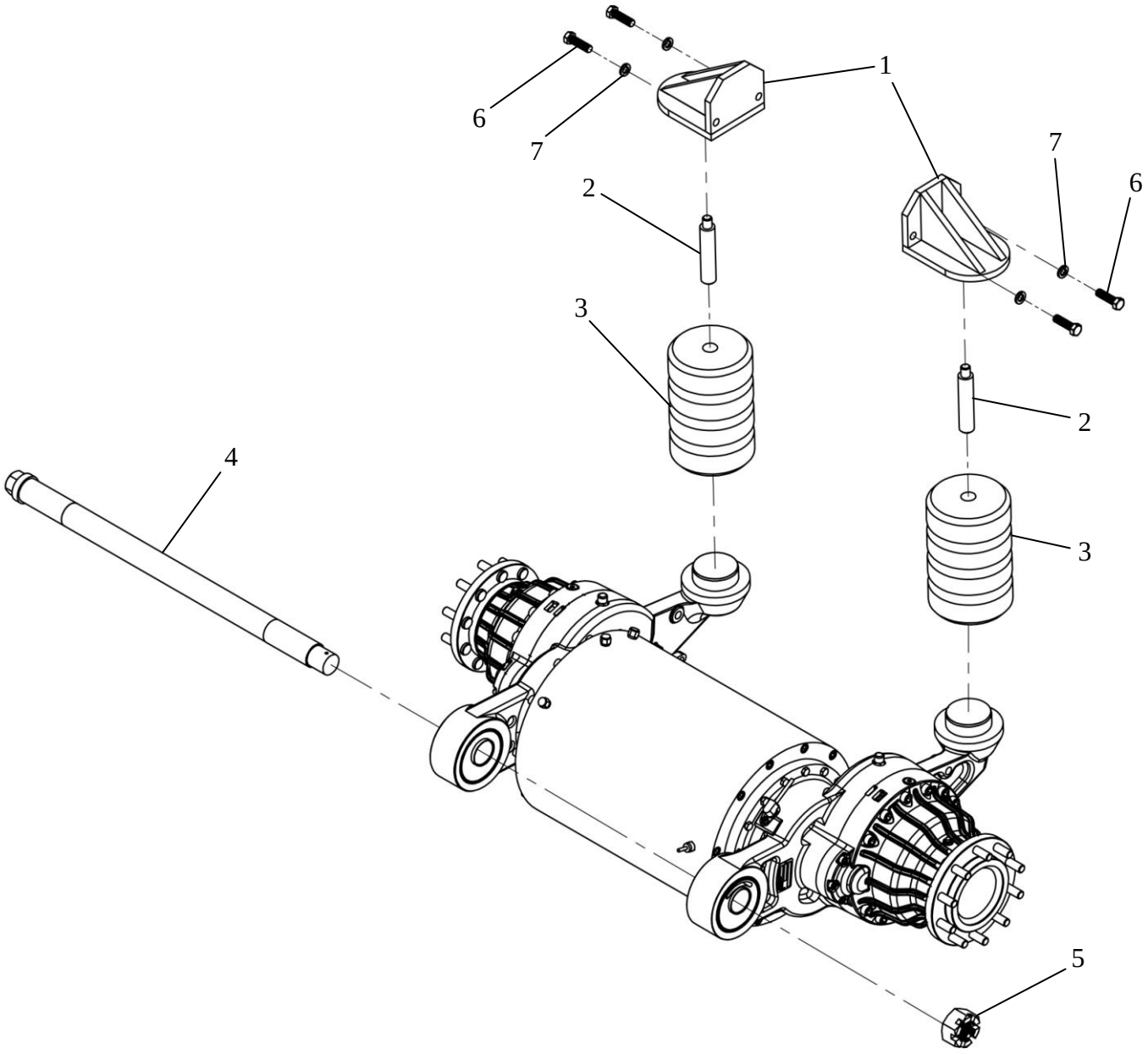
* Contact manufacturer

POWER STEERING WHEEL



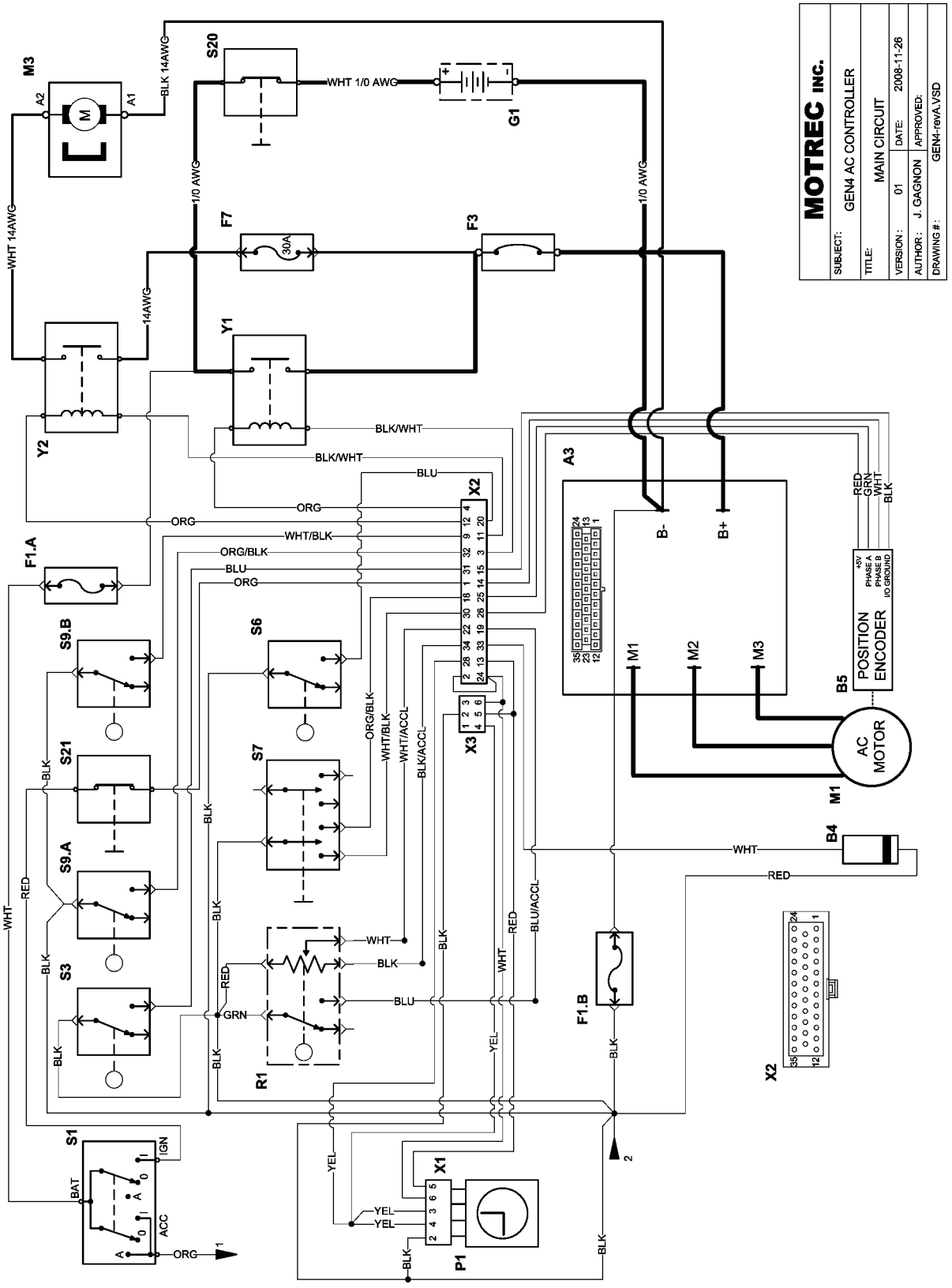
REF.	*PART NO.*	*DESCRIPTION*	*REF.*	*PART NO.*	*DESCRIPTION*
1	2208224002	HORN BUTTON	**11**	4190448001	ORBITROL
2	2208224001	STEERING WHEEL	**12**	3109210001	GREY HANDLE
3	2219224002	HORN BRUSH KIT	**13**	3109210004	NAMEPLATE F/R
4	2200224004	TILT / TEL COLOMN	**14**	2392224001	CASE F/R
5	2200224003	SHAFT	**15**	3109210002	SWITCH
6	2809000001	RUBBER BOOTS	**16**	3109210003	CONTACT BLOC
7	2200224001	NYLON COUPLER	**17**	2206800024	COLOMN SUPPORT
8	2200224002	SHAFT	**18**	2200224007	BUSHING
9	——	UNIVERSAL JOINT:	**19**	2200224006	WASHER
	2104250004	YOKE, U-JOINT	**20**	——	FLAT WASHER 5/16
	2104250005	CROSS, U-JOINT	**21**	——	LOCK WASHER 3/8
10	2219364001	ADAPTER, COLOMN/MOTOR	**22**	——	HEAVY BOLT 3/8-NC X 1 1/2

REAR SUSPENSION

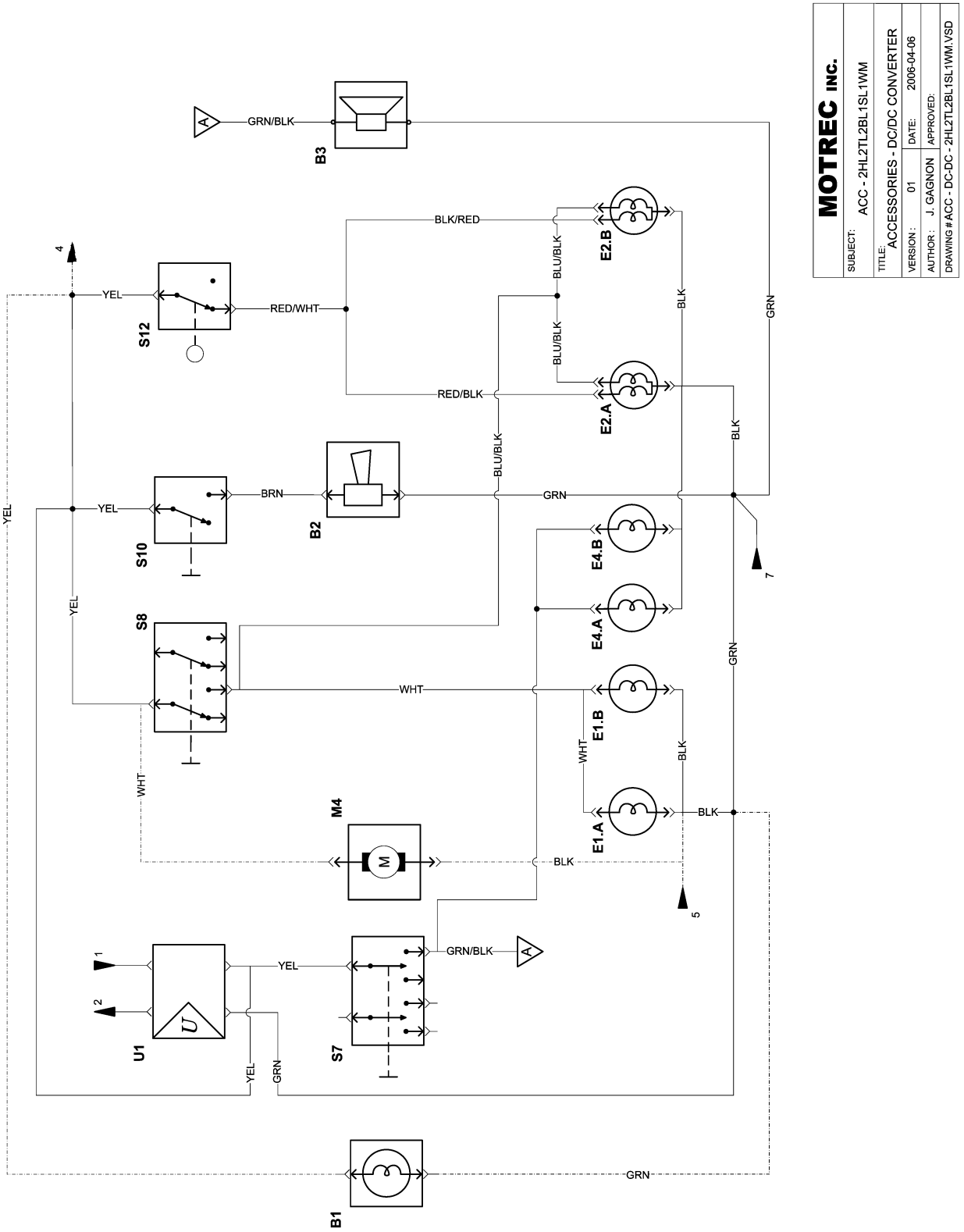


REF.	*PART NO.*	*DESCRIPTION*
1	2189800007	RUBBER SPRING BRACKET
2	2189800005	RUBBER SPRING GUIDE
3	2189800004	RUBBER SPRING
4	2189800006	PIVOT MOTOR SHAFT
5	2910800002	CASTELLATED NUT 1 1/2-NF
6	———	BOLT 1/2-NF X 1 3/4
7	———	LOCK WASHER 1/2

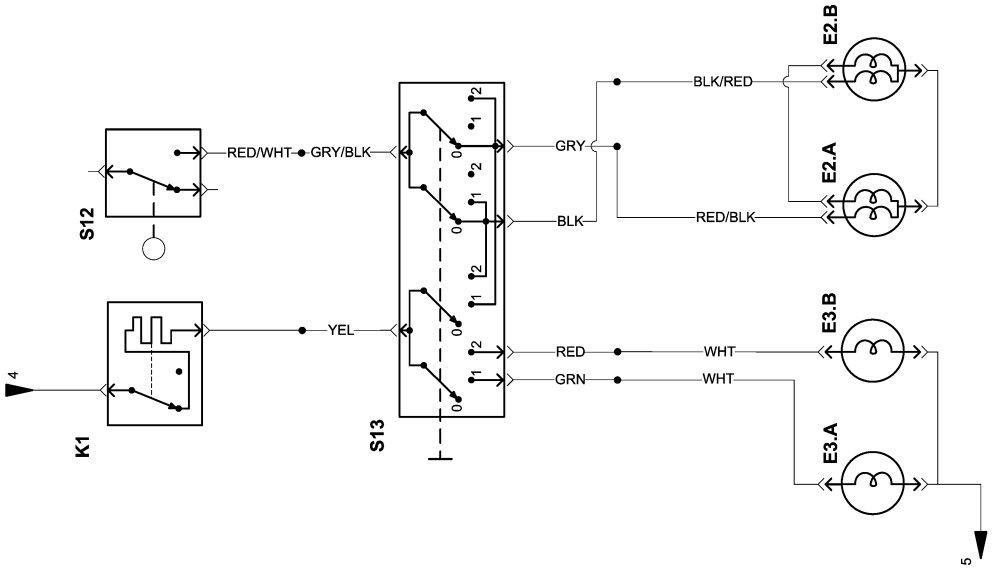
ELECTRICAL DIAGRAM – MAIN CIRCUIT
DIAGRAMME ÉLECTRIQUE – CIRCUIT PRINCIPAL



ACCESSORIES – DC-DC CONVERTER
ACCESSOIRES – CONVERTISSEUR DC-DC

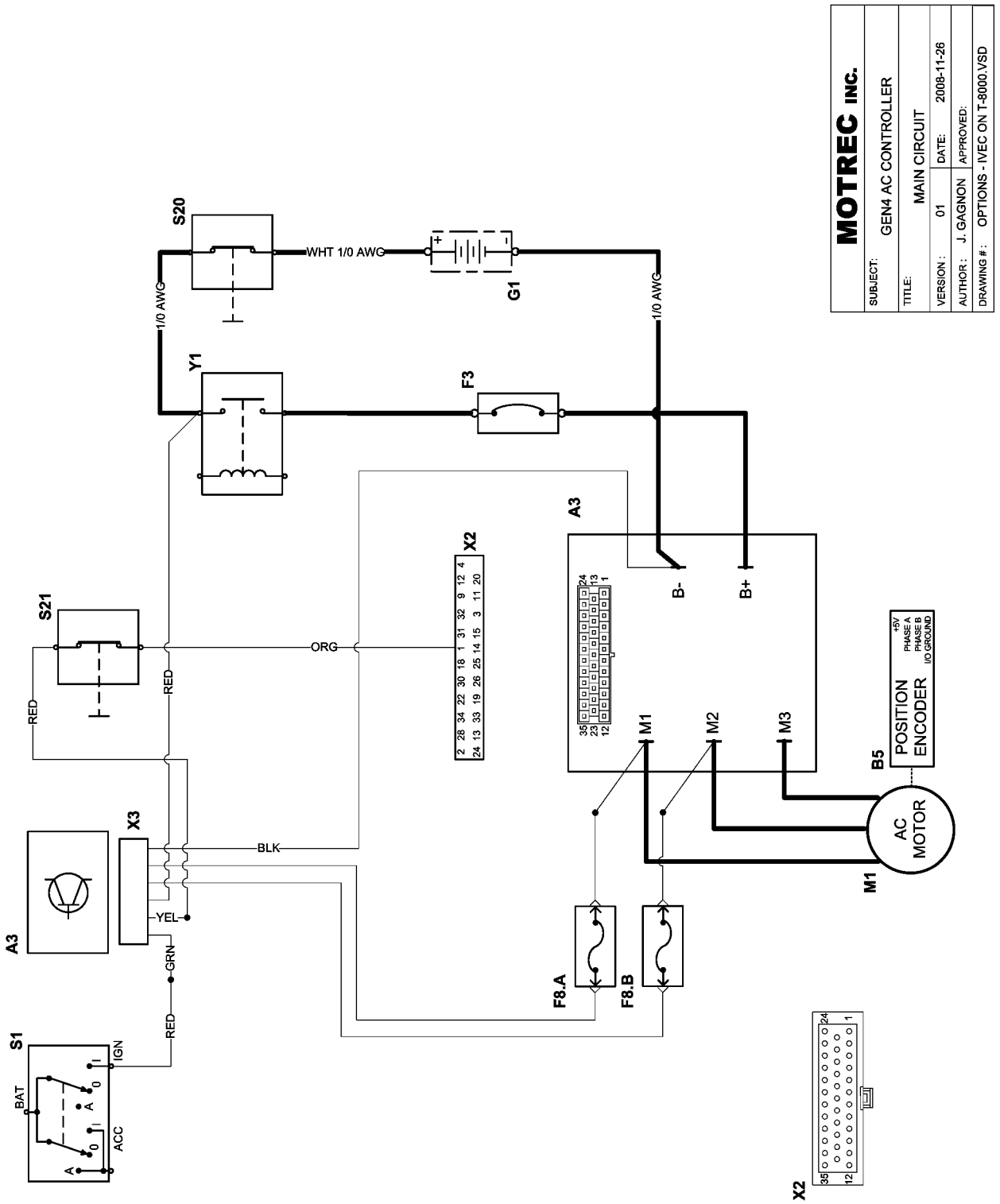


OPTIONS

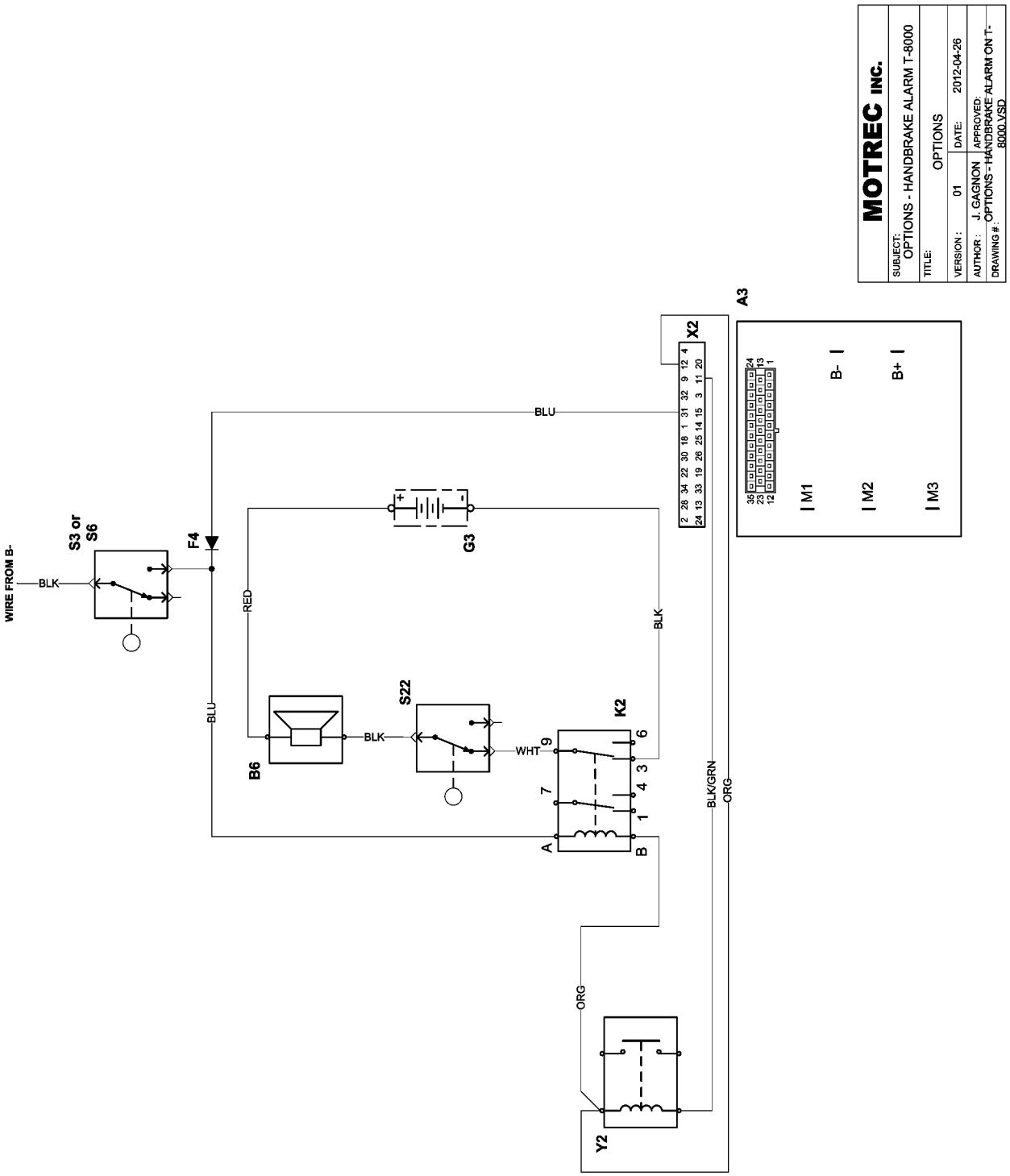


MOTREC INC.			
SUBJECT:	OPTIONS - FLASHERS		
TITLE:	OPTIONS		
VERSION :	01	DATE:	2006-04-07
AUTHOR :	J. GAGNON	APPROVED:	
DRAWING # :	OPTIONS - FLASHERS.VSD		

OPTIONS


MOTREC INC.
SUBJECT: GEN4 AC CONTROLLER
TITLE: MAIN CIRCUIT
VERSION : 01
DATE: 2008-11-26
AUTHOR : J. GAGNON
APPROVED:
DRAWING # : OPTIONS - IVEC ON T-8000.VSD
S20
WHT 1/0 AWG
G1
1/0 AWG
1/0 AWG
Y1
F3
A3
X2
B-
B+
S21
ORG
RED
RED
M1
M2
M3
B5
POSITION ENCODER
+5V
PHASE A
PHASE B
I/O GROUND
AC MOTOR
M1
X3
BLK
YEL
GRN
RED
A3
F8.A
F8.B
S1
BAT
IGN
ACC
X2

OPTIONS


MOTREC INC.
SUBJECT: OPTIONS - HANDBRAKE ALARM T-8000
TITLE: OPTIONS
VERSION : 01
DATE: 2012-04-26
AUTHOR: J. GAGNON
APPROVED:
DRAWING # OPTIONS - HANDBRAKE ALARM ON T-8000.VSD
WIRE FROM B-
BLK
S3 or S6
F4
BLU
RED
G3
+
-
B6
BLK
S22
WHT
K2
A
B
BLK
BLU
BLK/GRN
ORG
ORG
Y2
X2
A3
B-
B+
M1
M2
M3

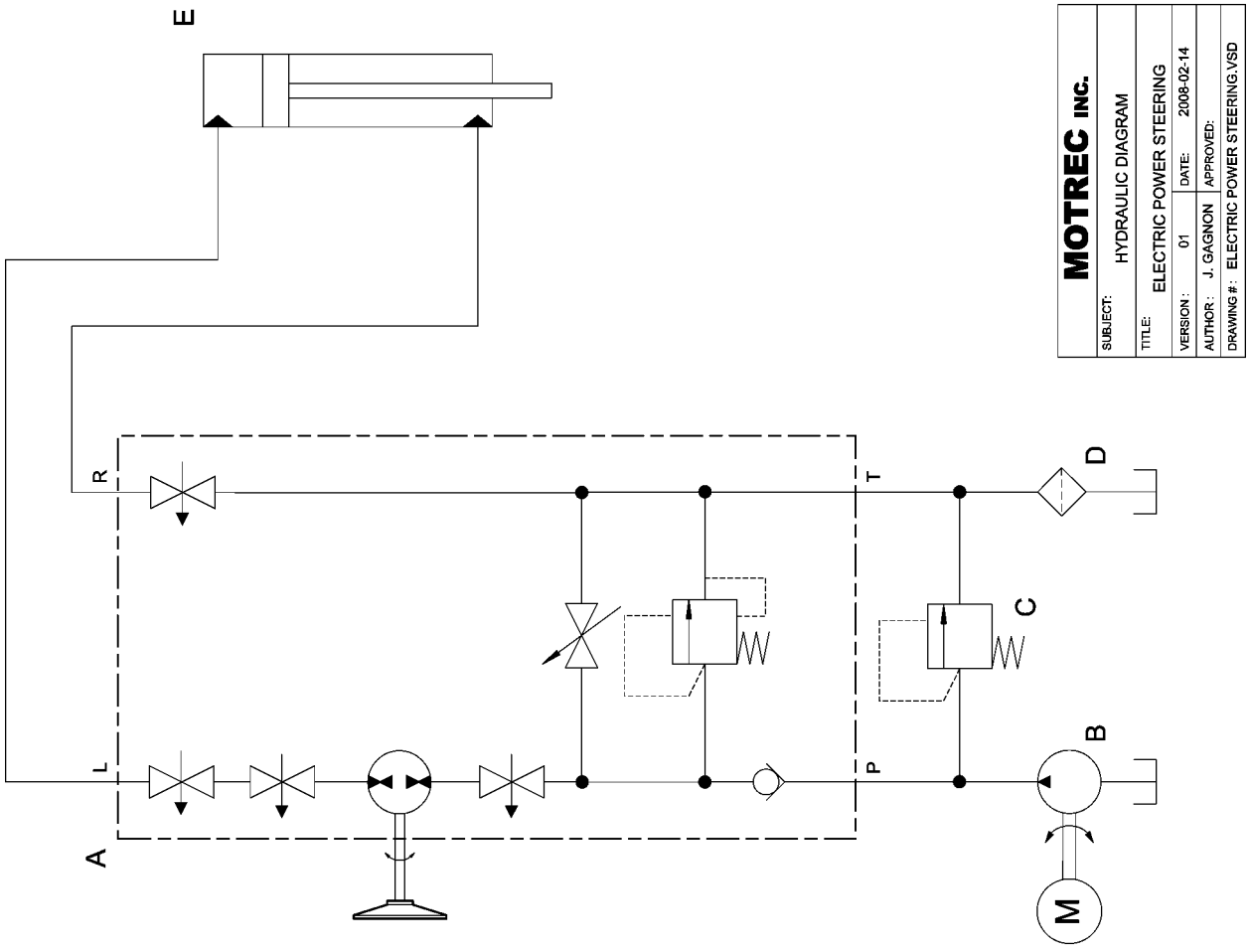
PARTS LIST

NO	DESIGNATION	REF	QTY
A3	I.D. PMC		1
A4	AC MOTOR CONTROLLER, SEVCON	3105800002	1
B1	STROBELIGHT	*	1
B2	HORN	*	1
B3	REVERSE ALARM	*	1
B4	MOTOR TEMPERATURE SENSOR		1
B5	POSITION ENCODER		1
B6	HANDBAKE ALARM	3100000005	1
E1.A,B	HEADLIGHT	*	2
E2.A,B	TAIL/BRAKE LIGHT	*	2
E3.A,B	AMBER FRONT LIGHT	*	2
E4.A,B	BACKUP LIGHT	*	2
F1.A,B	FUSE, 15A	246108K	2
F3	CIRCUIT BREAKER, 500A	3107800001	1
F7	MAXI BLADE FUSE, 30A	3118501005	1
	MAXI FUSE HOLDER	3118501006	1
	DUST CAP	3118501007	1
F8.A,B	FUSE, 5A		
G1	BATTERY		
G3	BATTERY – AA TYPE	14602	
	BATTERY HOLDER	3101000008	1
K1	FLASHER RELAY	3069004	1
K2	RELAY, HANDBRAKE ALARM	3127248002	1
M1	AC MOTOR		1
M3	POWER STEERING MOTOR	3112800002	1
M4	WIPER MOTOR	*	1
P1	INDICATOR (BDI), HOUR METER	3108000003	1
R1	ACCELERATOR	3062001C	1
	POTENTIOMETER	367008	1
	SPRING	2262004C	1
	MICRO-SWITCH	2262001C	1
	LEVER	2262003C	1
S1	KEY SWITCH	246205	1
S3	SEAT SWITCH, MICRO-SWITCH	3109100002	1
	SEAT SWITCH, SEAT MOUNTED	366216	1
S6	HANDBRAKE SWITCH	3109100002	1
S7	FOWARD/REVERSE SELECTOR	3109210005	1
S8	LIGHT SWITCH, ROCKER TYPE	1269004	1
	LIGHT SWITCH, PUSH/PULL	486002	1
S9.A, B	SEALED PUSH BUTTON, INCHING CONTROL	3109000024	2
	GREEN CAP	3109000025	2
	SPLASH COVER	3109000027	2
S10	HORN BUTTON	*	1
S12	BRAKE LIGHT SWITCH	246207	1
	HYDRAULIC BRAKE LIGHT SWITCH	3669004	1
S13	FLASHER SWITCH	*	1
S20	FRONT EMERGENCY PUSH BUTTON	3109364001	1
	EMERGENCY STOP LABEL	3109800006	1
S21	REAR EMERGENCY PUSH BUTTON	3109800001	1
S22	HANDBRAKE SWITCH, MAGNETIC	3109000037	1
U1	DC-DC CONVERTER	3124880001	1
	DC-DC CONVERTER CONNECTOR	3124280002	1
X1	HOUR METER CONNECTOR	3119800003	1
X2	SPEED CONTROL CONNECTOR	3105800001-C	1
X3	HANDHELD PROGRAMMER CONNECTOR	3119800002	1
	TERMINAL	3130800001	4
Y1	MAIN CONTACTOR	GE800AH208XO	1

Y2	POWER STEERING CONTACTOR	486222	1
	STATIC STRAP	2450001	1

* Consult Motrec Illustrated parts

HYDRAULIC DIAGRAM



PARTS LIST

NO	DESCRIPTION	REF	QTÉ
A	HYDRAULIC UNIT – STEERING	4190448001	1
B	POWER STEERING PUMP	*	1
C	RELIEF VALVE	*	1
D	FILTER	*	1
E	STEERING CYLINDER	4130448001	1

* Contact manufacturer

MOTREC ILLUSTRATED ACCESSORIES

Strobe light, pole mount
Amber 12-80V: 3116000002
Red 12-80V: 2469001
Blue 12-80V: 3690008

Strobe light, cab mount
Amber 12-48V: 3116250001
Red 12-48V: 3069026
Blue 12-48V: 3069014
Amber 72-80V:3116720001
Red 72-80V: 3116720002
Blue 72-80V: 3116720003

Amber turn lamp
12V: 3111000022
Bulb 12V: 3069021
Multi-LED amber turn lamp
Round Light: 3111000010
Grommet: 3111000008
Plug: 3119000009

Amber turn lamp 2”
12V : 3111330002

Amber turn lamp 2” LED white background
12V : 3111330003

Red Tail/Turn/Rev light
12V: 3111000002

Red Tail/Brake light
Grommet: 3269001
Plug: 246012A
12V : 2469021
24V : 2469022

Red Tail/Brake light
** Model EE **
Assembly: 3111000030
Housing: 3111000027
Plug: 3111000029
12V : 3111000028

Red Tail/Brake light
Housing: 3111000041
Red Tail/Brake light
Housing LED: 3111000044
Bulb 12V: 3117240001
Bulb 12V LED: 3117000010

Multi-LED Red Tail/Brake
Light: 3111000006
Grommet: 3111000008
Plug: 3119000009

Red Tail/Brake light
12V: 386002

Red Tail/Turn LED light
12-24V: 3111000037

Red Tail/Turn LED light
12-24V: 3111000037

Clear lamp Incandescent
12V: 3111000039
Clear lamp LED 12V: 3111000042
Bulb incandescent 12V : 1269008
Bulb 12V LED: 3117000001

Oval lamp
12V: 3111330001

LED Headlight
12V: 3111000036

Headlight
Left: 3111480003
Right: 3111480004
Bulb H/L: 3111480006
Bulb Turn: 3111480008
Bulb Mark: 3111480007

Headlight
Left: 3111480003
Right: 3111480004
Bulb H/L: 3117480001
Bulb Turn: 3117480003
Bulb Mark: 3117480002

Multi-LED Back-up
Light: 3111000007
Strobe light: 3111000013
Grommet: 3111000008
Plug: 3119000009

Back-up lamp
Grommet: 3269001
12V: 3669012
24V: 3669012A

Pedestal head lamp
12V: 3111240001
Bulb 12V: 2569001B
Bulb 24V: 2169001B

Pedestal head lamp - LED
12-48V: 3111000034

Headlamp 12V:3111250007

Headlamp
12V: 3111300001
Bulb 12V: 3111300002

Analog Voltmeter
12V : 3069007
24V : 2469002
36-48V : 3669002

HOBBS Gauge
24V: 2469026
36V: 3069038
48V: 4869037

DC-DC converter, 10A
12-48V: 3069019

DC-DC Converter, 25A
12-48V: 3124000002
72-80V: 3124880001

DC-DC Converter, 300W
24V: 3124224001
36-48V: 3124280001
72-80V: 3124880001

CONNECTOR:3124280002

Wiper motor
12V: 3113000001
24V: 486211

Wiper arm 2800000001

Wiper blade
14” Blade: 2800000002
18” Blade: 2800000003

Pantograph wiper arm
246233A

Pantograph wiper blade
246233

Limit switch 3109000029

Cab heater
12V: 3103300001
36V: 3669008
48V: 4869020

12V Dome light 3669006

12V Fan 3669013

Back-up alarm or
Motion beeper
12-48V : 3100000001
72-80V : 3105720001

12-24V Adjustable ECCO:
3100000002

12-48V Adjustable PRECO:
3100000004

Red Pilot light
12V: 246212
Bulb 12V: 246212B

Horn
12V: 246003
24V: 246013

Horn button VIP
2208224002

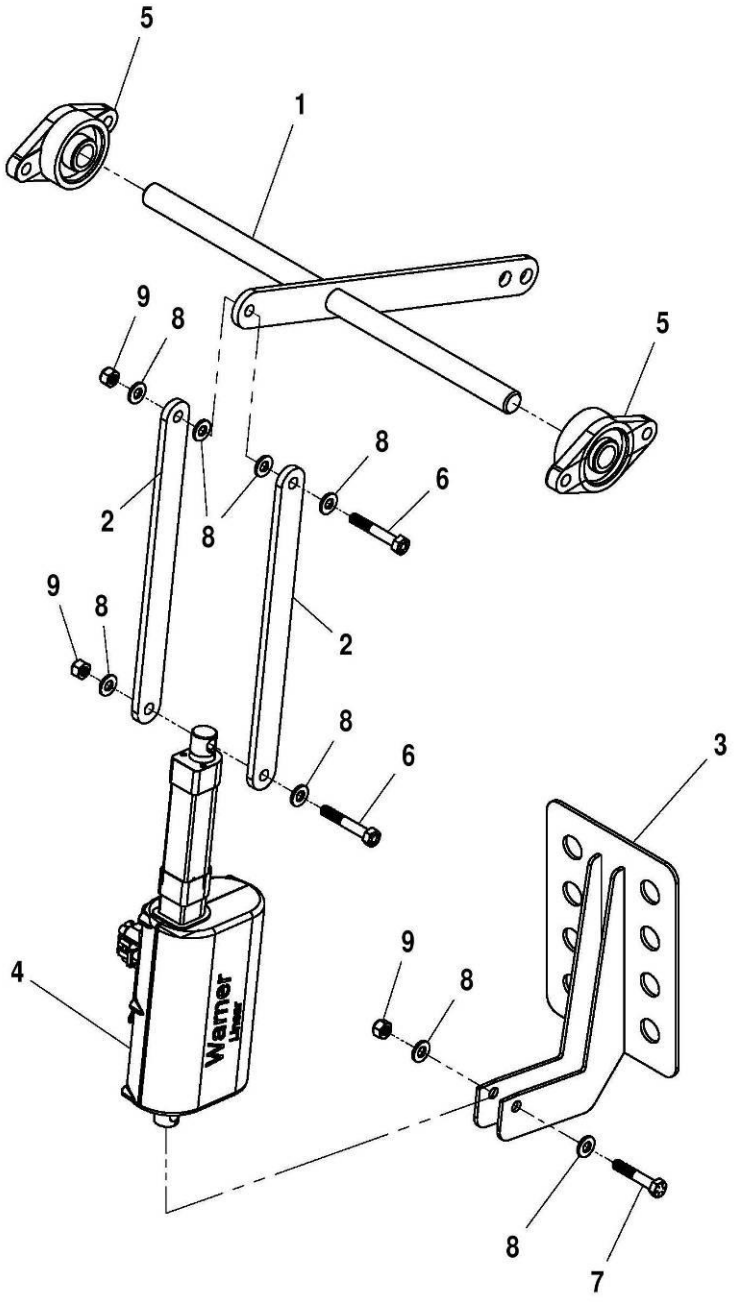
Horn button, column mount
3109000011

Horn button, dash mount
266210

Horn button 3109250001

Turn signal switch 246050

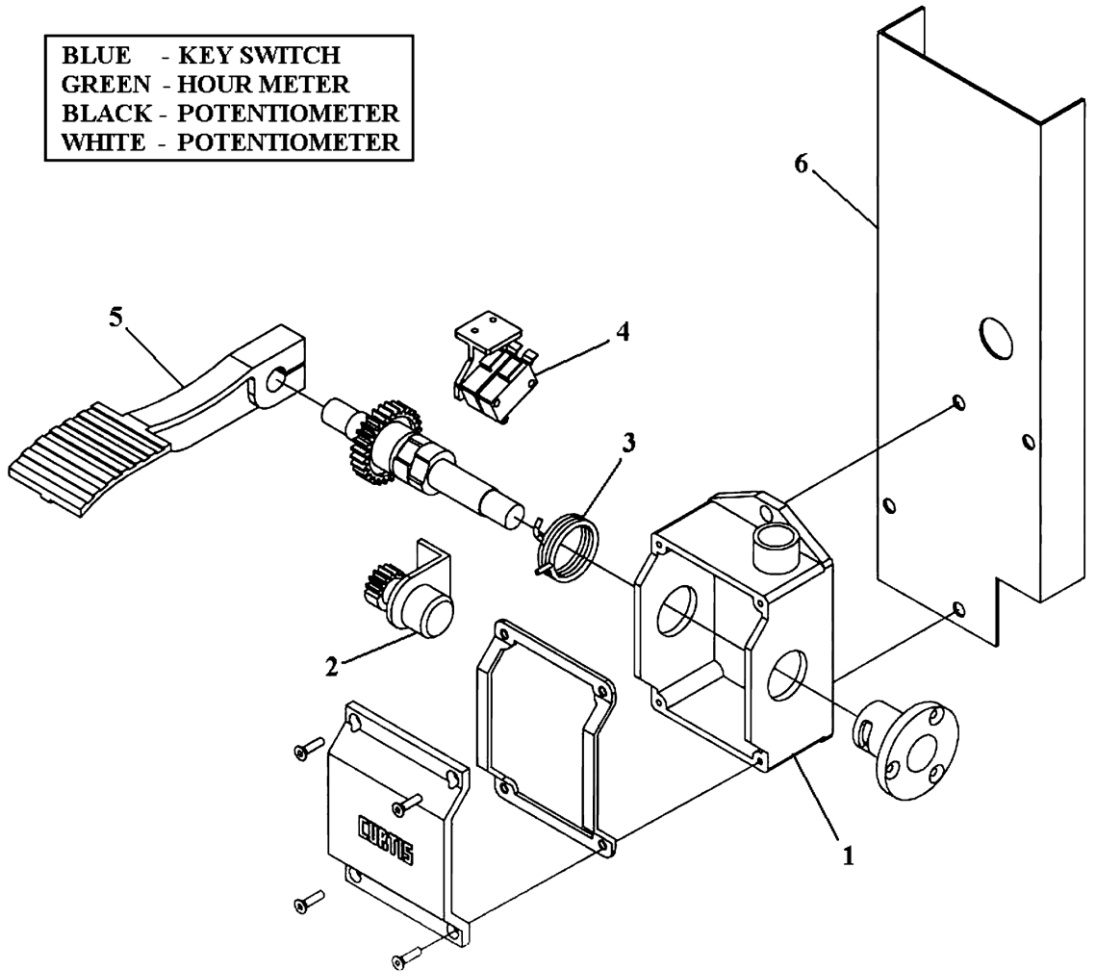
ELECTRIC HITCH RELEASE



REF.	*PART NO.*	*DESCRIPTION*	*REF.*	*PART NO.*	*DESCRIPTION*
1	2322800031	PIVOT, ROSE HITCH RELEASE	**6**	——	HEX. BOLT 5/16-UNC X 2
2	2322800037	PULL BAR, ROSE HITCH RELEASE	**7**	——	HEX. BOLT 5/16-UNC X 1 3/4
3	2322800032	MECHANICAL CYLINDER SUPPORT	**8**	——	FLAT WASHER 5/16
4	3113000016	LINEAR ACTUATOR 200LB CAPACITY	**9**	——	NYLON NUT 5/16-UNC
5	2106000001	3/4” FLANGE BLOCK			

ADDENDUM

CURTIS FOOT PEDAL



REF.	*PART. NO*	*DESCRIPTION*
1	***3062001C***	***ACCELERATOR CURTIS***
2	***367008***	***POTENTIOMETER***
3	***2262004C***	***SPRING***
4	***2262001C***	***MICRO-SWITCH***
5	***2262003C***	***LEVER***
6	***3662002***	***CABLE PROTECTOR***

RESP : ***CLAUDE L***	MODEL(E) : **E-320/360/480/500**
NO : ***321A320001***	*SER :* ***1018799*** *TO/À :* ***1019973***